Federal Communications Commission
Office of Plans and Policy
1919 M Street NW
Washington, DC 20554

OPP Working Paper Series

15 Spectrum Management Policy in the United States: An Historical Account

April 1985

John O. Robinson

[redacted]

SPECTRUM MANAGEMENT POLICY IN THE UNITED STATES: AN HISTORICAL ACCOUNT

by

John O. Robinson */

Office of Plans and Policy
March 1985

---

*/ The opinions and conclusions expressed in this report are those of the author. They do not necessarily reflect the policies or views of the Federal Communications Commission or any other organization or individual. I wish to thank the professional staff of the Office of Plans and Policy for their many helpful suggestions. I am particularly indebted to John R. Haring who actually composed some sections of the report.

PART I

INTRODUCTION

Government regulation of the electromagnetic spectrum was originally predicated on the need to prevent signal interference caused by users operating on the same or adjacent radio frequencies. There is nothing particularly novel or unique about government's assumption of this role as a rule-maker and umpire in spectrum use. The definition of legally enforceable resource rights is widely recognized as a necessary precondition for the successful operation of markets or, more generally, productive economic activity in a world in which resources are scarce. 1/ Just as no one would purchase a home or invest resources in home production if home ownership did not convey the right to exclude others from use of the property, so too would effective electronic communication be impossible without some elaboration and enforcement of rights of spectrum resource usage. 2/

In his famous book on Capitalism and Freedom, Milton Friedman (1962, p. 25) draws the following illustrative analogy:

> It is important to distinguish the day-to-day activities of people from the general customary and legal framework within which these take place. The day-to-day activities are like the actions of the participants in a game when they are playing it; the framework, like the rules of the game they play. And just as a good game requires acceptance by the players both of the rules and of the umpire to interpret and enforce them, so a good society requires that its members agree on the general conditions

---

1/ See Richard Posner, Economic Analysis of Law (1977).

2/ Where rights of resource ownership are significantly attenuated, as in say Soviet Russia, productive economic activity obviously suffers severely.

> that will govern relations among them, on some means of arbitrating different interpretations of these conditions, and on some device for enforcing compliance with the generally accepted rules....In both games and society also, no set of rules can prevail unless most participants most of the time conform to them without external sanctions; unless that is, there is a broad underlying social consensus. But we cannot rely on custom or on this consensus alone to interpret and to enforce the rules; we need an umpire. These then are basic roles of government in a free society.

There is thus little controversy associated with the idea that a governmental role in defining and enforcing rights of resource use is appropriate. Such a role is not only consistent with a market economy, it is a necessary condition for its existence. You cannot have trade without something to trade. What is traded in a market economy are resource rights ultimately defined and enforced by the government.

It is important to recognize, however, that government regulation of electronic communication involves much more than simply defining and enforcing spectrum resource rights. The government not only performs these necessary functions, but also determines the specific uses to which spectrum resources may be put and by whom. In a market economy, these allocative functions are normally determined by market forces of supply and demand, that is, through voluntary exchanges transacted by individuals with their own resources. In electronic communication, market allocation processes have largely been supplanted by bureaucratic and political allocation processes.

Different methods of resource allocation imply different results in terms of what activities are permitted and the efficiency with which they are carried out. This is because the factors which govern allocation decisions (i.e., the structure of incentives) differ as among these different processes. Factors that may be very important to a politician or bureaucrat

INDEX

PART I

Page

INTRODUCTION.....1

PART II

HISTORY OF RADIO REGULATION

Introduction.....5
Early Radio Background.....5
International Radio Regulation.....7
First U.S. Radio Regulation.....8
Radio Act of 1912.....10
Effective "Life" of the Radio Act of 1912.....11
Developments Leading to the Introduction of Broadcasting.....12
Beginning of Broadcasting.....15
Completion of the Radio Trust.....16
Radio Act of 1927.....17

PART III

ANALYSIS OF REGULATION HISTORY

Introduction.....23
Forces Favoring an Administrative Approach to
Spectrum Management From 1902 to 1927.....24
Reasons for Regulation of Spectrum Management
at the Time of the Radio Act of 1927.....28
Vested Rights in the Spectrum.....30
Use of Market Forces in 1927.....33
Summary of Part III.....40

PART IV

GENERAL LIMITATIONS OF REGULATED SPECTRUM MANAGEMENT

The Public Interest Criterion.....42
The Allocation Process.....44
Allocation Principles.....45
Information Required for Allocation.....46
"Public Need" Versus Market Demand.....47
Technical Information.....50
Summary - Part IV.....52

PART V

EXAMPLES OF SPECTRUM MANAGEMENT BY FEDERAL REGULATION

Page

Introduction.....53
Allocation of Frequencies Above 30 MHz.....55
Docket No. 6651 Proceeding.....58
Implementation of the Docket No. 6651 Decisions.....61
Private Versus Common Carrier Mobile Radio.....63
Reaction of Commissioners.....64
After the 1949 Report and Order.....65
UHF Television.....66
Channel Splitting.....69
Docket No. 11997.....71
Advisory Committee.....72
Reallocation of UHF-TV Spectrum.....73
A Final Note.....74

PART VI

CONCLUSIONS 77

APPENDIX A - SIGNIFICANT FACTORS AND GENERAL PRINCIPLES FOR ALLOCATION

APPENDIX B - HISTORY OF THE LAND MOBILE RADIO SERVICE

may be irrelevant to the market and, similarly, economic factors that would play a predominant role in determining outcomes in a market environment may carry little weight in a political or regulatory context.

The Communications Act of 1934 states as one of the purposes of the Act, "to make available, so far as possible, to all the people of the United States a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges." On the surface, it may appear that spectrum management as practiced in the United States since 1927 has satisfied this goal reasonably well. Certainly, nothing comparable to the "chaos" that existed in the AM-broadcast service just prior to the Radio Act of 1927 has recurred. Spectrum use has been expanded to much higher frequencies, and many new radio services such as land mobile, fixed point-to-point microwave, and satellite radio communication have been accommodated. In general, considerable progress toward an adequate and efficient radio communication service appears to have been made.

Closer inspection of events during this nearly six-decade period, however, reveals that spectrum management has exhibited serious deficiencies that have imposed incalculable, but conceivably large, social costs. These defects result from constraints that inhere in the regulatory process and cannot be eliminated without a fundamental change in national policy for spectrum management.

This study focuses on the results of spectrum management through administrative regulation by the federal government as they have manifested themselves in the land mobile sector. While the analysis is largely descriptive, it has important prescriptive implications. This is because the revealed disabilities of spectrum allocation under the current method of governance are likely to become increasingly severe in an operating

environment characterized by ever more rapid advances in technical capabilities and expanding consumer expectations with attendant economic penalties. At the same time, improvements in our understanding of radio transmission and our ability to measure spectrum outputs make reliance upon market allocation mechanisms more feasible. Thus, the analysis suggests that a high priority be placed on finding ways to substitute market forces for regulatory methods of spectrum resource allocation.

The study is organized in the following manner. Parts II and III trace the historical development of spectrum management through federal administrative regulation. These Parts attempt simply to explain what happened and why. Part IV examines the allocation principles and process as they evolved over time. Part V describes how the tools of administrative spectrum management were applied in the land mobile sector and to what effect. Finally, Part VI analyzes the results or characteristics of federal spectrum management as exemplified by the historical experience in land mobile radio. A history of land mobile radio providing relevant technical and institutional background is given in Appendix B.

PART II

HISTORY OF INTERNATIONAL AND DOMESTIC RADIO REGULATION

Introduction

This part discusses significant events in the history of radio regulation which led to the Radio Act of 1927 which in turn became Title III of the Commmunications Act of 1934. The initiation of international regulation with the Berlin Convention of 1906 and domestic regulation with the Radio Act of 1912 are described. The formation of the Radio Cooperation of America and cross-licensing agreements among major equipment manufacturers and their subsequent effect in the development of broadcasting and radio regulation are noted. Finally, the emergence of broadcasting and its role as the reason for the Radio Act of 1927 are discussed.

Early Radio Background

Interest in radiocommunication by other than experimenters began with the award of a British patent to Marconi for a radiotelegraph system in 1896, followed by successful demonstrations of the system. 3/ The implications for maritime safety and naval operations were immediately apparent. National governments began installing radiotelegraph equipment on naval vessels and at coastal locations. Merchant ships, particularly ocean liners, were also

---

3/ Prior events and dates that are relevant to the development and regulation of radio communication are: (1) the establishment of wire telegraphy in 1844; (2) the inauguration of telephone service in 1877; (3) publication of the theory of electromagnetic radiation by Maxwell in 1865; and (4) confirmation of Maxwell's theory by Hertz in 1887. A complete history of radio communication would encompass the entire development of man's knowledge of electricity and magnetism.

equipped to provide ship-to-ship and ship-to-shore communication. Commercial ventures were formed in many countries to manufacture radiotelegraph equipment and to provide ship-to-shore public correspondence. The most important and most active of these companies were Marconi Wireless Telegraph Company, Ltd. and the Marconi Wireless Telegraph Company of America formed in 1897 and 1899, respectively.

According to the report of a Board on Wireless Telegraphy convened by President Roosevelt, by 1904 there were twenty-four naval ships equipped with radiotelegraph equipment and ten more being equipped. Twenty Navy coast stations had been established and equipment for ten more had been ordered. In all, two hundred stations on shore and afloat were planned. Six stations were being operated by the Army and two by the Weather Bureau. Five private companies were operating coastal stations. One of these companies was serving the Pacific Coast. 4/

While the attention of governments was initially, and primarily, attracted to radiotelegraphy because of its importance in naval operations and maritime safety, the value of a commercial radiotelegraph service for public correspondence did not escape notice. The Marconi Company was particularly successful in establishing such a service. As a general practice, the Marconi Company would not permit coastal stations or ships for which it provided radiotelegraph equipment to accept messages from ships or stations using another company's equipment. Additionally, the rapid proliferation of Marconi stations made it undesirable for ship owners to equip their vessels with

---

4/ "Report of the Interdepartmental Board Appointed by the President to Consider the Entire Question of Wireless Telegraphy in the Service of the National Government"; Government Printing Office (1904). Reprinted in Documents in American Telecommunications Policy, Vol. I; Editor, John M. Kittross (1977).

radiotelegraph systems that would not be recognized by the Marconi stations. Marconi's success together with its exclusive marketing tactics led to concern that it would establish a world-wide monopoly in radiotelegraphy. 5/

International Radio Regulation

As a result of the developing control of radiotelegraphy by the Marconi Company, the First International Radio Telegraphic Conference was assembled in Berlin in 1903. The governments of Austria, France, Germany, Great Britain, Hungary, Italy, Russia, Spain and the United States were represented. Complete agreement was not reached, but the Conference drafted a protocol to serve as the basis for future international agreement on the use of radiotelegraphy. Among the articles of the protocol was the requirement that all coastal stations were required to exchange messages with all ships without distinction as to the system of radiotelegraphy used. All delegates agreed to submit the protocol for examination by their respective governments. The delegates of Great Britain and Italy, however, entered reservations to the requirement for exchange of messages irrespective of radiotelegraph system. Marconi had substantial interests in both countries.

A Second International Radio Telegraphic Conference was convened in Berlin in 1906. Twenty-eight countries, including the nine involved in the 1903 Conference, were represented. The Conference adopted a Convention that followed closely the Protocol of the First Conference. 6/ The main provisions of the Convention were: (1) a requirement for acceptance of messages by all coastal stations and ships regardless of system used; (2) priority for

---

5/ See, for example, History of Communications-Electronics in the United States Navy, pp. 67-71.

6/ Ibid, p. 557.

distress calls from ships; (3) establishment of an International Bureau to gather and distribute information about the radiotelegraph systems in use and the coastal station installations in each country; and (4) tariffs to be charged for international radio communications. The Conference also adopted regulations that prescribed specific wavelengths from which commercial communications were excluded. 7/

The Berlin Convention of 1906 was the beginning of international regulation of radio communication and spectrum allocation. The United States reacted cautiously to the new Convention. Hearings on ratification of the Convention were first held in January 1908. The commercial wireless interests led by the Marconi Wireless Telegraph Company of America were against ratification primarily because of the compulsory intercommunication requirement and tariff regulation. The strongest proponents of ratification were the executive departments of government including the Army, Navy and Department of Commerce and Labor. 8/ Despite a recommendation by President Roosevelt that the Convention be ratified, the opposition of the commercial interests was sufficient to prevent action at that time.

First U.S. Radio Regulation

Although ratification of the 1906 Berlin Convention was deferred by the Senate in 1908, the provision requiring compulsory communications was included in the first U.S. domestic law dealing with radio communication on June 24,

---

7/ The legislative history of the Radio Act of 1912 implies that the excluded band was reserved for use by governments, but the Convention does not so state.

8/ See History of Communications-Electronics in the United States Navy (p. 124) for a discussion of the Hearings.

1910. 9/ This 1910 Act was directed specifically at maritime safety and required any U.S. or foreign ocean-going ship carrying more than 50 persons (including passengers and crew) to be equipped with "efficient apparatus for radio-communication" in the charge of a skilled operator. It further specified that such apparatus would not be deemed efficient unless the company installing it contracted in writing to exchange, and in fact did exchange, messages with shore or ship stations using other systems of radio-communication. The Department of Commerce and Labor was designated by the Act to provide for its execution. Thus, the U.S. had its first regulation of radio, but spectrum management was yet to come. 10/

The 1906 Berlin Convention was eventually ratified by the Senate in 1912. The reason for a ratification at that time is interesting. A Third International Radio Telegraphic Conference was scheduled to be held in London in June 1912. By 1911, thirty-three countries had ratified the 1906 Convention, while the U.S. had not. 11/ The adhering nations, therefore, elected to withdraw the U.S. invitation to the London Conference. This action prompted the Senate Foreign Relations Committee to reconsider the matter and the treaty was ratified on April 3, 1912 and the U.S. invitation was reextended. 12/

9/ Public Law No. 262-61st Congress.

10/ The 1910 Act was modified in July 1912 to include ships navigating the Great Lakes, and to require two or more operators and an auxiliary electric power supply independent of the ship's main plant.

11/ See Report of the Commissioner of Navigation, Department of Commerce and Labor (1911) (p. 670). Reprinted in Documents in American Telecommunications Policy, Vol. I.

12/ History of Communications-Electronics in the United States Navy, p. 159.

Radio Act of 1912

The Radio Act of 1912 was the first domestic legislation that dealt with spectrum allocation. It should be noted that the ratification of the 1906 Convention was largely responsible for the timing of this legislation. One of the articles of the Convention bound the parties to take necessary measures to ensure execution of the Convention, and the associated regulations included a specific requirement for government licensing of private stations on ships. Interference between stations, however, had also become a problem. Essentially three groups of radio users had developed during the early years following the Marconi patent in 1896: government, commercial, and amateurs. Each group was interfering with the other, sometimes maliciously. 13/ The commonly recognized solution was Federal regulation that would separate the groups by frequency, or wavelength in 1912 terminology.

The Radio Act of 1912 provided the necessary separation. The wavelengths of 600 to 1600 meters (500 KHz to 187.5 KHz) were reserved for Government operations. 14/ Commercial coastal stations were required to have equipment capable of operating on either 300 meters (1000 KHz) or 600 meters (500 KHz). These allocations followed the international regulations associated with the 1906 Convention. Amateurs were constrained to wavelengths of 200 meters or less (frequencies above 1500 KHz). At that time, frequencies above 1500 KHz, which is below the upper end of the present AM-Broadcast band, were considered to be of little value for Government or commercial use.

13/ See for example, History of Communications-Elctronics in the United States Navy p. 73, 156 and History of Radio to 1926, p. 104.

14/ Conversions between wavelength ( ) and frequency (f) is straightforward: $f = 3 \times 10^8 /$, where "f" is in cycles per second and " " is in meters.

The Radio Act of 1912, unlike later radio legislation, was not a flexible document in the administrative sense. Licensing of stations and enforcement of regulations were delegated to the Secretary of Commerce and Labor. The regulations were written into the Act, however, and little was left to the discretion of the Secretary. According to the report which accompanied the Senate Bill, this narrow construction of the legislation was deliberate. The report noted that anything less would be a "surrender by Congress of its powers and the bestowal of legislation power to all intents and purposes upon administrative officers." 15/

Effective "Life" of the Radio Act of 1912

The provisions of the Radio Act of 1912 proved adequate for purposes of spectrum allocation and interference control until the advent of broadcasting in the early 1920's. During this period, commercial radio was still used primarily for maritime and military (naval) purposes, although transoceanic and some domestic point-to-point service had been established. With amateur stations relegated to frequencies above 1500 KHz, the number and types of stations in operation were such that radio communication with tolerable interference was possible under the regulations of the Act of 1912. Also, for almost three years of this period, following United States entry into World War I in April 1917, all private stations were either closed or operated under Navy conrol. During those three years then, there were no private stations per se to regulate. Spectrum management under the Radio Act of 1912 became increasingly ineffective when radio broadcasting emerged, and it was ultimately superseded by the Radio Act of 1927.

15/ Senate Report No. 698, 62nd Congress 2d Session (May 2, 1912).

The Developments Leading to the Introduction of Commercial Broadcasting

Important technical and economic events that occurred during the 1912-1920 period warrant brief mention because of their effect on broadcasting and the legislative effort that led to the Act of 1927. First, a significant technical achievement of this period was the development of the vacuum tube radio transmitter. None of the transmitting devices used in the early days of radio telegraphy were well adapted to radio telephone, although there was considerable experimental effort. 16/ The availability of the vacuum tube transmitter stimulated development of radiotelephony and eventually made broadcasting feasible since broadcasting was an application of radiotelephony.

Second, the formation of the Radio Corporation of America and the establishment of cross-licensing agreements among major manufacturers of radio equipment created economic pressures that provided the impetus for the development of broadcasting. 17/ During World War I, radio equipment manufacturers devoted their facilities to research and production of radio equipment for military use. When government procurement was curtailed at the end of the war, many companies were left with greatly expanded capacity and no immediate domestic market for their products. As the largest manufacturers, the General Electric Co. and the Westinghouse Electric and Manufacturing Co. were particularly affected. General Electric was then manufacturing what was considered to be the world's best high-power transmitter. When General Electric entered negotiations with the British Marconi Co., who represented

---

16/ History records the first transmission of the human voice by radio as occurring on Christmas Eve 1906. See History of Radio to 1926. p. 86.

17/ The basis for this discussion is found in History of Radio to 1926 and History of Communication-Electronics in the United States Navy. In the interest of brevity, specific documentation and most detail have been omitted.

the only market for this transmitter, the Navy became concerned that such a sale would lead to a British monopoly in international radio comparable to that which it enjoyed in cable communication.

At the suggestion of the U.S. Navy, The Radio Corporation of America (RCA) was formed by the General Electric Co. in October 1919. A primary purpose was to establish a commercial presence in the international radio field that would be capable of competing with the British Marconi Co. and prevent a British monopoly. The Corporation was also intended to provide a market for General Electric radio products. Included in the RCA corporate by-laws was a provision for a Government representative to discuss and present the Government's views and interests in matters coming before the RCA Board of Directors. On November 20, 1919 the American Marconi Company was merged with RCA. With this merger, RCA acquired the American Marconi communication business and property as well as patents it held.

In addition to a lack of markets to absorb radio equipment production, there were patent difficulties. Prior to the war, radio equipment patents were owned by many different individuals and companies. To provide for wartime production, the government pooled these patents and accepted responsibility for patent infringement. After the war this government role could no longer be justified. Since the patents were widely scattered among the various interested parties, with some in litigation, it was virtually impossible for any one entity to develop and operate a national or international radio communication service. This situation gave rise, with tacit Navy blessing, to several cross-license agreements.

The first cross-license agreement was executed in November 1919 between General Electric and RCA. The agreement established reciprocal rights in present or future patents or inventions of either company. In July 1920, the

RCA-General Electric agreement was extended to include the American Telephone and Telegraph Co. and the Western Electric Co., who also owned radio patents.

Meanwhile, Westinghouse was searching for a market for its radio products. In June 1920, it entered into a rather complex agreement with the International Telegraph Co. which included rights to patents and the organization of a new company that was to compete in the international radio communication field. The new company was incorporated with only a slight change in name as The International Telegraph Co.

The RCA-GE-AT&T-Western Electric combination, however, controlled enough of the radio patents that Westinghouse found it difficult to compete in the domestic radio communication market. Furthermore, at the time of the RCA-Marconi merger, RCA had managed to establish exclusive agreements for international radio communication with most of the commercially important foreign nations. Thus, the Westinghouse-International Telegraph affiliation found the world market foreclosed and was restricted to the western hemispheric and domestic markets.

All of the cross-license agreements, including that of Westinghouse and The International Telegraph Co., had been arranged for the purpose of participating in the fields of maritime or point-to-point radio communication. Although considerable progress in the development of radiotelephony had been made during the war, the idea of commercial broadcasting had not yet dawned. It was in its striving to find an outlet for its radio production that Westinghouse discovered the market for broadcasting. The cross-license agreements were, therefore, indirectly responsible for the timing, if not the actual introduction, of radio broadcasting.

Beginning of Broadcasting

During the war, Westinghouse had been involved in government directed programs to further the development of radiotelegraph and telphone equipment. Dr. Frank Conrad, a Westinghouse engineer responsible for research in radiotelephony happened also to be a radio amateur. He used his amateur station to extend his professional work and when testing transmission equipment would frequently use phonograph records when he grew tired of talking to his "public". His following grew to the extent that in 1920 a local Pittsburgh department store advertised that it sold radio sets that could receive Dr. Conrad's programs. A Westinghouse vice-president, Mr. H. P. Davis, noting this advertisement, was struck with the idea of erecting a station for regular broadcasting to attract listeners to whom Westinghouse could then sell receivers.

In a lecture delivered at the Harvard Graduate School of Business Administration during the 1927-28 academic year, Mr. Davis recounts the history of this Westinghouse development of broadcasting. In discussing his reaction to the newspaper advertistment he states that it,

> ...caused the thought to come to me that the efforts that were then being made to develop radio telephone as a confidential means of communication were wrong, and that instead its field was really one of wide publicity, in fact, the only means of instantaneous collective communication ever devised. Right in our grasp therefore, we had that service which we had been thinking about and endeavoring to formulate. 18/

18/ H. P. Davis, "The Early History of Broadcasting in the United States"; The Radio Industry: the Story of Its Development, a series of lectures at the Graduate School of Business Administration, Harvard University, p. 194; A. W. Shaw Co. (1928).

Plans for the station went forward with completion scheduled in time to broadcast the results of the presidential election on the eve of November 2, 1920. A few available receivers were distributed to clubs, friends, and Westinghouse executives. The broadcast from station KDKA was a success and the radio industry was forever changed. By June 30, 1922, there were 382 licensed broadcast stations. 19/

Completion of the Radio Trust

The introduction of broadcasting altered the balance among the industrial contenders for the radio market. Westinghouse had acquired patents that were of sufficient importance to the new field of broadcasting that it had become a force that could no longer be ignored. Consequently on June 30, 1921, the RCA-GE-AT&T alliance was extended to include Westinghouse. Cross-licensing agreements of one form or another now existed between RCA, General Electric, AT&T, Western Electric, Westinghouse, and the United Fruit Co. 20/ In addition, 65% of the RCA stock was owned by GE, Westinghouse, AT&T, and United Fruit.

