possible listeners.*308 We say quality because each program must be the best of its kind. If that ideal were to be reached, no home in the United States could afford to be without a radio receiving set. Today the best available statistics indicate that 5,000,000 homes are equipped, and 21,000,000 homes remain to be supplied. *Radio receiving sets of the best reproductive quality should be made available for all, and we hope to make them cheap enough so that all may buy.* The day has gone by when the radio receiving set is a plaything. It must now be an instrument of service. [FN92] It was only after 1929 that commercial radio shifted towards advertiser-supported radio, making station operation, in particular in networks, the leading business of radio. [FN93]

The year 1922 saw radio broadcasting blossom. In November 1921, five licenses were issued by the Department of Commerce under the new category of "broadcasting" of "news, lectures, entertainment etc." [FN94] By July 1922, the Department had issued another 453 licenses. [FN95] Home receiver orders swamped manufacturers. [FN96] Universities, seeing radio as a vehicle for broadening their role, began broadcasting lectures and educational programming. Seventy-four institutes of higher learning operated stations by the end of 1922. [FN97] The University of Nebraska even offered two-credit courses whose lectures were transmitted over the air. [FN98] Churches, newspapers, and department stores followed suit.

The same year also saw the consolidation of Herbert Hoover's power. Appointed Secretary of Commerce a year earlier, Hoover allied himself with both commercial radio interests and the American Radio Relay League, the amateurs' organization. [FN99] At the initiative of *309 President Harding, Hoover convened a conference of radio manufacturers and broadcasters, with some representation of engineers and amateurs. [FN100] This forum became Hoover's primary stage, and over the next four years Hoover would use its annual meeting to derive policy recommendations, legitimacy, and cooperation for his regulatory action, all without a hint of authority in the Radio Act of 1912. [FN101]

Hoover relied heavily on the rhetoric of public interest and on the support of amateurs to justify his system of private broadcasting coordinated by the Department of Commerce. [FN102] But from 1922 on, he followed a pattern that would systematically benefit large broadcasters over small ones; commercial broadcasters over educational and religious broadcasters; and one-to-many broadcast over the point-to-point wireless telephony and telegraphy that amateurs were developing. After January 1922, the Department inserted a limitation on amateur licenses, excluding from their coverage broadcast of "weather reports, market reports, music, concerts, speeches, news or similar information or entertainment." [FN103] This limitation, together with a Department of Commerce order to all amateurs to stop broadcasting at 360 meters (the wavelength assigned to broadcasting), effectively limited amateurs to radio telephony and telegraphy at wavelengths shorter than 200 meters, at the time considered a relatively useless frequency band. [FN104] In the summer, the Department assigned broadcasters, in addition to 360 meters, another band at 400 meters. Licenses in this Class B category were reserved for transmitters operating at transmit power levels of 500-1000 watts who did not use phonograph records. [FN105] Class B was to become the home of broadcasters who could afford the more expensive high-powered transmitters, and could arrange for live broadcasts, rather than phonograph record playing. The success of this new frequency was not immediate, because many receivers could not tune out stations broadcasting at one frequency in order to listen to the other. [FN106]

*310 Failing to move Congress to amend the radio law to provide him with the power necessary to regulate broadcasting, Hoover relied on the recommendations of the second radio conference in 1923 to adopt a new regime. He announced that the broadcast band would be divided in three. High-powered (500-1000 watts) stations serving large areas would have no interference in those large areas and would not share frequencies. They would transmit on frequencies between 400 and 545 meters. Medium-powered stations served smaller areas without interference and would operate at assigned channels between 222 and 300 meters. The remaining low-powered stations would not, as the bigger actors wanted, be eliminated, but would remain at 360 meters, with limited hours of operation and geographic reach. [FN107] Many of these lower-powered broadcasters were educational and religious institutions. They perceived the allocation as a preference for the RCA alliance. [FN108] Despite his protestations against commercial broadcasting ("If a speech by the President is to be used as the meat in a sandwich of two patent medicine advertisements, there will be no radio left."), [FN109] Hoover consistently

reserved clear channels and issued high-power licenses to commercial broadcasters. [FN110]

The final policy action based on the radio conferences came in 1925 when the Department of Commerce stopped issuing licenses. [FN111] The result was a secondary market in licenses, in which some religious and educational stations were bought out by commercial concerns, and in which commercial concerns like the Chicago Tribune could buy stations that a non-commercial organization like the Chicago Federation of Labor could not. [FN112] The result was further gravitation of licenses towards commercial ownership. [FN113] The pattern continued after the 1927 Act, when twenty-one of the twenty-four clear-channel stations created by the Federal Radio Commission went to network-affiliated stations. [FN114]

Following the boom of 1922, tensions surfaced in 1923 that would affect the structure of the industry for years to come. Receiver sales were growing phenomenally, and the RCA alliance held all the relevant patents. But RCA sales accounted for only nineteen percent of the *311 market. [FN115] The rest was taken up by some 200 companies that constructed partly assembled sets that lacked only the patented component--the vacuum tube. The customer could buy a vacuum tube, which the members of the alliance sold for replacement of burnt tubes and for amateur transmitter construction, and complete the set. [FN116] In 1923, the alliance responded. RCA sued competitors that built receivers complete but for the tubes. RCA also required tube dealers to provide it with a burnt tube for each new tube sold, and attached warnings that the tubes were not to be used in equipment not manufactured by RCA. [FN117]

Congressional concerns over leveraging of the tube monopoly into a receiving set monopoly and, eventually, a broadcast monopoly, led to a call for an FTC inquiry. [FN118] The resulting 347-page report seemed to confirm the legislators' concerns. [FN119] Meanwhile, AT&T considered all stations that used a transmitter not manufactured by Western Electric, its equipment-manufacturing arm, to have infringed its patent rights. [FN120] That meant all but thirty-five of the 600 stations then on the air. [FN121] Rather than risk a suit against almost all broadcasters, AT&T sought to persuade broadcasters to pay it a license fee for using equipment not manufactured by Western Electric. In return, AT&T would not sue for the use of this allegedly infringing equipment, and would grant broadcasters access to AT&T's long lines for remote broadcasts of sports or similar events. [FN122] Concerns rooted in these practices found their way into the 1927 Radio Act's prohibition on licensing of persons who violated the antitrust laws. [FN123] The fear of losing the NBC licenses under this provision apparently forced RCA in 1931 to release controls it had for years imposed on competitors. [FN124]

Tensions also began to emerge within the RCA alliance. The phenomenal success of receiver sales tempted Western Electric into that market. In the meantime, AT&T, almost by mistake, began to challenge GE, Westinghouse, and RCA in broadcasting, as an outgrowth of its attempt to create a broadcast common carriage facility. Despite the successes of broadcast and receiver sales, it was not clear in 1922-23 *312 how the cost of setting up and maintaining stations would be paid for. In England, a tax was levied on radio sets, and its revenue used to fund the BBC; no such proposal was considered in the United States. [FN125] AT&T was the only company to offer a solution. Building on its telephone service experience, it would offer radio telephony to the public for a fee. In February 1922, it established WEAF in New York, a facility over which AT&T was to provide no programming of its own, but instead would enable the public or program providers to pay on a per-time basis. [FN126] Since AT&T treated this service as a form of wireless telephony, it fell, under the alliance agreements of 1920, under the exclusive control of AT&T. RCA, Westinghouse, and GE could not compete in this area. [FN127]

Toll broadcasting was not a success by its own terms. There was insufficient demand for communicating with the public to sustain a full schedule that would justify listeners tuning into the station. As a result, AT&T produced its own programming. In order to increase the potential audience for its transmissions while using its advantage in wired facilities, AT&T experimented with remote transmissions, such as live reports from sports events, and with simultaneous transmissions of its broadcasts by other stations, connected to its New York station. By mid-1923, AT&T found itself with the first functioning precursor to an advertiser-supported broadcast network. [FN128]

The alliance members now threatened each other:AT&T to enter into receiver manufacturing and broadcast, and the rest of the RCA alliance, with its powerful stations, to enter into "toll broadcasting," or advertiser-supported radio. The patent allies submitted their dispute to an arbitrator, who was to interpret the 1920 agreements, reached in a world of wireless telegraphy, to divide the spoils of the broadcast world of 1924. [FN129] In late 1924, the arbitrator found for RCA-GE-Westinghouse on almost all issues. [FN130] Capitalizing on RCA's difficulties with the FTC, however, AT&T countered that if the 1920 agreements meant what the arbitrator said they meant, they were a combination in restraint of trade ***313** to which AT&T would not adhere. [FN131] Bargaining in the shadow of the mutual threats of contract and antitrust actions, the former allies reached a solution that formed the basis of future radio broadcasting. AT&T would leave broadcasting. A new company, owned by RCA, GE, and Westinghouse, would be formed, and would purchase AT&T's stations. The new company would enter into a long-term contract with AT&T to provide the long distance communications necessary to set up the broadcast network that David Sarnoff envisioned as the future of broadcast. [FN132] This new entity would, in mid-1926, become NBC. AT&T's WEAF station would become the center of one of NBC's two networks, and the division arrived at would form the basis of the broadcast system in the United States ever since. [FN133]

By the middle of 1926, the institutional elements that became the American broadcast system were, to a great extent, in place. The idea of government monopoly over broadcasting, which was dominant in Great Britain and Europe, was forever abandoned. The idea of a private property regime in spectrum, which had been advocated by commercial broadcasters to spur investment in broadcast, [FN134] was rejected against the backdrop of other battles over conservation of federal resources. [FN135] A relatively small group of commercial broadcasters and equipment manufacturers took the lead in broadcast development, with the aid of a governmental regulatory agency that, using a standard of the public good, would allocate frequency, time, and power assignments to minimize interference and to resolve conflicts that could not be resolved by contract. The public good, by and large, correlated to the needs of commercial broadcasters and their listeners. Later, the networks would supplant the patent alliance as the primary force to which the Federal Radio Commission would pay heed. But within this system, interests of amateurs (whose romantic pioneering mantle still held a strong purchase on the process), educational institutions, and religious organizations continued to exercise some force on the allocation and management of the spectrum.

The suit brought by Zenith Radio Corporation to challenge the Secretary's power laid bare the absence of a legal basis for the system ***314** that had evolved between 1921 and 1926. [FN136] Hoover's announcement that he would no longer regulate radio came after Congress had dispersed for the summer. [FN137] When Congress returned in December 1926, it produced the Radio Act of 1927 in about two months. [FN138] The fundamental institutional parameters of the system remained unchanged from those that had developed by the summer of 1926, before the "breakdown of the law." The most noticeable difference was that the federal agency was the new Federal Radio Commission, not the Secretary of Commerce.

C. A Call for Intellectual Flexibility

The lesson to be learned from the early business history of radio is twofold. First, the present system is a historically contingent arrangement, not one necessitated by either technological or economic parameters. Second, the market in radio equipment was a forceful engine of innovation and development of wireless communications technology, and was a crucial element in framing the problems associated with broadcast. In recognizing the contingency of the institutional details of the present regulatory framework, we must understand that the conceptual tools developed to explain, justify, and criticize these institutional elements are as contingent as the subject matter that gave rise to their development.

The present regulatory system was fashioned around the needs of one model of wireless communications:broadcasting. The companies that developed this model did so to make possible a consumer market in simple receivers, which were at the time the sole product appropriate for mass marketing. Consequently, the institutional problem to be solved involved allocating frequencies among powerful transmitters capable of being received by these simple receivers. Today we live in an economy powered by low-cost

processors. We have learned to communicate through distributed communications networks like the Internet that rely heavily on the computing capabilities of end-user equipment. Yet we continue to use a problem definition resulting from a market in equipment whose present-day successor is still one of the "dumbest" machines in our houses. We must instead open our minds to the possibility that the important question is no longer how to allocate spectrum among a small number of sophisticated service providers, but *315 rather how to allow better coordination among a large number of end-users with sophisticated equipment.

III. THE ECONOMIC CRITIQUE OF LICENSING AND THE EMERGENCE OF SPECTRUM PRIVATIZATION

The core of the economic critique of the broadcast licensing system is that interference makes spectrum an economic good, and economic goods are best allocated by market mechanisms. The best legal solution to interference would, according to this view, be to define a set of property rights in spectrum units, and to allow market transactions to allocate spectrum to its highest valued uses, as defined by the willingness of spectrum users to pay for spectrum units. Once this point is understood, the rest of the literature consists of fine tuning the property rights, defining their content, and conceiving of a method of allocation that would produce the best-functioning market.

A. The Basic Critique:Coase on the FCC

The person credited with being the first to propose the economic critique of administrative spectrum regulation was Leo Herzel. [FN139] Ronald Coase was next to claim that spectrum, like all other resources, should be allocated "by the forces of the market rather than as a result of government decisions." [FN140] Coase argued that pricing would yield better allocation than administrative fiat, that requiring government agencies to bid for spectrum would encourage more efficient use of spectrum within government bands, and that licensing in practice partially operates as a market due to the secondary market (except that it gives initial licensees a windfall profit because they receive a valuable marketable input for free). [FN141]

*316 The most important element of Coase's analysis was his insight into the possibility of using property rights in spectrum to eliminate interference:

> The main reason for government regulation of the radio industry was to prevent interference. It is clear that, if signals are transmitted simultaneously on a given frequency by several people, the signals would interfere with each other and would make reception of the messages transmitted by any one person difficult, if not impossible. The use of a piece of land simultaneously for growing wheat and as a parking lot would produce similar results. As we have seen in an earlier section, the way this situation is avoided is to create property rights (rights, that is, to exclusive use) in land. The creation of similar rights in the use of frequencies would enable the problem to be solved in the same way in the radio industry. [FN142] Similarly, Coase suggested that assigning a property right against interference, like trespass or nuisance, would solve the problem of interference between broadcasters on adjacent frequencies. [FN143] The person who values transmission more highly would pay the other to cease interference. [FN144]

The projects that remained after Coase's plain explanation were to identify the content of the property rights to be assigned and the most efficient way to allocate these rights, and to gain the political support to make it law. The former project was vigorously undertaken in the decade and a half following Coase's article. [FN145] The latter would have to wait until the 1980s for the first explicit endorsement of spectrum privatization by the then-Chairman of the FCC, [FN146] although it was only *317 in 1993 that the FCC actually received authority to auction certain licenses. [FN147] Since then, the wisdom of applying market mechanisms to spectrum allocation seems to have emerged as the new orthodoxy. [FN148]

B. The Interference Problem, Licensing, and the Economic Critique

The literature analyzing property rights based solutions to spectrum allocation clarifies that it is the

phenomenon of interference that makes the discussion of spectrum as an economic resource intelligible. [FN149] The value of wireless transmissions, like that of all methods of communication, is that they allow people to communicate with each other. [FN150] The baseline technical assumption of both the licensing approach and the various proposals for a property regime in spectrum is that in order for a transmission from a transmitter to be intelligible to a receiver, the signal sent by the transmitter must be "louder," by a technically sufficient degree, than the combination of all other signals received by the receiver. More formally, the ratio between the electromagnetic radiation detected by the receiver that carries the message of the sender must be high enough relative to all other sources of electromagnetic radiation similarly detected by the receiver to allow the receiver to decode the message. Interference occurs when for a given receiver, *R,* there are multiple transmitters, *Ta ... Tn,* that transmit at the same frequency, at the same time, and with such power, that given the relative spatial locations of *Ta ... Tn* to each other and to *R,* the ratio of signal to noise for the transmissions of at least one of *Ta ... Tn* makes the transmissions of that transmitter unintelligible to *R.* [FN151] What is important to remember is that, although transmitters propagate signals, interference "occurs" at the receiver.

***318** The traditional assumption that underlies both the licensing regime that still predominates spectrum allocation policy, and the economic critique that is emerging as its alternative, is that interference occurs *whenever* multiple transmitting devices simultaneously use the same frequency, resulting in "a reduction in the quality of the desired signal, with its actual intelligibility being determined by the (effective) radiated power of the various transmitting sources and their distances from the point of reception." [FN152] "Two separate communications operators cannot use the same [time, area, and spectrum frequency] without interfering with each other's service." [FN153] Part IV will explain why this central assumption is no longer true, but first we must see how, given this assumption (shared by both licensing and market-based approaches), a private property regime is presented as preferable to an administrative licensing regime.

It is cliche that the right to exclude is the central "stick" in the bundle of rights that is property. Similarly, the most important part of a license or property right in spectrum is that, in addition to the privilege its holder has to radiate at a given frequency/time/power dimension, [FN154] it protects the right holder from radiation by others in a manner that causes interference to the right-holder's transmissions. That a privilege to radiate without protection from the transmissions of others is of little avail to its holder is amply demonstrated by the period of the "breakdown of the law" in late 1926. [FN155]

The core difference between the licensing regime and a property regime resides in who controls the duty not to cause interference. Licensing prevents interference at point *A* (defined by frequency/time/power dimensions) by imposing obligations in the licenses of all transmitters who could technically interfere with reception of transmissions at point *A,* requiring them to transmit in a manner (at a frequency, power, or time) that will not cause such interference. The ***319** obligations are "owed" to the government and enforceable at its choice. Private property prevents interference by giving the "owner" of the privilege to transmit at point *A* a right against other transmitters to be free of interference at that point. It is the capacity of each owner to exercise this right or refrain therefrom that creates the possibility that spectrum use rights will be reallocated by agreement among users, leading the spectrum to its highest valued use. The economic critique relies on the assumption that if *B* values the right to transmit in a manner that causes interference to the owner of an interference-free transmission right at *A* more than the owner of the right at *A, B* will buy out the rights at *A.* The various studies of property regimes in spectrum focus on how to assure that the rights are defined so as to clarify who must be bought out in order to transmit in a given manner, and to limit the transaction costs, primarily detection and enforcement costs, that could prevent this market reallocation. [FN156]

C. FCC Implementation and Proposals for Market-Based Spectrum Allocation

It is obvious from this description that the spectrum-auction system that has been implemented by the FCC in the 1990s is a far cry from market-based spectrum allocation. Under its statutory authorization, [FN157] the Commission may use auctions to decide *who* gets a license. But the initial determination of what part of the spectrum will be used, for which service, must be made by the FCC using traditional criteria, [FN158] and rights associated with the license are no different from those created by the regular licensing process. [FN159] In effect,

auctions remedy a small part of the problem Coase identified--the windfall to initial licensees. Even that problem is solved only as to some licensees, while others, most notably television broadcasters, retain the windfall. [FN160] The important allocation decisions remain administrative. [FN161] In their present ***320** configuration, spectrum auctions are more a user-fee for government licenses than a market-based system of spectrum allocation. [FN162]

To remedy the limitations of the present system, the FCC is exploring the possibility of "substantial replication in the spectrum context of the freedoms inherent in property rights." [FN163] The proposal will privilege licensees to (a) use the spectrum for any use they choose; (b) use the spectrum with any technology and equipment that they choose; (c) aggregate and disaggregate spectrum allocations as they choose, along the dimensions of frequency band used and power/geographic coverage; (d) leave spectrum idle for future use; and (e) transfer the preceding four privileges to control spectrum to anyone else, with Commission approval. [FN164] Regulation will no longer be in terms of inputs (transmission power, antenna height, etc.), but in terms of outputs--by limiting the overall interference caused by a transmitter outside his or her license area (along frequency/space dimensions). [FN165] The proposal suggests that licensees be allowed to negotiate variances from the output levels set by regulation, thereby opening the possibility of market-based exchanges of freedom-from-interference rights, as proposed by Coase. [FN166] Initial allocation would be in blocks that approximate the Commission's best judgment of the highest valued use of the spectrum, in order to avoid situations where transaction costs prevent the spectrum from moving to that use in the secondary market. [FN167] The spectrum would be exhaustively auctioned, in order to allow market ***321** forces to optimize the use of as much of it as possible, as soon as possible. [FN168]

D. The Shared Assumptions of Administrative Licensing and Its Economic Critique

The proposals for market-based allocation of frequencies and the present system of administrative allocation share a central factual assumption about the prevention of interference. Both approaches assume that to avoid interference only one person may transmit in a given frequency/time/space dimension. The shared factual assumption translates into a shared organizational assumption. Both licensing and privatization assume that for a given band of frequencies there must be a determinable person who decides how the relevant band will be used and by whom. That person also decides when it is time to change a previous choice:by reallocating frequencies, altering the use of the same frequency, or changing the identity of the actual user at a given moment.

In order to create a centralized organizational model, the two approaches adopt a similar institutional rule. They both constrain would-be transmitters by pointing to a single entity who has the power to permit or prohibit a proposed transmission. While the property-rights approach includes no single centralized authority allocating use of the entire spectrum, as there is in theory in the regulatory system, nevertheless, for each defined portion of the spectrum, there is only one entity to whom the law points as the decision-maker. That person decides whether that channel will be used at all and for what, whether it will be divided and, if so, into which subsets, or whether it will be aggregated with other sets of frequencies, under one's own control (by buying) or someone else's (by selling to another spectrum owner). Administrative allocation bifurcates the function of making these decisions, but for each decision there is always a single entity--the regulator or the licensee--who has the power to make the decision.

Both institutional arrangements attempt to prevent the behavior that they see as causing interference--transmission by more than one person at a given frequency, time and power--by centralizing all decisions about transmission and reception at that frequency, time, and power. Coordination among putative transmitters is achieved through centralized control over the act of transmission. The difference between the two systems lies in how they allocate that control.

***322** Part IV explains why the factual assumption that interference can only be avoided by permitting one person to transmit in any defined frequency band is no longer valid and why the shared organizational model is no longer the only way to prevent interference. Removing these elements raises the question that occupies the remainder of the article:whether the institutional framework within which our society will produce the good of remote wireless

communications capacity should define discrete entities who have sole power over transmission at a given frequency/time/power dimension (as both licensing and property do), or whether it should foster multilateral coordination among users without assigning to any one person control over transmission at any specified portion of the spectrum.

IV. THE TECHNOLOGICAL OBSOLESCENCE OF THE LICENSING/PRIVATIZATION DICHOTOMY

A. Overview

The core assumption underlying both licensing and privatization is an anachronism. Recall that interference is a degradation of the fidelity of *reception,* caused by transmissions from different sources that are detectable by a *receiver,* which the receiver cannot sufficiently differentiate to be able to translate into intelligible information. [FN169] The dominant solution to interference since the inception of radio technology has been to "focus" high transmission power in a narrow frequency band, and thereby "drown out" interference in that channel. The receiver tunes in to the channel, and comprehends the intended signal because it is much "louder" than all other competing signals (interference) and noise in that narrow channel combined. Naturally, if more than one person uses this strategy for the same narrow frequency, neither can be heard.

This "loud transmission over a narrow channel" solution is the reason that both licensing and privatization use a system of exclusive transmission rights over narrow frequency bands. It is also the reason for spectrum scarcity as we know it, because the number of clear "channels" is limited by the radio frequency bandwidth divided by the ***323** minimal "size" necessary for a channel to carry a particular type of signal, such as video or audio, plus the separation between signal-carrying channels (known as a "guard" band) necessary to avoid interference from the spurious emissions of adjacent channels. [FN170]

Information theory has for a long time questioned the necessity of the technical solution to interference that underlies the regulatory system and its privatization alternative. [FN171] As early as World War II, there was a proposal for military use of technologies exhibiting high resistance to signal jamming and interception that relied on radically altered baseline assumptions concerning interference-free wireless communications. [FN172] In the past decade the dramatic drop in the price of processing power, the increase in the sophistication of digital information technology, and the pressures on mobile telephony providers have made the theoretical alternative to the approach of "loud transmission over a narrow channel" a consumer-market reality. Increasingly, companies are using a variety of wireless communications technologies that rely on processing power and sophisticated network management, instead of raw transmission power, to prevent interference, and are allowing many users to use broad frequency bands simultaneously, without interference, instead of ***324** allotting use of a narrow channel to a single user for the duration of the communication.

The technological shift derives from various techniques--such as spread spectrum and code division multiple access, time division multiple access, frequency hopping, and packet switching--for allowing multiple users to communicate at the same time using the same frequency range. [FN173] Some of these technologies complement each other; some conflict with each other. What is crucial to understand about these technologies is that they challenge the underlying assumption of both licensing and privatization:that the only way to assure high quality wireless communications is to assign one person the right to transmit in a given frequency band.

The effect of these technologies on the elements of the institutional framework of wireless communications is to shrink (or even eliminate, in the case of direct sequencing spread spectrum) the unit size of the most efficient frequency/time/space dimension that a user must occupy exclusively in order to communicate without interference. The relevant time units might be as small as 10 milliseconds, and the relevant space no more than 50 yards or so. These units are so small as to make the transaction costs involved in negotiating allocation of exclusive property rights to them prohibitive. Similarly, regulatory control is too cumbersome a vehicle to administer spectrum that is allocated dynamically among fractions of transmissions, on a fraction-by-fraction basis. In the case of spread spectrum technology, no individual user occupies the entire relevant frequency/time/space unit, no matter how small that unit is. The spread spectrum transmissions of multiple users occupy the same

frequency band, but are treated by each other as manageable noise, not as interference that causes degradation of reception. The claim here is not, then, that technology has eliminated spectrum scarcity. Instead, the claim is that the pattern of use that is emerging as the technically most efficient way to communicate does not lend itself to regulation through either a property system or a command-and-control regulatory system.

If it is no longer necessary to determine an exclusive user in clearly defined narrow channels, it is more difficult to sustain the central justification for both administrative and market-based regulation that relies on identifying who "the" exclusive user must be as well as how the narrow band will be used. Technology increasingly deployed today shifts the relevant question to how to share spectrum at any given moment among the greatest number of users without causing ***325** interference. While it is certainly possible to answer this question within the frameworks of licensing or privatization, the new technology opens up an institutional arrangement not previously available:like automobile traffic, wireless transmissions can be regulated by a combination of (a) baseline rules that allow users to coordinate their use, to avoid interference-producing collisions, and to prevent, for the most part, congestion, by conforming to equipment manufacturers' specifications, and (b) industry and government-sponsored standards. This is the nature of the "unlicensed operations" institutional arrangement, whereby individuals can use equipment to transmit and receive over a specified range of frequencies without obtaining a license.

The following section draws some flesh on the dry bones assertion that it is technically possible to provide extensive communications capabilities using wireless communications operating in an unlicensed environment. It describes three models of communication that have developed in the very limited frequencies in which the FCC has for a while permitted unlicensed operations.

B. Current Business Models Utilizing These Technologies over Spectrum in Which Unlicensed Operations Are Permitted

The FCC has, for some time, permitted low power transmitters, such as cordless phones or garage openers, to operate without an individual license in specifically defined, narrow parts of the radio spectrum. [FN174] Relying on the freedom to use these frequency bands without a license, a number of companies have produced equipment for high speed data transmission within the parameters set for unlicensed use, and this equipment has been used to build communications networks that operate in the unlicensed spectrum environment. The results of these initiatives provide a basis for assessing the pattern and viability of communications networks in such an environment.

1. Proprietary Infrastructure Cellular Network:Metricom's Ricochet Wireless Network

Metricom, Inc., a company founded in 1985, has developed a wide area wireless data network using frequency hopped spread-spectrum and packet-switching. [FN175] The company has deployed its "Ricochet" network, ***326** utilizing the 902-928 MHz band, in Seattle, San Francisco, and Washington, D.C. [FN176] The organizational model of the Ricochet system is similar to that of a cellular service. [FN177] The company installs radio transceivers on street lights or utility poles, placed every quarter to half mile. A twenty-square-mile radius will have about 100 transceivers, creating a microcellular network covering the area. This network is connected to a wired access point, which can connect the wide-area wireless network to the Internet, the wire-line telephone system, or a customer's wired local area network ("LAN"). The network relays signals from one transceiver to another, packet-by-packet, employing 162 frequency hopping channels in a randomly selected sequence along the most efficient route available. This allows sharing by multiple users with little congestion and a relatively high degree of security. Users connect to the network with wireless modems. The modems can connect to the network whenever they are within the coverage area of the wireless infrastructure (the network of installed transceivers). They can also communicate to each other on a peer-to-peer basis, which means that two users of these wireless modems can connect to each other without going through the network in areas outside network coverage.

Metricom's model suggests that unlicensed spectrum could lead to the development of a service model similar to that currently used by cellular and PCS providers. It is a fixed infrastructure system, in which the backbone of transceivers and wired gateway connections is installed and operated by a private company. The owner of the

backbone maintains control over communications, and users pay that owner a service fee. The difference between the Ricochet system and cellular or PCS providers is that it is provided not by a licensee or spectrum owner, but by a company that found a way to use an environment in which no one exercises unilateral control of spectrum use.

2. Ad-Hoc Network of Equipment Owned by Users:Rooftop Networks

An alternative model uses similar frequencies open to unlicensed devices in a completely different organizational pattern, relying solely on end-user owned equipment with no owned backbone. [FN178] In a rooftop *327 network, each user's device is both a client of the network and part of the network backbone used to relay the communications of other users. The network uses no licensed spectrum, and no fixed backbone components, like base stations in cellular networks, that must be purchased, installed, or maintained by a service provider. Software installed in the radios coordinates the forwarding of traffic from one peer radio to another and manages congestion. [FN179] In this form of ad hoc networking, [FN180] peer radios serve as the backbone for each transmission, based on the most efficient configuration of peer radios not-then-transmitting that form a path for relaying the message from transmitter to receiver.

The user of a rooftop network would purchase a digital radio, an antenna, and a connection to a computer inside the house. The radios use spread spectrum technology and the Internet packet-switching protocol to route information. They can therefore be used to transmit and receive any information that can be sent over the Internet. The radios operate continuously, but transmit only when there is information to be transmitted. Thus the user is always connected to the network to receive transmissions, and the radio is always available to relay messages routed through it by the network. The network could be connected to the Internet through a gateway leased or owned by a group of users.

The rooftop networks model has not yet been deployed, and presents a number of difficulties. As the size of the network increases, the complexity of distributed management rises, requiring a significant amount of overhead traffic to convey network controlling information among the nodes. As use increases, collisions will have to be addressed through increasingly sophisticated means. Furthermore, the network will be formed only after a critical mass of users have purchased expensive equipment [FN181] that, without similar purchases on the part of their neighbors, will be worthless. Collective action problems arise. [FN182] The *328 model nevertheless indicates how unlicensed devices could develop into a wireless local loop that is not owned or otherwise centrally controlled by anyone. Such a model could be used by neighbors or a local governmental body to create a network whose use would be free of service charges once its users invested in the equipment, and whose use would be completely user-defined. In densely populated areas networks might be formed even without coordination, because even at low penetration rates a sufficient number of radios may be available to form a network.

3. Publicly-Owned Infrastructure of Unlicensed Devices:The NSF Field Tests

A number of field tests funded by the National Science Foundation have studied and aided school districts that have chosen to connect their schools to each other and to the Internet using unlicensed equipment. [FN183] The immediate implication of these tests is that unlicensed operations can become an important alternative solution for public schools' data connection needs, using a different approach than the long term subsidies that are at the core of current universal service efforts. [FN184] More broadly, these tests suggest that the economies of unlicensed wireless local loops are such that communities may choose to create a publicly funded wireless infrastructure, much as local governments maintain public streets and local roads, for the benefit of their residents.

One of the field studies involved the networking of the eight schools of the Belen Consolidated School District of Valencia County, New Mexico, which span an area over fifty square miles, with a student population of 4,800 and a staff of 250. [FN185] The entire school district was interlinked at DS1 signal rates, which is the benchmark for high speed *329 data connections using optical fiber, [FN186] by installing in the schools radios that operated without licenses, some in the 2.4 GHz range, and some in the 900 MHz range, and a number of routers and servers to manage the network. In operation, the system provided transmission rates of up to 1.22 Mbps, connecting all schools in an effective high-speed wide area network ("WAN"). [FN187]

The cost comparison between the network implemented and a wired WAN at similar transmission rates is instructive. The cost of the wireless WAN was $108,000. Because the infrastructure the wireless network used was not owned by anyone else, there were no service fees. The initial cost (to the school district) of the equipment necessary to use a wired connection would have been only $8000, but the expected service costs for a wired network were quoted to the school district at $84,000 a year. The break-even point of the wireless network would therefore be the fifteenth month of operation. For the expected life of the equipment, assumed to be ten years, the cost of the wireless network would be about one-eighth of the cost of the wired connection. [FN188]

The primary drawback of the system was that the closest Internet Point of Presence was thirty miles away in Albuquerque. Radios operating within the power limits imposed on unlicensed devices by the FCC cannot reach that distance, and the school district was forced to buy a wired connection from the local telephone company. Unable to afford a high-speed wired connection, the school district spent $125 a month for a 56 kbps frame-relay connection, which was the bottleneck for its Internet access. The community's immediate plans were to make the network available for dial-up modem connections serving the local community, although the district was also investigating wireless connections to avoid the cost of maintaining telephone modem banks.