These cross-license agreements clearly had the appearance of an attempt to monopolize the radio equipment market. On the other hand, without some

---

19/ Annual Report of the Commissioner of Navigation to the Secretary of Commerce for FY 1922. Reprinted in Documents in American Telecommunications Policy, Vol. I. This was the first year in which broadcast stations were separately reported.

20/ The United Fruit Co. was engaged in growing and transporting fruit from Central and South America to the United States. It was an early user of radio telegraphy and acquired a subsidiary, the Wireless Specialty Apparatus Co., to develop and manufacture radio equipment for its communication system. It also owned and operated radio stations open to public correspondence. United Fruit and Wireless Specialty owned many important radio patents, and both executed cross-license agreements with General Electric and RCA on March 7, 1921 to which AT&T and Western Electric assented.

consolidation of the conflicting interests in patents and inventions there seemed little hope of developing a U.S. national radio system or of competing in the international arena. In any event, the alliance was not to be a happy one. The next few years saw several disagreements among the participants and a Federal Trade Commission investigation at the request of Congress. 21/ Concern over a possible monopoly undoubtedly affected the form of regulation that was imposed on the radio industry.

Radio Act of 1927

Regardless of what motivated the cross license agreements, with the development of broadcasting there came a fundamental change in the demand for spectrum. The Radio Act of 1912 proved totally inadequate to cope with the spectrum demands of the rapidly growing radio broadcasting service. The Act required a Federal license to operate a radio station but permitted essentially no discretionary action by the licensing authority for spectrum management purposes. Its most fundamental flaw was that it provided no authority for the licensing authority to grant some applications and reject others. The authority of the Secretary of Commerce under the Radio Act of 1912 was the subject of two court decisions in the 1920's, both of which affected spectrum management.

In 1921, the Secretary of Commerce refused to grant a renewal of license to the Intercity Radio Company for a radio telegraph station on Long Island because no frequency could be found that would not result in interference to government and other private radio stations. Intercity Radio entered a

---

21/ For a detailed account of the history of this alliance, see History of Radio to 1926 and Gleason L. Archer, Big Business and Radio; The American Historical Company, Inc. (1939).

mandamus proceeding in the District of Columbia Supreme Court. The court decided that the Secretary must issue the license, and the case was appealed to the District Court of Appeals. The Court of Appeals affirmed the decision of the lower court and stated inter alia,

> In the present case the duty of naming a wavelength is mandatory upon the Secretary. The only discretionary act is in selecting a wave length, within the limitations of the statute, which in his judgment will result in the least possible interference. 22/

While that part of the Intercity decision that stated that the Secretary of Commerce could not refuse to issue a radio license under the Act of 1912 was important for spectrum management purposes, the opinion that he could use his judgment in the selection of a wavelength (frequency) had even greater near-term effect on broadcasting.

When broadcasting first appeared, the Department of Commerce selected two frequencies to which all stations in that service were assigned. This was essentially in accord with the policy of the Act of 1912 of assigning frequency by service grouping. With only two frequencies available, the growth in broadcasting soon resulted in considerable interference between stations. Following the Intercity decision and a recommendation by the Second Radio Conference in March 1923, the Secretary began to specify a unique frequency in the license of each station from within a band allocated for this purpose. This procedure continued until 1926, and according to one commenter, "The broadcasting system of the United States was erected under it." 23/

22/ Hoover v. Intercity Radio, 286 Fed. 1003 (1923).

23/ Stephen Davis, The Law of Radio Communication; Mc-Graw-Hill Book Co. (1927), p. 42.

In April 1926, the Department of Commerce brought suit in a District Court in Illinois against the Zenith Corporation under the punitive provisions of the Radio Act of 1912 for operating on a frequency and at a time other than assigned. The Court decided that the penalty clauses of the Act could not be enforced in this case because the Congress had provided no standard or criteria by which the discretion of the Secretary was to be guided in the selection of a frequency. 24/ In effect this decision denied the Secretary the authority to require stations to operate on assigned frequencies or at a specified time.

Because the Zenith decision was contrary to the opinion expressed in the Intercity case, the Secretary of Commerce asked the Attorney General for a definition of his powers and duties with respect to the Radio Act of 1912. The opinion rendered by the Attorney General was in effect the same as the decision of the Court in the Zenith case. New legislation was required to regulate broadcasting, and the Radio Act of 1927 followed very shortly in February 1927.

The Radio Act of 1927 was actually in the making for five years. It would be very difficult, perhaps impossible, to reconstruct in a chronological manner the evolution of the concepts and policy that finally formed the basis for this Act. Certainly, the recommendations of four radio conferences called by the Secretary of Commerce between 1922-1925 had a major influence. A bill carrying out the recommendations of the first conference held in February 1922 was

---

24/ United States v. Zenith Radio Corporation 12 Fed. 2nd 614 (1926).

introduced in the Senate and the House of Representatives in June 1922. 25/ This bill, which would have conferred greater authority on the Secretary of Commerce to regulate radio, was apparently the first attempt by Congress to address the problems associated with broadcasting. The bill was passed by the House but not by the Senate. 26/ Several additional bills were introduced before passage of the Act of 1927.

Both the timing and substance of the Radio Act of 1927 were a Congressional response to broadcasting. Had broadcasting developed at a later date there would have been no new radio law in 1927 because except for broadcasting there was no need for one. As late as November 1925, at the last of the four radio conferences convened by Secretary of Commerce Hoover, the Committee on Maritime Problems reported that, "...there are no problems in the marine radio field that require legislative action at this time." 27/ Likewise the Committee on Amateur Problems indicated, "Amateur operation during the past year under existing regulations has been generally satisfactory...." 28/ There was no committee designated for the point-to-

---

25/ "Annual Report of the Commissioner of Navigation to the Secretary of Commerce for FY 1922;" Government Printing Office (1922). Reprinted in Documents in American Telecommunications Policy, Vol. 1.

26/ "Annual Report of the Commissioner of Navigation to the Secretary of Commerce for FY 1923;" Government Printing Office (1922). Reprinted in Documents in American Telecommunications Policy, Vol. 1.

27/ "Proceeding of the Fourth National Radio Conference, November 9-11, 1925;" Government Printing Office (1926), p. 26. Reprinted in Documents in Telecommunications Policy Vol. 1.

28/ Ibid, p. 27.

point service, but Secretary Hoover in his opening remarks indicated that in the international telegraphic field there were no pressing problems. 29/

While the original impetus for legislation to revise the Radio Act of 1912 was the growing demand for radio broadcast channels, by 1927 the Congress had become concerned with much more than just technical management of the broadcast spectrum. Three general topics that had emerged as major concerns were: (1) vested rights in the spectrum, (2) the basis or criteria for granting a license, and (3) monopoly of radio equipment. In addition, several matters uniquely associated with broadcasting had gained attention. 30/ Thus, out of an initial effort to develop a framework for management of broadcast spectrum, there evolved a legislative environment that created a regulatory mechanism with far-reaching powers that would control all radio services. This point was emphasized by Commissioner Henry A. Bellows in an address before the League of Women Voters in Washington in April 1927 when he stated,

> Congress has grasped the significance of radio as a vital force in American life and has recently enacted a law which in many ways is absolutely unique. I know of no other activity, conducted entirely through private enterprise which has seemed to Congress so important and so complex in its problems as to require the creation of a new and separate branch of Government exclusively for its regulation. Nor do I know of any other law which, like the Radio Act of 1927, sets up as the sole guide for the body charged with its administration the interest, convenience, or necessity of the public. 31/

29/ Ibid, p. 2.

30/ These included such matters as programming (e.g., cultural versus entertainment), applicants' qualifications, equitable distribution of broadcast stations among states and localities, the use of advertising, chain broadcasting, and monopoly of broadcasting.

31/ Quoted in the Annual Report of the Federal Radio Commission for Fiscal Year Ended June 1927, p. 6. Commissioner Bellows was a member of the first Federal Radio Commission.

Eventually, even without broadcasting, there undoubtedly would have been legislation to revise the Act of 1912. As the spectrum became more crowded, some means to select among users would have been required. It is, of course, impossible to know what form such revised regulation would have taken. It is very reasonable to assume, however, that something quite different from the Radio Act of 1927 would have resulted. It bears repeating that this Act was written for broadcasting and then all radio services were regulated accordingly. For example, in his book "Radio Law," Mr. Dill discusses the origin of "public interest" as a criteria for a license grant and notes,

> Congress legislated primarily concerning broadcasting when it established this test. 32/

It is possible if the focus of legislation has not been broadcasting, the criterion might have been different.

The development of the regulatory stance adopted with the Radio Act of 1927 is analyzed in Part III of this paper. Also the origin of some of the Congressional concerns that influenced the legislation are discussed to the extent such information was available.

32/ Clarence C. Dill, Radio Law, Practice and Prodecures; National Law Book Company (1938), p. 88. Mr. Dill was a member of the U.S. Senate from 1923-1935 and was very active in the construction of the Radio Act of 1927.

PART III

ANALYSIS OF REGULATION HISTORY

Introduction

In a lecture entitled "The Law of the Air" delivered at the Harvard Graduate School of Business Administration during the 1927-28 academic year, Judge Stephen B. Davis made the following statement:

> The history of radio law is largely the story of the attempt to establish methods for the distribution of radio channels among rival stations competing for their use. 33/

It would be difficult to compose a more succinct definition of the purpose of radio spectrum management. Judge Davis, who as Solicitor of the Department of Commerce was intimately involved in the legislative effort that produced the Radio Act of 1927, was referring to regulatory statutes when he mentioned 'history of radio law'. Nevertheless, the statement would be equally applicable to other methods of radio channel distribution. This section analyzes the background of the Radio Acts of 1912 and 1927 to

---

33/ Stephen B. Davis, "The Law of the Air"; The Radio Industry: The Story of Its Development.

determine as nearly as possible the reasons for selection of government regulation as the method of spectrum management. 34/

Theoretically, one alternative to government regulation that could have been considered to accomplish the functions of spectrum management would have been to open the resource to the market. This would have required a definition of property rights and an initial distribution of these rights to the private sector. A less extreme option would have been government regulation combined with selective use of market forces.

This Part explains the factors that led to an administrative approach to spectrum management. Part II recited the important events that resulted in the Radio Act of 1927, and noted that this Act was written especially for broadcasting. This Part analyzes these events and relates their effects to the ultimate Congressional decision to adopt the policy of spectrum management by regulation. Parts IV and V will examine the regulatory process in practice and cite examples of the difficulties that have been encountered with the process.

Forces Favoring An Administrative Approach to Spectrum Management From 1902 to 1927

There is no evidence that market forces in any form were even considered in the legislative process that led to the Radio Act of 1912. In fact, there were two circumstances existing during this early period of radio development

---

34/ By "government regulation" is meant total control of spectrum use by Federal agency decision and administration. Public comment may influence the form that regulations take, but the ultimate decision remains with the agency. A government license is required to gain access to the spectrum, but the holder has no discretion in the use of the spectrum assigned.

that suggest that serious contemplation of market forces in spectrum management would have been highly unlikely.

First, the phenomenon of wireless or radio transmission was not well understood even by experts at the time. There were hypotheses and even an empirically derived formula, but no satisfactory explanation had been developed to account for the electromagnetic propagation characteristics observed. In a paper presented to the Royal Institution of Great Britain in June, 1911, Mr. G. Marconi stated, "...so far we understand but incompletely the true fundamental principles concerning the manner of propagation of the waves on which wireless telegraph is based." 35/ Thus, even if such an alternative had been considered, the inability to characterize the mechanism by which radio signals were propagated would have rendered the use of market forces impracticable because of inadequate information by which to define rights.

It should be noted that there was at least one reference to property rights in the "air", but not in terms of their use for spectrum management purposes. In February 1910, the House Committee on Naval Affairs held hearings on a resolution by Congressman Roberts to establish a civilian-government board to prepare a plan to govern the operation of all radio stations under the cognizance of the United States. During the hearings Congressman Roberts commented that it had always been understood that a person who owned land also owned the air above it and then stated,

> We have been brought up with the idea that the air was absolutely free to everyone; but the march of civilization has brought about conditions, particularly in this matter of wireless communication, that render it imperative, in my estimation, that there be some change

---

35/ G. Marconi, "Radiotelegraphy", June 1911; Reprinted in The Development of Wireless to 1920, Edited by George Shiers, Arno Press, New York 1977.

> of the old common law with regard to rights in the air, in the interest of modern progress and development. 36/

A second reason for not expecting consideration of market techniques in the 1912 era was the conviction within several executive departments that government ownership, or at least regulation, of radio was necessary for its survival. Advocacy for government control of radio telegraphy was active in the U.S. Navy as early as 1902. 37/ At the recommendation of the Secretary of the Navy, President Roosevelt in June 1904 appointed an Interdepartmental Board on Wireless Telegraphy to consider "the entire position of wireless telegraphy in the service of the National Government." The Board consisted of representatives of the Navy, Army, Department of Commerce and Labor and the Department of Agriculture (Weather Bureau).

Among matters addressed by the Roosevelt Board were control of interference between radiotelegraph stations in general, and nonduplication of coastal stations by government departments. To achieve the latter, the Board recommended that all government coastal radio facilities be placed under Navy control. To prevent interference between private and government stations, as well as for other reasons, the Board recommended that all private stations be licensed by the Department of Commerce and Labor. As part of the justification for this recommendation, the Board stated,

> This method of placing private stations under full Government supervision is desirable in order to regulate them for their mutual and the public welfare, as well as from considerations of national defense. Aside from the necessity of providing rules for the practical operation of such stations, it seems desirable that there should be some wholesome supervision of them to prevent the

---

36/ History of Communications-Electronics in the United States Navy, p. 156.

37/ Ibid, p. 69.

exploitation of speculative schemes based on a public misconception of the art. 38/

The "speculative schemes" mentioned by the Board were, no doubt, a reference to questionable promotions of radiotelegraph company stock by some individuals. 39/ On July 29, 1904, the President approved the recommendations of the Board to the extent they applied to government stations and directed all Departments concerned to put the recommendations into effect. It is obvious from what has already been said that the Congress took no action at that time on the recommendation for licensing of private stations. The situation whereby government departments were striving for regulation of radiotelegraphy and private interests were opposing it, while Congress took no action, persisted until the enactment of the Radio Act of 1912. It will also be seen to have occurred again just prior to 1920. 40/

By 1912, the Congress had been, so to speak, overtaken by events. There were the international requirements of the recently ratified Berlin Convention to be met. Interference between stations had become serious. Finally, there

---

38/ "Report of the Inter-Departmental Board Appointed by the President to Consider the Entire Question of Wireless Telegraphy in the Service of the National Government;" Government Printing Office (1904). Reprinted in Documents on American Telecommunications Policy, Vol. I; Editor John M. Kittross (1977).

39/ See, History of Communications-Electronics in the United States Navy, p. 67-69.

40/ History records an interesting parallel between the effort to establish government control of radio during its early years and that of the Post Office Department to wrest control of the telegraph and telephone from the private sector. One of the more intriguing arguments used, recalling similar statements about the "airwaves," was that of the Postmaster General who stated in 1891 that, "The electric current belongs to the people by right...." See, "Selections from Government Ownership of Electrical Means of Communication"; Government Printing Office (1914). Reprinted in Documents in American Telecommunications Policy, Vol. I.

were matters of longstanding concern such as maritime safety, national defense, monopoly practices, and questionable business practices and stock promotion that many believed needed Congressional attention. Given this context, some form of government regulation of radio communication was perhaps inevitable.

Reasons for Regulation of Spectrum Management at the Time of the Radio Act of 1927

Spectrum management by government regulation seems to have been a widely accepted concept from the very beginning of the period during which the Radio Act of 1927 evolved. Within the Executive Branch of government, the belief in government regulation had, if anything, grown stronger since passage of the 1912 Act.

Immediately following World War I, the Navy made a final bid to establish a Government monopoly over ship-shore radio. 41/ During the war, the Government (Navy) had assumed operational control of all U.S. radio stations. As a part of this process the Navy had purchased almost all coastal stations. In December 1918, Navy Secretary Daniels was successful in reviving hearings on a pre-War bill drafted by an Executive Department committee. The bill was aimed at effectively eliminating commercial interests in ship-shore radio. Post-War enactment of this bill would have perpetuated Government ownership and operation of all coastal stations. The Congressional committee that held hearings in the matter was unconvinced by the Navy's arguments and the bill was tabled. The President approved the return of radio stations to private owners effective March 1920.

41/ See, History of Communications-Electronics United States Navy, pp. 313-318.

There does not appear to have been any further effort to establish Government ownership of radio communication. A major reason could have been, and probably was, that interest in radio communication took a major turn with the introduction of broadcasting in November 1920.

It is apparent that the Department of Commerce also assumed government regulation of radio. Several times during the four National Radio Conferences convened between 1922 and 1925, Secretary Hoover called on the radio industry to voluntarily establish and comply with rules to prevent interference. Still, it is clear that he did not envisage a spectrum management system devoid of a central administrative authority. In his opening remarks to the first Conference in February 1922 he stated that one purpose of the Conference was,

> ...to advise the Department of Commerce as to the application of its present powers of regulation and to develop the situation generally with a view to some recommendation to Congress, if it be necessary, to extend the present powers of regulation. This is one of the few instances that I know of in this country where the public - all of the people interested - are unanimously for an extension of regulatory powers on the part of the Government. 42/

42/ Minutes of Open Meeting of (1st) Department of Commerce Conference on Radio Telephone (February 27 and 28, 1922), p. 4. Copy in the Federal Communications Library, 1919 M Street, N.W., Washington, D.C. 20554.

Also, the very existence of the Radio Act of 1912 no doubt affected the thinking of those concerned with the spectrum management problems induced by the appearance of broadcasting. Administrative action under this statute had quite successfully controlled radio interference up to that time. Thus, a natural response to broadcasting would have been to consider a solution in the form of modification of a system that appeared to be working for all other radio services. In fact, legislation labeled "A BILL to amend an act to regulate radio communication, approved August 13, 1912, and for other purposes" was passed by the House of Representatives in January 1923. This bill was not acted upon by the Senate. 43/

Quite aside from what appears to have been a general acceptance of Federal regulation as the solution to the spectrum management problem posed by broadcasting, Congressional concern with the non-technical matters mentioned in Part II would very likely have prompted such regulation. 44/ Because of the important role it played in subsequent spectrum management the congressional concern with vested rights is discussed here.

Vested Rights in the Spectrum

The first reference to property rights in the spectrum was found in Secretary Hoover's opening remarks to the First National Radio Conference in February 1922. After discussing the need for extended Federal authority to control broadcasting interference he stated,

> There is involved, however, in all of this regulation the need to so establish public right over the ether roads

---

43/ House Report No. 464, 69th Congress 1st Session, Minority Views.

44/ See fn. 27 and associated text.

> that there may be no national regret that we have parted with a great asset into uncontrolled hands. 45/

An excellent discussion on the matter of property rights and the Radio Act of 1927 is found in Dill. 46/ He notes that Congress had no intention of permitting property rights in the spectrum and feared that "...this one and only remaining public domain in the form of free radio communication might soon be lost unless Congress protected it by legislation." Dill states that Congress was particularly concerned by what he termed "property by right of user." This is the established principle of law that conveys title to a property on the basis of long use without opposition. According to Dill, there were several instances of claims to rights vested by use, and also a related court case. In November 1926, the Circuit Court of Cook County, Chicago, Illinois decided a case in which a station that had been broadcasting on a frequency of 990 KHz for some years complained of interference from a newcomer on a nearby frequency. The Court ruled that 'priority of time creates superiority in right' and found in favor of the longtime user under the Radio Act of 1912. 47/

The matter of vested rights had been addressed by the Senate as early as April 1924 when it passed a bill declaring the ether to be the inalienable possession of the people of the United States and their government. The bill

---

45/ Minutes of Open Meeting of (1st) Department of Commerce Conference on Radio Telephone (February 27 and 28, 1922), p. 4. Copy in the Federal Communications Commission Library, 1919 M Street, N.W., Washington, D.C. 20554.

46/ Radio Law, p. 77-85.

47/ The Tribune Co. v. Oak Leaves Broadcast Station, Inc., et. al. (November 17, 1926); Ct. Crt. Cook County, Illinois. This case was apparently not printed but was reproduced in the Congressional Record on December 10, 1926. See Cong. Rec. Vol. 68, Part I (pp. 216-219).

granted temporary privilege to use the ether under the current law (Act of 1912) for a period not to exceed two years. Following this period, no license was to be granted or renewed without acknowledgement by the applicant that all claims to the use of the ether were in accord with the provisions of the bill. A substitute bill containing similar language regarding ownership was reported by a House committee, but not acted upon. Regarding the Senate bill, Dill notes,

> This bill is important because it shows that the purpose of Congress from the beginning of consideration of legislation concerning broadcasting was to prevent private ownership of wave lengths or vested rights of any kind in the use of radio transmitting apparatus. 48/

Following the Zenith decision in April 1926 which denied authority to the Secretary of Commerce to effectively regulate use of the spectrum, Congressional concern for vested rights increased. Although both the House and the Senate had passed new radio regulation bills, there were differences that could not be resolved before adjournment. As a stopgap measure, therefore, the Congress passed a Joint Resolution on July 3, 1926 to deal with the vested rights issue. This Joint Resolution declared that the term of all broadcast licenses was to be limited to 90 days and that of all other radio licenses to two years. In addition, it required that following the date of the Resolution, no license was to be granted unless the applicant waived any right, or claim to any right, to use of the ether because of prior use. Due to administrative difficulties the Resolution was not sent to the President until after Congress reconvened and was signed December 8, 1926. A similar

---

48/ Radio Law, p. 81.

waiver requirement was eventually included in the Radio Act of 1927 and still exists today.

Use of Market Forces in 1927

It should be clear at this point that Congressional intent for use of the spectrum, particularly for broadcasting, at the time of the Radio Act of 1927 would have permitted nothing less than complete administrative management. The concern over vested rights made unthinkable any use of market forces for spectrum allocation or assignment. 49/ Before reviewing the administrative process in practice it is instructive to examine the status of radio development of that era to determine the extent to which the use of market forces might have been technically feasible.

A completely free spectrum market is one in which the only government involvement would be provide a legal framework for the enforcement of property rights and an official record of these rights. Spectrum allocation or assignment decisions would be made by private transactions in the market. A free market requires rights that are sufficiently well defined that the commodity being exchanged is readily identifiable by buyer and seller.

Spectrum property rights can be completely defined for all legal purposes in terms of field strength, geographical area, bandwidth and time. Furthermore, such rights can be specified independent of any other consideration. In order to comply with these rights and permit a free market to function efficiently, however, it must be possible to relate them to station operating parameters such as power, antenna height, etc. In 1927,

---

49/ In the field of spectrum management it has become common to refer to the distribution of spectrum among uses (radio services) as 'allocation' and the selection of users (licenses) as "assignment".

knowledge of electromagnetic propagation characteristics was inadequate to establish this relationship except on a very approximate basis. 50/ Although the concept of 'service area' was in use, these areas could not be accurately defined, and the term 'protected service area' was not found in the literature of that time. In this regard, a comment by Secretary Hoover at the Fourth Radio Conference is pertinent. In discussing the service areas available with different radiated power levels, he remarked,

> For some reason or other the area is not always a circle, as you know, and it varies in different parts of the country for the same power. 51/

He then explained that the Department of Commerce was conducting an investigation of the phenomenon and expected that the information derived would provide a basis for, "more efficient allocation of wavelengths."