Another field study involved the wireless wide area network and Internet gateway installed by a Colorado Springs school district with 14,000 students and 3,000 staff members. This network combined unlicensed spread spectrum wireless, licensed microwave wireless backbones, and fiber components to link twenty-six of the total twenty-eight sites in the district to each other and to the Internet, at about twenty-seven percent of the cost of a wired network with similar ***330** capabilities. [FN189] The system included a hub, at the administration building, which was connected to the Internet by two T1 lines. From the hub, four licensed microwave links (using 8 microwave radios, at $16,000 a pair), operating at 10 Mbps, connected as a backbone to four clusters of schools. Within these clusters, connections were achieved by deploying thirty spread spectrum radios operating at 2 Mbps, using the 900 MHz and 2.4 GHz ranges open to unlicensed use. The licensed microwave backbone, although not necessary, was included because the budget could accommodate it and because it solved the problem of regulatory limitations imposed on unlicensed devices as backbone elements. Over one year of operation, the system had no failures, even during storms, and the slowest observed speed of Internet access was 256 kbps. [FN190]

The organizational model presented by these field tests suggests that unlicensed devices could allow communities to install a public infrastructure, much as they build and maintain streets and roads today. The tests were conducted in a framework that affords unlicensed devices minimal operating space, at an early stage of market development. As unlicensed devices become more ubiquitous and equipment prices drop, the cost effectiveness of wireless infrastructure will increase. Limiting the range of spectrum in which transmission without a license is prohibited (or devoting more spectrum to unlicensed use) would enhance the capacity of communications using unlicensed devices. Such solutions could be particularly appropriate for rural and suburban communities, and may involve combinations of public and private, wireless and wired, and peer-to-peer as well as fixed-infrastructure backbone networks.

***331** V. UNLICENSED OPERATIONS AS THE INSTITUTIONAL ALTERNATIVE TO LICENSING AND PRIVATIZATION:THE U-NII ORDER

A. The U-NII Order

The U-NII Order [FN191] is a document both pedestrian and inspiring. Pedestrian because it revolves around defining power limits and antenna gains for as yet undeveloped equipment, in defined frequency bands in the 5 GHz range. Inspiring because it gave birth to a new industry and pointed to a new way to regulate wireless communications. It also showed how we could build an infrastructure commons that may be as central to our freedom to communicate in the digitally networked environment as are public sidewalks and streets to our freedom of movement in the physical environment.

The initiative for the Order came from equipment manufacturers. In May 1995, two petitions for rulemaking were filed, one by WINForum, an industry group, the other by Apple Computer. [FN192] Apple's petition

suggests that the proposed band would "mak[e] possible high-bandwidth access and interaction throughout a limited geographic area ... both on a peer-to-peer, *ad hoc* basis and through wireless local area networks," and "would provide for unlicensed, wireless, wide area 'community networks' connecting communities, schools, and other groups underserved by existing and proposed telecommunications offerings." [FN193] After notice and comment, the Commission adopted a final order providing for an Unlicensed National Information Infrastructure Band on January 9, 1997. Its provisions became effective on April 1, 1997. [FN194]

In the U-NII Order, the Commission permitted unlicensed operations in 300 MHz of the 5 GHz range--5.15 GHz-5.35 GHz, and 5.75 GHz-5.85 GHz. Parts of these bands and frequencies immediately adjacent to them are already occupied by various licensed services. [FN195] ***332** The Order imposes certain constraints on the operations of U-NII devices (the radios permitted for unlicensed use in these bands), intended primarily to protect incumbent services from interference. The regulatory requirements imposed, as well as requirements proposed and rejected during the notice and comment process, provide some insight into the institutional choices involved in designing a framework for unlicensed operation. They also provide a valuable understanding of the ecological competition between licensed uses, as a class, and unlicensed uses.

B. Institutional Elements

1. Generalized Rules Applicable to Classes of Equipment

The most important institutional attribute of unlicensed operations is that regulation focuses on general specifications for equipment design and use. Unlicensed operations are intended to occur more generically than traditional licensed transmissions, without analysis of the specific effects of transmission in a given location or time. The regulatory purpose of preventing interference is therefore achieved by imposing generic requirements on equipment seeking to transmit without a license in the specified frequency band, leaving decisions about individual design and use to manufacturers and users.

The U-NII Order imposes four primary substantive requirements on devices for unlicensed operation. First, by definition U-NII devices must provide "wideband, high data rate, digital, mobile and fixed communications." [FN196] Given the increasing use of data transmission for all types of communication, including telephony and video programming, this limitation is minimal. Second, transmission within bands where unlicensed operations are permitted must not exceed certain specified power levels. [FN197] Third, transmissions must assure that spurious emissions outside the band be attenuated by a specified factor below the maximum power allowed for within-band transmission. [FN198] And fourth, a device must transmit only when it has information to transmit, and must cease transmission when it has no information to transmit. [FN199]

***333** 2. Peak Power and Power Spectral Density

The most important substantive constraints imposed on U-NII devices limit the power at which they may transmit. The limits are measured in terms of (a) peak power--the maximum power the transmitter may use for the duration of a transmission burst--and (b) power spectral density--the maximum power used divided by the breadth of the frequency band over which the transmission is sent at that power. [FN200] The peak power limits are linked to antenna gain, and transmitters are given some leeway in adjusting antenna gain and power to attain the desired output. [FN201] The power spectral density limits were arrived at by dividing the peak power limits by 20, reflecting the Commission's baseline assumption that U-NII devices would transmit on broad bandwidths of at least 20 MHz. Its purpose is to require devices that use less bandwidth to reduce their power. [FN202]

It is crucial to understand that the specific power limits imposed on U-NII devices are not based on an assessment of the power levels at which such devices can operate without interfering with each other. The limits were imposed to address concerns that U-NII devices would cause interference to incumbent licensed services operating in narrow bands within the broad band in which unlicensed operations were permitted. [FN203] These power limits therefore represent a clear instance of how commitment to an institutional path chosen in the past--licensed operations--resists attempts to shift course, and can prevent new developments, or at least warp their contours. [FN204]

*334 *C. Regulatory Alternatives Not Followed*

Proposals considered for inclusion in the U-NII Order but ultimately rejected are more enlightening than the U-NII Order itself, in terms of highlighting the parameters of an institutional framework necessary to allow users of unlicensed equipment to share the spectrum.

1. Mandated Spectrum Etiquette

The Notice of Propose Rulemaking ("NPRM") that preceded the U-NII Order had proposed two types of rules intended to permit U-NII devices to share the spectrum. [FN205] First, the NPRM proposed a "listen before talk" protocol [FN206] along lines similar to the CSMA/CA protocol: [FN207]

> . A person wishing to transmit in the spectrum of frequencies allotted for unlicensed wireless must, immediately prior to the transmission, monitor the spectrum for at least fifty microseconds. . If there is frequency bandwidth sufficient to accommodate the transmitter's intended transmission bandwidth, in which no other transmission is detected, the transmitter may emit a transmission burst. . The transmission burst may be no longer than ten milliseconds. . After the burst, the transmitter must wait a deference time randomly chosen from a range of 50 to 750 microseconds, and then begin the process again. . Congestion is minimized by requiring transmitters who find no open spectrum to double the deference time each time they try to access the band unsuccessfully, up to a ceiling of twelve milliseconds between attempts. This creates a *335 feedback mechanism that limits collisions and in effect slows the rate of all transmissions in the band during peak periods. . All transmissions must be packetized, must assume equal access to the spectrum (no transmissions have priority, and no one centrally determines who will go first when there is congestion), and must therefore be capable of accepting some delay. This proposal would have, in effect, chosen one spectrum-sharing technique. While reasonable, it is not the sole option for operating without interference. The Commission decided to avoid technique-specific regulation, and to allow equipment manufacturers flexibility in designing their system. Should shared protocols become necessary, the Commission would rely initially on cooperative development. [FN208] While the Commission's concerns about locking in a single technological standard are understandable, the question of whether a specific set of minimal access-protocol rules is necessary to assure that equipment manufacturers have the right incentives to manufacture spectrum-efficient devices remains one of the central research questions raised by the U-NII order. [FN209] Furthermore, if standardization is required, it is unclear that awaiting market-based development is the wisest option. [FN210]

2. Channelization

The second proposal considered was a channel-based internal allocation of the band in which unlicensed operations are permitted. The initial idea was to divide the band into channels 20 MHz wide, and require devices to use the entire bandwidth of a channel. This would assure that the U-NII band would be used for high-rate data transmission, and would be used only by equipment within minimal spectral efficiency attributes. [FN211] The Commission rejected this proposal, but requested further comment on whether to impose maximum bandwidth limitations, so as to prevent devices from occupying too much spectrum. [FN212] The Commission finally rejected both versions of the channelization plan. It explained that determining channelization by regulation, instead of by equipment function or through cooperation *336 among manufacturers, would impose too great a burden on innovation in spectrum use technology. [FN213] Instead, the Commission's definition of U-NII devices required them to provide "wideband, high data rate" communications. [FN214]

3. "Part 16" Operation

The last important path not taken was Apple's proposal that the U-NII band be protected from licensed services under what was termed "Part 16" status. [FN215] The Part 16 proposal would have allocated the band to unlicensed use and treated the band as though it were licensed to all U-NII device users, providing them collectively the same protection from interference as a licensee receives for its licensed transmissions. Although they would share the spectrum among themselves, U-NII devices would not have to be designed around the needs of devices licensed and engineered to operate on an exclusive basis. The idea was that unlicensed operations are no less important than licensed services.

The Commission rejected the Part 16 proposal. [FN216] Based on the experience of existing unlicensed devices operating under Part 15, the Commission determined that U-NII devices did not need the protection envisioned in Apple's proposal. [FN217] The language of the report, however, indicates that the Commission's focus on protecting incumbent licensees caused it to misunderstand the Part 16 proposal. For example, with respect to the higher frequency parts of the U-NII band, the Commission explained that "we believe U-NII device manufacturers and users can feel confident that their operations will not cause interference to primary operations." [FN218] Similarly, in the lower part of the band, the Commission *337 found that interference would be prevented by the strict limits on the power of U-NII devices and the requirement that they be limited to indoor operation. [FN219] The irony of finding that unlicensed devices need no protected band because they have already been limited in operation in order to accommodate competing uses seems to have escaped the Commission. The request for Part 16 status and the Commission's approach to it raise the question of how unlicensed use competes or conflicts with licensed operations.

D. Signs of Ecological Competition with Licensed Devices

Given that the U-NII Order permits equipment users to operate simultaneously, on the same frequency, without a license, with the expectation that as many as 540 million devices could be deployed in only the bottom third of the band permitted for unlicensed use, [FN220] surprisingly little in the U-NII Order addresses the prevention of interference among U-NII devices. Most of the institutional framework adopted for permitting use of U-NII devices addresses concerns raised by licensed services sharing the same bands, not by potential suppliers of U-NII devices seeking standards to allow them to share the spectrum. Throughout the Order, the justification for most limits on operation is the need to protect incumbent licensed services from interference.

The Commission divided the 300 MHz band into three 100 MHz sub-bands, each with different maximum peak power and power spectral density limits. [FN221] This separation was put into effect because each sub-band is shared with different kinds of incumbent devices. [FN222] In addition to different power limits, each sub-band is required to maintain different attenuation levels for out of band emissions. [FN223] On the band shared with the most interference-sensitive incumbent service, mobile satellite system ("MSS") feeder links, U-NII devices are prohibited from operating outdoors and are required to have a built-in antenna to enforce the peak power/antenna gain rules. [FN224]

The effect of this decision is to create three distinct regulatory environments, each available to different types of devices. The most powerful devices will be capable of providing all types of services:indoor LANs, short-range multi-building wireless LANs, and longer *338 range communications networks for organizational WANs, community networks, local loops, and mobile communications. The operation of these versatile devices is, however, limited to the top 100 MHz of the available range. The other two sub-bands will allow only shorter-range communications services. To take advantage of the full 300 MHz, manufacturers will have to develop three different types of equipment-- indoor, short-range outdoor, and longer-range outdoor devices. Customers will have to buy different equipment for each type of use, instead of buying one piece of equipment and deploying it as need arises. The reason for the creation of three types of devices, using three layers of frequency bands, is not that this division is more efficient for unlicensed wireless operations. It is simply the historical contingency that parts of the band in which unlicensed operations were to be permitted had already been allocated to certain licensed services, and that the different incumbents have different sensitivities to interference.

The conflict between incumbent licensees and unlicensed users is dramatically illustrated by a statement that could easily have replaced Coase's confectioner story: [FN225]

[W]e note that it may also be appropriate to reassess the technical parameters governing U-NII devices in light of second generation MSS systems. For example, second generation MSS systems may be more sensitive and therefore more susceptible to interference from U-NII devices. On the other hand, if European HIPERLAN systems proliferate and operate at more power than U-NII devices, second generation MSS systems may of necessity be designed to be more robust and immune to interference from such devices. [FN226] The reciprocity of the interference, in the economic sense, seemed to have escaped the drafters of this statement. The

future choice by MSS *339 systems designers to make those systems more sensitive is treated independently, instead of as a form of interference with U-NII devices already designed for the procrustean dimensions of the lower 100 MHz of the unlicensed band. Manufacturers and buyers of the low-power U-NII devices must make and buy the equipment not knowing whether, at some future date, unilateral decisions of MSS systems designers will make their equipment an obsolete "source of interference."

The Order is strewn with examples of objections by incumbents that were rejected or partly accepted by the Commission. The Commission cites an objection from AT&T, for example, arguing that the higher-powered devices envisioned as the basis for community networks should not be allowed to operate without a license purchased at auction, because allowing such operations would bring unlicensed devices into competition with AT&T's purchased spectrum. [FN227] A local telephone carrier raised similar objections to competition from unlicensed operations as an alternative local loop. [FN228] Fixed point-to-point microwave licensees objected that their business of longer-range wireless relay could suffer competition. [FN229] The only similar objection raised by a manufacturer of unlicensed devices came from Metricom, who objected to non-spread spectrum devices in the higher-power range. [FN230]

The role played by licensed services in the notice and comment period of the U-NII Order indicates two broad types of conflict between licensed and unlicensed uses. First, licensed users occupy spectrum with claims to protection from interference. Their claims, their sensitivities to interference, are a direct constraint on how unlicensed devices may operate. Because of the privileged position of licensed uses within the prevailing conceptual framework, the needs of licensed users trump the needs of users of unlicensed devices. This creates conflict between a model that requires of all users robustness to interference and the capability to share spectrum, and a model that allows some users to be as "sensitive" to interference as they choose, while requiring all other users to adjust their operations to work around that sensitivity.

The second type of conflict is the conflict between two business models:one, a model based on owned infrastructure whose owners capture the value of their investment through service fees over time; the other, a system based on end-user equipment ownership. This is the *340 conflict made clear by the objections of AT&T, PacTel, and the point-to-point microwave link licensees. The NSF field studies [FN231] indicate that the latter model may be more cost effective. Incumbents who have invested large sums of money in infrastructure, hoping to recoup their investment through service fees over time, have much to fear from the development of a competing business model based on relatively high-priced end-user-owned equipment and free infrastructure.

VI. SOME ECONOMIC PARAMETERS OF THE CHOICE BETWEEN CENTRALIZED AND DISTRIBUTED CONTROL OVER WIRELESS COMMUNICATIONS

The choice concerning regulation of wireless communications is who will decide who may communicate, with whom, how, and for what purposes. The traditional answer has been that the spectrum licensee will make these decisions, within bounds set by the FCC. Increasingly, the dominant answer is shifting towards preferring a spectrum owner over a licensee, and seeking to determine how wireless communications equipment will be used by exhaustively auctioning transmission rights in the entire spectrum, and allowing wireless communications to be used, or remain unused, based on the decisions of these transmission rights owners. The sophisticated spectrum-sharing techniques that made the U-NII Order possible raise a third alternative, which is that no single entity will decide how transmissions in a discrete range of frequencies will be used, but rather that many users will coordinate their transmissions multilaterally.

The question this Part addresses is whether there are systematic reasons, within conventional economic analysis, to think that decisions about wireless transmissions made by a single identifiable entity (in particular, a transmission-right owner) will necessarily be superior to decisions made by an undetermined group of users privileged to transmit and receive in a given band, in terms of maximizing the value of communications to the users of wireless equipment. [FN232] The analysis *341 suggests that there are no such systematic reasons. It appears that equipment manufacturers and end-users combined, operating in an unlicensed environment, have incentives that are no worse than those driving transmission-rights owners. Furthermore, end-users are likely to

have better information, at lower cost, about the most highly valued uses of wireless communication; a system geared to distributing choices about wireless communications use to end-users is therefore likely to produce better decisions.