Thus, inability to satisfactorily correlate station operating parameters with spectrum rights would likely have resulted in frequent and widespread cases of interference and correspondingly high transaction and enforcement costs. Even if the public and the Congress were not already opposed to a property right approach, they may not have tolerated the delay involved while the courts determined liability for the interference in each case.

Nevertheless, acceptance of the fact that some form of government intervention was likely to manage the explosive demand for broadcast spectrum does not imply that the Radio Act of 1927 was required. The necessary regulation was already in place and effective under the Radio Act of 1912

50/ Stephen S. Attwood, "Radio-Wave Propagation Between World Wars I and II;" Proceedings of the IRE, Vol. 20, No. 5 (May 1962), p. 688.

51/ Fourth National Radio Conference, p. 4.

until the time of the Zenith decision. Prior to that time, the Department of Commerce had provided for orderly growth of the radio broadcast service and had produced what could have been used as an initial broadcast station assignment plan from which a spectrum market could have been launched. In at least two important ways, market forces were allowed to operate within the administrative system. They suggest that even greater reliance might have been possible.

First, a virtual market in radio licenses existed at the time in question due to Department of Commerce policy with regard to license transfer with the sale of a station. In hearings before a Senate Committee in January 1926 on the bill that resulted in the Radio Act of 1927, the Solicitor of the Department of Commerce, Judge Stephen B. Davis, responded to a question about the Department's policy for permitting license transfers by stating,

> We have felt this way about it, Senator, that the license ran to the station rather than to the individual...a man can transfer his apparatus, and if there is no good reason to the contrary we will recognize that sale and license the new owner of the apparatus. 52/

The Radio Act of 1912 did not explicitly address license transfer, but it did require that the license specify the owner of the station. This would have precluded transfer without government awareness.

Second although not identified as such, another example of market operation was cited by Judge Davis at the same hearings. He noted that on occasion, the Department would assign the same frequency to two stations in

---

52/ Hearings before the Committee on Interstate Commerce, United States Senate, 69th Congress, 1st Session on S1 and S1754 (January 1926), p. 39. S1754 after compromise with House bill H.R. 9971 became the Radio Act of 1927.

the same geographical area, but that the division of time for use of the frequency was left to the stations to decide. When asked what the Department would do in the case of a disagreement between stations, he replied that while the Department had the authority to specify operating times, the necessity to do so had not arisen because the stations "have been able to get together and agree among themselves." 53/ These private agreements for frequency use are clearly an example of market forces working within an administered assignment scheme. The details of the negotiations between stations are not known, but it must be assumed they included whatever exchanges (including monetary) that were necessary to result in mutual benefit to the parties involved.

Finally, these marketplace features suggest that a market in broadcast spectrum could have been an alternative to the Radio Act of 1927. On the recommendation of the Third National Radio Conference (October 1924), the Department of Commerce allocated the frequency band of 550-1500 KHz to broadcasting. This allocation, which provided 89 radio channels was in effect at the time of the 1927 legislation. Thus, the spectrum to be used by broadcast stations had been administratively decided. The next matter was to select among users. It was the problem of selecting among users that, more than anything else, generated calls for new legislation.

In the January 1926 hearings on S1754, Judge Davis noted that there were 536 licensed broadcast stations on the 89 channels allocated and then stated,

> Under the present situation we are getting by, but we have today applications from 250 more people who want to build broadcasting stations and operate them. Now

---

53/ Ibid, p. 16.

> obviously we cannot provide them. In other words, the wavelengths are gone. 54/

Judge Davis' purpose in making this statement was to emphasize the need for legislation, because according to the Intercity Radio decision, the Secretary of Commerce did not have authority under the 1912 Act to refuse to grant licenses to the 250 applicants.

There was, however, a market alternative to administrative selection among users. Judge Davis' statement that they were 'getting by' can be interpreted to imply that the authorized locations, frequencies, and power of the 536 stations must have been such as to provide a broadcast service with acceptable interference. Further, Judge Davis had stated earlier in the hearings that the broadcasting system as it existed did not represent a conscious plan but rather the result of natural growth. 55/ Thus, the stations were apparently located where the broadcasters anticipated a demand for service.

A technically feasible procedure would have been to legally designate the 536 stations with their authorized operating characteristics (location, frequency, and power) as an initial broadcast station assignment plan. 56/ If Judge Davis' assumption was correct, that this configuration of stations provided service with acceptable interference, such an assignment plan could have been the basis for the future development of AM broadcasting without further administrative selection of users.

54/ Ibid, p. 18.

55/ Ibid, p. 17.

56/ It does not appear that such a plan could have been authorized under the Radio Act of 1912. New legislation would have been required.

The operating characteristics of each of the stations could have been vested as a set property rights protected against additional interference. An initial distribution of the rights could have been accomplished by vesting them in the then current licensees, or by auction or lottery if that were deemed more equitable. These rights could then have been bought and sold just as the Department of Commerce had already authorized for stations, except that no government approval would have been required. The only government administrative involvement that would have been necessary would have been maintenance of an official record of the ownership right.

The broadcast station assignment plan described thus far would have been technically no different than that which was operating under license by the Department of Commerce. The rights conveyed by the license would have simply become a vested private property right. This plan, however, would only have provided a baseline from which AM broadcasting would have been expected to expand. 57/ To accommodate this expansion a legal procedure to permit entry of a new station or modification of one in the original plan would have been necessary. An obvious procedure would have been to require that a new or modified station protect the owners of established rights from any additional interference. Having satisfied this requirement, the owner of the new or modified station could have been permitted to establish a new property right in the spectrum by registering the change with the agency maintaining the official record of ownership.

57/ According to an October 12, 1984 FCC news release there were 4754 licensed AM-broadcast stations on September 30, 1984. Most of the increase over what was fesible 60 years ago is due to the introduction of the 'daytime only' station and the directional antenna. Improved knowledge of propagation characteristics, however, has also had considerable effect. Also, a few more broadcast channels have been added.

Certainly claims of additional interference would have been generated by the addition or modification of stations, either because real interference occurred or as a ruse to prevent increased broadcasting competition. Those claims that could not be resolved by negotiation would have required referral to the courts. Admittedly, the courts may have experienced difficulty in the adjudication of these interference claims when they were first encountered. Unlike today where interference protection is specified in rather precise ratios of desired to undesired signal level, only a qualitative measure of interference based on the clarity of receiver output appears to have been available at the time in question. Signal strength ratios could not be used because field strength could not be predicted with sufficient accuracy.

The feasibility of the hypothetical market approach just described would have depended on whether the negotiated agreements could have been enforced. As noted, the courts may have experienced difficulty initially. Recognition that the courts would have experienced difficulty when initially confronted with the problem of radio interference does not, however, justify a conclusion that they could not have dealt with the matter. The lack of refined protection criteria due to the technical limitations of the times would have presented no greater problem to the courts than it did to the Federal Radio Commission. The courts would have relied on the testimony of witnesses, experts if necessary, just as the Radio Commission did. 58/ In other words, whether interference between broadcast stations was to be arbitrated by the courts or a regulatory agency, there was a deficiency of technical information

---

58/ The Commission's General Order 15 issued June 7, 1927 was entitled "Interference Hearings". This Order described the procedure for scheduling such hearings and indicated that interference complaints would be resolved on the basis of the testimony given by the parties of interest. Annual Report of the Federal Radio Commission for FY 1927, p. 16.

to be overcome and a learning process to be completed. In one instance case law would have been developed, and in the other regulations. Even if it had been concluded that existing courts did not have the expertise necessary to deal with the matter of radio interference, Congress could have created a single court to specialize in such cases. Tax and patent courts are examples of such specialized courts.

In the only two cases found in the literature in which the courts were asked to decide matters pertaining to radio "rights," they did not appear to be overwhelmed by the subject. One of these cases was that of Tribune Co. v. Oak Leaves previously noted. 59/ In another case decided by a Federal Court in Missouri in July 1926, one party proposed to abrogate a voluntary two-party agreement to time-share a frequency. 60/ The judge found the agreement, even though voluntary, had become a condition of the license issued under the Act of 1912 and could not be broken arbitrarily.

Summary of Part III

This part has reviewed the circumstances that led to spectrum management by regulation under the Radio Act of 1912 and even more stringent regulation with the Radio Act of 1927. It was noted that almost from its beginning, Federal regulation of radio was promoted by many of the Executive Departments, although the Congress appeared initially reluctant to adopt the necessary legislation. Even with the advent of broadcasting and the accompanying political pressure to reduce radio interference, the Congress considered

---

59/ See fn. 47 supra.

60/ Charmichael v. Anderson, 14 Fed. Rep. 2d 166, (1926).

several bills over about five years before passing the Radio Act of 1927. As discussion of the need for broadcast regulation proceeded at four National Radio Conferences as well as in the Congress during the five year period, the Congress became increasingly concerned about broadcast matters other than interference, particularly vested rights in the spectrum. By the time of the Radio Act of 1927, it seems clear that Congressional determination to prevent vested rights would have precluded any consideration of market forces as an alternative to Federal control of spectrum management. Finally, market forces in a limited sense were permitted by the Department of Commerce under the Radio Act of 1912 and greater reliance on a market in broadcast spectrum than was possible under the Radio Act of 1927 may have been feasible.

PART IV

GENERAL LIMITATIONS OF REGULATED SPECTRUM MANAGEMENT

Parts II and III reviewed the history of the Federal statutes under which spectrum management has been conducted and the Congressional reasoning that led to regulation. This Part first describes the allocation process including the principles by which the Commission defined the "public interest" and the factors about which it sought information. It then discusses the difficulties the Commission has encountered in using these principles and factors and compares the regulatory process and its results with the operation of a market. It is shown that the present regulatory process is inherently limited in its ability to produce an efficient allocation of the spectrum.

The Public Interest Criterion

The Communications Act of 1934 requires that any spectrum management decision, whether pertaining to allocation, assignment, or interference control, must satisfy the public interest criterion. A major drawback in the application of this criterion has been that the term "public interest" has no unique definition. This inability to uniquely define the public interest was recognized soon after the passage of the Radio Act of 1927. In 1928, the Federal Radio Commission released a statement regarding its interpretation of the clause, and in response to criticism that the Commission had not issued a precise definition it noted,

> To be able to arrive at a precise definition of such a phrase which will foresee all eventualities is manifestly impossible. The phrase will have to be defined by the United States Supreme Court, and this will probably be done by a gradual process of decisions on particular combinations of fact. 61/

Then, in 1930, Louis G. Caldwell, the first General Counsel of the FRC, wrote as part of a general legal discussion of the public interest clause,

> The standard has no fixed meaning; it must be construed in the light of the context and of the purpose of the statute in which it is found.... 62/

As a result of the lack of a unique definition, the Commission has been required to subjectively interpret the "public interest, convenience, and necessity" on a case-by-case basis. For each decision, the Commission must first define the public interest relative to a proposed action and then ascertain that the form the action takes satisfies the definition. In many instances, the information required to distinctly identify a proper course of action is not available and the Commission must decide the issue on the basis of its own best judgment. The public interest has become, therefore, whatever the Commission decided it to be. In any particular instance it may be impossible to distinguish between the use of the clause to justify a

---

61/ "Statement made by the Commission on August 23, 1928, relative to public interest, convenience, or necessity." Reprinted as Appendix F(6) in the Second Annual Report of the Federal Radio Commission for the Year Ended June 30, 1928, p. 167.

62/ L.G. Caldwell, "The Public Interest, Convenience, or Necessity as Used in the Radio Act of 1927", Air Law Review (July 1930) p. 295.

Commission action already decided upon and its use as a criterion by which to select a course of action, which was its original purpose. The Commission's interpretation of the public interest has changed over time. These changes have occurred in some instances because circumstances have been altered, while in other cases results did not materialize as expected.

While the public interest criterion is applicable to decisions affecting any function of spectrum management, the most significant issues in which it has posed problems have been those involving allocation and reallocation of the spectrum. Since these occasions also most vividly demonstrate the effect of inadequate information and resulting inefficiency of regulated spectrum management, the remainder of the discussion in this Part will be focused on allocation matters. 63/

The Allocation Process

The result of spectrum allocation is the designation of uses of the various parts of the spectrum. The allocation process, however, must consider not only the relative merits of the uses of the spectrum, but also many technical factors associated with both the propagation characteristics and the technology of the radio equipment involved. In this process, the Commission has been quite explicit in distinguishing between a definition of the public interest for purposes of comparing different uses of the spectrum and the information it requires about a proposed use to decide whether that use satisfies the definition.

63/ Examples of other issues which involve cost-benefit compromises, and thus the public interest, are the rigidity with which equipment standards to control interference are specified and the use of pre-engineered allotment tables rather than market demand for station assignment.

As early as 1935, the Commission issued a list of significant factors about which it said it would require information to arrive at an allocation decision in the public interest. 64/ The list was divided into two categories identified as "public need and benefit" and "technical."

It was not until later that the Commission first issued its definition of the "public interest" for allocation purposes. In an allocation proceeding in 1945, the Commission published a list of principles by which it said it was guided in making allocation decisions. 65/ These were in essence a set of criteria defining public interest priorities, and have been restated in later rulemaking proceedings with only minor change. The list as published in 1945 is included in Appendix A. In the same Report of Proposed Allocations the Commission reissued, with slight alteration, its 1935 list of information factors. This revised list of factors is also included in Appendix A.

Allocation Principles

A review of the allocation principles indicates that the Commission favored radio services for which non-radio communication was impossible or impractical, services that promoted safety of life and property, and services that served large groups of people. Investment by a previously authorized service was given careful consideration in the case of reallocation of spectrum. For new services, it was necessary to show that a substantial

---

64/ Memorandum No. 14019 To the Licensees of Radio Stations Operating on Frequencies Above 30,000 Kilocycles (August 22, 1935) Copy in the FCC Library. The list of factors was also included in the Notice of Informal Hearing and in the Report in Docket No. 3929. (See f.n. 81 and 82 infra).

65/ Report of Proposed Allocations from 25,000 Kilocycles to 30,000 Kilocycles; Docket No. 6651 (January 15, 1945) (available in the FCC Library, 1919 M Street, N.W., Washington, D.C. 20554).

public need would be met and that there would be "public acceptability and use of the service."

These principles reflect the Commission's priorities for spectrum use as established at the time, and as subjective criteria they are open to question. For example, they contain no explicit recognition of the economic contribution of a radio service as a criterion for spectrum allocation. Certainly a radio service that increased the productivity of a business or industrial enterprise can make a substantial contribution to the public welfare even though it may appear to directly serve only the private interest of an individual or an organization. Eventually, this fact was recognized and the use of the spectrum for purely economic reasons has been authorized for both mobile and fixed operations. As previously stated, the definition of the public interest has been subject to change.

More important than any deficiencies that might be identified on the particular list of allocation principles discussed here, is the fact that any such list will likely be imperfect. The reason is lack of information. Allocation policy at any point in time will reflect the subjective judgment of the Commission sitting at that time, and that Commission's judgment will be influenced by the information available to it. It will be seen in the discussion that follows, and in the examples in Part V, that this information in objective form is never complete. Any particular list of allocation criteria or priorities is a result of the regulatory process, not a cause of its defective operation. Nevertheless, imperfections in such a list may impose a high social cost.

Information Required for Allocation

The list of Significant Information Factors contains a series of questions for which the Commission sought answers in the allocation proceeding

in Docket No. 6651 (discussed below). It is representative of the information the Commission has attempted to acquire in all allocation proceedings. In general, there is little on the list that could be declared unnecessary given the environment in which the Commission must function. The difficulty has been that it is virtually impossible to obtain this information in a complete and reliable form and the resolution of conflicting opinion in attempts to do so has introduced delays measured in years.

Answers to the questions under Public Need and Benefit are obviously intended to permit the Commission to determine whether a proposed radio service qualifies for spectrum access according to the criteria in the list of principles. As a group, the questions are aimed at determining the need or demand for a service, and in the interest of generalization they will be discussed in those terms.

"Public Need" Versus Market Demand A comparison of the treatment of "public need" by the Commission with the operation of a market may be helpful in describing the Commission's difficulty with this subject. The market measures the demand for a good or service by the objective action of the price system. An important characteristic of market demand is that it represents an aggregation of individual preferences that cannot be determined or expressed by any other means. Market demand represents not a single number but rather a schedule of how much spectrum (or any other good) users are willing to buy at a given price. This market demand schedule provides information on the aggregate preferences of users for spectrum given their alternatives. "Public need" tends to treat possible uses of spectrum as absolute concepts, while a market process recognizes that all needs are relative to the alternative uses of the resource.

Indirectly, there may be a relation between these aggregate preferences and "public need" in that consumers would not be expected to buy a good or service unless they perceived a need for it. The market, however, responds only to willingness to pay and is not concerned with the subjective concept of need. The market process thus imposes a discipline on the proponents of any given use of a scarce resource that the regulatory process may not. The market process counts only expressions of desire by those who are willing to sacrifice alternative desires by paying an explicit price.

The Commission, on the other hand, has endeavored to determine "need" for a radio service in its allocation proceedings because it cannot ascertain a demand schedule prior to establishment of the service. 66/ In effect, the Commission attempts to imitate the market's allocation function by substituting "public need" for "demand." In the process, information in the form of public comment, proposals and studies is solicited in an effort to establish "public need." This information is submitted primarily by parties with an immediate interest either in establishing a new radio service or protecting the allocation or market position of an established service. Objectivity is not necessarily a goal of these submissions, and it is not uncommon for some to claim to show that there is a need for a service while others argue the contrary.

In the end, frequently after long delay, the question of 'public need' is most often resolved by the subjective judgment of the Commission. Actually, it would appear that the "need" as used in the allocation process is more an interpretation by the Commission of what is best for the public than it is a

---

66/ It will be noted below that even after establishment of a new radio service, the Commission cannot obtain a correct measure of demand either for the service or the spectrum required for the service.

real need or want of that public. This would explain why there have been instances of allocated spectrum remaining unused, and other instances of radio services being oversubscribed.

"Public need" is not a satisfactory surrogate for market demand. The latter can be objectively and precisely determined and depends only on individual preferences expressed as a willingness to pay. "Public need," on the other hand, is an illusive concept and cannot be measured because of lack of information. It must be subjectively determined. It would be entirely fortuitous, therefore, for a Commission decision to result in the same allocation of spectrum that would occur by individuals voting with their dollars in the market. Thus, the spectrum is not likely to be used under regulation as it would if allocated by consumers' choices in the market place.

It might appear at first glance that the Commission can determine the demand for a radio service after an allocation for the service by observing its operation. While the Commission can certainly observe the number of consumers who use the service, this outcome will be different from that produced by a market allocation. The reason is that the Commission distorts prices faced by consumers by the very act of regulating. There is an inverse relationship between the amount of spectrum available in terms of bandwidth and the cost of the radio equipment that must be used to obtain the same quality of service. Thus, unless the Commission happens to allocate exactly the same amount of spectrum as would result from a market, the price of the service will be higher or lower than in a market with the obvious effect on the qunatity demanded.

The discussion to this point has concentrated on the Commission's inability to determine the true demand for a <u>radio service</u> by applying a "public need" standard. The Commission is even less able to measure the

market demand for spectrum. In an unrestricted market, the demand for any particular use or by any particular user would ultimately depend upon the relative consumer demand for various radio services.

The outputs of some radio services such as broadcasting and common carrier offerings are used directly by consumers. In other cases such as land mobile radio or private microwave, the radio service is a factor in the production of some product other than communication, and thus the radio service, including spectrum, is indirectly valued by the consumer. In any event, in a market the demand for spectrum and its value in use would be established by the preferences of individual consumers.

The quantity of spectrum demanded in the present regulated system is, of course, immediately distorted by the explicit price of zero. 67/ This fact aside, it is clear from what has just been noted that the Commission could not obtain the information necessary to replicate the market process and establish the true market price or demand for spectrum. The market internalizes an incredibly complex process that cannot be emulated successfully by a central planning authority.

Technical Information The task of acquiring the information to answer the questions in the Technical Category of the Significant Factors would at first glance seem to be more straightforward because the term "technical" is normally associated with objectivity. As in the case of "need" and "demand," however, difference of opinion can and does arise. Two general areas of technical knowledge are involved in the allocation process. One area is that concerned with propagation characteristics of electromagnetic energy. The other deals with expected performance of radio equipment.

67/ It should be mentioned, however, that the use of spectrum is not without cost due to application filing expenses including legal fees.

Lack of propagation information was a particularly acute problem during the earlier years of radio development. Perhaps even into the 1950 decade, this inadequacy accounted for much of the delay in arriving at allocation decisions. While knowledge of propagation cannot be considered complete, it is adequate for most allocation matters today. Predictions of transmission characteristics may be qualified by statements about limits of certainty, but delays in allocation seldom occur due to lack of propagation knowledge.

Acquiring information relative to the future level of performance or quality of radio equipment, however, has become no less difficult with the growth of the radio industry. Except in the rare case where the Commission has sponsored design research, the only sources of this information are the radio equipment manufacturers. Any prediction of radio equipment performance or operating techniques will be influenced by the marketing plans of the various manufacturers. These marketing plans are in turn based on the regulations or standards in place at the time of the inquiry. Therefore, rather than information describing future equipment performance capability based on purely technical development, which might provide a basis for changes in standards or allocation, the Commission is more apt to receive projections of what would be technically feasible given present standards and techniques.

This does not imply that manufacturers submit deliberately biased information. They undoubtedly report what they believe are the facts based on their knowledge of the technological state-of-the art and the market. Depending upon the regulatory and operating history of the service in question, however, there may have been no good business reason for a manufacturer to have diverted research funds into an investigation seeking to improve what appears at the time to be a technically satisfactory mode of operation. In the absence of such research, manufacturers have no basis for

predicting technological development except to extrapolate present experience into the future. This may lead to entirely different conclusions from prediction based on analyses and test results of new technological concepts.

A very recent illustrative example of predictions regarding future equipment technology is that of the application of amplitude compandored sideband (ACSB) modulation to land mobile radio. In this case, research to investigate the use of this technology was initiated by the Commission in 1977. Comment by the larger established landmobile equipment manufacturers in response to this effort was that the concept was not feasible. Meanwhile, two smaller companies, one organized specifically for the purpose, began producing and marketing ACSB equipment. Development tests by several hundred land mobile licensees have shown that the concept is indeed quite feasible. The Commission recently authorized use of ACSB for regular service in the 150-170 MHz band.

Summary - Part IV

The Commission in its function of spectrum allocation attempts to replicate the functioning of a market and is handicapped by inadequate objective information. To apply the "public interest" criterion, it must first define the term and then verify that a contemplated action satisfies the definition. To accomplish this verification, the Commission it requires information by which to establish the level of need for a radio service and also technical information to determine the best spectrum location for the service and the amount of spectrum required. This information is not available in complete and objective form. The end result of the process as will be shown in the following section is not only imperfect and inefficient allocation of the spectrum, but also long delay in its use.

PART V

EXAMPLES OF SPECTRUM MANAGEMENT BY FEDERAL REGULATION

Introduction

This Part examines some results of spectrum management under the Radio Act of 1927 and the Communications Act of 1934. These results are drawn primarily from decisions associated with the development of the Land Mobile Radio Services, although some significant decisions affecting other services are cited where appropriate. 68/

Land mobile radio was selected as the primary case to be studied for several reasons. First, because it was nonexistent at the time of the Radio Act of 1927. Therefore, its entire development has been subject to the "public interest" standard as a justification for spectrum allocation. Second, the spectrum location considered most desirable for mobile radio has required that service to compete for spectrum with other radio services considered to be especially important to the public interest, particularly television broadcast and aeronautical radio. Third, the service has experienced rapid growth and includes several million transmitters for which spectrum must be made available. Finally, because of continuing growth, the spectrum demands of the Land Mobile Radio Services are even today presenting the Commission with some of its most challenging spectrum management problems. More than any other radio service, land mobile has demonstrated an

---

68/ For purposes of this examination, a "History of the Development of the Land Mobile Radio Services" has been compiled and is included as Appendix B. This history is written in terms of Commission actions. It does not, therefore, include some important contributions from the private sector such as the evolution of Frequency Coordinating Committees and mobile radio equipment design, production and marketing. Much of the documentation contained in this history is not repeated in this Part.

insatiable demand for spectrum. Even as bands have been allocated at higher frequencies where new and (at least initially) more costly equipment was required, the radio channels have been loaded as fast as the Commission could make them available.

The establishment of the Emergency Police Radio Service and allocation of spectrum for its use was accomplished by the Federal Radio Commission. The number of frequency channels available was increased by the FCC in 1936 and were included in a band between 1610 KHz abd 2490 KHz. The most significant aspect of these early allocation decisions was the recognition by the FRC and the FCC that emergency police communication with mobile units was a use of the spectrum that was in the public interest. It is hard to imagine other uses of land mobile radio that would have been authorized at that time. In fact, the FRC stated it could not justify frequencies for municipal fire departments. If the initial proposal had been for commercial or industrial use, for instance, it would no doubt have been denied. Spectrum use that was in the public interest was very narrowly defined at that time.

The development of the land mobile services has been marked by intermittent allocation proceedings and major changes in the Commission's interpretation of the "public interest". The more significant of these Commission actions are described in the following sections. The first such action is the allocation of frequencies above 30 MHz which represented a milestone in the development of <u>two-way</u> land mobile radio. Next is a major allocation proceeding (Docket No. 6651), followed by a 1949 proceeding, which together established the land mobile radio service essentially as it is today. Beginning in the 1950's, Commission activity in land mobile has been directed primarily to satisfying spectrum requirements for these rapidly growing services. This included "channel-splitting," the UHF-TV allocation,

and finally two important reallocation proceedings, Docket Nos. 18261 and 18262.

All of these actions exemplify the difficulties associated with spectrum management by regulation and the deficiencies that can result. In particular, they demonstrate the lengthy delay that has occurred in arriving at allocation decisions. A consequence of the delay, of course, is foregone radio communication service of some unknown value. Part VI specifies the conclusions to be drawn from this allocation experience and from the analyses in other parts of the report.

Allocation of Frequencies Above 30 MHz

Apparently, land mobile radio operation at frequencies above 30 MHz (VHF) became technically feasible during the first half of the 1930 decade. According to the Sixth Annual Report of the FRC, experiments at these frequencies were underway by 1931. In March 1933, the Bayonne, N.J. Police Department established a two-way communication system between headquarters and mobile units at 33.1 MHz under an experimental license. 69/ Regular two-way communication capability had been requested earlier by police but had been denied due to lack of available frequencies in the lower band.

Regular service at frequencies above 30 MHz had not been authorized because neither the FRC nor the FCC was confident that sufficient information was available to support an allocation "in the public interest". In its First Annual Report the FCC in discussing the need for a VHF allocation and its concern that the allocation not be made prematurely stated:

69/ Daniel E. Noble "The History of Land Mobile Communications," Proceedings of the IRE Vol. 50, No. 5 (May 1962), p. 1407.

> Every effort has, therefore, been made, not only during the past year, but throughout the past 4 years, to obtain the requisite technical and nontechnical data. Not only must reliable information on the transmission characteristics of the frequencies be obtained, but the many services seeking frequency assignments must be evaluated from the viewpoint of the public's interest. 70/

By 1935, there were 138 experimental licensees operating 393 stations in the Emergency Police Service on frequencies above 30 MHz. A large number of these experimental stations were providing operational police communications on a regular basis. By June 30, 1936, the number of police experimental stations operating above 30 MHz had increased to 963. There was also a simultaneous decrease in the growth of the regular police service at the lower frequencies during that year. It is clear from these facts that many police departments were using experimental licenses of frequencies above 30 MHz to obtain better radio service than that available with a regular license at the lower frequencies (1610-2490 KHz). In addition to providing for two-way communication, less interference was encountered on the VHF channels.

In June 1936, the FCC convened an informal engineerng hearing in Washington, D.C. to, among other things, obtain information in the matter of allocation of the spectrum above 30 MHz. 71/ The Commission discussed preliminary results of the hearing in its Second Annual Report (June 30, 1936). As a part of this discussion it stated:

> The evidence also indicated that insufficient knowledge is available to date with respect to the practicality of much of the spectrum between 30,000 and 200,000 KC

70/ First Annual Report of the Federal Communications Commission, p. 48.

71/ Notice of Informal Engineering Hearing, Docket No. 3929, April 22, 1936; 1 FR 537 (May 26, 1936).

> [30-200 MHz], and that while development in this portion of the spectrum might be considered as emerging from the laboratory, it nevertheless requires further development before it could be allocated to various services for commercial operation on a permanent basis. 72/

The VHF spectrum was eventually allocated in October 1937. Available records do not reveal the reason for the date of the allocation or what additional information was acquired subsequent to the June 1936 Hearing. Except for a brief mention in the Third Annual Report of the FCC for FY-37, no further discussion of the frequencies above 30 MHz was found prior to the allocation.

This account of the allocation of frequencies above 30 MHz is an example of the delay in spectrum use that has occurred as the Commission was striving to obtain the information necessary to decide the public interest. Even ignoring the earliest experimental effort at VHF and accepting 1933 (when 32 police licensees were operating 87 experimental stations) as the initial year of significant VHF occupancy, the allocation process required six years.

The discussion of preliminary results of the hearing in the Second Annual Report mentioned above identified another problem associated with spectrum management by government administration. Following the conclusion that further development was required before the spectrum could be allocated, the Commission stated:

> However, the evidence showed the necessity for making tentative allocation in order to avoid the pitfalls of premature entrenchment resulting from huge expenditures for experimental apparatus, developing into future

---

72/ Second Annual Report of the Federal Communication Commission, p. 34.

> obstacles of a practical nature when the time becomes opportune for permanent allocation. 73/

In other words, the FCC required the results of physical radio experiments at frequencies above 30 MHz to establish a basis for allocation of that spectrum. On the other hand, the very authorization of the experimental licenses could present the Commission with the political difficulty of a de facto allocation. This particular problem has never been satisfactorily resolved and exists yet today.

Docket No. 6651 Proceeding

In late 1944, the Commission initiated an allocation proceeding designated Docket No. 6651. Several Commission proposals, reports, orders and modifications were issued in this proceeding over the next roughly seven (7) years. 74/ The proceeding was terminated in March 1952. It was in connection with this docket that the Commission first published its allocation principles previously mentioned and contained in Appendix A.

In its Public Notice announcing procedures for the oral hearings in Docket No. 6651, the Commission invited proposals for new radio services for which frequency allocations should be provided. 75/ Several new radio services were proposed and the Commission decided that frequency allocations for many of them were justified according to its allocation principles. These new services were the Railroad Radio Service, a General Mobile Radio Service,

---

73/ Second Annual Report of the Federal Communications Commission, p. 35.

74/ See 39 FCC pp. 33-333.

75/ 9 FR 10271 August 13, 1944.

and a Citizens Radio Communication Service. 76/ The General Mobile Radio Service was composed of the Bus Radio Service, Truck Radio Service, Taxicab Radio Service, and Common Carrier Mobile Radiotelephone Service.

The Citizens Radio Communication Service was proposed on the Commission's own motion. This service was to be available to any U.S. citizen and entail minimum regulation. It was intended for any private or business use except broadcasting or common carrier operation.

In addition to the allocation of frequencies to the new services just mentioned, the Commission in its May 1945 report upgraded the status of power and urban transit utilities as mobile radio users. Prior to this time, these utilities had been authorized to operate in what was defined as the special emergency service on shared frequencies with radio to be used only in cases of actual emergency. Exclusive frequencies were allocated for power utilities and for transit utilities.

In retrospect, the Docket 6651 proceeding was clearly a turning point in the Commission's spectrum allocation policy for land mobile radio. It is true that no new radio services had been created, per se. Frequencies had been allocated, but no rules recognizing the new services were adopted. Furthermore, safety of life and property as a criterion for allocation was very much in evidence in the Commission's discussion of its decisions in the proceeding. Nevertheless, much greater weight was given to the use of radio to support commercial service to the public. In the case of the taxicab service, for example, a reduction in "dead" or non-passenger-carrying miles

---

76/ Report of Allocations from 25,000 Kilocycles to 30,000,000 Kilocycles, May 25, 1945; 39 FCC (1945) pp. 137-146. While this report reflects the final allocation action of the Commission in this mater, it should be read in conjunction with the 'Report of Proposed Allocations' cited in Appendix B at fn. 27. The proposal contains detailed discussion of the testimony received and the basis for many of the decisions in the report of May 25, 1945.

could be discerned as a primary justification for the allocation. Thus, even though Commission allocation policy at the time of the Docket No. 6651 proceeding was far too restrictive to have permitted land mobile radio operation as it is known today, later events indicate that the seeds for a more liberal policy were planted during this proceeding.

A statement that might be taken as an explanation, or even a justification, for the somewhat relaxed policy in the Docket No. 6651 proceeding is found in the Commission's Annual Report for FY 1945. In a discussion of the advances in radio technology during World War II, this report states:

> These developments have resulted in extending the useful portion of the spectrum to such an extent that radio channels can now be made available for the establishment of many new radio services and the expansion of certain existing radio services. 77/

This rather optimistic appraisal of spectrum availability conflicts to some extent with a statement made elsewhere in the same report where it was indicated that even with the extension of the usable spectrum the demand for channels exceeded the supply. Apparently, it was not yet obvious to the Commission in 1945 that at a zero price the demand for technically useable spectrum would always exceed supply. That is, spectrum allocation would require denying frequencies to some attractive uses given that other uses were more beneficial.

77/ Eleventh Annual Report of the FCC (FY-45), p. 66.

Implementation of the Docket No. 6651 Decisions

Despite the designation of frequencies for new services very early in the Docket No. 6651 proceeding, the process of implementing these decisions proved to be no exception to the general finding here that spectrum allocation can result in long delay when the only basis for authorizing a radio service is the public interest. Frequencies allocated to established services which had already qualified under the public interest standard were made available immediately. For the new services, however, the Commission stated,

> While the use of radio in these new services will unquestionably prove feasible, there are many technical and policy problems which must be solved before the services can be established on a regular basis. 78/

Once again, the Commission was faced with inadequate information and had to resort to experimental authorizations. The Railroad Radio Service was established on a regular basis in December 1945 and the Utility Radio Service in August 1946. In both cases, there were strong safety arguments as well as some history of operation. For the rest of the new services, operation on a regular basis would not occur until 1949, four years after the May 1945 report.

In April 1949 the Commission issued a Report and Order in an omnibus proceeding that completely revised and enlarged the land mobile radio service. 79/ This Report and Order combined nine (9) rulemaking proceedings dealing with spectrum allocation and the establishment of rules and regulations for land mobile radio. In many respects, it was a 'sequel' to the

---

78/ Ibid, p. 66.

79/ Report and Order, April 27, 1949; 13 FCC (1949) p. 1190.

May 25, 1945 Report in Docket No. 6651. The administrative structure established for the land mobile radio services by the Report and Order looked very much like that in Part 90 of the current rules. The most significant difference was the lack of a Business Radio Service.

The 1949 Report and Order included provision for a Special Industrial Radio Service. While the eligibility requirements for this service were rather restrictive, they did authorize radio use solely to support an economic activity with no reference to a safety of life or property justification. The Report and Order also established a Low Power Radio Service (3 watts) which was available to any person engaged in a commercial or industrial activity.

With the advantage of hindsight, it is now clear that the direction the service was to take was established by the 1949 Report and Order. The availability of the Special Industrial and Low Power Radio Services together with the Citizens Radio Service permitted a demonstration of the latent demand for spectrum access by private commercial entities that could not be ignored. 80/ As a consequence, in 1958 the Commission authorized the Business Radio Service, the Manufacturers Radio Service, the Telephone Maintenance RadioService, and the Local Government Radio Service. 81/ The structure of the land mobile services was then essentially fully developed. Future effort of the Commission, as well as the industry would be devoted to the matter of locating spectrum space to satisfy the rapid growth of the service.

80/ The Citizens Radio Service was established as a regular service in March 1949 (effective June 1, 1949). See 14 FR 1596 (April 1949).

81/ First Report and Order Docket No. 11991 (June 18, 1958); 17 RR 1569.

Private versus Common Carrier Mobile Radio

One matter left undecided in the 1949 Report and Order was the relative merit of the provision of mobile radio communication by common carrier versus private license. This issue was raised in the Docket No. 6651 proceeding in connection with the land transportation services (bus, truck, and taxicab) which were the only new private services under consideration at the time. In general, the Commission favored common carrier operation on the basis that it made service available to the greatest number of people. In its May 25, 1945 Report the Commission allocated frequencies for experimental operation to both common carrier and private services to obtain information by which to resolve the issue.

The Commission did not decide the matter in its 1949 Report and Order, but instead allocated frequencies for regular use by both private and common carrier licensees. The Report and Order acknowledged, however, that the common carrier allocation was inadequate to satisfy predicted public demand for this service. It stated that further consideration of a "broad band" allocation for common carriers was to be undertaken in the proceeding to allocate spectrum for UHF television above 470 MHz.

The significance of the failure to provide more spectrum for common carrier operations is that it delayed a determination of whether mobile radio is more efficiently provided by common carrier or private licensee. It is conceivable that there have been private users of mobile radio who would have found it economically advantageous to subscribe to a common carrier service rather than install and maintain their own radio equipment. Since the Commission did not make spectrum available for common carrier service in the UHF television proceeding the question has remained unanswerable until the recent inauguration of cellular service.

Reaction of Commissioners

Statements issued by three members of the Commission expressed less than complete satisfaction with the 1949 Report and Order and to some extent indicated a recognition that it represented a precedent-setting decision. All three Commissioners noted particularly that frequency allocated for common carrier mobile radio telephone was inadequate.

Commissioner Paul A. Walker, who was the only Commissioner to have also served at the time of the May 25, 1945 Report, stated that he was voting in favor of the Report and Order only with the understanding that consideration would be given to common carrier operation at UHF. As noted, the allocation he sought in 1949 for common carrier mobile radiotelephone at UHF was not to become available until 1975 with the Commission decision in cellular radio, and the first system did not become operational until 1982.

While the statement of Commissioner Edward M. Webster acknowledged the inadequacy of the common carrier allocation, he appeared to be more concerned about the number of new services that had been authorized relative to spectrum availability. He expressed the opinion that since 1945 the Commission had "permitted growth to go beyond the capabilities of the art and radio spectrum." He suggested that the reason it did so was,

> The Commission, like many other groups, looked forward in the postwar period to an expansion of all phases of communications arts based on wartime innovations. Unfortunately, our hopes for additional spectrum space were not realized nearly in proportion to the number of new communication devices and services developed. 82/

82/ "Additional Views of Commissioner E. M. Webster", Report and Order April 27, 1949; 13 FCC (1949) p. 1236.

Commissioner Robert F. Jones actually dissented from the Report and Order because he believed it was a mistake to permit the growth and development of nonbroadcast radio services on a private and unintegrated basis. He argued that such service should be provided either through a common carrier or through an industry wide coordinating agency such as Aeronautical Radio, Inc. which serves the commercial air transport industry. In his discusion of what might be expected as a result of the rulemaking, he made what has been proven to be a very accurate prediction when he stated,

> The adoption of the report and the associated allocations and rules catches us on the horns of a dilemma. In the light of spectrum limitations as we see them today, we must either make adequate provisions for future expansion of these nonbroadcast services, and any new ones which may hereafter be developed, by taking spectrum away from FM or TV broadcasting, or both; or we must accommodate any expansion of the nonbroadcast services by forcing on the licensees a further sharing of spectrum space and resultant degradation of service. 83/

After the 1949 Report and Order

In addition to establishing new services, the 1949 Report and Order assigned frequencies for regular (as contrasted to developmental) use by the various land mobile services from the bands that had been allocated during the Docket No. 6651 proceeding. All mobile radio services grew rapidly following the 1949 Report and Order. This was especially true of those services associated with private commercial use of mobile radio. During the first half of the 1950 decade, for example, while all land mobile services together with

---

83/ "Dissenting Opinions of Commissioner Jones", Report and Order April 27, 1949; 13 FCC (1949) p. 1238.

the Citizens Radio Service expanded by 277 percent, the Special Industrial Service growth was 1054 percent and that of the Citizens Radio Service 5682 percent.

By 1955, it was evident that the spectrum allocated for land mobile would be inadequate. Thus began a 20 year saga of how to satisfy the spectrum demand of the land mobile radio services. It began in 1955 with radio channel respacing (channel-splitting) and ended with reallocation of spectrum from UHF television to land mobile radio in 1975. In between was a seven year review of the spectrum allocation in the 25-890 MHz band, a three year study of land mobile spectrum use by an Advisory Committee, and a seven year reallocation process, all in series.

UHF Television

To place the events of this twenty year period in proper context, it is necessary to summarize the Commission's concern for the development of UHF television. In 1948, the Commission initiated a series of rulemakings in a consolidated proceeding concerned with television broadcasting.

In its Sixth Report and Order in the consolidated proceeding the Commission adopted a Table of Assignments for television based on 12 VHF channels and 70 UHF channels derived from the UHF allocation of 470-890 MHz to television. 84/ The Commission's decision that 82 television channels were required to achieve the desired "nationwide competitive television broadcast system" and its belief that the 82 channels would be occupied as implied by the Sixth Report and Order was a subjective judgment based on the information

---

84/ Sixth Report and Order Docket No. 8736 et al April 11, 1952; 41 FCC (1952) p. 148.

available at the time. It subsequently became, however, and for several years remained, an inviolate commitment that was not easily changed.

For the first decade after the Sixth Report and Order there was little progress in the development of UHF television broadcasting. Of the few stations that attempted operation, many failed for economic reasons. The Commission was confronted with a highly anomalous allocation matter. Normally, allocation problems developed because the demand for spectrum by a radio service exceeded the available supply. In the case of UHF television, the opposite situation prevailed, but the Commission remained convinced that the demand would appear if the right set of circumstances could be established. The Commission took action in many ways to create an environment conducive to UHF television development of which two examples will be discussed.

Because there were few UHF television stations on the air, receiver manufacturers found little incentive to equip television receivers with UHF tuners. Converters that permitted a UHF signal to be received on a VHF-only receiver were available but were not widely used. The Commission, therefore, requested Congressional legislation giving it authority to require all-channel tuning on all television receivers sold in interstate commerce. This legislation was approved in July 1962, and the Commission adopted rules requiring all-channel tuning capability in receivers manufactured after April 30, 196[illegible]. This example has been cited because, as will be seen later, the very presence of the all-channel requirement had the effect delaying allocation of spectrum to the land mobile services.

A second example of Commission dedication to the promotion of UHF television is both more interesting and significant. This is the matter of the constraints placed on Community Antenna Television Systems (CATV) to

protect UHF television. In a rulemaking concerned with CATV in March 1966, the Commission addressed the issue of the economic impact of CATV on UHF television. 85/ This Second Report and Order noted that CATV was beginning to move into the larger markets and could thus offer competition to UHF television just as the all-channel equipped receivers were arriving on the market. The Commission stated that while it could not conclude from the evidence available that UHF television would suffer economic harm in the general case, there was "a substantial problem of great significance to the public interest which must be thoroughly explored." 86/ The Commission then included in the CATV rules the requirement that no CATV system operating in the top 100 markets could import a distant signal without a showing in an evidentiary hearing that such importation would be consistent with the establishment and healthy maintenance of television broadcast service in the area. In other words, the Commission was willing to restrain the introduction of CATV into the larger markets if this was necessary to protect the development of UHF television. 87/

An interesting aspect of the CATV decision from the standpoint of spectrum management is the contradiction between this decision and one of the Commission's allocation principles. The Commission listed as its first principle in determining whether spectrum should be allocated to a service, the question of whether wireline might be a practical substitute for

---

85/ Second Report and Order Docket No. 14895 et al March 4, 1966; 2 FCC 2nd (1966) p. 725.

86/ Ibid, p. 776.

87/ For an excellent history of the regulation of CATV, see: S. M. Besen and R. W. Crandall, "The Deregulation of Cable Television"; Law and Contemporary Problems, Vol. 44, No. 1 (Winter 1981), pp. 74-124.

radio. 88/ Both radio and television broadcasting qualified, of course, because wireline was not economically practical. CATV, on the other hand, was a wireline service that the Commission believed might be sufficiently viable to supplant some or all of the functions of over-the-air television. Thus, the Commission found it necessary "in the public interest" to constrain the development of a viable wireline service to protect a service that required access to the spectrum.

With that very brief background of the Commission's concern with UHF television, the major events dealing with land mobile spectrum management between 1955 and 1975 can be reviewed. These events are described in much greater detail in the appended history of land mobile radio. This is especially true for rulemaking documentation.

Channel Splitting

As previously noted, the growth of the land mobile services following the 1949 Report and Order was of such a magnitude that an impending shortage of spectrum was soon apparent. The most immediately available source of additional spectrum was a reduction in channel spacing, or channel-splitting as it was called. Between 1955 and 1958 the Commission issued several rulemaking documents in eight (8) different dockets to accomplish the channel-splitting, adopt new narrow-band standards, and assign the new frequencies derived. The frequency bands involved included 25-50 MHz, 150.8-162 MHz, 173-174 MHz, and 450-470 MHz. It was during these proceedings that the Commission established the Business, Manufacturers, Telephone

---

88/ See Appendix A.

Maintenance, and Local Government Radio Services that were previously mentioned.

Arguments can be conceived that would appear to support the Commission's decision to split the mobile radio channels. The channels were becoming congested; technology that permitted closer channel spacing had become available; and there was no incentive for voluntary adoption of narrow-band equipment. That congestion was present and the technology to produce narrow-band equipment was available were observable facts and therefore reasonable arguments. The lack of incentive for conversion to narrow-band equipment, however, was a defect of the regulatory system. It contained no provision for the user of a wide-band channel to gain any benefit from the channel created by an investment in narrow-band equipment. If the licensee of a wide-band channel had been permitted to use or lease the new channel, the wide-band channel would have been split as soon as either the licensee's own requirements, or the revenue from a lease, justified the cost of narrow-band equipment. This assumes, of course, that no other uncongested channel was available merely by applying to the Commission.

Voluntary conversion would have reduced the cost of channel splitting. The Commission found it in the public interest to require the use of new narrow-band equipment on a national scale at a common future date. This effectively established a fixed amortization schedule for all wide-band equipment. There undoubtedly were licensees in areas where congestion was not a problem who under voluntary conversion would have continued to use their wideband equipment indefinitely and certainly beyond the date mandated by the Commission. On the other hand, some users perhaps should have converted sooner. In either case, voluntary conversion would likely have been more efficient.