A. Identifying the Comparison to Be Made

The cluster of decisions that determine who will communicate with whom, how, and for what purposes can be stylized as described in Table 1. Decisions may concern either the physical layer available for transmission of intelligence, or its content. [FN233] There is no necessary order in which decisions must be made, but once either content or physical layer decisions are made, they may constrain choices concerning the other type of decision. [FN234] Each type of decision is divided into primary and secondary decisions. This division is based not on any notion of inherent importance of the decision, but of which decision precedes, and hence constrains, the other.

C1-3Table 1:Decisional Elements Determining Use of Wireless Communications..... C2Physical Layer..... C3Content Layer..... Definition of frequency/power/time (which band of radio wave frequencies are available at given power/time dimension).....Medium; format (one-to-one voice; one-to-many video)..... Primary Decisions..... Definition of transmission technology (AM, FM, digital vs. analog)..... Secondary Decisions.....Standards and protocols (NTSC; AM stereo; HDTV; CDMA vs. TDMA vs. CSMA/CA).....Specific content of intelligence transmitted and received (Seinfeld; "Hi Mom, it's me").....

***342** Physical layer decisions begin with the basic allocation decision regarding which clusters of frequencies will be available for use in a single emission (e.g., the FCC has decided that the 6 MHz from 54 MHz to 60 MHz can be used by a single emitter, known to us as TV channel 2). The other primary physical layer decision is what technology the emitter will be permitted to use (e.g., an emitter using the said 6 MHz channel must use frequency modulation in a manner that produces a television signal). The secondary physical layer decision concerns standards and protocols. There may be different ways of supplying similar communications services, using the same primary technology. A television signal using frequency modulation can be created using the North American NTSC standard, for example, or the European PAL standard. A decision must be made concerning which standard will be used to transmit in the stated channel. In the case of the channel between 54 to 60MHz, in the United States the emitter must use the NTSC standard. It is impossible to develop a standard without a decision about how broad a channel is available for a single emission, and thus the primary decision maker can exert control over the secondary decision. But standards are not necessary to the definition of emission units, so the decision maker of the primary physical layer decisions may decide without making or awaiting the secondary decision.

***343** Primary content layer decisions concern the medium or format of communications using the transmission capacity made available by the physical layer decision. For example, the FCC decided that the 6 MHz band defined in the preceding paragraph be used in a one-to-many transmission mode (broadcast) of combined pictures and voice for eighteen to twenty-four hours a day. This leaves undetermined, but constrained, the secondary content layer choice, which concerns decisions of what will actually be transmitted and received over a given channel, using given standards in a given medium. So we might, for example, see Seinfeld or the local news on Channel 2--a joint choice made by the station licensee and the viewer tuning in--but Mom could never see or hear little Johnny calling from school. The decision about the medium not only precedes the decision about the content of a particular transmission, it is also severable from it, so the primary decision maker has the option to control the secondary decision or to refrain from controlling that decision.

The value to be maximized is the aggregate value of communications using wireless transmission to all its users. This value is to be maximized by the aggregation of decisions at each layer, along both horizontal and vertical axes. Table 2 compares who makes which decision under a number of institutional arrangements: licensing, auctioning, privatization, and unlicensed operation. [FN235] Note that the table reflects the observation that the major difference between auctioning as currently practiced and licensing is that in an auction, the federal government appropriates the value of the license, whereas in a licensing regime, initial licensees do so in the secondary market for licenses. [FN236] Efficiency gains from privatization are likely to accrue if and when

decisions about spectrum use are finally made by spectrum owners. Such gains are unlikely to accrue as long as government continues to decide what part of the spectrum will be used for which type of service, and uses auctioning simply to decide who will be the private organization providing that service over the allocated channels. The discussion therefore focuses on comparing exhaustive privatization, as described in Part III, to the unlicensed wireless alternative.

Table 2:Decision Makers Under Alternative Institutional Arrangements for Spectrum Allocation

	Licensing
Auctioning	
Privatization	
Unlicensed	
Primary Physical	
Government	
Government	
Government initially; Owner through reconstitution of rightsFN [FNa]	
Government as to power; Equipment manufacturers through hardwired protocolsFN [FNb]	
Secondary Physical	
Licensees; Equipment manufacturers; Government	
Licensees; Equipment manufacturers; Government	
Owners; Equipment manufacturers; Government	
Equipment manufacturers; Government	
Primary Content	
Government; Licensees	
Government; Licensees	
OwnersFN [FNa]	
End-users	
Secondary Content	
Licensees (TV); can delegate to users (cellular)	
Licensees (MMDS); can delegate to users (PCS)	
Owners; can delegate to users	

End-users

FNa. The primary reason justifying transition from licensing to privatization is that it transfers more of the decision making from government to market-signal-sensitive owners.

FNb. The current U-NII band provides no special subband for unlicensed operations protected from interference by competing licensed uses in the same bands. It consists merely of permission to emit at stated powers in a broader swath of spectrum than necessary for any single unlicensed transmission. This means that for the power dimension of the unit, government makes the primary physical layer decision, but for the frequency/time dimensions, unlicensed equipment following embedded protocols (secondary physical layer decisions) dynamically makes primary physical layer decisions on a transmission-by-transmission basis.

***344** From this table it appears that there are two central questions to be answered from a neoclassical economics perspective about the choice between the unlicensed wireless arrangement and exhaustive privatization. First, there is the question of whether there is systematic reason to believe that spectrum owners who hold allocations initially determined by government will make better physical layer decisions than equipment manufacturers operating within a range minimally defined by government regulation. The second question is whether spectrum owners will make better content layer decisions about spectrum they ***345** own than will end-users of unlicensed wireless devices. The conclusion of this Part is:(a) that there is no good reason to hold the first view, or at least that to find out whether spectrum owners or equipment manufacturers will make better decisions is probably too costly to justify using exhaustive privatization to find out whether a commons-like model develops for part of the spectrum; and (b) that it is uncertain whether owners or end-users will make better content decisions, but that there are reasons to believe that users will value more highly the ability to make their own choices about content, even at the loss of quality, than they will value high-resolution content determined by others, namely, spectrum owners.

B. Are Spectrum Owners Better than Equipment Manufacturers Operating in an Unlicensed Environment at Making Decisions About the Use of Spectrum?

1. The Incentives of Spectrum Owners

The reasons supporting the efficiency of decision making by spectrum owners were discussed in Part III, and require only brief clarification here. Spectrum owners capture the value of their right to make unilateral physical and content layer decisions about a given channel by either leasing parts of the transmission right, in the form of the right to make secondary content decisions, to users who wish to use the channel to transmit, [FN237] or by selling secondary content layer decision-making services (i.e. programming) themselves to those who wish to receive transmissions. [FN238] These owners will make physical layer decisions that will permit them to maximize the value they can appropriate from the sale or lease of these rights. If another organization believes that it can better use the physical layer owned by an owner, that organization will bid for the transmission right and buy out the inefficient owner. Since the owner can sell its spectrum, and the new purchaser can change the physical and content layer decisions made by its predecessor, at each point in time an owner will put the spectrum to ***346** the use for which it can receive the highest payment from users, which is deemed to be the use most highly valued by users.

There are a series of transaction costs involved in management and reconstitution of transmission rights that affect the likely efficacy of decision making by spectrum owners. These costs are associated with deciding how to use the transmission rights, including costs of collecting information about what the highest valued use is at a given time, processing that information, and deciding to switch uses when appropriate. They are continually incurred by the transmission rights owner and by putative purchasers of transmission rights to determine what the highest value of transmissions will be.

Transaction costs also include the costs associated with switching between uses. Because, as explained below, owned transmission rights will tend to focus on higher quality provided for a narrower range of uses, the equipment that is likely to be deployed for their services will be relatively specialized. A shift in use will entail the purchase of new specialized equipment. This cost will present a barrier to shifting uses of the transmission right. Use will only be changed if its added value will be greater than the cost of retooling. Further, opportunity

costs associated with the continued use of equipment after a shift would have been undertaken but for the partial lock-in effect of specialized equipment, are part of these transaction costs. In addition, there are costs of communicating the availability of a new service to purchasers of transmission rights or to purchasers of reception services, and transaction costs incurred from time to time in signing customers up for new, higher-value services, and disengaging from users of old uses.

Another cost of management of transmission rights can be viewed either as an enforcement cost or as a lost positive externality. The owner of transmission rights will offer only services for which it can internalize the benefit, because those are the only services it identifies as valuable. For example, assume two customers of *A*, *m* and *n*, where *A* is the owner of the transmission rights in a certain band and offers wireless telephony. Assume that *m* and *n* are close enough to each other (e.g., within one cell of *A*'s system) that they could use wireless phones to call each other peer-to-peer using *A*'s spectrum allocation. *A* could design its system to allow peer-to-peer calls, or it could design its system so that all calls, including intra-cellular calls, must bounce off a base station. *A* would have a preference for designing the system with a bounce, instead of without it, even though this requires additional equipment and network management costs, because this allows *A* to capture the value of the conversation between *m* and *n* while peer-to-peer communications would not. To avoid this problem, *A* might resist manufacture of equipment capable of peer-to-peer communications over its band, ***347** impose a royalty on such equipment, or raise the rates for all its users to cover the lost value of peer-to-peer communications. Services not provided because the transmission rights owner cannot internalize their value, and marginal users who drop off because of the incremental price increase to offset uncaptured value, are lost positive externalities. Costs incurred by owners to identify and capture externalities are enforcement costs.

To the extent that management costs and transaction costs will prevent an owner from identifying the highest valued use, or prevent a putative better user from acquiring the channel and changing its use, spectrum owners will be inefficient decision makers as to how spectrum should be used. In this context, it is worth noting that the distributed model does not incur the costs of centralized determination of the use of the transmission rights, because that decision is made by end-users. The distributed model also does not incur the costs of network management over time. These costs are rolled into equipment design costs, and thus into the cost of equipment capable of transmission without interference over an uncontrolled band of frequencies. Therefore, the primary cost of the distributed model is the relatively high initial investment in equipment, and that cost comes to represent the value that users attach to the capability to transmit and receive in the unlicensed environment. [FN239]

***348** 2. The Incentives of Equipment Manufacturers

The value of communications in an unlicensed environment is, then, measured primarily in the price of equipment capable of unlicensed operation. [FN240] To maximize the value of the equipment they produce, manufacturers must maximize the value of communications their equipment makes possible for its end-users. There are two types of investments that must be made in order to maximize the value of communications in a given range of frequencies, and which will be made by equipment manufacturers where they would have been made by spectrum owners/licensees in a privatization or licensing regime. The first type of investment involves development of standards and protocols to allow networking (secondary physical layer decisions). The second type involves investment in increasing equipment efficiency, and hence spectrum utilization efficiency, to gain an advantage over competitors in the market for equipment (primary physical layer decisions).

a. Standard Setting Incentives

Table 2 [FN241] suggested that secondary physical layer decisions--those involving standard setting and the creation of shared protocols--will not be centralized under any of the regimes. In the traditional models of licensing, auctioning, and privatization, standards come into play in one of two ways. First, where the primary content layer decision is to offer a broadcast model service (so that secondary content layer decisions are also made by licensees), standards are necessary to allow a critical mass of equally accessible complimentary programming offered by competing licensees/owners to induce consumers to buy the equipment necessary for receiving the type of programming offered. Second, where the primary content layer decision is to produce an end-to-end communications model, like mobile phones, standards are necessary for interconnection between the

services offered by competing licensees.

Firms operating under conditions of incomplete information and communication will have difficulties in establishing standards, even if establishing any given standard will be beneficial to them all. [FN242] The history of standard setting for wireless communications applications in the United States suggests that spectrum licensees are not exempt from *349 the difficulties involved in deciding about standards. [FN243] The incentives and difficulties faced by equipment manufacturers in developing a standard are no different from those facing licensees/owners. They might attempt to do so, for example, by using an industry forum, like those that lobbied for the petition that resulted in passage of the U-NII Order. They might seek intervention from the FCC as a form of honest broker. Furthermore, since the market in devices of this type, like the markets for computers and faxes, will likely be typified by network externalities, [FN244] it is not impossible that developers will open their standards fully or partially in order to establish a favorable product ecology and capture network externalities for the developer's products, and that competitors will adopt one or another of the standards in order to gain network effects, leading to tipping that will establish a single de facto standard. [FN245] However standards might eventually develop for *350 unlicensed wireless equipment, in the absence of evidence that one or another group has better mechanisms or incentives to collaborate in standard setting, we must be agnostic as to whether equipment manufacturers will have a harder time agreeing on standards in order to sell devices than will spectrum owners in order to sell transmission services or programming.

b. Efficient Spectrum Use Incentives

Even if there is no good reason to treat the likelihood of appropriate standard-setting as a distinguishing feature between unlicensed wireless and licensed/privatized spectrum, there remains the question of whether, assuming that necessary standards have been established, equipment manufacturers will have the appropriate incentives to invest in increasing the efficiency of spectrum use by their equipment. [FN246]

Manufacturers who deliver more reliable throughput more quickly will have an advantage. Users will value equipment that allows them to transmit and receive more rapidly, with higher fidelity, and so forth. Systems that provide high ratios of information sent to frequency time/bandwidth/space used (through, for example, higher compression rates) will tend to fare better in an environment operating on a first-come, first-served basis than systems that use more spectrum (i.e., more bandwidth, for more time) to send the same amount of information. Systems capable of detecting spatial or frequency band congestion points (say, a cell or frequency range with high traffic) and routing around it, will similarly fare better in an environment where congestion is the primary expression of spectrum economic scarcity than systems that do not incorporate congestion avoidance mechanisms. This is the mechanism by which unlicensed operations provide an incentive for intensive margin development of the spectrum resource. [FN247]

*351 Furthermore, government can encourage manufacturers to develop and be first to market with equipment using new, uncongested frequencies by signalling to them that unlicensed tranmissions will be permitted in as yet unused ranges of frequencies should they develop equipment for unlicensed use in those bands. By this mechanism unlicensed operations would create an incentive to develop the extensive margin of the spectrum equivalent to that sought to be achieved by exhaustive privatization of unused frequencies.

In other words, in an unlicensed environment, equipment manufacturers in general will fulfill the same role allotted to the spectrum owner in the property rights approach to spectrum management. The market in equipment will reward equipment manufacturers for producing and marketing devices that deliver the best possible transmission services in an unlicensed environment, just as the market in transmission rights rewards spectrum owners for efficient use of their spectrum allocations. [FN248] The question then remains of whether content layer decisions, made in an unlicensed environment by end-users, can be said to be systematically inferior to decisions made by transmission rights owners.

3. The Role of User Incentives as to Physical Layer Decisions

Before treating the question of content, there is the issue of the concern that, even if manufacturers have proper incentives as to physical layer decisions, users will not. Once a user has sunk the cost of equipment into

the unlicensed device, the argument would be, marginal use of wireless transmissions with that equipment would be free, thereby causing overuse. This objection is misleading for two reasons. First, as to the choice between unlicensed wireless devices and devices based on wired or licensed wireless infrastructure, the value of communications over time using an unlicensed device is expressed in the price of the equipment. Ex ante, a consumer would compare the cost of all communications over the life of the equipment to the cost over the same period of use-priced communications. [FN249] If a user then uses the equipment extensively, the possibility of such use will be reflected in the *352 initial equipment price, and will be a valued use reflected in the market for equipment, which replaces the market in spectrum in the unlicensed environment. Second, use over time is not free. A user of an unlicensed device continues to incur costs over time in terms of the opportunity cost of time not spent on activities other than communicating using an unlicensed device. Users will not use their unlicensed wireless device if the value of the time spent using the device is lower than the value of that time to them employed in some other use, whether that other use is communicating with a different method or on a non-communicative activity. Overuse expressed as congestion will lead to queuing--or higher prices-- expressed in time. Queuing, in turn, is the appropriate allocation method whenever the cost of avoiding queuing--increasing capacity or instituting a price system without a queuing component--is higher than the cost of the time lost in the queue. [FN250]

C. Are Spectrum Owners Better than End-Users at Making Content Layer Decisions?

The difference between the unlicensed wireless and privatization models as to content layer decisions is that in the former, transmission rights owners make choices on a channel-by-channel basis, while in the latter, end-users make them on a transmission-by-transmission basis. At the outset it should be made clear that unlicensed wireless, as currently understood, would technically permit all forms of digitally-encoded information to be transmitted in a high-capacity wireless local loop, and could be connected to the Internet--or a future broadband medium--for relay or reception beyond the reach of the locally deployed wireless network. The unlicensed nature of the environment does not, therefore, in and of itself, impose constraints on the types of content it can carry. *353 The question, therefore, is whether transmission rights owners have better incentives and better ability to define the highest valued use--in terms of content-- of their channel, or whether end-users in an unlicensed environment do.