Docket No. 11997

However well justified the Commission channel splitting effort may have been, the increase in radio channels available to land mobile did not satisfy the rapidly growing demand of these services. Partly in response to the land mobile demand for spectrum, the Commission initiated a proceeding in April 1957 in which it proposed to conduct an overall review of current spectrum allocations and future requirements for the frequencies between 25 MHz and 890 MHz. 89/ The results of the review were issued in a Report and Order in March 1964. 90/ This Report and Order was devoted primarily to spectrum requirements of the land mobile radio services and acknowledged that land mobile frequencies were extensively used and that vast expansion was indicated. It further noted that if this spectrum demand was to be met by making additional spectrum available, the spectrum would have to be reallocated from UHF television broadcasting which the Commission was unwilling to do. The Report and Order stated that the Commission remained convinced that a 70 channel UHF allocation together with 12 VHF channels was necessary to achieve a national competitive television system, and that the feasibility of an 82 channel system had been ensured by the passage of the all-channel tuner legislation in 1962.

The general conclusion of the Report and Order was that the spectrum demand of land mobile radio could not be met by reallocation from other services and that only more efficient use of land mobile spectrum could resolve the matter. To determine how this increased efficiency might be best

---

89/ Order of Inquiry Docket No. 11997 April 5, 1957; 22 FR 2684 April 17, 1957.

90/ Report and Order Docket No. 11997 March 26, 1964; 2 RR 2d 1513.

achieved, the Commission established an Advisory Committee for the Land Mobile Service simultaneously with the release of the Report and Order.

Thus, 14 years after the allocation of spectrum to UHF television, the Commissison was still deeply committed to the development of a service for which demand was languishing. Meanwhile, at some unknown opportunity cost, the land mobile services were without adequate spectrum. The Report and Order did not explain why its date of issue was 7 years after that of the initiating Notice of Inquiry except to note,

> ...a determination with respect to the allocations future of television and the feasibility of the expanded television system which had been a central facet of Commission policy since 1952 was required before this proceeding could be concluded. 91/

Advisory Committee

The Advisory Committee for the Land Mobile Service under the Chairmanship of Commissioner Kenneth A. Cox conducted an extensive study of land mobile radio operation over a period of about 3 1/2 years. Representatives of over 140 private organizations from almost every sector of the land mobile community participated. The results of the study were submitted in a three volume, 800 page report on November 30, 1967. Despite this effort the Committee was unable to discover any solution to the land mobile spectrum congestion other than allocation of additional spectrum.

On the surface, the Advisory Committee study would appear to have contributed little more than delay to the resolution of the land mobile spectrum shortage. It can be argued, of course, that the study was necessary

---

91/ Ibid, p. 1539.

to establish beyond doubt that reallocation of spectrum was the only alternative. From this, it follows that the study was inevitable given the Commissions commitment to UHF television. It is another example of the delay inherent in an administrative spectrum management system as it seeks information on which to base decisions.

Reallocation of UHF-TV Spectrum

As a result of the finding of the Advisory Committee study and perhaps also some political pressure, the Commission initiated proceedings to make UHF-television spectrum available to land mobile radio. 92/ In April 1967, the Commission announced that it was establishing a special staff committee to investigate the possibility of meeting the frequency needs of the land mobile radio services with spectrum currently allocated to UHF-television. This was followed in July 1968 with two Notices of Proposed Rulemaking in Docket Nos. 18261 and 18282.

The NPRM in Docket No. 18261 proposed to permit sharing of the seven lowest UHF-television channels by land mobile radio. The NPRM in Docket No. 18262 proposed to reallocate the 14 highest UHF-television channels plus an additional 31 MHz for the exclusive use of land mobile. Both proceedings were highly controversial and required several years to complete. The major Commission actions in each of the proceedings are discussed in more detail in Appendix B.

92/ The 1966 Annual Report of the FCC devoted a separate chapter to the land mobile radio spectrum problem. At one point in this discussion, the Commission stated: "Congressional interest in mobile radio is manifest in testimony before various committees." See, FCC Annual Report for FY 1966, p. 52.

The features of either rulemaking most relevant here are: (1) they represented the culmination of a 20 year effort to meet the spectrum demand of land mobile radio; and (2) each is another example of the long period of time required to complete an allocation proceeding. The primary purpose of the sharing concept proposed in Docket No. 18261 was to provide immediate relief for land mobile radio. Since the 7 lowest UHF-television channels (470-512 MHz) were just above the 450-470 MHz land mobile band, radio equipment to operate in the television channels could be readily produced based on current design. Equipment to operate on the upper channels (above 806 MHz), on the other hand, would require some years to develop. Despite the objective to provide immediate relief, three years elapsed between the NPRM and the order authorizing assignment of shared radio channels.

The NPRM in Docket No. 18262 which proposed to reallocate spectrum to land mobile was adopted in July 1968. It was not until July 1975 that the Commission began accepting applications for private licenses to operate on the reallocated frequencies. Some of this delay can be attributed to a requirement for General Accounting Office approval of the application form to be used and responding to petitions for reconsideration. Nevertheless, the seven year period from proposal to licensing was all consumed by the regulatory process. Common carrier operation of cellular radio systems was even further delayed because the Commission decided that additional development was required before this service could be licensed on a regular basis. The first cellular system was not licensed until November 1982.

A Final Note

This discussion of the results of spectrum management by regulation has noted several times, and even emphasized, the lengthy delay experienced by the

allocation function of spectrum management and the contribution that inadequate information has made to that delay. The inability to acquire the information necessary for proper allocation decisions has proven to be the most serious deficiency in FCC spectrum management. None of the material reviewed for this paper stated this fact more clearly than the special chapter devoted to land mobile radio in the 1966 Annual Report of the FCC. Excerpts from this report are quoted below.

In discussing the types of information required for allocation decisions, the Commission stated:

> Apportionment of this valuable natural resource among the many services is not, however, derived from formulas and slide rule calculation, but rather is dependent on the considered judgment of those entrusted with this task. The basic apportionment of this part of the spectrum was begun in 1944 in a lengthy allocations proceeding and more or less fixed in its present form in a 1949 decision of the Commission based on estimates of projected need for the services in existence at that time. With the possible exception of a few unavailing voices, no one then envisioned the birth of so many more diverse services and the astonishing growth pattern of the entire group. 93/ (Emphasis in the original.)

The Commission went on to note that of the portion of the spectrum then considered appropriate for land mobile radio (25-890 MHz), television and FM broadcasting had received 60 percent and land mobile only 4.7 percent. It then followed with this explanation:

> The underlying reason, then, behind this apparent imbalance in allocations is simply that the unusual growth in the Nation's economy and its resulting impact

---

93/ 32nd Annual Report of the Federal Communications Commission for FY 1966, p. 48.

> on the Land Mobile Radio Services was not foreseen by those concerned. 94/

These statements by the Commission in 1966 suggest that the inability to obtain information is inherent in the present allocation process. They further emphasize the need for flexibility and a willingness on the part of the Commission to accept change in past allocations.

94/ Ibid, p. 49.

PART VI

CONCLUSIONS

The analysis and examples of governmental spectrum management decisions described in the earlier parts of this report highlight several characteristics of resource allocation under a system of administrative regulation. The salient features may be summarized in the following terms:

(1) Delay: There has generally been long delay (several years) in arriving at allocation decisions due to: (a) inadequate and often unavailable information, and (b) Commission endeavor to avoid allocation mistakes. At prices set equal to zero, the demand for access to the spectrum has virtually always exceeded the technically usable supply. In any allocation proceeding, therefore, the Commission has been required to choose among competing applicants using subjective selection criteria in accord with the Communications Act. Application of these criteria, in turn, has required a determination of "need" for a radio service and a prediction of its future spectrum requirements, the latter necessarily entailing guesses about the future technical capabilities of associated radio equipment. Information on which to base such findings is difficult to come by in the best of circumstances and may not be available at all prior to allocation when learning requires doing.

(2) Inflexibility: Regulatory decisionmaking has frequently proven inflexible. There has been reluctance to reallocate spectrum even when it has become obvious that the spectrum was not being used as extensively as expected or as efficiently as it might otherwise have been. One prominent example has been the allocation to UHF-TV broadcasting. This inflexibility represents

more than an intellectual or emotional attachment by certain Commissioners to past decisions, although unwillingness to admit error is certainly not an uncommon human trait.

In the case of UHF-TV, for example, between the time of the initial allocation in 1952 and the Notice proposing to reallocate in 1968, more than twenty Commissioners had participated in the several decisions to retain the 82-channel television allocation. One reason for regulatory inflexibility is that the decisionmaking process does not provide a simple mechanism for altering past decisions. The UHF-TV allocation was based on a decision that the "public interest," a compelling if entirely amorphous concept, required 82 channels to provide a satisfactory national television system. The fact that valuable land mobile services would be necessarily foregone did not really figure in that decision. Nor did the increasingly widespread availability of UHF substitutes over time.

Eventually the growing demand for spectrum by land mobile and effective political organization by the land mobile community lead the problem to be reframed, at least roughy, in terms of allocating a scarce resource among competing uses. Broadcasting and land mobile produce different communication products both of which are valued by the public (i.e., both are "needed"). The information that was not available initially (and was never actually produced under the regulatory management system) was that regarding the marginal valuation that members of the public placed on these services in terms of a derived demand for spectrum. As a consequence, the matter was resolved only after the land moble community was able to muster enough political pressure to force a reallocation. Even now, there is little basis for a claim that the current service mix represents an optimal allocation of scarce transmission rights.

(3) Bureaucratic Allocation Bias: With very few exceptions, Commission policy has been to provide some spectrum for all proposed radio services rather than attempt to optimize the value of scarce spectrum resources. This is in part simply a natural consequence of bureaucratic organization. Bureaucrats, no less public spirited than any other member of the public, will nevertheless naturally seek to avoid taking decisions that threaten their stature and power. They will seek to avoid resolving issues in ways that lead to complaints by interested factions. This leads to a "something-for-everybody" system of allocation, even though it is by no means clear that this type of allocation actually maximizes the value of scarce spectrum rights to society. The inability to define uniquely and precisely the "public interest" and the absence of effective means for measuring opportunity costs reinforces the political practicality of this approach.

An additional source of bureaucratic allocation bias arises in the case of spectrum use by different branches of the government itself. Special concessions have traditionally been made to public (State and local government) users in the form of extended time for amortization of equipment and for making use of allocated spectrum. This has been due in part to concern for the funding cycle of these public users, but is a privilege they do not receive in the case of other resources. It clearly leads to inefficient use of the spectrum again because of a failure to consider adequately the value to society of foregone alternative resource usage.

(4) Bias Against Innovation: Spectrum management under administrative regulation has retarded technical innovation and the development of new services. This has occurred for two reasons. First, because scarce spectrum has been treated as a free good, little incentive has been provided to economize on its use. There is little incentive to develop and implement

spectrum-saving (or productivity-enhancing) technical advances under a system in which the result would be loss of assigned transmission rights. Second, the Commission has limited the scope of developmental tests primarily because of concern that the capital investment involved may result in a de facto allocation of the spectrum used. Assignment of experimental transmission rights creates an interest group desirous of maintaining the allocation beyond the initial period. Because the Commission is a political body, it has difficulty in denying such demands. To avoid putting itself in the position of having (and probably proving unable) to deny such demands, the Commission is naturally reticent to undertake experiments to begin with. But this has the undesirable effect of denying the Commission valuable information on which to base allocation decisions. The Commission is thus, in effect, damned if it does and damned if it doesn't.

The Market v. the Bureaucrat

There are no perfect methods of resource allocation. The question is what is the least imperfect method. In economic terms performance is frequently conceptualized in terms of how well a particular set of institutions optimizes the use of scarce resources. But what is "optimal" in no small measure depends on whose preferences are to count. The strength of one set of institutions on one set of preferences may actually be a weakness in terms of another. This is an important point because which preferences are likely to count will itself depend on what kinds of allocation mechanisms are adopted.

Markets and bureaucracies both respond to the wishes of citizen-consumers. The question in any given setting is which will prove more

effectively responsive. Under which system will relevant information be more effectively transmitted and acted upon? In a static world in which it was clear what consumers desired and what means could be brought to bear to satisfy these desires and in which means and ends never changed or changed only slowly, it would probably make little difference whether allocation decisions were rendered by an impersonal market or an impersonal bureaucracy. Both would do a tolerably satisfactory job. In a dynamic world in which knowledge of means and ends is scarce and the means and ends themselves are constantly changing, the question of institutional choice assumes much greater significance. And in that world, which is, of course, the one in which we actually reside, there would seem to be little doubt about the superiority of the market as an organizing principle. Certainly the record of administrative regulation we have detailed does not suggest otherwise.

In Part III of this report, it was postulated that a market in broadcast spectrum would have been possible in the mid 1920's. Also it was inferred that if such a course had been taken at that time, there would have been no need for the system of spectrum management by regulation that followed from the Radio Act of 1927. Reality, however, requires recognition that the Act of 1927 was enacted and as a consequence, there is a multibillion dollar telecommunication system operating under regulation. Thus, establishing the elements of an unfettered spectrum market would be a much more complex matter today. It would simply not be feasible to abruptly replace regulation with the market at this point. Instead, what must be considered is a process for introducing market forces on a gradual but increasing basis. This caveat notwithstanding, it must be emphasized that until market forces are permitted

to significantly influence spectrum management decisions, especially allocation among uses and users, the inadequacies and inefficiency ascribed herein to regulation will persist.

APPENDIX A

SIGNIFICANT FACTORS AND GENERAL PRINCIPLES FOR ALLOCATION

This Appendix contains the significant factors about which the Commission stated it required information to arrive at allocation decisions and the general principles it followed as allocation criteria in the Docket No. 6651 proceeding. 1/ With the exception of minor revisions in section titles everything that follows is quoted directly from the Commission's Report of Proposed Allocations cited below.

Significant Factors

1. Public Need and Benefit:

(a) The dependence of the service on radio rather than wire lines.

(b) The probable number of people who will receive benefits from the service.

(c) The relative social and economic importance of the service, including safety of life and protection of property factors.

(d) The probability of practical establishment of the service and the degree of public support which it is likely to receive.

1/ Report of Proposed Allocations from 25,000 Kilocycles to 30,000 Kilocycles; Docket No. 6651 (January 15, 1945) (available in the FCC Library, 1919 M Street, N.W., Washington, D.C. 20554).

(e) The degree to which the service should be made available to the public, that is, whether on a limited scale or on an extended competitive scale.

(f) When it is proposed to shift a service from its present location in the spectrum, data should be presented showing the feasibility and cost of the shift, particularly with respect to the technical, economic and other considerations involved, and the length of time and manner for completing the shift.

Technical:

(a) The frequency bands required for a given service and the exact position thereof in the radio frequency spectrum; also the width of communication bands or channels within each portion required for station frequency assignments.

(b) Suitability and necessity for particular portions of the spectrum for the service involved. This includes propagation characteristics and reliable range data.

(c) Field intensity required for reliable service.

(d) The number of stations required to enable efficient service to be rendered.

(e) The distance over which communication must be maintained.

(f) The relative amount of radio and other electical interference likely to be encountered.

(g) The relative amount of noise which may be tolerated in the rendering of service.

(h) Apparatus Limitations, both transmitter and receiver.

General Principles Followed by Commission in Making Proposed Allocations

As appears from the preceding section, in most cases the request for frequencies by the various non-governmental radio services far exceeded the supply and in some of these cases the evidence showed little or no correlation between the number of channels requested and the number and locations of the units or stations proposed to be installed. Hence, the Commission could not in all cases propose an allocation based strictly upon the number of channels requested. Furthermore, the engineering standards or basis upon which channel widths were estimated appeared somewhat conflicting, thereby necessitating a detailed examination of all the engineering facts presented in order that a proper adjustment of these conflicts could be made. As has been pointed out, some of these requests were completely unsupported by adequate engineering studies or satisfactory technical data, and therefore had to be rigidly discounted. Even after this was done, the demand for frequencies still far exceeded the supply. This was true throughout the entire spectrum. It was therefore obvious that all of the requests based upon statements as to the number of channels required could not be met, and in most instances, the Commission has had to allocate fewer or narrower channels than were requested or assign the service to a different portion of the spectrum from that sought, or both.

There were six general principles that guided the Commission in making this determination. In the first place, the Commission examined each request to determine whether the service in question really required the use of radio or whether wire lines were a practicable substitute. Obviously, with the severe shortage of frequencies, it would not be in the public interest to assign a portion of the spectrum to a service which could utilize wire lines

instead. The Commission's determination was not limited to technical considerations but also took into account economic and social factors and considerations of national policy. For example, while fixed point-to-point service between countries could be carried on by cable as well as by radio, the great disparity in costs between the two types of service and considerations of national policy clearly required the assignment at least at this time of frequencies for such fixed point-to-point service.

As a second principle, the Commission determined that not all radio services should e evaluated alike. Radio services which are necessary for safety of life and property obviously deserved more consideration than those services which are more in the nature of conveniences or luxuries.

Thirdly, the Commission was concerned with the total number of people who would probably receive benefits from the particular service. Where other factors were equal, the Commission attempted to meet the requests of those services which proposed to render benefits to large groups of the population rather than of those services which aid relatively small groups.

Fourth, and this applied particularly to proposed new services, the Commission undetook to determine whether such newer services met a substantial public need and what the likelihood was, if frequencies were granted, that the service could be established on a practical working basis. With the shortage of frequencies available, the Commission did not believe that it would be in the public interest to assign frequencies to a new service unless it could be shown that there would be public acceptability and use of the service.

The fifth principle related principally to consideration of the proper place in the spectrum for the service in question. There was much evidence introduced in the record - some of it available for the first time - concerning the radio wave propagation characteristics of the various portions

of the spectrum. This evidence showed that operation on frequencies within certain regions of the radio spectrum was more suitable for some types of services than others. Certain frequencies could be more effectively used by those services where long range communication was necessary. Other frequencies were better suited for sh ort range communication. In the case of some frequencies, the principle source of interference to a station on these frequencies would be from stations located nearby, while in the case of other frequencies the principal source of interference would be caused by distant stations. All of these factors had to be evaluated so that the service could be assigned to that portion of the spectrum where it could render its best service.

The sixth principle also pertained to assignment of each service to the proper place in the spectrum. In determining the competing requests of two or more services for the same portion of the spectrum, when one of more of the services was already operating in that portion of the spectrum, the Commission gave careful consideration to the number of transmitters and receivers already in use, the investment of the industry and the public in equipment, and the cost and feasibility of converting the equipment for operation on different frequencies, as well as to the time required for an orderly change to the new frequencies.

APPENDIX B

DEVELOPMENT OF THE LAND MOBILE RADIO SERVICES

Introduction

This account of the development of the land mobile radio services is in essence a chronical of Commission actions with regard to these services. It is not a complete history in that it does not include the contribution to land mobile development by the private sector. The primary purpose in compiling this historical record was to trace the evolution of the authorized service (sub-service) structure of land mobile radio and to identify those spectrum allocation proceedings, and other regulatory actions, which had a significant effect on the growth of land mobile.

The present structure of the land mobile services has existed with very little change since the latter part of the 1950 decade and the last major allocation to land mobile was made in 1975 in Docket 18262. This history, therefore, covers the period from the origin of land mobile in 1928 to the middle 1970's. While there have been several land mobile rule making proceedings in the last eight years or so, some deregulatory in nature, none of these proceedings had a significant effect on land mobile allocation policy or altered the list of eligible services included in the land mobile administrative structure.

This development of land mobile radio is documented primarily in chronological sequence. The procedure could not be followed exclusively, however, because in some instances influential events were more appropriately described in connection with a period of land mobile development that was later in time while in other cases clarity required mention of an incident

before its chronological occurrence. The discussion is divided by section headings intended to identify in a general manner the topic under discussion. These headings may refer to a point in time, a period of time, or an action by the Federal Communications Commission (FCC), particularly rulemaking proceedings.

The initial four sections describe the origin and development of land mobile radio from 1928 to 1944, near the end of World War II. These sections are concerned first with police radio (the first, and for some years, the only land mobile radio service) and eventually with the Emergency Radio Service which included the Police Service. A point of some significance is that during these first sixteen years land mobile radio was permitted only for emergency communications in the protection of life and property.

Section 5 describes the impact on the development of land mobile of a major FCC spectrum allocation proceeding (Docket No. 6651). This was the most extensive allocation proceeding ever undertaken by the Commission. It was also a turning point for the land mobile radio service in that the Commission invited and adopted proposals for new uses of land mobile radio.

Sections 6 and 7 discuss events of the post-World War II period (1945-1949), during which the decisions of the Docket No. 6651 spectrum allocation proceeding was influencing activity both in the land mobile community and within the FCC. The result was a Commission rulemaking in 1949 that established the administrative structure of the land mobile services very much like that of the present FCC rules. Except for the addition of a few radio services (Business Radio being most important), the remainder of the history is a discussion of the Commission's efforts to provide sufficient spectrum to support the radio services authorized in 1949.

Sections 8 deals with the growth of the land mobile services following the 1949 decision and the demand for radio service by business and industry. The Commission's attention was being focused on the matter of increased eligibility as well as radio channel availability for these potential users. Section 9 is a brief review of the status of the spectrum allocated to land mobile in this early 1950's period.

Section 10 describes the process of "splitting" the VHF channels allocated to the land mobile services in an effort to satisfy the growing demand for spectrum. Three rulemaking proceedings are involved and the discussion by necessity becomes somewhat detailed. In an effort to make the text easier to follow, docket numbers are used as subsection headings. Section 11 is a summary of these FCC actions.

Section 12 discusses five rulemaking proceedings in which the Commission among other things "split" the UHF (450-470 MHz) channels and authorized their use for regular service. In addition, both the VHF and UHF "split" channels were suballocated among the land mobile services. New land mobile radio services were established and the Citizens Radio Service rules were extensively revised. Each docket is treated separately in Section 12, and again, the docket numbers are used as subheadings.

Section 13 recounts the growing landmobile spectrum shortage that persisted throughout the 1960 decade. This shortage accurred in spite of the additional channels made available by "channel splitting." To address the problem, the Commission initiated a proceeding that lasted seven years to review the allocation of the entire spectrum band between 25 MHz and 890 MHz. This was followed by the establishment of an Advisory Committee for the Land Mobile Service which studied the matter for four years. Even the Congress held hearings on the subject.

Sections 14, 15 and 16 deal with the Commission's decision to reallocate spectrum from UHF-TV to land mobile including a review of the proceedings in Docket No. 18261 and Docket No. 18262. Docket No. 18261 provided for sharing of certain of the lowest seven UHF-TV channels by land mobile in the thirteen largest metropolitan areas. Docket No. 18262 allocated the upper fourteen UHF-TV channels to land mobile in addition to 26 MHz reallocated from Government use and 5 MHz from the Broadcast Auxiliary Service, for a total of 115 MHz.

Section 17 briefly outlines the efforts of a Spectrum Management Task Force established by the Commission to establish a facility in the Chicago area capable of computerized automatic frequency assignment and license preparation. The program involved the concept of inter-service sharing of frequencies with assignment based on local radio service need.