The comparative advantages of owners and end-users at making choices about content depend on the assumptions one makes about what is valuable in communication. The centralized system will tend to provide a higher resolution [FN251] signal for the communications of fewer users, while the distributed system will tend to provide a more flexible fit to the communications needs of more people, but at a cost to the resolution of the signal provided for each use. The relative value of each system will depend on the relative values of resolution and flexibility to end-users engaged in acts of communication.

The rationale for the centralized system is that it identifies an owner/licensee who decides how the equipment that transmits and receives in the frequency band is used. That arrangement is deemed efficient because it allocates the spectrum hierarchically, based on the willingness of users to pay. Once a channel owner has identified a channel use that will maximize the owner's value, the channel will be devoted to that use. The owner will then offer as high quality a service for that communicative use as necessary to increase the paying users of that use, as long as the price of adding quality is no greater than the income from marginal users. For example, over-the-air television is mostly sold to advertisers. The service they buy is the broadcast of a mix of direct advertising and programming that attracts the attention of viewers from the advertiser's target markets. Maximizing revenue depends on transmitting content that captures the attention of receiver users who tend to buy the products advertised. It therefore also maximizes the value of receiver owners most likely to purchase products based on television advertising. This business model is dominant, although the same equipment can be used to satisfy different preferences, as evidenced by public television.

The distributed approach relies on individual, moment-by-moment decisions of end-users to use the equipment for their highest valued use at that moment. The immediate cost of use is the opportunity cost to the individual's time. An individual will use an unlicensed device (whose capital cost is sunk at the moment of use) if using that device, for a *354 particular use, at a given moment, is a higher valued use of the individual's time and

attention than any alternative use. To allow this form of maximization, equipment must provide flexibility in terms of the uses to which it can be put and adaptability as the user's needs change over time. In this sense, it is likely to provide a better fit for the communications needs of more people. Because of the greater flexibility, however, there will likely be a lower incentive to invest in optimizing any given use than in a system that provides less flexibility and a smaller range of potential uses.

In comparing the utility of each of the systems of regulation, therefore, an important consideration is the relative value of flexibility and breadth of fit between equipment use and the needs of every user, versus quality of fit between the equipment use and the preferred use that the users who, as a group, are willing to pay the most. The question is whether the value of the additional "quality" achieved through centralized management is outweighed by the value of adaptability to the needs of more users made possible by the "flexibility" of a system based on distributed coordination. A contemporary choice concerning a similar tradeoff faces television and cable companies with the introduction of digital transmission. While the broadcasters' focus has been on the delivery of High Definition TV (higher quality of the narrow menu of offerings already in existence), cable companies facing competition from direct broadcast satellites are planning to use the same technology to add more channels at lower resolution. [FN252] These competing market trends indicate that it is not yet clear whether providing a smaller range of uses at higher resolution or greater flexibility and breadth of coverage at lower resolution will yield higher value.

D. Comparing the Models:Examples of Similar Choices

In the absence of good systematic reasons to prefer transmission-rights owners to equipment manufacturers and end-users, the central question is which of the two systems will more efficiently deliver the communications uses most valued by users-- an empirical question that will be determinable upon the development of markets for each type of service. Should such markets develop, it will be possible to compare the value users place on communicating in an unlicensed environment to the value consumers place on communicating in a licensed environment, by ***355** measuring the expenditures in the relevant markets (including equipment, services purchased, and time spent). Early empirical studies comparing these systems for delivery of wide area data networks favor unlicensed operations, but those comparisons are based on distorted costs for both unlicensed and licensed systems. On the unlicensed side of the comparison, the equipment market is almost non-existent, and has not yet captured any of the scale or scope economies that it should in the future. On the licensed side of the comparison, the costs of the Internet high-speed connections were presumably artificially high, due to the service providers' market power in the heavily concentrated markets that were studied. [FN253] The costs of both alternatives were thus inflated in these studies, each by a factor independent of that inflating the other.

A better indication of the possible advantages of the distributed model, at least for some classes of uses, arises in two other instances where a value could be generated both by a centralized, proprietary model, and by a distributed, non-proprietary model. These examples are the transportation system and computer networks.

In the nineteenth century there developed two competing solutions to the problem of transportation. One approach was based on proprietary routes, operated and managed by a centralizing owner operating under a franchise from the state, and offered to users for a fee. These included first turnpikes, then canals, which were very shortly thereafter supplanted by railroads. [FN254] The alternative approach was based on privileged use for all, with no proprietary control. Use of these routes was coordinated by custom or general use rules. These included roadways and navigable waterways, [FN255] which were operated as a commons managed by customary norms followed by their users. [FN256] After the internal combustion engine equalized to some extent the capabilities of rail and road, the twentieth century has seen the parallel development of a system based on proprietary control of infrastructure and a system based on multilateral coordination of equipment users operating on an infrastructure regulated as a managed commons. In ***356** 1992, for example, the year for which the latest numbers are available from the economic census, total revenue from rail transportation, including local and interurban passenger services, was $40,998,202,000. [FN257] Total revenue for the same year from local and long haul trucking services alone, excluding warehousing, was $111,912,000,000. [FN258] This value excludes the value of trucking performed by independent operators with no employees, private motor carriage departments

within firms, and, of course, the value of local and long haul transportation of passenger automobiles. While the distributed model has not completely eclipsed the centralized/owned model in ground transportation, it seems to be the dominant model, despite the associated queuing/congestion costs, and despite the high end-user equipment costs relative to the cost of service-based payment for rail tickets or freight.

The usefulness of the roadway-railroad comparison is compromised by two objections:highways are publicly subsidized, while railroads are not; and toll highways do not fall neatly into either category. First, it is hardly surprising that people use a subsidized good more than they use another (imperfectly) substitutable good that is not subsidized. Recall, however, that the comparison of licensed and unlicensed wireless is between:(1) a service with high upfront costs, relatively low resolution, and the potential for delay or congestion, but with the benefit of flexibility of use to fit the user's specifications as they change over time; and (2) a service with costs incurred over time rather than up front, relatively high resolution, and little potential for congestion or delay, but with a more controlled menu of choices. Similarly, trucks are high-upfront-cost, low-usage-cost devices that offer congestion-prone, flexible use; trains are low-upfront-cost, high-usage-cost devices that offer congestion-free, fixed-menu use. What the subsidy to roads does is increase the usage cost differential between the alternatives. It does not affect the qualitative inference that for some given differential usage cost, consumers will prefer a high upfront cost device to a low initial cost, and that for some measure of increased flexibility (time of departure), users will accept a reduction in resolution (sitting in traffic jams). In particular, it should be noted that in the U-NII band scenario, *357 the free usage of the common infrastructure is not the result of subsidy, because no cost is involved in developing, maintaining, or recovering the infrastructure. The low usage price reflects the shifting of the network management costs into the initial equipment cost.

The existence of toll roads, the second concern with the roadway-railroad analogy, would in fact be a significant criticism of the degree to which one can rely on the analogy, except that toll roads, as they are in fact used in the United States, fulfill a different role in the roadway network than the unlicensed spectrum would fulfill in the broadband communications network. Toll roads are limited to main artery highways or to high-cost bottlenecks like bridges and tunnels. The role of these components of the Interstate Highway System is more akin to the role of trunks (public or leased) in the Information Infrastructure, and either central office switches in the public switched network or Internet Point Of Presence ("POP") servers. The U-NII band would have its effects not as a replacement to fiber trunks or to POP servers, which, like toll roads, would continue to operate on a priced-use model, but as a replacement for local loop and small cells in cellular systems. In this sense, the relevant analogy is provided by sidewalks and small city streets, not toll roads, bridges or tunnels. We do not observe toll booths on sidewalks and city streets, either because of transaction costs or because they would be politically untenable. What we see are people relying on open-access transportation, with all its delays and problems, rather than closed-access transportation, like toll roads or railways.

While there are no similarly competent statistics for computer network use, the rapid shift towards Internet access services and away from proprietary online services in the second half of the 1990s suggests a similar dynamic. At the beginning of the 1990s, commercial computer network services, like Prodigy, CompuServe, and America Online, were the primary popular method of computer network communications. The development of the World Wide Web and of graphical web browsers, however, countered the advantage that these proprietary online services had previously enjoyed over the Internet in terms of user interface. At that point, the breadth of capabilities offered by the Internet became vastly more valuable than the value of a controlled environment offered by the online service providers. The result was that all the proprietary service providers were forced to connect to the Internet, and that by late 1995 the number of users using the Internet directly had already surpassed the number of users of all proprietary services combined. [FN259] The starkest consequence of this trend was the process by which *358 Prodigy, for years the largest online service provider, slipped out of the race as its approach of providing high quality, family oriented communications facilities met with competition from the Internet. [FN260] America Online, the first online service to offer Internet access, became the largest proprietary online service. [FN261] Similarly, even in 1995, as sophisticated a player as Microsoft had launched MSN as a proprietary online service. A year later the company reoriented its service and became an Internet access service. [FN262]

Both the transportation system and computer network examples suggest that a distributed model has advantages over a centralized-managed model, where the value to be maximized is the value individuals place on their communications capability (assuming equivalence between the values of transportation and communication capabilities). Greater flexibility and broader coverage, coupled with greater individual choice, seem to provide greater benefits, even at the cost of time lost queuing, than higher quality facilities satisfying a narrower range of preferences. [FN263] In both examples, a system for distributed coordination of infrastructure use proved to be the dominant model in direct competition with commensurate services offered in a centralized-managed model.

E. Two Microeconomic Objections

There are two intuitively forceful microeconomic objections to extending the policy represented by the U-NII Order into a broader conceptual framework that would build an important part of the information infrastructure by permitting operation of unlicensed wireless devices. The first is that the proposal treats the infrastructure of wireless communications--spectrum--as a commons. It is therefore subject to a well known critique:we expect that the spectrum will be overused and under-maintained. The second is that, if allowing unlicensed operations over a broad band of frequencies is efficient, then a market *359 in spectrum will lead to the development of such a space for unlicensed operations. All the FCC need do is consistently apply exhaustive privatization, and spectrum will be allocated to unlicensed use.

1. The Tragedy of the Commons Problem

In Hardin's classic statement, the "tragedy of the commons" to a situation where a resource is shared without rules to allocate its usage. [FN264] Under such conditions, every individual with access to the resource internalizes the full benefit of using whatever part of the resource the individual is capable of using, but shares the costs of depletion caused by his or her use with all other potential users of the resource. Similarly, the benefits of an individual's investment in maintenance of the resource are shared with all other potential users, while the costs of such investments are not. The individual's private cost-benefit analysis therefore leads all users of the commons to make rational personal choices that lead them, with tragic determinacy, to lose the resource.

In identifying the potential role of tragedy of the commons concerns in wireless communications, it is important to remember the heuristic limitations of treating "spectrum" as a resource. Spectrum is not a thing, like a pasture, that can be eliminated by overgrazing or that needs constant upkeep. To be precise, if one wishes to treat spectrum as a resource, one must recognize that it is a perfectly renewable resource that is an input into the value sought to be maximized--the capacity of users to send and receive communications. The spectrum is perfectly renewable in that time is one of its defining dimensions; the availability over time of a given frequency/power unit as an input for communications is in no way affected by its use at any previous time. [FN265] Thus, for any given band of frequencies that might be owned or operated as a commons, there are no issues associated with initial investment in creating the resource, or in maintenance, recovery, or development.

What makes frequency/time/power units an economic good, and hence defines the extent of potential tragedy of the commons effects, is the potential for interference, or conflicting uses, and, in the case of devices with the spectrum sharing capabilities, congestion. Overuse by *360 a device capable of sharing spectrum consists of that device using, for a given transmission more spectrum than necessary to transmit the information it has to transmit, hence increasing its potential to conflict with other users. Under certain conditions an equipment manufacturer could increase the performance of its equipment by transmitting for longer bursts than necessary, using a broader band of frequencies than necessary, or using greater power than necessary; this behavior will likely lead to a degradation in quality of performance for all manufacturers, the defector included. [FN266] Such behavior, if unchecked, is in fact the equivalent of overgrazing. The question that must be answered in defense of the unlicensed regime is whether this type of behavior can be eliminated by incorporating incentives to avoid overuse into the market in equipment, or whether it must be resolved by instituting a regime based on exclusive control of spectrum allocations, such as privatization or licensing.

In an unlicensed environment, where no one controls transmission decisions, rules concerning power limits (primary physical layer decisions), in combination with transmission protocols (secondary physical layer

decisions), can operate to prevent interference and avoid congestion. As described in Part VI.B, equipment manufacturers operating in such a regulated commons have incentives to tend the commons that are not demonstrably inferior to the incentives motivating spectrum owners in a property-based system. What motivates equipment manufacturers is that they will sell more devices than their competitors if their devices can deliver more reliable, faster transmissions in an unlicensed environment where allocation is attained by queuing. To avoid overuse of frequency/time/power units by unlicensed devices, the initial rules defined by the FCC for use of unlicensed devices and industry standards, perhaps to be developed under FCC supervision, should be designed to take advantage of the equipment manufacturer's incentives, by tying the access a device may gain to the unlicensed spectrum to the efficiency of that device's use of the spectrum.

By designing the spectrum sharing protocol so as to reward a device that uses no more spectrum than necessary to transmit its message by giving it faster repeated access to the spectrum for each of its transmission bursts, and penalizing an inefficient device by delaying its access, spectrum utilization protocols can bring into play the incentives *361 of equipment manufacturers to design their equipment so that it suffers the least delay. [FN267]

For example, a device that uses too broad a band of frequencies, given its power spectral density, to convey a given amount of information may be required to scan the spectrum to find a frequency range that is free of competing transmissions for a longer time interval than that required of a device that uses a narrower band with the same power spectral density (i.e., with lower peak transmit power) to transmit the same amount of information. This would give the more efficient device--the device transmitting the same amount of information over a narrower band of frequencies at lower power-- an advantage every time the two devices competed for a transmission slot. [FN268] Or a device could be required to wait longer deference periods between transmission bursts in some proportion to the length of its previous transmission burst, so as to make a strategy of transmitting for longer than necessary a self-defeating exercise. [FN269] Since overuse by one manufacturer will lead to countermeasures for similar overuse by its competitors, [FN270] equipment manufacturers will all benefit if standards that prevent or penalize defection are adopted; they will therefore likely adopt such standards if the familiar collective action problems involved in standard-setting are overcome. This, in turn, should focus FCC efforts on facilitating adoption of such standards.

It is important to realize that this solution to the tragedy of the commons problem does not rely on the elimination of excess demand for transmissions over the supply of frequency/time/power units available for transmission. It does not, in other words, suggest or rely upon the notion that spectrum sharing will eliminate spectrum scarcity. It suggests, instead, that just as property rules can bring into play the incentives of spectrum owners to maximize the value of their spectrum, spectrum-sharing rules can bring into play the incentives of equipment manufacturers to optimize the use of spectrum by their devices. That is not to say that the current U-NII Order imposes such rules. Rather, it is to say that an important area of study into unlicensed spectrum is to *362 identify which rules will reward efficient devices with better access to the shared spectrum and penalize inefficient devices-- whether such rules take the form of administrative regulations by the FCC or protocols and standards set by the industry to prevent defection and degradation of the quality of performance all industry members can deliver to their customers. What is important from the perspective of the tragedy of the commons objection is that the tragedy can be resolved within the framework of the equipment market, and does not require a shift to the spectrum market. Assuming the development of appropriate spectrum-sharing rules and protocols, and in the presence of an equipment market to reward investment in more efficient devices, the absence of a property system in spectrum should not result in a tragedy of the commons.

2. If Unlicensed Operations Are Efficient, They Will Emerge from an Efficient Spectrum Market

The second objection to using administrative regulation to permit unlicensed operations is that, if indeed a model of multilaterally coordinated devices using first-come, first-serve allocation is an efficient mode of communication, then an efficient spectrum market will devote frequencies to such applications. If the value of spectrum to users of devices capable of distributed coordination is higher than it is to the owners of exclusive transmission rights, then someone will aggregate enough spectrum to allow such use, and then make that spectrum available to devices of this type for a fee. Making spectrum available for unlicensed use by administrative decision

would allocate the spectrum without the benefit of a market valuation that unlicensed use is indeed a more highly-valued use of this part of the spectrum.

The answers to this objection fall into three categories of well-known difficulties:collective action problems, risk of monopolization, and unnecessary transaction costs. Analysis of these difficulties leads to the conclusion that a market in spectrum rights is unlikely to produce the spectrum necessary for unlicensed-like use; that if it will produce the necessary spectrum, the process of using a market to make such use possible will likely distort the equipment market capable of utilizing that spectrum; and that the costs associated with market determination of whether spectrum should be deployed in an unlicensed model are the sort of transaction costs that are best avoided by correct initial allocation, in this case, of universal limited transmission privileges.

First, there are collective action problems associated with collecting enough spectrum to sustain a robust unlicensed operations market. To create a functioning market in spectrum, the FCC must define the initial units subject to trade. Since the market would be in rights to exclusive ***363** control of a narrow band, the units that would produce an efficient market are much smaller than the broad bands necessary to allow efficient unlicensed operations. A market actor attempting to collect a spectrum allocation equivalent to the U-NII band would have to persuade multiple licensees to sell their rights in order to form a broad contiguous band. The collector of such a band would face problems familiar in the context of infrastructure development requiring the aggregation of private land. These problems are the most universally accepted justification for the power of the state purposefully to counteract market decisions by property owners. [FN271]

Second, the difficulty of assembling a broad swath of frequencies would render unlikely the initial development of more than one such band. During a period during which there were only one band available, equipment manufacturers would have developed equipment for use in that band. A potential competitor to the first band would then face not only the barriers of collecting an equivalent band, but also the need to introduce new equipment capable of transmitting at its newly assembled frequencies. These attributes lead to a high likelihood that market allocation of spectrum for unlicensed-like use would result in monopoly control over infrastructure. Historically, such control has proven an effective tool for monopolization of both equipment and service markets that depend on access to the infrastructure. [FN272] Moreover, the most likely consolidators of spectrum would be equipment manufacturers seeking to make space for their products. [FN273] Without regulatory intervention, it ***364** is unlikely that these manufacturers would offer competitors nondiscriminatory access to their spectrum.

Requiring that spectrum for unlicensed-like uses be purchased by someone, to prove its value, will therefore involve either costs of lost efficiency in the equipment market, upon which the efficacy of unlicensed use relies, or costs due to administrative regulation of competition (and the failures of such regulation), given that the equipment market is systematically sensitive to monopolization by leveraging of ownership over its essential infrastructural input-- spectrum. It should be recalled that the costs of the market-based approach (in terms of risk of monopolization) are not a necessary evil forced by the need to provide returns to investment in infrastructure. Spectrum, like manna and unlike twisted copper pair, falls from the heavens to those who collect it. The monopolist, if one would emerge, would therefore not be a product of a "natural" monopoly based on large initial investment in infrastructure. The monopoly would be an administrative cost of the decision to use market forces instead of a regulatory process to determine whether to allocate spectrum for unlicensed operations.

Finally, the transaction costs involved in assembling and subletting the required spectrum are likely to be high. In fact, because there are no maintenance or development costs for the spectrum itself, payments to the owner would reflect compensation solely for the effort of identifying the need for spectrum for unlicensed operations, collecting that spectrum, and making it available for unlicensed use. [FN274] Given these foreseeable transaction costs, if there is good reason to believe that unlicensed operations will be an efficient model for wireless communications, the better choice is to allocate spectrum for unlicensed operations by regulation. This would avoid the transaction costs involved in creating the space for such communications through the ***365** market and the risk that these costs will be so high as to prevent reallocation to such use.

VII. SOME ECONOMIC IMPLICATIONS OF THE CHOICE BETWEEN CENTRALIZED AND

DISTRIBUTED CONTROL OF COMMUNICATIONS INFRASTRUCTURE

A. Who Invests What in Information Collection Under Different Institutional Mechanisms for Infrastructure Management?

The primary institutional difference between licensing or auctioning, on the one hand, and unlicensed operations, on the other hand, is that the former rely on instituting asymmetric constraints on how people may communicate using wireless communications, while the latter constrain the choice sets of all wireless communications users symmetrically. [FN275] The asymmetry is a purposeful institutional feature. It is considered necessary to allow users to communicate, because it provides the necessary framework for a centralized organizational model. The person with the right to control becomes a clearinghouse for information about who wants to communicate at a given frequency/time/power unit and how they would like to communicate. That person also becomes the sole person with whom transactions have to be made, thereby limiting the number of transactions necessary to attain coordination. In the absence of such a clearinghouse, every potential user would have to collect this information about every other potential user, communicate his or her preferences to these others, and transact with all of them to assure coordination. The cost of coordination would be prohibitive. The alternative institutional option--imposing symmetric constraints that do not identify an organizational center--therefore presented itself only when it became technologically possible to reduce these transaction costs by instituting simple coordination rules that can be implemented through transmission control protocols and computer processing power. The question is what are the implications of the now-possible choice between the two institutional frameworks.

Organizations and individuals structure their interactions so as to take advantage of the institutions within which these interactions occur. In the case of privatized spectrum, both owners/licensees and users will tend to structure their use of wireless communications so as to exploit *366 the asymmetrical constraints imposed on them. The primary attribute of the asymmetry is that owners can decide how wireless transmissions will be used, by whom, and at what time. Users can then decide whether to use wireless transmissions within the parameters set by owners. [FN276] Expenditures on the part of end-users towards obtaining full information about how wireless communications might be used, developing and articulating their own utility function with respect to the full range of possible uses, and processing that information to identify their first-best uses of wireless communications are irrational. Unless their preferences happened to coincide with those of many others, or unless they incurred the large costs necessary to coordinate preferences with others, the costs of articulating a preference order would be wasted. The most likely benefit of their investment would be an increased capacity to identify which, among the menu of options offered by the owner, is their closest second-best.

The likely outcome of the asymmetry is therefore that users will attempt to shift the initial costs of articulating the menu of potential uses of wireless communications to the owners of transmission rights, and will limit their expenditures to choosing from the menu of options defined by owners. Owners are left to develop a menu of communications capabilities that will maximize the value of their unilateral power to determine how wireless communications will be used over a given channel, in the rational absence of articulated preferences of potential end-users.

The alternative institutional framework, which imposes symmetrical constraints on all users, creates different incentives for information collection and preference articulation. On the one hand, end-users can communicate in any fashion, at any time, and for any purpose, within set symmetrically-imposed constraints. These constraints are neutral as to the content, time, or nature of the communications. End-users, who have already incurred the capital costs of equipment, have an increased incentive to invest in accurately identifying and articulating their individual highest-valued use of a communications facility operating under the constraints of multilaterally-coordinated wireless transmission. On the other hand, there is no clear single entity with the incentive to articulate and service aggregate preferences. Organizations that cannot control how communications facilities are used will likely thrive by providing end-users with capabilities to maximize their choices within the framework of symmetrical constraints. In turn, this focus will save *367 the organizations the costs of collecting information about end-user preferences (representing a shift of these costs to end-users), and the costs of monitoring, measuring, negotiating,

and enforcing agreements concerning appropriation of the value of communications over time.

B. Implications of Symmetric and Asymmetric Constraints for the Pattern of Information Flow and Knowledge Production

Because obtaining information is costly, we continuously act on incomplete information and make our choices under conditions of uncertainty. [FN277] By constraining the choices available to any individual in a given interaction, institutions (laws, norms) reduce uncertainty and the amount of information that must be collected in order to act in most routine interactions. They allow people to coordinate their behavior in a world where obtaining the information necessary to attain such coordination without institutional constraints may be too costly. [FN278] Nested within this general function of institutions is the fact that the specific institutional choice with which we are concerned affects the organization of our information infrastructure. In other words, institutional choices intended to solve informational deficiencies about the best way to organize our communications facilities have feedback effects on how we identify, collect, process, and communicate information, because the subject of the institutional choice is itself our facility to perform these tasks.

In the asymmetric constraints model, the costs of collecting information about how communications infrastructure would best be used are not borne by end-users, but by the owner of the right to decide how the communications infrastructure will be used. Having incurred these costs, the organization controlling the infrastructure is in the position to decide what information will be available, to whom, and in what form, as well as to what degree and to whom to to sell or license these decision-making powers. An owner of infrastructure could choose to become transparent to its users, and allow them to do as they please on its facilities. It would do so if the cost of retaining more control over the use of its facilities would be greater than the benefits of categorizing and tracking services so as to impose a more discriminating pricing scheme than possible without monitoring and control. Even if the owner chose transparency, it would retain the power to reassert active control.

***368** An admittedly stereotyped comparison between the information environment associated with television broadcast and that associated with the Internet will illustrate. In the broadcast model, the broadcaster makes all decisions about what information in the world is relevant, reliable, or truthful; about the appropriate frame of reference within which to comprehend that information; and about how to structure and articulate it. Viewers come to rely on, and value, the centralization of these functions. The broadcast model allows each viewer to minimize information collection costs, but the costs are cut at the expense of the viewer's capacity to effect the knowledge environment generated by this model of communications. We articulate this exchange through the popular images of the "boob tube" and the "couch potato."

The Internet, on the other hand, is the best model we currently have of a distributed information infrastructure. It imposes high information collection and processing costs on its end-users, and creates significant problems of identifying relevant and reliable information for users habituated to a centralized information infrastructure like the broadcast model. On the other hand, the Internet provides a broader range of communicative alternatives to its users. The distinction between the production of knowledge or information and its consumption are less clearly defined than in the broadcast model (as the rise in multiplayer online games dramatically illustrates). In this framework, the part an end-user plays in defining the information and knowledge environment within which he operates is much greater than in the centrally-controlled environment created by the broadcast model.

Whether a broadcast model or an Internet model isbetter depends on the values by which the question is measured. One approach to comparing the two models is offered in Part VIII. What is important to recognize here, however, is that the institutional background against which organizations manage a society's information infrastructure has implications for the relative role played by different actors in shaping that society's knowledge environment. [FN279]

C. Institutional Implications for Articulation of Demand

The effects of variations in formal institutions on economic performance are complex and in no useful sense deterministic. It is nevertheless possible to identify one likely relationship between the *369 institutional choice to adopt centralized or distributed control over communications infrastructure and the pattern of information flow in the economy. If the patterns described in the preceding section in fact represent the likely effects of such an institutional choice, then adopting a distributed model of communications should allow better articulation of end user preferences and better communication of those preferences to producers. This, in turn, would allow an upward shift in the aggregate demand curve (as perceived by suppliers) of an economy that could have been in equilibrium at a lower state due to poorer information both consumers and producers would have had about actual and potential consumer preferences.

Because information in the broadcast model flows from the center to the periphery, the model offered an obvious and "natural" point to centralize information and standardize perceptions of demand and consumer utility functions in a mass production economy. The model was originated in the mid-nineteenth century, with the introduction of a number of technological advances in printing, the development of mass circulation newspapers and magazines, railroad-based distribution, and the introduction of managed demand through advertising. [FN280] It was enhanced when radio broadcast combined with mass production techniques in the 1920s. [FN281] The organizational development of the American broadcast system into networks financed as a demand-management branch of a mass production economy was a rational response to a combination of the state of radio technology in the 1920s, the institutional parameters of the spectrum allocation system (itself largely a product of the efforts of the progenitors of the American broadcast model), [FN282] and the need of American mass production industries to manage the demand for their products. [FN283]

*370 This system has significant drawbacks where the production capacity of a society has developed in the direction of allowing manufacturers to respond to individually defined needs. [FN284] As explained in Part VII.B, a communications system responding to centrally-produced perceptions of demand, with limited feedback mechanisms based primarily on statistical sampling intended to identify average responses (e.g., the Nielsen ratings system), is a poor mechanism for allowing the development and communication of individual utility functions. The closer the production of information about an individual's needs is pushed towards the individual, the more it will tend to reflect that individual's actual then-perceived utility function. If the same communications system allows the individual to communicate that utility function to producers, these producers can begin to work on fulfilling that demand by tailoring their products ever more finely to fit the individually-generated demand. While averaging serves well the preferences of those at the peak of the normal distribution curve of consumer preferences, it will not similarly fulfill the preferences of outliers. Fulfillment of actual demand will continue to offer the former group a service that fulfills its demand, but will better serve the preferences of the outliers. As seen by manufacturers, then, the aggregate demand curve shifts upwards, since it now reflects more closely the aggregate of actual individual highest valued uses, rather than the product of multiplying an average individual utility function as perceived by a producer by the number of individuals in the producer's target market.

D. Institutional Path-Dependency and Lock-In

The potential for productivity gains from an organizational shift to distributed control over information infrastructure raises the same question for the neoclassical economist that was raised at the end of Part VI:if in fact distributed communications offer the more efficient model of organizing communication in an economy capable of mass customization, then that is the model of communication that will evolve over time. Producers who find ways to allow consumers to articulate *371 and communicate their individual utility functions will thrive at the expense of those who rely on average demand articulated and communicated through mass media and thus produce below capacity.

The response suggested by institutional economics [FN285] is that institutional arrangements, and the adaptations developed to maximize their utility within a given institutional framework, can persist over time even if they are economically inefficient, because institutions have increasing-returns attributes and operate in imperfect markets with high transaction costs. An institutional framework acts like a product or service with network externalities, [FN286] in that the more contracts, transactions, and economic or political behavior is pursued

within an institutional framework, the more useful the framework is for all who use it to predict the behavior of others with whom they are likely to interact. Institutions also have relatively high setup costs, in terms of resources devoted to institution-building instead of to material transformation, as well as in transactions to obtain the benefits of specialization within an already-established institutional framework. Furthermore, institutional frameworks involve significant learning effects. In an imperfect market with high transaction costs, individuals and organizations must expend time and resources to optimize their behavior in accordance with a given set of rules. Once these costs are incurred, organizations are well-tailored to fit the existing institutional framework, and a shift entails new learning costs. Finally, perceptions of what is efficient or desirable are shaped over time to reduce the perceived opportunity cost of the stable condition in which a society exists. As an institutional framework persists over time, people who live in it develop better stories to justify its continuation and filter out information whose assimilation could require the expenditure of resources on institutional transformation and involve the risk of uncertain patterns of redistribution. [FN287]

***372** The political decision to require the American economy to spend billions of dollars to retool its household communications equipment so as to receive higher resolution signals in the traditional television broadcast model--High Definition TV ("HDTV")--is an excellent example. The change over time in the name of the goal, from HDTV to advanced TV ("ATV") and then to digital TV ("DTV"), [FN288] expresses the gradual realization that HDTV is no different than all other communications today--digital transmission of a particular kind of content. But digital communications need not be chained to the traditional broadcast model. The 6 Mhz channel allocated to broadcasters in the DTV Orders can be used to carry a number of old-resolution programs, up to two high-resolution programs, or data transmissions, etc. [FN289] Recognizing the technological obsolescence of the idiom of high-resolution television, the FCC nonetheless persisted in requiring the continuation of the communicative model it represents. With two actions, the Commission sought to maintain the old broadcast model in new imperial cloths. First, the Commission required each broadcaster to offer one program, continuously, that would replicate old television programming at the same or higher resolution. [FN290] Second, the Commission required all viewers who wish to continue to view old-style television programming to purchase new digital television sets. (This requirement was formally imposed on transmitters, not viewers, by requiring that all analog broadcasts stop after a number of years. [FN291]) The requirement was imposed ostensibly so that the spectrum allocations used for analog transmissions could be reclaimed and auctioned. When broadcasters themselves began to resist the requirement that they use their spectrum for high-resolution delivery of the same menu, rather than ***373** low-resolution delivery of a broader menu, they were quickly beaten into submission by Congress. [FN292]

The DTV Orders are a quintessential instance of an old institutional and organizational model resisting change and forcing a radically changed technological environment to conform to the assumptions of an old framework so as to allow its continued survival. If American consumers spend billions of dollars in the next ten years on high-definition televisions, capable of high-resolution reception of a limited menu of programs (assume even 500 channels, as compared to, for example, millions of web pages) and limited upstream communications capability, it may be difficult to persuade them to spend the same amount again to buy unlicensed broadband devices during the same time frame. This would be true even if such devices were much better (in some important sense), since the purchase of a high-definition television might have exhausted the portion of the household budget devoted to information collection and communications capability for the expected life of the television set. DTV may yet emerge as an instance of both institutional and technological lock-in operating in a feedback loop with each other. [FN293]

Interests created by spectrum privatization also operate to resist unlicensed operations. At a simple level, licensees who have purchased their licenses in auctions will object to competition from unlicensed operations. This can be seen in the objections of AT&T and others who could find themselves in competition with powerful U-NII devices. [FN294] Even where incumbent licensees (whether they bought their license in an auction or not) cannot block unlicensed operations completely, they still exert a pull on the institutional framework for unlicensed operations, as one sees in the relatively large role protection of incumbent uses played in the U-NII Order. [FN295] Both broadcasters and licensees who ***374** purchased their licenses at auctions are examples of entities that resist transition in order to protect their investment in an incumbent institutional framework.