1. Genesis of Land Mobile Radio.

According to one source, land mobile radio began in Detroit, Michigan on April 7, 1928 with the first successful use of radio by the Detroit Police Department for emergency dispatch of patrol cars. 1/ Actually, it would probably be as difficult to determine with certainty the exact date and location of the first use of land mobile radio as it is to unequivocally defend the selection of KDKA, Pittsburgh as the first broadcast station. The efforts of the many individual experimenters who contributed to the early development of radio are not that well recorded. For example, effort by the

---

1/ Daniel E. Noble, "The History of Land-Mobile Radio Communications" Proceedings of the IRE Vol. 50, No. 5 (May 1962), p. 1406. See also the Fifth Annual Report of the Federal Radio Commission, p.49.

Detroit Police Department began in 1921. 2/ In any case, it is apparent that by 1928 at least one police department was using land mobile radio.

In October 1929, the Federal Radio Commission (FRC) assigned three frequencies for police emergency radio. 3/ Then in April 1930 it established the Emergency Police Radio Service and assigned eight frequencies between 1712 KHz and 2470 KHz for its use. 4/ The service was defined as ". . . the broadcasting of emergency communications from central police headquarters to squad cars or other mobile units." Two-way communication as well as general (non-emergency) dispatch were yet to come.

The Commission also noted that it did not consider that provisions for similar communications for fire departments could be justified given the few frequencies available because such service could be rendered by coordination with police departments using radio or wire. Scarcity of useable spectrum was already influencing spectrum allocation for land mobile in 1930. At this time, the spectrum had been allocated internationally to 60 MHz. 5/ Above 23 MHz, however, it was allocated only to amateurs and for experimentation. Domestic allocation was in accord with this international agreement.

2. Early Development of Land Mobile Radio (1930-35).

From 34 municipal stations and 9 State police stations in 1930 the Emergency Police Radio Service had grown to 194 municipal stations and 58 State police stations by 1935. At this time, 11 channels or frequencies were

---

2/ Ibid, p. 1405.

3/ FRC General Order No. 74.

4/ Annual Report of the Federal Radio Commission for FY 1930; General Order No. 85, April 8, 1930.

5/ International Radiotelegraph Conference, October 5 to November 25, 1927.

allocated to this service. 6/ The FCC (which by this time had replaced the FRC) recognized that more channels were required to satisfy the growing service and allocated a total of 34 channels for use by the States and municipalities. These channels were still at frequencies just above the AM broadcast band from 1610 KHz to 2490 KHz. 7/

Other types of radio stations that might be considered forerunners of the land mobile radio service had also been licensed by the FRC. These were mobile press, broadcast pick-up, motion picture, and special emergency stations. These services, however, do not appear to have experienced the growth nor did they engender as much discussion in the FRC annual reports as did the Emergency Police Radio Service. In fact, the early operation of these stations may have been more of a portable nature than mobile. A possible exception to this observation is the broadcast pick-up service which by 1935 had grown to 102 stations. 8/

Frequencies had been allocated for the broadcast pickup stations because, as the FRC noted, "Events of interest to broadcast listeners often occur at locations at which wire-line facilities are unavailable or unsuitable." 9/ The station was described as a low-power transmitter located on an airplane, a train, an automobile, or carried by an announcer. 10/ In 1936, the station

---

6/ First Annual Report of the Federal Communications Commission (FY 1935) p. 37.

7/ FCC Telegraph Division Order No. 18, July 1, 1936; 2 FCC p. 33.

8/ First Annual Report of the FCC (FY 1935), p. 27.

9/ Fifth Annual Report of the FRC (FY 1931), p. 53.

10/ Ibid, p. 53.

designation was changed to relay broadcast station and included as a part of the broadcast service. 11/

During the early years of the 1930 decade, several municipal police stations began operating on an experimental basis at frequencies above 30 MHz. In 1935, there were 138 experimental licensees operating 393 stations in the Police Radio Service. 12/ Two-way communication was included in this experimental work, and in March 1933 the Bayonne, N.J. Police Department, established the first two-way communication between police mobile units and headquarters on 33.1 MHz. 13/ Four police cars were equipped with transmitters as well as receivers and operated under a temporary experimental license.

3. Expansion of Land Mobile Radio (1935-41).

Several events in the second half of the 1930 decade influenced the development of land mobile radio. Until 1935, nearly all of the equipment used in police radio systems was of a do-it-yourself variety. Only a few commercial receivers were available. In 1936, however, RCA and GE entered the mobile radio manufacturing field, followed by Motorola in 1937. 14/ In addition, there were important actions by the Commission.

First, the rapid development of radio equipment for operation above 30 MHz together with increasing demand for access to the lower frequencies

---

11/ Second Annual Report of the FCC (FY 1936), p. 62.

12/ First Annual Report of the Federal Communicaitons Commission (FY 1935), p. 38.

13/ Daniel E. Noble, "The History of Land Mobile Communications", Proceedings of the IRE Vol. 50, No. 5 (May 1962), p. 1407.

14/ Ibid, p. 1408.

prompted the Commission to consider extension of the allocation table to higher frequencies. A public hearing on the matter was held in June 1936. As a result, the Commission established an allocation of the spectrum to 300 MHz. 15/ Twenty-nine (29) channels between 30.58 MHz and 39.90 MHz were reserved for police mobile communications. Channels were also allocated for several land mobile stations not yet recognized as part of the land mobile service. Channel spacing was 40 kHz.

The allocation of VHF frequencies had a major impact on police communication. Perhaps the most immediate effect was increased growth in both the number of licensed stations and two-way communication systems. It also undoubtedly led to experimentation with frequency modulation (FM) in the mobile service. Frequency modulation required the wider channel width that could be made available at VHF.

Second was an expansion in the types of mobile stations recognized by the Commission. In 1937, Congress amended the Communications Act of 1934 which among other things, added the words, "for the purpose of promoting safety of life and property through the use of wire and radio communications" to Sec. 1 of the Act. 16/ While the amendment was passed largely because of concern for maritime safety, the Commission interpreted the change in purpose of the Act to include all aspects of public safety, and took that mandate very seriously. 17/

In June 1938, the Commission adopted new rules for the Emergency Radio Services. 18/ These new rules included municipal and State police, marine,

---

15/ FCC Order No. 19 (October 13, 1937) Docket No. 3929; 4 FCC (1937) p. 30.

16/ Public Law No. 97, 75th Congress, 1st Session (May 20, 1937).

17/ Fourth Annual Report of the FCC (FY 1938) p. 75 and Fifth Annual Report of the FCC (FY 1939) p. 59.

18/ 3 FR p. 1734 (July 15, 1938).

fire, forestry and special emergency stations within the Emergency Radio Services. The rules were intended to comply with the new Congressional mandate to promote safety of life and property. They were designed to take advantage of the availability of VHF channels and for the first time identified forestry as a separate radio service. Public utilities were also specifically included under the Special Emergency stations to which 10 VHF channels were assigned. Land mobile operation was authorized in all services except marine-fire which was intended only for communication with fire boats. It should be noted that only emergency communication was permitted. General dispatch was not yet authorized in the land mobile service. It is not clear, however, how 'emergency' was distinguished from 'dispatch' in the police radio service.

Another event of importance to land mobile that occurred as the 1930 decade ended was the introduction of frequency modulation (FM). The Commission had become aware of the advantages of FM over amplitude modulation from the results of FM broadcast experiments. These experiments had demonstrated the noise suppression characteristic of FM and the tendency of an FM receiver to select the strongest signal present ("capture" effect). Recognizing that FM was now a highly developed technique the Commission adopted rules for a regular FM broadcast service in June 1940. 19/

The Commission was not satisfied, however, that it had enough information to authorize FM in other services. Instead, in January 1940 it began accepting applications for experimental authorization for the use of FM for other than broadcast. 20/ At the end of FY 1941 (June 30), 179 authorizations for FM

19/ Sixth Annual Report of the FCC (FY 1940), pp. 65 & 66.

20/ Ibid, p. 94.

experimental operation had been granted in the Emergency Radio Service. 21/ Finally, in October 1941, FM was authorized for regular use in the police, forestry, and other stations in the Emergency Service. 22/

4. Land Mobile Radio at the End of World War II.

During the years of World War II, the land mobile service continued to grow, but (with one exception) there was no change in the structure of service. The one exception was a change in the Emergency Radio Service rules in May 1944 that deleted "marine-fire" stations and substituted "municipal fire" stations. Because of frequency limitations, only fire departments serving a population of 150,000 or more persons were eligible for a station license. As noted above, prior to this time radio communication with fire department mobile units was provided through the municipal police radio systems. Municipalities of less than 150,000 people were expected to continue this cooperative procedure.

Even with the inclusion of the municipal fire stations, the Commission had by 1944 adopted rules for only five of the land mobile services existing today. These included the police, fire and forestry stations in the Emergency Radio Services and motion picture and relay press stations in the Miscellaneous Radio Services. The Commission had not yet adopted subservice designations. Instead, it established rules and assigned frequencies in terms of station classifications. For each of the five classes of stations just mentioned, there were separate rules and frequency assignments. Other land mobile operations of a less permanent nature were conducted as special emergency stations or in the Miscellaneous and Experimental Services.

21/ Seventh Annual Report of the FCC (FY 1941), p. 49.

22/ Eighth Annual Report of the FCC (FY 1942), p. 47.

Special Emergency stations were authorized in the Emergency Radio Services to provide radio communication for random and relatively short time emergencies. Most such facilities were operated by utilities, including telephone utilities, to assist in restoration of disrupted service. Both fixed and mobile stations were used.

In addition to the motion picture and relay press stations, the Miscellaneous Radio Services included geological, provisional, and mobile press stations. 23/ Mobile press stations provided telegraph press service to Maritime mobile stations and made no use of land mobile. The geological and provisional stations were intended for use for short periods of time where telecommunication facilities other than radio service were not available. Geological mobile stations were used largely in oil exploration and provisional stations at large construction sites.

The Commission had maintained this relatively restrictive policy in its authorization of land mobile radio because frequencies for more extended use were considered to be unavailable. Land mobile communication was authorized only for safety of life and property or, in a few instances, to support operations deemed essential and for which no other communication facility was available. Examples of the latter were relay press stations to transmit news from remote locations and geological stations involved in oil exploration.

5. Impact of World War II Technical Development (Docket No. 6651).

In late 1944, the Commission initiated an allocation proceeding that would have a major impact on the development of land mobile radio. Designated Docket No. 6651, it was the most extensive allocation proceeding ever

---

23/ Rules for the Miscellaneous Radio Services had been adopted in December, 1938. 3 FR p. 3024 (December 17, 1938).

conducted by the Commission. A primary reason for the proceeding was an anticipated expansion of non-Government radio use as a result of the technical advances in radio equipment that had occurred during World War II. In particular, equipment capable of operating at much higher frequencies was expected to be commercially available. The proceeding dealt with the frequency range from 10 KHz to 30 GHz. Prior to this, the spectrum had been allocated only to 300 MHz.

The Commission began the Docket No. 6651 proceeding by holding oral hearings for 25 days between September 28 and November 2, 1944 at which 231 witnesses were heard and 4559 pages of testimony were recorded. Several Commission proposals, reports, orders and modifications, were issued and additional hearings were held over the next roughly seven (7) years. 24/ The proceeding was terminated in March 1952. While the proceeding was concerned with all radio services, only the decisions affecting land mobile radio development are discussed here.

Although the Docket No. 6651 proceeding was lengthly and entailed the release of many Commission documents, the decisions which led to major changes in land mobile radio were all contained in the Commission's first report in May 1945. 25/ This report was concerned with frequency allocation above 25 MHz. 26/ The allocation decisions contained in the May 1945 report reflected a much more liberal policy for the authorization of land mobile radio and

---

24/ 39 FCC pp. 33-333.

25/ Report of Allocations from 25,000 Kilocycles to 30,000,000 Kilocycles; May 25, 1945; 39 FCC (1945), p. 68.

26/ Commission action in Docket No. 6651 at frequencies below 25 MHz can be found in 39 FCC 33 and 303. Allocation decisions at these frequencies had no significant effect on land mobile radio and will not be discussed further in this history.

prepared the way for the development of several new radio services as well as providing for expansion of established services. 27/

In its Public Notice announcing procedures for the oral hearings to begin in September 1944, the Commission had invited proposals for new radio services. In this Notice, it advised that in addition to testimony on established radio services, it would ". . . receive testimony on the question of whether any new radio services not heretofore recognized should be provided for in any frequency allocation." 28/ As a result of the testimony received, the Commission, in its May 1945 report, allocated frequencies for several new services. The new radio services for which frequencies were allocated included the Railroad Radio Service, the General Mobile Radio Service, and the Citizens Radio Communication Service. The General Mobile Radio Service was composed of the Bus Radio Service, Truck Radio Service, Taxicab Radio Service and Common Carrier Mobile Radiotelephone Service.

What was perhaps the most innovative proposal for a new service, the Citizens Radiocommunication Service, was in fact made on the Commission's own motion. 29/ The service was to be available to any U.S. citizen and entail minimum regulation. It was intended for any private or business use except broadcasting or common carrier communication. No charge was to be permitted for any use of facilities licensed in the service. The frequency band of 460-470

27/ In January 1945, the Commission issued a proposed allocation for frequencies above 25 MHz: Report of Proposed Allocations from 25,000 Kilocycles to 30,000 Kilocycles; Docket No. 6651 (January 15, 1945) (available in the FCC Library, 1919 M Street, N.W., Washington, D.C. 20554) This proposal contains a detailed discussion of the testimony received during the oral hearings and explains the basis for many of the decisions cited in the May 1945 report.

28/ 9 FR 10271 August 23, 1944.

29/ This service should not be confused with the Citizens Band Service (CB) located at 27 MHz.

MHz was allocated with no channels specified. No interference protection was to be afforded. While the Citizens Radiocommunication Service never developed as proposed, the Commission had clearly anticipated the Business and Personal Radio Services in its description of the intended service. 30/

In addition to the frequency allocation to new radio services, the May 1945 report made special provision for utilities which had been operating radio stations in the Special Emergency Service. Exclusive allocations were made to power utilities and transit utilities. The Commission also noted in its January 1945 proposal that it would consider authorizing broader use of radio by both services. 31/ As previously noted, the Commission had recognized public utilities as eligible users of land mobile radio in 1938. Frequencies were available, however, only on a shared basis with other stations in the Special Emergency classification. Also, radio use was restricted to actual emergencies. It could not be used, for example, to dispatch maintenance crews in anticipation of an emergency.

The Docket No. 6651 proceeding was clearly a turning point in the development of land mobile radio. Although no new radio services were established per se, the seeds for such had been planted by the allocations made. Safety of life and property as a criteria for spectrum allocation was still very much in evidence in the Commission's discussion of requirements. At the same time, however, much greater weight was given to commercial service to the public. In the case of taxicabs, in fact, a reduction in "dead" or non-passenger-carrying miles could be discerned as the primary reason for the allocation to the Taxicab Radio Service.

30/ Report of Proposed Allocation from 25,000 Kilocycles to 30,000,000 Kilocycles; Docket No. 6651 (January 15, 1945), p. 184-186.

31/ Ibid, pp. 127 & 129.

An explanation, or what might even be read as a justification, of the more liberal policy adopted in the Docket No. 6651 proceeding is found in the Commission's Annual Report for 1945. In a discussion of the advances in radio technology during World War II, this report states,

> These developments have resulted in extending the useful portion of the spectrum to such an extent that radio channels can now be made available for the establishment of many new radio services and the expansion of certain existing radio services. 32/

As a final observation, of perhaps not great significance, it might be noted that in the Docket No. 6651 proceeding land mobile radio sub-groups were designated by "service" rather than "station". For example, police and fire radio users were identified and discussed as the Police Radio Service and Fire Radio Service not as stations in the Emergency Radio Service. This appeared to be the first use of this designation, and no explanation for the change was found. It may have been an implicit recognition by the Commission of impending change in land mobile radio.

6. Implementation of Docket No. 6651 Decisions.

Although the Commission had identified new radio services for which it decided frequency allocations were justified, it was not yet ready to establish rules for the services. In its 1945 Annual Report, the Commission stated, "While the use of radio in these new services will unquestionably prove feasible, there are many technical and policy problems which must be solved before the services can be established on a regular basis." 33/ In the meantime, the services were permitted to operate on an experimental basis.

32/ Eleventh Annual Report of the FCC (FY 1945), p. 66.

33/ Ibid, p. 66.

During the years immediately following World War II, several developments led to increased activity in land mobile radio. Materials and production facilities that had been restricted to military support were released for production of commercial radio equipment. Technology that permitted use of higher frequencies was applied to the design of commercial equipment resulting in a considerable expansion of the useable spectrum. 34/ There was increased demand for radio licenses in established services, and also a great demand for experimental licenses, particularly by the new services to which the Commission had assigned frequencies in the Docket No. 6651 proceeding. In the midst of this activity, the Commission was studying the reports of the experimental effort, reviewing the results of its frequency assignments in the May 25, 1945 report in Docket No. 6651, and developing plans for the new land mobile services.

The first of the new services to be established as a regular service was the Railroad Radio Service in December, 1945. 35/ As a result of several serious passenger train accidents in 1943 and a suggestion in February 1944 by Senator Burton K. Wheeler, Chairman of the Senate Interstate Commerce Committee, the Commission had initiated an investigation into the use of radio in railroad operations and made provision for public hearings on the subject in September 1944. The record of the hearings in this proceeding (Docket No. 6593) was incorporated by reference into Docket No. 6651. 36/ Based on the combined records, the Commission allocated 60 radio channels between 152-162 MHz for exclusive use by railroads in its May 25, 1945 report in

---

34/ See for example, Thirteenth Annual Report of the FCC (FY 1974), p. 45.

35/ Twelfth Annual Report of the FCC (FY 1946), p. 45.

36/ Report of Proposed Allocation from 25,000 Kilocycles to 30,000,000 Kilocycles; Docket No. 6651 (January 15, 1945), p. 149.

Docket No. 6651. With these channels available, the railroads moved rapidly with plans to implement radio communication within their operations. Sufficient progress was made that the Commission could justify the establishment of regular service status by the end of 1945.

The next use of mobile radio to be established as a regular service was the Utility Radio Service in August 1946. This service authorized radio communication for power, transit, and petroleum pipeline utilities. In addition to messages related directly to safety of life and property, to which the utilities had been restricted as part of the Special Emergency Service, communication in connection with operations such as dispatching of maintenance vehicles was authorized under the rules of the new service. 37/

7. Origin of Present Administrative Structure for Land Mobile Services.

In April 1949, the Commission issued a Report and Order in an omnibus proceeding that completely revised and enlarged the structure of the land mobile radio service. 38/ This Report and Order combined a proceeding concerned with policy for the new general mobile radio services, four allocation proceedings reviewing the results of the May 25, 1945 report, and four proceedings to establish rules and regulations for the land mobile services.

The resulting administrative structure for the land mobile radio services is shown in Table I. It will be noted, that the structure looks very much like that existing in Part 90 of the FCC Rules today. Perhaps the most significant difference is the lack of a Business Radio Service.

37/ Thirtheenth Annual Report of the FCC (FY 1947), p. 42.

38/ Report and Order, April 27, 1949; 13 FCC (1949) p. 1190.

The decisions in the Report and Order of 1949 mark a milestone in the development of the land mobile radio service. Implicit in the decisions was the recognition that land mobile radio had more to offer in the public interest than promotion of safety of life and property. Business productivity was also important. Most of this result can be traced directly to the policies adopted in the Docket No. 6651 allocation proceeding. There was, however, one significant change in Commission policy that developed between the May 1945 Report in Docket No. 6651 and the Report and Order in 1949 that should be noted. By 1949, the Commission had become even more liberal in its authorization for use of mobile radio for private commercial or industrial purposes as noted by the inclusion of a Special Industrial Radio Service.

In the Docket No. 6651 allocation proceeding, the requests for spectrum from the established and proposed users far exceeded the supply. The Commission, therefore, found it necessary to adopt criteria by which it measured the relative public benefit of each of the potential spectrum users. The criteria to which the Commission gave greatest attention were the dependence of the service on radio rather than wireline communication, protection of life and property, the number of people to be served, and the probability that a service would be established if spectrum were allocated. 39/ The Commission emphasized that it was particularly important that new services satisfy these requirements, and stated that all new services to which it had allocated frequencies did so.

39/ Report of Proposed Allocation from 25,000 Kilocycle to 30,000,000 Kilocycles; Docket No. 6651 (January 15, 1945); p. 18.

TABLE I

Land Mobile Radio Services - June 30, 1949

Part 6	Domestic Public Mobile Radiotelephone Service
	Telephone Companies
	Miscellaneous Carriers
Part 10	Public Safety Radio Services
	Police Radio Service
	Fire Radio Service
	Forestry-Conservation Radio Service
	Highway Maintenance Radio Service
	Special Emergency Radio Service
Part 11	Industrial Radio Service
	Power Radio Service
	Petroleum Radio Service
	Forest Products Radio Service
	Motion Picture Radio Service
	Relay Press Radio Service
	Special Industrial Radio Service
	Low Power Radio Service
Part 16	Land Transportation Radio Services
	Intercity Bus Radio Service
	Highway Truck Radio Service
	Railroad Radio Service
	Taxicab Radio Service
	Urban Transit Radio Service
	Automobile Emergency Radio Service

It will be recalled that all of these new services were involved in transportation. In each case, direct service to large segments of the public was obvious. Also, it could be, and was, argued that the use of radio promoted highway safety. With one minor exception, the only allocation that was authorized for general commercial or industrial use of land mobile radio was the Citizens Radio Communication Service. The one exception was an allocation for a new low-power station classification in the already established Provisional Radio Service. These low-power stations were to be permitted broader application than the regular Provisional Service.

It cannot be determined from the discussion in the January 1945 proposal or the May 1945 report in Docket No. 6651 whether an allocation for general commercial or industrial use of radio was proposed in the hearing testimony. Nor can it be determined how such a proposed allocation might have fared at that time when judged by the Commission's criteria. Whatever the explanation for the lack of an authorization in the Docket No. 6651 proceeding for broader use of radio communication by private commercial or industrial interests, the omission was only temporary.

In its Annual Report issued in June 1946, the Commission included the Industrial Radio Service as a new service the Experimental Radio Service. The Commission stated that it appreciated ". . .the need for short-distance radio communications in many businesses and industries such as construction, manufacturing, mining, agriculture, and related activities." 40/ The Commission also noted that several experimental authorizations had been issued to explore the merits of radio use by this Service and more were anticipated.

40/ Twelfth Annual Report of the FCC (FY 1946); p. 49.

This experimental use of radio by industry was undoubtedly the forerunner of the Special Industrial Radio Service established in the 1949 Report and Order. Eligibility in the Special Industrial Service was somewhat restricted. It was limited to activities devoted to production, construction, fabrication or manufacturing as distinguished from activities of a service or distribution nature. It was expected to be used primarily in remote areas or within the yard area of a single plant. Other commercial or industrial users were expected to rely on common carrier facilities or the Citizens Radio Service for mobile radio communication. 41/ Nevertheless, the Report and Order in the 1949 proceeding did recognize a broad demand for mobile radio by private commercial and industrial enterprises. In this respect, it went beyond the new service authorizations of the Docket No. 6651 proceeding.