At a more subtle level, the cultural and organizational entrenchment of two conceptual paradigms operates to resist adoption of a distributed model of communications infrastructure regulation. First, the intellectual dominance of neoclassical economics and the cultural centrality of property rights aid the continued conceptualization of the spectrum as "a resource" and the intuitive resistance to treating spectrum as a commons. [FN296] Second, the cultural centrality of the one-to-many broadcast model also operates to resist the distributed model. We see this most clearly in attempts to develop "push" technologies for the Internet, in order to force the broadcast model upon our most robustly distributed remote communications facility. [FN297]

Considering the increasing-returns attributes of institutions, and the resistance of entrenched organizations and conceptual apparatuses to institutional transition, it is possible that an institutional framework will persist in the face of a more efficient institutional alternative. Recognizing this possibility does not militate that a transition be politically undertaken whenever it seems that a new framework will be more efficient than the last. It does, however, suggest that relying on market mechanisms to identify when an existing institutional framework is less efficient than a feasible alternative is unlikely to be an effective strategy. A polity must treat the study of institutional alternatives as though institutional transitions were a form of public good, and when a polity is persuaded of the advantages of transition, it must effectuate the transition by political decision.

*375 VIII. TOWARDS A POLITICAL ECONOMY OF THE CHOICE BETWEEN CENTRALIZED AND DISTRIBUTED PRODUCTION OF A SOCIETY'S INFORMATION ENVIRONMENT

A. Individual Autonomy, Robust Political Discourse, and Medium-Specific Law

"In an age of omnipresent radio, there scarcely breathes a citizen who does not know some part of a leading cigarette jingle by heart. Similarly, an ordinary habitual television watcher can avoid these commercials only by frequently leaving the room, changing the channel, or doing some other such affirmative act. It is difficult to calculate the subliminal impact of this pervasive propaganda, which may be heard even if not listened to, but it may reasonably be thought greater than the impact of the written word." *It is no answer to say that because we tolerate pervasive commercial advertisements we can also live with its [sic] political counterparts.* [FN298] Thus, writing for the Court in *Columbia Broadcasting System v. Democratic National Committee* ("*CBS v. DNC* "), [FN299] Chief Justice Burger explained why broadcast licensees, in the name of protecting the openness of the marketplace of ideas, could refuse to accept paid political advertising, even though they accepted commercial advertising. [FN300] More recently, Justice Breyer, concurring in the Court's rejection of cable system operators' claims that their rights to be free from "forced speech" were violated by statutory "must carry" obligations, wrote:"I believe that this purpose--to assure the over-the-air public 'access to a multiplicity of information sources,' ...-- provides sufficient basis for rejecting appellants' First Amendment claim." [FN301] The passage Chief Justice Burger quotes in *CBS v. DNC* conveys the sense of invasion of the individual's informational environment by radio commercials, of resistance by the individual who *376 switches channels, leaves the room, and yet cannot get the jingle out of his head. When Burger compares radio advertising to writing, the difference he focuses upon is that writing necessitates action on the part of the reader, thereby shifting control over information flow from the sender to the recipient, while the jingle can be heard even if not listened to. [FN302] Justice Breyer's concurring opinion in *Turner Broadcasting System, Inc. v. Federal Communications Commission* ("*Turner II*") [FN303] adds a layer of insight. An institutional framework that produces a lopsided distribution of access to information and communications capabilities substantially reduces the capacity of those people whose access to information is constrained to be politically self-governing citizens.

These two statements outline the importance of the choice between permitting unlicensed wireless operations and exhaustively licensing or privatizing the spectrum. Chief Justice Burger's statement emphasizes that even if we accept centralized production of the information environment when we consider its effects on us as economic actors, we must be more cautious about its effects on us as citizens in a democracy. Justice Breyer's *Turner II* concurrence suggests that, at least when a society has no option but to make an institutional choice that will produce different patterns of distribution of communications capability, important First Amendment values weigh in favor of a system that more broadly distributes "access to a multiplicity of information sources." [FN304] Given the analysis in Part VII of the information flow implications of distributed infrastructure organization, this

Part suggests that there are good reasons to endorse unlicensed wireless operations when these effects are considered in light of our democratic values. Broader distribution of the capacity to produce and control the knowledge *377 environment helps to maintain both robust political debate [FN305] and individual autonomy. [FN306]

The analysis progresses in two stages. First, I suggest why institutional choices regulating a communications technology can affect information flow patterns in a society in politically significant ways. Second, I suggest how the information flow patterns likely to develop, given the choice between licensed and unlicensed operations, are likely to effect the values of robust public discourse and personal autonomy.

*378 *B. Communications Technology, Institutional Choices and Organizational Structure*

Different communications technologies, arising at different times and subject to different institutional developmental paths, organizational structures, and social patterns of use, have very different effects on the distribution of social control over information and knowledge in the societies that adopt them. [FN307] Perhaps the starkest example we have of this phenomenon can be seen in the effect of print on the Reformation and, eventually, on the rise of liberal philosophy and democratic institutions. Nailing religious disputations to the doors of a church was not an uncommon practice in late medieval and early Renaissance Europe. But the printing press put over 300,000 copies of Luther's *Ninety-Five Theses* into the hands of sixteenth-century Europeans within three years of its publication in Wittenberg; the printing of both Bibles and indulgences for fifty years before Luther's tracts were published prepared the fertile ground for his attacks on indulgences and his defense of Bible-reading. [FN308]

The relevance of technology arises from a combination of at least three factors. First, the technology itself may have attributes that affect the flow patterns of information in a society that uses it. [FN309] For example, *379 the use of manuscript on parchment codex (a durable storage medium suited to large volumes, but not to smaller, more portable volumes), reproduced by hand copyists, undergirded the resilience of the monastic monopoly over knowledge. [FN310] With the introduction of print, the ease with which large circulation editions of identical books could be manufactured and distributed forever altered the possibility of access to sources of study and to competing perceptions of the world. [FN311] Combined with the introduction of paper to replace parchment, print made books ubiquitous. The increased access to books made the expansion of literacy possible, and with it a decline in the monopolistic control over interpretation of the world. [FN312]

The second factor involves the institutional treatment of a technology. Analysis of the first factor suggested that wide availability of inexpensive books was the catalyst for literacy and its attendant broad distribution of access to information. Institutional factors, however, can counteract, enhance, or give direction to the technological effect. The first books to expand readership in Europe from learned classes to what would become the middle class were vernacular Bibles. [FN313] Catholic *380 countries prohibited vernacular Bible-reading, but Protestant countries strongly supported--and in some cases mandated--it, affecting the pattern and timing of literacy expansion in Europe. [FN314] What is important for our purposes are not the direct effects of censorship and sponsorship, i.e., whether vernacular Bibles were or were not read. What is important is that institutional insistence on reading vernacular Bibles moved populations to become literate in their vernaculars. [FN315] Once literate, their capacity to access information was not limited to Bible-reading. Literacy created expanding markets for printers. Printers could produce and sell more if they expanded the range of products they manufactured, [FN316] and increasingly they turned out the secular, free-thinking, and hedonist literature that attracted prohibition from Rome. These unintended consequences changed the universe of perceptions of the world available to these "new" readers in a manner unimagined by either the Counsel of Trent or the theologians and monarchs who supported vernacular Bible-reading. [FN317]

The third factor relates to the way that organizations structure their information collection, processing, and communications in relation to technology. One of the clearest instances of self-conscious organizational determination to track a technology into one, rather than another, communications model is AT&T's choice to use telephone technology solely to provide point-to-point switched communications rather than developing it as a

broadcast medium as well. Early in the development of telephony, wireline broadcast to the home was considered an important application of the technology. [FN318] But AT&T chose to focus on providing a point-to-point communications network. There are several circumstances that may have influenced AT&T's organizational decisions to track telephone technology in the United States toward point-to-point communications, rather than broadcast: [FN319] *381 AT&T's business model was oriented towards telephony as an improvement of telegraphy; [FN320] the cost of providing high-fidelity entertainment services may have been too high to be supported by the low penetration rates of telephone at the end of the nineteenth century; [FN321] or AT&T may have perceived its relative advantage over new entrants to be in switching and long-distance amplification technology. [FN322] This organizational choice responded to, and was reinforced by, institutional decisions. Initially, the telephone company was treated by some legal decisions as a form of telegraph. [FN323] Later, as the telephone system evolved, it was subjected to regulation that solidified its monopoly in the point-to-point switched model while constraining it to operate within that model. [FN324]

A more subtle example exists at the end of the period of printing press dominance, and concerns the shift to modern printing press technology that gave birth to the organizational structure of the mass-mediated environment in which we live today. Newspapers in the eighteenth century were produced by hand presses, in small circulation editions, distributed over short distances. [FN325] Many of the papers were subsidized by political parties, [FN326] often through grants of postal monopoly positions, [FN327] and their primary role was to serve as a medium for political commentary and debate. [FN328] With the introduction between 1839 and 1886 of the electric press, rotary printing, wood pulp paper, the curved stereotype plate, paper folding machines, the high speed printing *382 and folding press, half-tone engraving, the linotype, and distribution by rail, [FN329] newspapers shifted from a narrowcast medium (one-to-few with higher feedback capabilities) to a broadcast medium (one-to-many with low feedback capabilities).

The production capabilities made mass-circulation and illustrated papers possible. The capital costs associated with this machinery made mass-circulation, advertiser-supported newspapers and magazines a robust organizational method of exploiting the potential created by the technology. [FN330] In order to create and sustain this mass circulation, prices per copy were dropped, the newspapers and magazines themselves became the subject of advertising, as well as its medium, and the content of the publications that now surrounded the advertisements changed. [FN331] The genres of pulp fiction, sensationalism, muckracking, graphic illustration, and comic strips developed to provide a sufficiently broad appeal to the diverse audience necessary to sustain mass production costs through advertising fees. [FN332] The most important shift, however, was achieved in combination with another crucial communications development--the telegraph. The daily paper came to rely on that most universal of contents to sell its advertising--fresh factual reportage, or news. [FN333] Facts (unlike commentary and analysis) require relatively little shared background among readers, and can be produced anew every day. To cope with the costs of news production, newspapers developed news agencies like the Associated Press; [FN334] these organizations flattened and homogenized news. These organizational changes invited new institutional choices, sometimes supporting concentration, [FN335] sometimes working to counteract it. [FN336]

*383 The newspaper had shifted over the nineteenth century from a medium of political debate into a medium of commercial advertising. The representations of the world carried in newspapers shifted from commentary and opinion to fresh facts and sensational reporting. [FN337] The information environment in which these papers continuously comprised a component of central importance shifted, from one where points of view and positions expressed on the basis of assumptions about values shared by readers took center stage, to one in which commentary is secondary to the presentation of factual, and thus value-neutral or apolitical, perceptions of the world. The focus on factual reportage provides a "thin" reflection of the tastes of a broad readership, rather than a "thick" expression of the positions of authors and a small readership with shared social or political values.

The examples illustrate that the three factors--technology, institutional framework, and organizational structure--are not independent of each other, and are historically contingent, rather than technologically determined. The historical context in which a technology is introduced affects both the institutional treatment of that technology in a given society and the organizational structure through which the technology is deployed. Each vector--the institutional and the organizational--has a feedback effect on the other, and together they affect

the continued development path of the technological parameters of communication. Different societies introducing similar technologies at different points in their institutional and organizational histories experience the technological shift differently, in terms of its effects on how the knowledge environment of that society is produced, controlled, and used.

C. From Recognizing the Importance of Communications to Institutional Design of the Digitally Networked Environment

The approval of unlicensed wireless operations currently provides the sole institutional avenue for the creation of an unowned, fully distributed component in our communications infrastructure. For this reason, the debate over unlicensed wireless devices is crucial to the future development of our information environment. Contemporary discussions usually identify five facilities for connecting individuals to ***384** public networks. Each of these facilities has its own historically contingent legal basis and incumbent physical facility with which to develop its infrastructure. These facilities are:

(1) Wires, historically copper "twisted pair," strung over telephone companies' rights of way; [FN338] (2) Wires, historically coaxial cable, strung over cable companies' rights of way; (3) Wires, including already installed electric wiring, strung over electric utilities' rights of way; (4) Land-based wireless transmission, including one-way-- television, traditional radio, MDS (wireless cable); and two-way-- cellular, PCS; and; (5) Space-based wireless transmission, including one-way models like direct broadcast satellite, and two-way facilities like Low Earth Orbit ("LEO") satellites and Mobile Satellite Systems ("MSS"). All five of these facilities are privately-owned. In each, the owner determines the best use of the infrastructure, under the same assumptions discussed in Parts VI and VII. This model is derived from the federal government's decision not to invest in building public infrastructure, but instead to rely on private initiative to lay wires or optical fibers and upgrade the switches, or deploy satellites, transmitters, and antennas. [FN339] As a consequence, the infrastructure will be privately owned.

For the reasons expressed in Part VII.A., owned infrastructure will tend to be used by, and for the highest valued use of, those users whose preferences cluster around the peak of the normal distribution curve of individual communicative preferences as perceived by the owner of the infrastructure. The primary force counteracting this dynamic is the historically-contingent inertial force of the common carrier model that has to date dominated one of the most important channels to the digitally networked environment--telephone lines. In the process of effecting ***385** a transition to a more competitive market in telephony, [FN340] the Telecommunications Act of 1996 instituted a presumption (albeit with little institutional detail) that all communications services that facilitate communications of the end-user's choosing will operate as common carriage. [FN341]

There are three reasons why common carriage does not completely negate the phenomenon of information-environment centralization. First, the carrier still defines the range of services or communicative uses available through its service. Common carriage assures that all comers will be able to use this menu, not that they will be able to control the menu of options itself. Accordingly, it does not reverse the incentives for preference articulation discussed in Parts VII.A-B. Second, given a choice between operating as a contract carrier or a common carrier using similar facilities, organizations have an incentive to act as contract carriers in order to "cherry-pick". Given that the Act imposes carriage obligations only on services that a carrier offers that do not affect the content of messages, [FN342] organizations have good reasons to structure their services primarily around components that affect the intelligence carried, and thus to retain more control over the communications carried and their pricing. The model of the open video system, offered as a hybrid common carriage/proprietary video delivery system in the 1996 Act, [FN343] is an excellent example of the direction in which these institutions might evolve, with large portions of the networks devoted to owner-controlled content subject to more discriminating pricing, rather than to end-user-generated content. Finally, privately-owned infrastructure relates as a bottleneck or essential facility to services or communications that rely on it for carriage, and suffers from an endemic need for regulation against anti-competitive abuses. Enforcement shortfalls would lead to centralization of control over information content flowing on the infrastructure, even assuming that an otherwise-efficient market in information uses would not lead to such centralization in a common carriage model.

The only available path to develop a significant component of unowned infrastructure under present technological and organizational conditions is to permit extensive deployment of unlicensed wireless *386 devices. Because such devices require neither wires nor privately-owned spectrum allocations, there is no large initial investment to be made, and thus no single entity with investment-backed claims can demand centralized control. Moreover, since the network is coordinated in a distributed, rather than centralized, fashion, there is no organizational need for an owner to manage or monitor the flow of communications in the network. Thus, while unlicensed operations *can* be organized on an owned-infrastructure basis, as in the case of Metricom, [FN344] they *need* not be. The network can be deployed piecemeal, through the additions of individual network users or small network groups, organized through private enterprise or public/community organizations and working independently of each other.

Unlicensed wireless devices can offer a portion of the infrastructure to users who cannot otherwise gain effective access to the communicative environment. It can be the infrastructure of first resort for those who cannot pay for information on a continuous basis, similar to over-the-air television today. Unlike television, unlicensed devices will allow those who rely on them to be producers of information and knowledge, and not solely consumers. Unlicensed devices also offer an infrastructure of last resort for those who are refused the facilities of owned infrastructure because their views are unorthodox or offensive, or because the information they offer is valuable only to a market segment too small for infrastructure owners to consider worthwhile.