The Commission apparently recognized that its Report and Order in the 1949 proceeding was a precedent-setting decision. Two Commissioners (P.A. Walker and E.M. Webster) filed additional statements expressing concern that the use of private mobile radio was being encouraged while the frequencies allocated for common carrier were inadequate. Commisisoner R.F. Jones actually dissented from the Report and Order out of concern that the Commission's action did not make the most efficient use of the spectrum and would lead to future problems. At the outset of his dissent, he stated:

> It appeas to me that it is a mistake to permit the growth and development of nonbroadcast radio services on a private and unintegrated basis. 42/

At another point in his dissent, Commissioner Jones noted,

41/ The Citizens Radio Service was established as a regular service in March 1949 (effective June 1, 1949). See 14 FR 1596 (April 1949).

42/ Report and Order April 27, 1945 13 FCC (1949) p. 1238.

> Prior to the allocation proceedings of 1944 (Docket No. 6651), the Commission's policy seems to have been rather firmly established as being one which gave virtually no recognition to the use of radio by noncommon carrier licensees (other than broadcast licensees), except for purposes directly and primarily related to public safety.
>
> In the Docket No. 6651 proceedings, the door was thrown open to requests for the establishment of new radio services, private in nature and having little direct and primary relationship to the preservation of life and property. As a result of that opening of the door, the Commission has today taken an action which establishes 18 noncommon carrier services on a regular basis. Though the new services claimed that they fostered the protection of life and property, the primary purpose of some is to foster the more efficient administration and greater economic exploitation of the industries with which they are associated. If there were enough frequencies to go around, I would have no objection to such use of them. 43/

With the advantage of hindsight, it is clear that the form that the land mobile service was to take was established by 1949. Future effort by both the Commission and industry would be devoted to the matter of locating spectrum space to satisfy the rapid growth of the service. In this regard, Commissioner Jones included a highly prophetic statement in his dissenting opinion when he stated,

> The adoption of the report and the associated allocations and rules catches us on the horns of a dilemma. In the light of spectrum limitations as we see them today, we must either make adequate provision for future expansion of these nonbroadcast services, and any new ones which may hereafter be developed, by taking spectrum space away from FM or TV broadcasting, or both; or we must accommodate any expansion of the nonbroadcast services by forcing upon the licensees a further sharing of spectrum space and resultant degradation of services. 44/

43/ Ibid, pp. 1239-1240.

44/ Report and Order April 27, 1949; 13 FCC (1949) p. 1240.

8. Growth as Result of 1949 Rulemaking.

The effects of the 1949 rulemaking on the growth of the land mobile radio services soon became apparent. While all of the mobile services increased at a relatively rapid rate, the growth was by far the greatest in those radio services devoted to industry and commerce. For example, the total number (including the Citizens Radio Service) of authorized land mobile stations increased by 277 percent in the first half of the 1950 decade. 45/ During the same period, however, the Special Industrial Service increased by 1054 percent and the Citizens Radio Service by 5682 percent. The reason for including the Citizens Radio Service as a part of the land mobile services will be explained shortly.

The growth in the Special Industrial Services would have been even greater if the Commission had not imposed very restricted eligibility requirements. Because of the limited number of frequency channels available, the rules adopted for this service in 1949 restrictive eligibility to those engaged in production or construction activities confined to remotely or sparsely settled regions, the yard area of a single manufacturing plant or a construction project of a public character. No provision was made for such operations as mobile dispatching by retail stores or by service or distribution businesses. The only radio service available for this type of operation was the Citizens Radio Service.

As noted, the Citizens Service was established as a regular service in June 1949. At that time, the use of the service was limited by the lack of

---

45/ Including the Citizens Radio Service, there were 13602 licensed land mobile stations on June 30, 1949 and 51240 stations on June 30, 1954. See, Fifteenth Annual Report of the FCC (FY 1949), p. 88 and Twentieth Annual Report (FY 1954), p. 86. The number of licensed stations does not indicate total number of authorized transmitters. Each licensed station might have been operating several mobile units.

type-approved equipment for operation at 460-470 MHz. By 1952, equipment had become commercially available and the service began to expand rapidly. 46/ Most of this expansion was in the form of business users, including large corporations, who were not eligible for a license in any other service.

The Commission had not anticipated this development when it established the Citizens Radio Service. Instead, it had expected the service to provide for short-distance radio communication for personal convenience or miscellaneous business purposes as well as radio signaling and remote control of objects and devices by radio. 47/ As a result, the Commission was prompted to reconsider its frequency allocation for the Citizens Service and the eligibility structure of the Industrial Radio Services. It was because the primary users of the Citizens Radio Service were entities that would become a part of the land mobile service, that the Citizens Service was included in the growth number cited above for the first half of the 1950 decade.

During the latter half of the 1950's the Commission was engaged in several rulemaking proceedings directed toward the spectrum scarcity problem that developed in the land mobile services. These proceedings involved spectrum allocation, channel splitting, establishment of new services, and revision of old services.

46/ In 1949, there were only 122 stations authorized in the Citizens Radio Service. By 1952 there were over 1400 licensed stations and in 1954 there were over 7000 stations.

47/ In the Statistical Summaries of the FCC Annual Reports from FY 1951 through FY 1959, the Citizens Radio Service was actually listed under Land Transportation Services.

9. Summary of Land Mobile Spectrum Allocation.

As background for discussion of the 1950 rulemaking proceedings, it will be advisable to briefly review the spectrum allocation that had been made to the land mobile services up to this time. An initial allocation of eight frequency channels between 1700 KHz and 2500 KHz had been adopted for the Emergency Police Radio Service in 1930. This was increased to 34 channels in the same part of the spectrum in 1936. In 1937, 29 channels were added for the Police Service in the 30-40 MHz band. Several channels in this band had also been allocated to stations not yet recognized as part of the land mobile service such as forestry, special emergency and motion picture. During the Docket No. 6651 proceeding, the 42-50 MHz, 152-162 MHz, and 450-460 MHz bands had been added to the land mobile service allocation while the 460-470 MHz band had been designated for the Citizens Radio Service. By the middle of the 1950 decade all of the land mobile bands except 450-460 MHz, were intensively used.

In the May 1945 report in Docket No. 6651, the Commission had allocated the 450-460 MHz band temporarily to the Aeronautical Radionavigation Service and permanently to the fixed and mobile services. At that time it was being used for special air navigation aids. During the omnibus proceeding (see fn. 35) in 1949, the band was allocated to the land mobile services and suballocated equally among the Land Transportation, Public Safety, Industrial, Domestic Public, and Remote Pickup Radio Services 48/ The band was resuballocated in 1953 to provide frequency pairs for repeater operation. Each of the services retained a 2 MHz share of the band. The channels were

---

48/ Domestic Public and Remote Pickup were by this time included as part of the Common Carrier and Broadcasting services respectively.

spaced at 100 KHz, thus providing 10 paired channels per service. 49/ At this time only developmental operation was permitted.

The Commission recognized that although increased use of the 450-460 MHz band would provide some relief from the growing spectrum congestion, many more frequency channels would be required to produce any significant effect. The most immediately available source of additional spectrum was a reduction in channel spacing, or channel splitting. Development in radio equipment performance had made such action feasible. Commission action to reduce the channel spacing and assign the new channels involved eight rulemaking proceedings over a period of about five years beginning in 1955.

10. "Channel Splitting" - VHF Bands.

Docket No. 11253. The channel splitting effort was initiated by a Notice of Proposed Rulemaking (NPRM) in January 1955 that would reduce the channel spacing in the 25-50 MHz and 152-162 MHz bands. 50/ In a Report and Order (R&O) in this proceeding in September 1956 the Commission reduced the channel spacing in the 152-162 MHz band but elected not to do so in the 25-50 MHz band at that time. The reason given was the potential for adjacent channel interference caused by long range ionospheric propagation at 25-50 MHz. Such interference might be caused by foreign as well as domestic stations. 51/ The channel spacing at 152-162 MHz was reduced from 60KHz to 30 KHz for same area assignment and 15 KHz for adjacent area. 52/ New standards were adopted for

---

49/ Report and Order Docket No. 10323 May 14, 1953; 18 FR 2941 May 22, 1953.

50/ NPRM Docket No. 11253 January 12, 1955; 20 FR 463 January 20, 1955.

51/ Report and Order Docket No. 11253 September 19, 1956; 8 R ¶ 1577.

52/ Adjacent area was defined generally as an area at a distance removed by one-half the cochannel separation required.

the narrow band operation and dates for the conversion to these standards were established. New authorizations were to comply with the narrow band standards by September 19, 1958 (two years) and all stations were to be converted by September 19, 1963. This allowed a seven year equipment amortization period. No channel assignments were included. This was deferred to a later rulemaking.

Although the Commission did not split the 25-50 MHz channels in the sense that no new channels were assigned, it did establish narrow band technical standards for this band in the Report and Order in Docket No. 11253. The use of these standards was not mandatory, but voluntary application was encouraged to reduce interference. A year later, however, because the Commission continued to receive reports of harmful skywave interference, it decided that the narrowband standards should be mandatory. 53/

Docket No. 12169. Simultaneous with the order making the narrowband standards at 25-50 MHz mandatory, the Commission released a NPRM in a new docket proceeding to once again consider reduced channel spacing in the 25-50 MHz band. 54/ A primary reason for this reconsideration was a reallocation of a portion of the 42-50 MHz band to the Government for implementation of a communication technique known as forward propagation by ionospheric scatter (FPIS). 55/ This reallocation displaced some land mobile licensees and new channel locations had to be found.

Actually, the reallocation of the 42-50 MHz spectrum to the Government had been accompanied by a transfer of the 150.8-152 MHz from Government to

---

53/ Second Report and Order Docket No. 11253, September 19, 1957; 8 RR 1588.

54/ NPRM Docket No. 12169, September 19, 1957; 22 FR 7660 September 26, 1959.

55/ The reallocation included the frequency bands 46.51-47 MHz and 49.51-50 MHz which were made available for both Government and non-Government FPIS.

non-Government use. This more than compensated for the loss of spectrum in the 42-50 MHz band. The Commission was also engaged at this time, however, in other rulemaking proceedings to assign the channels derived from the 152-162 MHz respacing as well as to administratively restructure the land mobile services. In particular, the establishment of the Business Radio Service was under consideration. The analyses associated with these proceedings made it clear that all of the channels that could be made available, including the 42-50 MHz band, would be needed.

In December 1957, the Commission issued a Report and Order that reduced channel spacing from 40 KHz to 20 KHz in the 42-46.51 MHz and 47.0-49.51 MHz bands and designated channels at 30 KHz spacing in the 151.8-152 MHz band. 56/ In addition, the R&O assigned the new channels among the land mobile subservices with an effective date of April 1, 1958.

Docket No. 12295. In the R&O in which the Commission had made the use of narrow band standards mandatory in the 25-50 MHz band (see fn. 47), the Commission also established dates for compliance. Stations licensed on or after November 1, 1958 were required to use narrowband equipment, and all stations were to be so equipped by November 1, 1963. These dates were also applicable to the 152-162 MHz band which represented a slight change from those originally set. Considerable controversy arose over these dates much of it expressed in comments in the Docket No. 12169 proceeding to split the 42-50 MHz channels.

The reason for the controversy was that the assignment of the new channels created by respacing was, in the practical sense, tied to the introduction of radio equipment which met the narrow band standards. Some of

---

56/ First Report and Order Docket No. 12169 December 18, 1957; 16 RR 1569.

the older wider bandwidth receivers were subject to interference from stations operating on the split channels even though narrow band transmitting equipment would be used. Even more important, the larger deviation (± 15 KHz) permitted under the old rules could result in interference to receivers (old or new) on adjacent split channels. Furthermore, if the deviation were reduced to comply with the new standards (± 5 KHz) the performance of the older radio systems would be somewhat deteriorated.

Extremes in the controversy were represented by those (particularly the police service) who requested full protection of their older systems until the November 1, 1963 date and potential users (such as the Industrial Service users) who preferred immediate assignment of the split channels. Because of this wide divergence of views, the Commission opened yet another proceeding specifically aimed at establishing a date for assignment of the split channels and conversion to the new narrow band standards in the 25-50 MHz and 152-162 MHz bands. 57/

In June 1958, the Commission released a Report and Order in the Docket No. 12295 proceeding which reaffirmed the November 1, 1963 date for conversion of all radio stations and made the split channels in the 25-50 MHz and 152-162 MHz bands available for assignment as of the effective date of the R&O (August 1, 1958). 58/ The R&O also required all radio systems authorized after the effective date to use equipment which met the narrow band standards

---

57/ NPRM Docket No. 12295 January 22, 1958; 23 FR 598 January 29, 1958. Because there were no land mobile licensees operating in the reallocated 150.8-152 MHz band this band was not included. The assignment date remained April 1, 1958 and only equipment meeting narrow band standards was authorized.

58/ Report and Order Docket No. 12295 June 26, 1958; 17 RR 1582. In the case of the Public Safety Radio Service, split channels were to be assigned prior to November 1, 1963 only where a satisfactory showing could be made that no harmful interference would be caused to stations operating on adjacent channels.

established in Docket No. 11253. Finally, the frequency deviation of all transmitters was to be reduced to the narrow band standard of ± 5 KHz within six months from the effective date for all except the Public Safety Service which was allowed a period of two years.

11. Summary of "Channel Splitting" - VHF Bands.

At this point (1959), the Commission had split the land mobile channels in the 150.8 MHz-162 MHz band, split and assigned some of the channels in the 25-50 MHz, established standards for narrow-band equipment in both bands, and established dates by which the new standards were to be effective and new channels were to be available. There remained the tasks of assigning the new channels created in the 150.8-162 MHz band and disposition of the 450-460 MHz and 460-470 MHz bands. In addition, demand for radio service required the Commission to review the administrative structure of the land mobile services. On April 3, 1957, the Commission released Notices of Proposed Rulemaking in five separate dockets that had the common objective of dealing with these matters. 59/

12. Suballocation of VHF and UHF Channels.

Docket No. 11990 dealt with the Public Safety Radio Services. In June 1958, the Commission adopted a Report and Order in this docket that affected several parts of the Public Safety rules. 60/ It reduced the channel spacing in the portion of the 450-460 MHz band allocated to the Public Safety Services from 100 KHz to 50 KHz. It also removed the developmental restriction on the

---

59/ NPRM Docket Nos. 11990, 11991, 11992, 11993 and 11994 April 3, 1957; 22 FR 2584 April 16, 1957.

60/ Report and Order Docket No. 11990 October 8, 1958; 17 RR 1553.

450-460 MHz frequencies and made them available to all Public Safety Services on a shared basis. To provide greater flexibility for local governments to satisfy their communication requirements, the R&O established the Local Government Radio Service within the Public Safety Services.

Although a primary purpose of the NPRM in Docket No. 11990 had been to assign the "split-channel" in the 152-162 MHz band to Public Safety sub-services, the Commission in its R&O noted that investigation of this matter was simultaneously being conducted in Docket No. 12295 (see fn. 52) and indicated that assignment of the 152-162 MHz channels would be made in that proceeding. This action was completed by a combined Report and Order in October 1958. 61/ This is an example of the interrelatedness of the various rulemaking proceedings in which the Commission was involved during the channel respacing exercise.

Docket No. 11991 was concerned with the Industrial Radio Services and was perhaps the most complex of the proceedings referenced in footnote 59. The Commission adopted a Report and Order in this proceeding in June 1958 that allocated considerably more spectrum to the Industrial Services and created three new Industrial subservices, as well as splitting and assigning channels in the frequency bands allocated to the subservices. 62/

As noted previously, the 460-470 MHz band had been allocated to the Citizens Radio Service in the May 1945 report in Docket No. 6651. While some licensees were using the spectrum for short-range personal and business communications as the Commission intended, the primary use was by large industrial entities who were not eligible for a mobile license in any other

---

61/ Further Report and Order Docket Nos. 11990 and 12295 October 8, 1958; 17 RR 1562a.

62/ First Report and Order Docket No. 11991 June 18, 1958; 17 RR 1569.

service. The Commission decided, therefore, to reallocate 6.55 MHz of the band to the Industrial Radio Services and also stated in the R&O that an additional 1.9 MHz was designated for possible reallocation at a future date.

In recognition of the demand for wider eligibility for industrial and business users the Report and Order established the Business Radio Service, the Manufacturers Radio Service, and the Telephone Maintenance Radio Service as new Industrial Services. The Business Radio Service absorbed the Low Power Industrial Radio Service and some elements of the Special Industrial and Citizens Radio Service.

The Report and Order in Docket No. 11991 also reduced the channel spacing from 100 KHz to 50 KHz in the 450-470 MHz band and provided for regular rather than developmental assignment of all frequencies allocated to the Industrial Radio Services. It also reduced the spacing of some frequency channels allocated to the Industrial Radio Services at 173-174 MHz and 27.23-27.28 MHz from 50 KHz to 25 KHz and 20 KHz to 10 KHz, respectively. Finally, it assigned and reassigned frequencies to Industrial Radio subservices in the 25-50 MHz, 152-162 MHz, 173-174 MHz and 450-470 MHz bands.

Docket Nos. 11992 and 11993 were both concerned with the Land Transportation Services. In two Reports and Orders in Docket No. 11992, the Commission assigned the new channels created in the 152-162 MHz band among the Transportation subservices, and specified that the new channels were to be immediately available. 63/ Licensees required to change frequencies were permitted to operate on their current channels until November 1, 1963 to permit amortization of equipment.

63/ First Memorandum Opinion and Order Docket 11992 January 22, 1958; 16 RR 1595. Second Report and Order Docket 11992 July 31, 1958; 17 RR 1665.

The Commission adopted a Report and Order in Docket No. 11993 in February 1958 which reduced the spacing between channels in the portion of the 450-460 MHz band allocated to the Land Transportation Services and made the channels available for regular assignment. It also made channel assignments in the 450-460 MHz and 27.23-27.28 MHz bands to the Land Transportation subservices. 64/

The Docket No. 11994 proceedings resulted in a general revision of the Citizens Radio Service Rules. Of primary interest here is the reallocation of part of the 460-470 MHz band to the Industrial Radio Services which has already been discussed under the Docket No. 11991 proceeding. Other aspects of the Docket 11994 proceeding are included at this point, however, to provide a more complete record of the history of the Citizens Radio Service which in its own way played an important role in the development of business and industrial use of land mobile radio. In particular, it was the availability of the 460-470 MHz spectrum together with very permissive eligibility requirements in the Citizens Service that permitted a convincing demonstration of the demand for mobile radio by a large number of users who were not then eligible for a license in the Industrial Radio Services.

A First Report and Order in the Docket No. 11994 proceeding was adopted in April 1958. 65/ This Report and Order included rule changes to promote more efficient administration of the service. A Second Report and Order in August 1958 reallocated the spectrum band 26.96-27.23 MHz from the Amateur Service to the Citizens Service, established a new Class D Citizens radio station, and specified the frequencies on which all classes of citizens

---

64/ Memorandum Opinion and Order Docket No. 11993 February 26, 1958; 16 RR 1614a.

65/ First Report and Order Docket No. 11994 April 16, 1958; 17 RR 1538.

stations were to operate. 66/ Only the Second R&O is pertinent to the present discussion.

The Citizens Radio Service prior to Docket No. 11994 included three classes of stations. Class A stations were authorized for radio telephony with relatively high power (60 watts). Class B stations were authorized for radio telephony and remote control of objects or devices with low power (10 watts). Class C stations were intended only for remote control purposes and were authorized to operate only at 27 MHz. The 460-470 MHz band had been occupied primarily by Class A stations operated by commercial enterprises not otherwise eligible for a mobile radio license. It was to satisfy this demand that the Commission established the Business and Manufacturers Radio Services to supplement the Special Industrial Services.

With the reallocation of a large portion of the 460-470 MHz band (6.55 MHz), the Commission recognized the need for additional spectrum for personal radio use, particularly for those individuals then holding Class A station licenses but who, despite the new services, would not be eligible in either the Industrial or Land Transportation Services. Consequently, the Commission reallocated the 26.96-27.23 MHz band to the Citizens Radio Service. The Class D Station was established because the technical standards applicable to Class A stations in the 460-470 MHz band differed from those at 27 MHz; e.g., maximum authorized power of the Class D stations was 5 watts. The Class D stations (CB) along with the Business Radio Service were destined to experience enormous growth.

66/ Second Report and Order Docket No. 11994 July 31, 1958; 17 RR 1607.

13. The Growing Land Mobile Spectrum Problem.

The land mobile radio services had clearly demanded a large share of the Commission's attention during the 1955-1958 period. Frequency channel spacing had been reduced in the 25-50 MHz, 150.8-174 MHz and 450-470 MHz bands. New narrow-band standards were adopted. Several new land mobile radio services were established and the Citizens Radio Service rules were extensively revised. 67/ Despite this effort, the Commission was not able to satisfy the demand for spectrum by these still rapidly growing services.

Anticipating the imbalance between spectrum demand and availability, the Commission in April 1957 adopted an Order of Inquiry in Docket 11997 to conduct an overall review of spectrum allocations and future requirements between the frequencies of 25 MHz and 890 MHz. 68/ The Commission noted that it had not conducted such a review since the allocation proceeding in Docket No. 6651, initiated in 1944. The Inquiry was directed to all existing or potential users of the 25 MHz-890 MHz band which, of course, included the land mobile services. Among the objectives of the Inquiry was that of gathering information in preparation for the World Administrative Radio Conference scheduled for 1959. The Commission's findings were released in a Report and Order adopted in March 1964. 69/

The major portion of the discussion in the Report and Order was concerned with channel loading and prediction of future spectrum requirements for the

---

67/ All of the subservices now listed in Part 90 of the rules for the Public Safety, Industrial and Land Transportation Radio Services had been established with the culmination of the several rulemakings involved during this period.

68/ Order of Inquiry Docket No. 11997 April 5, 1957; 22 FR 2684 April 17, 1957. An accompanying rulemaking for frequencies above 890 MHz was initiated by a Preliminary Notice of Hearing Docket No. 11866 November 9, 1956; 21 FR 8956 November 16, 1956.

69/ Report and Order Docket No. 11997 March 26, 1964; 2 RR 2d 1513.

land mobile services. It was mentioned that the majority of those filing comments in the proceeding represented these services. The R&O stated that the record of the proceeding showed a picture of the land mobile services not only making extensive use of their available frequencies for various purposes beneficial to the nation but, also looking forward to a continuation and vast expansion of such uses. Further, it indicated that the extent of this demand was such that if it was to be met by making additional spectrum available, this spectrum would have to be withdrawn from television broadcasting. This last statement was based on a review of all spectrum in the 25 MHz-890 MHz band allocated to either non-Government services or to Government.

The Commission, however, was not yet prepared to reallocate any spectrum away from television. According to the Report and Order, it remained convinced that an 82 channel (12 VHF and 70 UHF) television allocation was necessary to permit the development of a national competitive system. Furthermore, it believed the feasibility of the 82 channel system had been assured with the passage of the all-channel tuner legislation in 1962 which would provide for UHF tuning capability in all subsequently manufactured TV receivers.

The general conclusion of the Report and Order was that the land mobile services required more frequency channels, but the channels needed could not be obtained by a reallocation of non-Government (including television) spectrum within the 25 MHz - 890 MHz band. Only more efficient use of land mobile spectrum could resolve the matter. To that end, the Commission established an Advisory Committee for the Land Mobile Service. 70/

70/ Public Notice FCC 64-266 March 26, 1964; 2 RR 2nd 1547.

This Advisory Committee was established under the Chairmanship of Commissioner Kenneth A. Cox. Its membership was to be drawn from licensees, manufacturers, and radio service associations in addition to Commission staff members. Representatives of over 140 private organizations from virtually every sector of the land mobile community actually participated in the work of the Committee. The Committee's charter included a review of all aspects of land mobile radio operation, including: channel usage, growth predictions, existance of interference, measures to increase spectrum utilization efficiency, use of frequencies above 890 MHz, and possible improvement in Commission administrative and frequency assignment procedures.

The work of the Advisory Committee continued from March 1964 to September 1967. The Committee submitted the results of its study in a three volume report of over 800 pages to the Commission on November 30, 1967. The report noted that during the study, an attempt had been made to investigate any technical, operational, or administrative change or idea that might alleviate the crowded land mobile frequency situation. This considerable effort notwithstanding, the Committee was unable to find any long-term solution other than allocation of additional spectrum to the land mobile services. It did note that relief of a more immediate but limited form could be gained by reducing the spacing of the 450-470 MHz channels to 25 KHz and permitting interservice sharing of unused frequencies among the land mobile services. 71/

During the years of the Advisory Committee study, frequency congestion in the land mobile services grew increasingly more serious. In its FY 1966

71/ The Commission had already reduced the channel spacing at 450-470 MHz to 25 KHz in November 1966 based on results of tests sponsored by the Advisory Committee. See Report and Order Docket No. 13847 November 30, 1966; 8 RR 2nd 1629.

Annual Report, the Commission devoted a separate chapter to the subject. The opening sentence of this chapter stated:

> The major problem facing the Land Mobile Radio Services, as well as one of the thorniest confronting the Commission, is the congestion in the limited spectrum space available to these intensely populated services. 72/

In this same chapter it was also noted that: "Congressional interest in mobile radio is manifest in testimony before various of its committees." 73/

As one example of "Congressional interest," the report by a subcommittee of the House Select Committee on Small Business in 1968 is worth mention. 74/ This subcommittee held hearings during 1968 in Washington, Los Angeles, Detroit and Chicago to obtain the testimony of two-way radio users concerning the urgent need for additional frequency spectrum for the land mobile radio services. While the subcommittee report commended the Commission for its actions in Dockets Nos. 18261 and 18262 (discussed below), it concluded that relief for the land mobile services was long overdue. The report then recommended, among other things, that if adequate relief was not forthcoming, the next Congress should hold hearings and in those hearings consider the recommendation of the President's Task Force that the spectrum management function be shifted to another entity within the Federal Government. 75/

72/ FCC Annual Report for FY 1966, p. 48.

73/ Ibid, p. 52.

74/ The Allocation of Radio Frequency and Its Effect on Small Business; A Report of Subcommittee No. 5 to the Select Committee on Small Business, House of Representatives 90th Congress, 2nd Session, House Report No. 1978 (December 23, 1968).

75/ This recommendation by the Task Force was intended to improve spectrum management efficiency at the national level for both Government and non-government uses. See, Final Report President's Task Force On Communications Policy (December 7, 1968).

14. Commission Decision to Reallocate Spectrum.

Even before the official submission of the Advisory Committee report, the Commission had anticipated the conclusion that additional spectrum would be required to relieve the congestion in the land mobile services. In a Public Notice on April 14, 1967, the Commission announced that it was investigating the possibility of meeting the frequency needs of these services with spectrum allocated to the upper and lower ends of the UHF-TV band. 76/ The Commission appointed a special staff committee under the Chairmanship of the Chief Engineer to conduct the investigation. Three alternative spectrum allocations were to be studied:

(1) reallocation of four to seven lowest UHF-TV channels.

(2) shared use of seven lowest UHF-TV channels.

(3) reallocation of the upper 14 UHF-TV channels.

The staff committee report was released in March 1968. The committee found that if the lower UHF-TV channels (470-512 MHz) were reallocated to land mobile, they could be replaced by higher channels for TV broadcasting. It also determined, however, that such a reallocation would, be both disruptive and expensive. Conversely, the upper 14 UHF-TV channels could be reallocated at litle cost, but would provide no immediate relief because of unavailability of land mobile radio equipment at these frequencies (806-890 MHz). Finally, the committee found that shared use of the lower seven channels was feasible and would provide near-term relief from the land mobile congestion. 77/ On

---

76/ FCC Annual Report for FY 1967; pp. 89 and 141.

77/ By "shared use" in this case is meant that UHF-TV channels not assignable for television in a particular geographical location because of "taboo" restrictions could be allocated for land mobile use.

the basis of these findings, the Commission opened two rulemaking proceedings in July 1968. 78/ Together, these rulemakings were intended to relieve the immediate frequency congestion and provide spectrum for long-term growth in the land mobile services.

The NPRM in Docket No. 18261 proposed to reallocate the seven lowest UHF-TV channels for shared use by land mobile and TV broadcasting in the 25 largest urbanized areas. Since these channels are located at 470-512 MHz, the radio equipment then operating in the 450-460 MHz band could be readily redesigned and made available for these adjacent frequencies in relatively short time. The NPRM and NOI in Docket No. 18262, on the other hand, proposed a reallocation of 115 MHz of spectrum between 806 MHz and 947 MHz to the land mobile services, including common carrier service. 79/ The amount of spectrum to be provided was much larger than in Docket No. 18261, but the development of radio equipment for operation at these frequencies was expected to take several years.

Both proposals generated considerable controversy and the proceedings went on for six years in the case of Docket No. 18261 and seven years for Docket No. 18262. In addition, both proceedings led to further rulemaking in subsequent years, especially Docket No. 18262.

78/ Notice of Proposed Rulemaking Docket No. 18261 July 17, 1968; FR 33 10943 August 1, 1968. Notice of Inquiry and Notice of Proposed Rulemaking Docket No. 18262 July 17, 1968; 33 FR 10807 August 1, 1966. The NPRM in Docket No. 18261 contains considerable detail relating to the findings of the staff committee.

79/ The sources of the 115 MHz were: 84 MHz (upper 14 channels) from UHF-TV, 5 MHz broadcast auxiliary, and 27 MHz Government.

15. Docket No. 18261 Proceeding.

In its First Report and Order in Docket No. 18261, the Commission adopted a more conservative approach than originally proposed and reallocated UHF-TV channels for shared use by land mobile in only the 10 largest metropolitan areas. 80/ Further, the Commission restricted the sharing to one or possibly two of the lowest seven channels. It had proposed to permit as many as four channels to be shared in some areas. The Commission noted that its decision was influenced by the necessity to provide maximum protection to television stations while allowing adequate power and antenna height to provide meaningful relief for the land mobile services in the areas where the need was most urgent. The results of the sharing experiment, including effects on television, were to be reviewed in five years.

A Second Report and Order in June 1971 suballocated the 470-512 MHz among the various land mobile services and modified the rules of the Public Safety, Industrial, and Land Transportation Radio Services accordingly. 81/ This Order made the channels available for assignment effective August 1, 1971. It is interesting to note that three years elapsed between the initiation of the Docket No. 18261 proceeding and the availability of the shared channels for use by the land mobile services. This occured despite the fact that the primary purpose of the reallocation proceeding was to provide "immediate" relief for land mobile.

Shared use of the 470-512 MHz band was extended to three additional metropolitan areas by a Fifth Report and Order in Docket No. 18261 in July

---

80/ First Report and Order Docket No. 18261 May 20, 1970; 19 RR 2nd 1585.

81/ Second Report and Order Docket No. 18261 June 16, 1971; 22 RR 2nd 1691.

1974. 82/ This Order also terminated the proceeding. The Third and Fourth Reports and Orders dealt with a modification of the suballocation of channels in New York and Washington, D.C. and technical matters concerned with antenna height. 83/ They are mentioned here only for completeness.

The sharing of the UHF-TV channels by land mobile has been quite successful in that no serious interference between the services has occurred. In October 1984, the Land Mobile Communications Council filed a petition with the Commission to extend the sharing concept to the entire UHF-TV band (470-806 MHz) in the twenty-one largest metropolitan areas.

16. Docket No. 18262 Proceeding.

As noted, the NPRM and NOI in Docket No. 18262 proposed to reallocate 115 MHz of the spectrum between 806 MHz and 947 MHz to the land mobile services. Also proposed was a division of 75 MHz for common carrier mobile use and 40 MHz for private land mobile. In May 1970, the Commission adopted a First Report and Order and Second Notice of Inquiry that reallocated and divided the band of spectrum as proposed and modified Part 2 of the rules accordingly. 84/ It also tentatively designated the band 806-881 MHz for common carrier mobile service and the bands 881-902 MHz and 928-947 MHz for private land mobile use. The Commission envisioned a high capacity cellular common carrier system that might satisfy some of the private land mobile demand for dispatch service as well as provide a public mobile radiotelephone service.

82/ Fifth Report and Order Docket No. 18261 July 17, 1974; 31 RR 2nd 115.

83/ Third Report and Order Docket No. 18261 July 26, 1972; 25 RR 2nd 1584 Fourth Report and Order Docket No. 18261 November 14, 1973; 28 RR 2nd 1393.

84/ First Report and Order and Second Notice of Inquiry Docket No. 18262 May 20, 1970; 19 RR end 1663.

The spectrum between the two bands designated for private land mobile (902-928 MHz) was allocated to Industrial, Scientific and Medical Equipment (ISM). In general terms, this equipment produces radio frequency energy not intended for communication. Prior to Docket No. 18262 the frequency band 890-940 MHz (915 ± 25 MHz) had been allocated for operation of this equipment. The Commission had noted in the NPRM and NOI that a 50 MHz band could no longer be tolerated because of other demands on the spectrum. The First Report and Order modified Part 18 of the rules to establish the new limits for this ISM band at (915 ± 13) MHz.

The Inquiry component of the First R&O and Second NOI raised the question of the types of radio systems to be developed for the new spectrum bands allocated to the private and common carrier land mobile services. In particular, the Commission wished to determine how the bands could most effectively be used to satisfy land mobile requirements. There were also some unresolved issues pertaining to ISM equipment.

The Commission adopted a Second Report and Order in Docket No. 18262 in May 1974 that established the rules for land mobile operation in the 806-947 MHz band. 85/ The band was suballocated in a manner that departed radically from past practice. Traditionally, the Commission had suballocated land mobile spectrum by designating blocks of frequency for the various subservices such as Police, Taxicab or Business Radio Service on a national basis. The "block" allocation scheme had been criticized for its lack of flexibility and failure to recognize variation in subservice requirements with geographic area. In lieu of "block" method, the Second Report and Order suballocated the spectrum according to radio system technology.

85/ Second Report and Order Docket No. 18262 May 1974; 30 RR 2nd 75.

The Commission identified three types of radio systems: conventional, trunked, and cellular. It then divided the 115 MHz band into 30 MHz conventional/trunked systems, 40 MHz for cellular systems, and 45 MHz was labeled "land mobile reserve." 86/ The suballocated bands were positioned to provide a 45 MHz separation between base station and associated mobile frequencies. Channel spacing was established at 25 kHz.

The conventional/trunked bands were further divided between the two systems. The Commission was eager to encourage the development of trunked systems because they were expected to be more efficient. These systems were also, however, much more expensive which raised question about the extent and rate of their application. The Commission decided therefore to authorize only 300 of the 600 paired channels that could be derived from the 30 MHz allocation. The remainder were held in reserve for later release when the relative growth of conventional and trunked systems had been established. To stimulate the development of trunked systems, the Commission designated 200 channels for these systems and 100 channels for conventional.

The Second Report and Order also established a new license classification in the private land mobile services called "common user systems." 87/ These licensees were to be commerical entities engaged in providing communication service for all users eligible in the private radio services as well as to the public. This new license classification became the most controversial element of the Docket 18262 proceeding.

86/ This was a considerable change from what had been adopted in the First R&O. The specific suballocated bands were: 806-821 MHz and 851-866 MHz conventional/trunked; 825-845 MHz and 870-890 MHz cellular; the remainder as "reserve." This allocation exists today, except for a small portion of the "reserve" has been allocated for other then land mobile use. Rulemakings are in progress to allocate the remainder of the "reserve".

87/ This classification later became Special Mobile Radio Systems (SMRS).

At the time of the Second Report and Order in Docket No. 18262 there was still a deficiency of both technical and market information relative to the cellular systems. Although, the R&O included the spectrum suballocation of 40 MHz for these systems only developmental operation was authorized. Further, the Commission restricted developmental operation of these systems to wireline common carriers because as noted in the R&O, they were: "... The only organizations which have demonstrated that they possess the resources and the expertise necessary to establish cellular systems which would have nationwide compatibility." Additional reasons given for this restriction were that the characteristic of a cellular system were such that competing systems in the same area were not feasible and extensive interconnection with the telephone system was required. To counter any tendency for cross-subsidization, separate operating subsidiaries were required. Also restrictions were imposed on the manufacture of cellular equipment, as well as maintenance of the mobile equipment.

Although the Commission had adopted rules for regular operation of private landmobile at 800 MHz in the Second Report and Order, it could not accept applications. The new rules required submission of information that was in addition to that required by the application form in use for lower frequencies. This change required approval of the General Accounting Office, and such approval had not been received. In the meantime, the Commission encountered other difficulties with the Second Report and Order.

When the Commission adopted the Second Report and Order, it apparently assumed that its work in the Docket No. 18262 was complete because it terminated the proceeding. The public response, however, included 9 Petitions for Reconsideration, 2 Petitions for Clarification and Partial Reconsideration, 2 Petitions for Stay, 18 sets of comments on the Petitions for reconsideration, 8

sets of comments on the Petitions for Stay, and 5 Requests for Associated Relief. The Commission addressed these petitions in a Memorandum Opinion and Order adopted in March 1975. 88/

The MO&O, with some exception affirmed the decisions of the Second R&O and denied most elements of the petitions. One change was to permit other than wireline carriers to operate cellular systems. Any organization that met the technical and financial qualifications could apply. The MO&O also adopted the term Specialized Mobile Radio System (SMRS) for those systems to be operated on a commmercial basis to provide service to users eligible in the land mobile. The authorization for service to the general public by SMRS licensees was determined to be unncessary to meet the objectives of the Docket 18262 proceeding and was deleted. It was also decided that operators of the mobile equipment (eligible users) would be separately licensed.

Another matter addressed in the MO&O and that resulted in a change from the Second R&O was the operation of trunked systems by radio equipment manufacturers. Throughout the Docket 18262 proceeding the Commission was concerned with encouraging the development and use of trunked radio systems by private land mobile to improve the technical efficiency of spectrum use. The Commission recognized that these systems would be expensive to construct and, in fact, used as one justification of the SMRS the ability to garner the resources necessary to construct trunked systems. The radio equipment manufacturers were obvious candidates to promote trunked systems. There was concern, however, that the integration of equipment manufacture and system operation could lead to a monoply of trunked system operation. Consequently, the Second Report and Order limited ownership of trunked systems by equipment

---

88/ Memorandum Opinion and Order Docket No. 18262 March 19, 1975; 33 RR 2nd 457.

manufacturers to five systems nationwide. The MO&O further restricted ownership to one system with the note that the restriction would be reconsidered in the future if it resulted in adverse effect on trunked system development. This restriction was removed by a subsequent rulemaking in July 1982. 89/

The proceeding was again terminated by the MO&O. Because Government Accounting Office approval of the additional application information required had not been received, applications still could not be accepted. 90/

17. Regional Spectrum Management Program

The decision to allocate more spectrum to the land mobile services did not diminish the Commission's interest in methods to improve the technical efficiency of spectrum use. In this regard, a common recommendation of the many studies of spectrum management during the 1960 decade was the adoption of more flexible allocation and assignment procedures. This included application of more sophisticated spectrum engineering, and allocation based on local or regional requirements rather than national in scope. To evaluate the feasibility and effectiveness of such management techniques, the Commission established a Spectrum Management Task Force (SMTF) in February 1970 to

---

89/ Second Report and Order Docket No. PR 79-191 July 22, 1982; 47 FK 41002 September 16, 1982.

90/ GAO approval was received and announced by the Commission in a Public Notice in June 13, 1975. The effective date for receipt of applications, except applications for SMRS licenses, was July 1, 1975; 40 FR 26061 June 20, 1975. The U.S. Appeals Court had stayed that part of the Order in Docket No. 18262 that authorized the SMRS pending its review of an appeal of the Order by the national Association of Regulatory Utility Commissioners, et al. The Court found in favor of the Commission January 5, 1976, and removed the stay on June 3, 1976.

develop the items of hardware and software together with rules necessary to operate a regional spectrum management facility. 91/

Primary objectives in the design of the spectrum management facility were frequency assignment and license preparation by automatic data processing. This required a data base that was compatible with computer processing and that contained the necessary engineering and channel occupancy data and the operational characteristics of the radio equipment in use and proposed. To satisfy these data base requirements, mobile channel monitoring units were designed and procured, and a new application form containing the mobile radio operational information was developed. In addition, engineering models for radio propagation analyses and channel loading optimization were defined and adapted for computer processing.

In February 1971, the Commission initiated a rulemaking proceeding to establish a prototype regional spectrum management center in Chicago. 92/ The center was to be equipped and staffed to assign frequencies and issue licenses to land mobile applicants in the Chicago area. It was to be sufficiently flexible, however, to permit extension of the concept to other radio services. Also, it was anticipated that if the management technique proved feasible, it would be expanded to a national system involving some 10-12 regional centers. Spectrum use optimization was an ultimate and a primary goal of the Center.

91/ For a brief history of the efforts of the Spectrum Management Task Force, see: Diane King, Chronology of the National Spectrum Management Program; Federal Communications Commission, Office of Chief Engineer Report No. FCC/OCE SMTF 76-01 (August 1976).

92/ Notice of Proposed Rulemaking Docket No. 19150 February 3, 1971; 36 FR 2793 February 10, 1971.

For the Chicago experiment, the Commission proposed to replace its procedure of allocating blocks of spectrum on a nationwide basis to the more than 20 land mobile services with a system of inter-service shared usage based on local needs. The radio services were to be divided into two categories. One category would include only the Police and Fire Mobile Radio Services. All other mobile services, including the remainder of the Public Safety Services, were to compose the second category. The frequencies then assigned to the Police and Fire Services were to be pooled and shared by both services. Likewise, the frequencies assigned to all other services were to be pooled and shared according to need.

In October 1971 the Commission adopted a First Report and Order in Docket No. 19150 in which it introduced a new application form for land mobile and established rules for its use. 93/ The primary purpose of the R&O was to initiate procedures for gathering the information necessary to establish an adequate data base for computer supported frequency assignment and license processing.

By a Second Report and Order in December 1972, the Commission adopted the inter-service sharing concept with the two categories of users as proposed in its NPRM. 94/ On the same date the Commission adopted an administrative Order, delegating authority to the Chief Engineer to conduct the operation of the regional spectrum management center(s). 95/ This Order effectively placed

---

93/ First Report and Order Docket No. 19150 October 28, 1971; 32 FCC 2d 347.

94/ Second Report and Order Docket No. 19150 December 13, 1972, 38 FCC 2d 625. While the Commission adopted the inter-services sharing concept, it instructed the SMTF that it was not to be implemented until results of the Chicago Region occupancy monitoring and computerized frequency assignment program had been evaluated.

95/ Order December 13, 1972; 38 FCC 2d 622.

the management of the Chicago center under the authority of the regional manager at that location.

Licensing of Chicago systems using SMTF procedures began in Washington in May 1972. The Chicago Regional Office began processing land mobile licenses in January of 1973. In February 1974 automatic frequency assignment was initiated for the purpose of comparing frequencies selected with the choices of the private frequency coordinators. Finally, in October 1974, the requirement for prior frequency coordination of applications was eliminated. 96/ Essentially, the Chicago regional center had achieved operational status with frequencies for new applicants selected automatically by computer and licenses issued by the center under delegated authority.

Although the Spectrum Management Task Force had achieved the objective for which it had been established, there remained the question of whether the highly automated Chicago licensing system was sufficiently cost-beneficial to warrant extension of the concept to other metropolitan areas. After a series of studies beginning in 1973, the Commission decided that budgetary constraints would not permit even the continuation of the Chicago effort. In a Public Notice in June 1976, the Commission stated that the SMTF was to be disbanded and the responsibility for frequency selection returned to private coordinators. 97/ It also stated that the Commission's primary effort in land mobile would be the creation of a nationwide data base similar to that developed in Chicago and that a reduced monitoring program would be

---

96/ See, "Chronology of the National Spectrum Management Program" pp. 15 and 18.

97/ Public Notice "Action on Regional Spectrum Management Program"; released June 29, 1976, FCC 76-605.

continued. License processing continued in Chicago until March 1977 after which the licensing process and Chicago computer were moved to Washington.

In April 1977, the Commission announced its plans for future land mobile spectrum management. 98/ This involved abandoning the regional assignment concept and automatic frequency selection and returning to assignment on a national basis with private frequency coordination. The Notice of Inquiry also stated the Commission's immediate objectives which included development of a computerized nationwide data base, establishing rules and standards for private frequency coordinators, and monitoring in congested urban areas.

98/ Notice of Inquiry Docket No. 21229 April 27, 1977; 42 FR 26030.

Recent Working Papers & Staff Reports
Office of Plans and Policy
Federal Communications Commission

Implications of Asymmetric Regulation for Competition Policy Analysis by [illegible], Working Paper #16, December 1984.
NTIS #PB85-[illegible]; $[illegible]; pp. [illegible]

Promoting Competition Processes in International Telecommunications by [illegible], Working Paper #15, [illegible] 1984.
NTIS # PB85 [illegible]; $[illegible]; pp. [illegible]

Bypass of the Local Exchange: A Quantitative Assessment by [illegible], Working Paper #12, September 1984.
NTIS # PB85 [illegible]; $[illegible]; pp. [illegible]

[illegible] and the Separations [illegible] Arrangement by [illegible], Working Paper #11, March 1984.
NTIS # PB84 [illegible]; $[illegible]; pp. [illegible]

The Effects of Higher Telephone Prices on Universal Service by [illegible] and [illegible], Working Paper #10, March 1984.
NTIS # PB84 [illegible]; $[illegible]; pp. [illegible]

A Framework for a Decentralized Radio Service by [illegible] and [illegible], September 1983.
NTIS # PB84 [illegible]; $[illegible]; pp. [illegible]

Implementing New Technology in the Land Mobile Radio Service by [illegible], September 1983.
NTIS # PB84 [illegible]; $[illegible]; pp. [illegible]

Measurement of Concentration in Home Video Markets by [illegible] and [illegible], December 1982.
NTIS # PB84 [illegible]; $[illegible]; pp. 117

[illegible] Interrelationship of Radio Stations' Revenues and Trading Prices by [illegible], Jr.; Working Paper #9, August 1982.
NTIS # PB83 [illegible]; $[illegible]; pp. [illegible]

Deregulation after Divestiture: The Effect of the AT&T Settlement on Competition by [illegible], Working Paper #8, April 1982.
NTIS # PB82 [illegible]; $[illegible]; pp. [illegible]

A COMPLETE LIST OF OPP PAPERS IS AVAILABLE UPON REQUEST.

ABOVE PUBLICATIONS MAY BE ORDERED FROM NTIS BY MAIL OR TELEPHONE. PLEASE INCLUDE NTIS NUMBER (SEE ABOVE) WHEN ORDERING.

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
[illegible]