D. Implications for Personal Autonomy and Political Discourse

To be able to choose the path of one's life, one must be able to perceive the world, form a belief about the present state of the world and alternative possible states, and develop a preference ordering of possible states of the world among which one can then choose. The capacity to acquire information about the world, to determine for oneself what information is credible and what is relevant, to access information with which to make that judgment, and to apply the conceptual structures necessary for selecting and processing the information into an intelligible personal conception of the world as it is and as it might be, is therefore central to the capacity of an individual to be a source of commands concerning his or her way in the world. Furthermore, we do not live alone. To live one's life according to one's own decisions, one must be able to communicate his or her conception of the preferred state of the world, and must have the facility to persuade others of the validity of *387 that preference and the course of conduct leading to it, so as to seek their cooperation in permitting or aiding the execution of the individual's choice. Similarly, one must have the capacity to reject the persuasive communications of others when acquiescing in their preferences would quash one's own will. The capacity to communicate or not as one wills, to choose one's mode of expression and one's audience, are therefore germane to a person's ability to effectuate his or her life plan.

An individual's communicative environment is the sum of communicative inputs and outputs with which an individual comprehends the world, chooses a course of action, and coordinates behavior in society. A system that gives individuals the power to make more of the decisions that make up their communicative environment offers them more control over the important decisions in their lives. As more of the decisions that define a person's practically-useful choice set in a given set of circumstances are controlled by the individual, a greater proportion of the determinants of the individual's action in those circumstances is self-generated. The individual is more self-governing.

A similar dynamic operates at the level of community self-governance. No less than individuals, the degree to which political communities are self-governing is affected by the extent that the views of more of their constituents, and others as well, are available to the body politic for consideration. The recognition of the importance of open information flows and robust confrontation of views to political self-governance has been a recurring theme in First Amendment decisions and commentary. [FN345] Privately-owned infrastructure operating in a broadcast model has tended to homogenize and standardize information content for mass appeal, and has thereby acted to smooth out differences of opinion, impoverish the competition of ideas, and, ultimately, make public debate thinner and less productive. [FN346] Part VII.A. offered an institutional economic explanation for this phenomenon. Its conclusions indicate that an institutional framework *388 that relies on

symmetric, as opposed to asymmetric, constraints on how individuals can use the communications facilities of an infrastructure will tend to produce a more diverse range of communicative uses. This diversity of use, in turn,

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munications were generally recognized. The possibilities for entertainment broadcasting, however, were only dimly appreciated.

Young was aware of the importance of timing in the exploitation of a new invention.

> Fifteen years [he has declared] is about the average period of probation, and during that time the inventor, the promoter and the investor, who see a great future for the invention, generally lose their shirts. Public demand even for a great invention is always slow in developing. That is why the wise capitalist keeps out of exploiting new inventions.[37]

By 1919, many people were convinced that there were substantial business opportunities in international radio communications. The problem that confronted GE was how to enter the industry. The Marconi companies had emerged from the war with their international monopoly stronger than ever and with no important competitor in ship-to-shore communications. During the war the American subsidiary had erected a very powerful modern transmitting station at New Brunswick and had built an important radio manufacturing plant at Aldene, New Jersey. Though Marconi's patent position was less strong than it had been, the Fleming patent was still basic to the vacuum-tube art. Moreover, the Telephone company controlled the all-important de Forest patents on the triode and feedback circuits. And in the high-vacuum case, General Electric had not succeeded, as it hoped, in obtaining undisputed control of the field. The Arnold-Langmuir litigation was to last for years and to result finally in a Supreme Court decision that there had been no invention. This, of course, could not have been predicted, but GE knew that the Telephone company was determined to fight the case vigorously with the support of some of the leading physicists of the day.

To buy out the Marconi interest and create a unified American wireless company which would bring together all the major conflicting interests called for diplomatic strategy of a high order. Young believed that the directors of British Marconi could be persuaded to sell their American subsidiary to General Electric, because of the intense opposition of United States government officials toward British domination of American wireless. His-

[37] Archer, *History of Radio*, *op. cit.*, p. 94.

torically, this feeling dated from the early rental policy of the Marconi company. The American Navy, which was the largest customer for wireless equipment, had objected strenuously to the company's refusal to sell any of the apparatus on which it had patent control. The antipathy toward British control of wireless was greatly increased in 1914 when the English cut the cables linking America with Germany. During the war, in an effort to defeat various congressional bills for government ownership of wireless, the American Marconi company attempted to promote the idea that a substantial proportion of its stock was in American hands. Although these particular bills were not passed, the company's efforts to prove itself free of foreign control were unsuccessful. The United States Shipping Board, early in 1919, refused to allow American Marconi to equip shipping board vessels unless the company could furnish an affidavit showing that over 50 per cent of its stock was owned by American citizens. This the company could not do.[38] After the war, a new wave of proposed legislation, giving the government various degrees of peacetime control of wireless, further jeopardized the future of American Marconi.

In Washington, Franklin Roosevelt, as Assistant Secretary of the Navy, and other Navy officials in the communications field were strongly in favor of establishing an "All-American" company.[39] Secretary of the Navy, Josephus Daniels, preferred government ownership of overseas communications service; but his influence was not great enough to obtain legislation to this effect.

Stimulated by the Navy, Young persuaded the directors of the General Electric Company to purchase a controlling interest in American Marconi. The British finally agreed to terms; the Radio Corporation of America was formed; and the assets of the Ameri-

[38] Testimony of Lewis MacConnach, F.T.C. *Hearings*, *op. cit.*, p. 885.

[39] Mr. Young has commented on the part that particular officers in the Navy played in the formation of RCA as follows: ". . . The facts are that the initiative which brought into being our American radio policy and resulted in preventing us from being outdistanced by other nations started with Hooper. It was he who spurred on Admiral Bullard in his negotiations with the General Electric Company, and he was always ready to help overcome every kind of difficulty. I don't want to detract in any way from the able work of Admiral Bullard; Commander Hooper could not have accomplished what he did without the Admiral's assistance. The original thought, the initiative and the persistent pushing were Hooper's, and he should have full credit for them." Clark, *op. cit.*, p. 69.

can Marconi company were transferred to the new corporation. GE contributed something over $3,000,000 to set up the new enterprise.[40]

There was not unanimous enthusiasm for this step in the top management of GE. Mr. E. W. Rice, president of General Electric, with a record of wise selection of new activities in the engineering field, had grave doubts. But Charles A. Coffin, chairman of the board and dominant figure in the company, with a history of successful creative ventures, was stirred by the potentialities of radio. Concerning this difference of opinion between the two chief executives of General Electric, Mr. Young has written:

> Here again one sees that the engineer as distinguished from the inventor may in the field of responsible business be more conservative than the man of business who is less well informed about technical difficulties but who may have a more correct appraisal of the possibilities of a new art.[41]

Of his own feelings, Young has said:

> My interest in promoting the project was twofold—a feeling that I was performing a useful service to the country and to my company in undertaking the task, and a personal interest in radio. This interest was increased later when I learned from engineers of its possibilities for entertainment. I had been brought up on an isolated New York farm and felt very strongly that any service which would bring the outside world to rural communities, especially in the long winter months, was a service well worth performing.[42]

The relative parts played by the government and the General Electric Company in the initiation of what was later termed "the radio trust" were to become the subject of heated controversy[43] when RCA was being attacked in Congress as an unlawful monopoly. There is no doubt, however, that there were many officials in the Navy who favored the formation of a single American company in international wireless communications. The opposition to RCA, which developed in the 1920's, grew out of the animosity arising from its dominant patent position in radio sets

[40] F.T.C., *The Radio Industry*, *op. cit.*, p. 17.
[41] Letter to the author, Oct. 1947.
[42] Interview, Aug. 1944.
[43] See testimony of Oswald F. Schuette, executive secretary of the Radio Protective Association, before the Committee on Interstate Commerce hearings of the U.S. Senate, 71st Congress, 1st sess., on S.6 (Washington, Supt. Docs., 1930), p. 12.

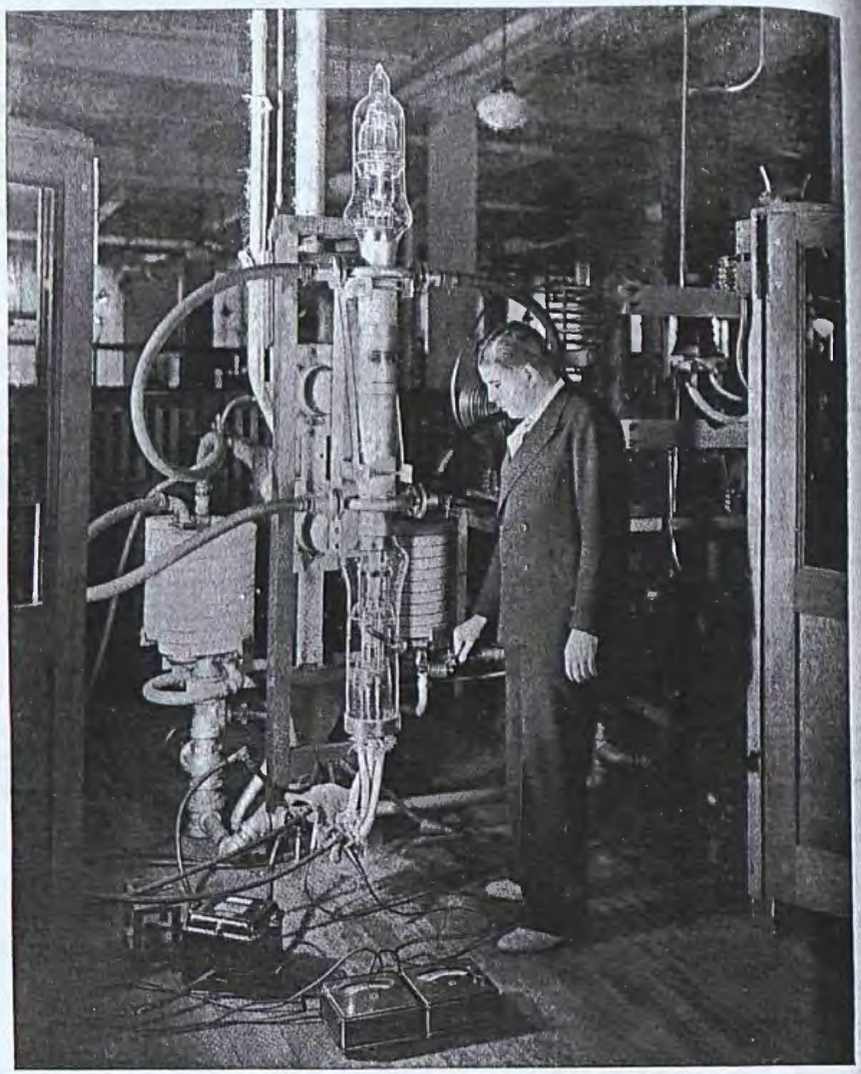
and tubes rather than from its position in international communications.

Young was made chairman of the board of RCA, and Edwin J. Nally and David Sarnoff of the old American Marconi company were appointed president and commercial manager respectively. It was planned from the outset that the Radio Corporation of America would not manufacture radio sets and tubes; these would be supplied by the General Electric Company and sold through RCA.[44]

The newly formed company was immediately faced with a difficult patent situation and some agreement between the principal patent holders was *essential*. The Navy, in a patent investigation in 1919, had "found that there was not a single company among those making radio sets for the Navy which possessed basic patents sufficient to enable them to supply, without infringement, . . . a complete transmitter or receiver." [45]

Young was anxious to create an industry in which competition would be "orderly and stabilized." This, he believed, could best be accomplished through an accord with the Telephone company which was the other principal patent-holding concern. Since the Telephone company proved equally interested in reaching a satisfactory solution, a cross-licensing agreement was signed on July 1, 1920;[46] and the Telephone company purchased 500,000 shares each of RCA common and preferred stock for $2,500,000.[47] All current and future radio patents of the two companies were to be available to each other, royalty free, for ten years. AT&T was given exclusive licenses in wire telegraphy and telephony and certain rights to radio telephony in conjunction with the telephone network. In its turn GE was granted wireless telegraphy and, rather secondarily, "an exclusive license to make, use, lease and sell all wireless telephone apparatus for amateur purposes." [48] Many provisions of the agreements, however, were ambiguous, leading to subsequent disputes among RCA's partners.

[44] GE was to sell to RCA for cost, plus 20 per cent, or a negotiated price. License agreement, GE–RCA, Art. IV, par. 3.
[45] Memorandum of Commander Loftin as quoted in Clark, *op. cit.*, p. 82.
[46] The Navy, through Commander Hooper, again helped in the negotiations.
[47] F.T.C., *The Radio Industry*, Exhibit Q, p. 21.
[48] License agreement, GE and AT&T, July 1, 1920, Art. V, par. 4 (d) (3).



250 kw. tube—largest ever made in the United States—developed by the Bell Laboratories and manufactured by Western Electric Co. (Courtesy American Telephone & Telegraph Company)

he had lost a skirmish, he had not lost the battle. Westinghouse soon found that it was seriously handicapped in building up an international system of radio communications. RCA had already concluded watertight agreements with the British Marconi company and other foreign groups that made it exceedingly difficult for International Radio to develop a competing system.[52]

Nevertheless, Westinghouse was now in a strong bargaining position on patents, and Owen Young was anxious to have it join RCA. His strategy was to avoid cut-throat competition. Negotiations were initiated and a settlement was reached whereby rights under the patents of International Radio were granted to the Radio Corporation, and Westinghouse joined the "radio group" on June 30, 1921. Thereafter, RCA was to purchase 40 per cent of its radio apparatus from Westinghouse and 60 per cent from General Electric.

As a result of these and other agreements,[53] RCA obtained rights to over 2,000 issued patents,[54] including practically all the patents of importance in the radio science of that day.

RCA's most important agreements in the international sphere were with the British Marconi company, the Compagnie Générale de Télégraphie sans Fil, and the Telefunken Corporation. These three companies were the dominant concerns in radio communications in their respective countries. The agreements entered into in 1919 were to run until January 1, 1945. Each corporation was to have the *exclusive* right to the use of the other company's patents within its respective territories, as well as for "mutual traffic arrangements wherever possible throughout the world." [55] Thus was organized the first international radio cartel.[56]

[52] Archer, *History of Radio*, *op. cit.*, p. 196.

[53] The United Fruit Company and Wireless Specialty Apparatus were also brought into the cross-licensing arrangements.

[54] F.T.C., *The Radio Industry*, *op. cit.*, p. 3.

[55] Exhibit DD, Traffic Agreement, Radio Corporation of America and Marconi's Wireless Telegraph Company, Ltd., F.T.C., *The Radio Industry*, *op. cit.*, p. 239.

[56] *Ibid.*, pp. 51–59. Later in 1925 an agreement was reached with the Philips company in Holland in which RCA obtained exclusive rights under Philips company patents in the United States and Canada, and Philips obtained exclusive patent rights from RCA in Holland, Czechoslovakia, Denmark, Esthonia, Finland, Latvia, Lithuania, Norway, Sweden and Switzerland, together with their respective colonies and dependencies.

The position of RCA in 1923 was described by the Federal Trade Commission in the following terms: ". . . the Radio Corporation has acquired all the high-power stations in this country with the exception of those owned by the government, and it has practically no competition in the radio communication field." [57] Had radio continued to be confined primarily to international communications, the plan might have worked smoothly. The growth of entertainment broadcasting, however, radically altered the nature of the industry. In the competitive scramble that resulted, the operating arrangements under which GE and Westinghouse did the manufacturing and RCA the selling, proved too cumbersome. Mr. Young's genius lay in the formulation of policy rather than in operational detail, which he delegated largely to

TABLE IV: RADIO CORPORATION OF AMERICA—SALES, LICENSE, AND TRAFFIC AGREEMENTS
1919–1923

Party	*Scope*	*Date*	*Termination* *
General Electric Co.	Cross-licensing	1919	1945
British Marconi	Traffic and cross-licensing	1919	1945
Extension of GE–AT&T agreement	Cross-licensing	1920	1930
Imperial Japanese Government	Traffic	1920	——
Reichspostministerium	Traffic	1920	1930
Government of Norway (assignment from American Marconi)	Traffic	1920	——
AT&T	Traffic	1920	1930
Elmer T. Cunningham † (Audio Tron Mfg. Co.)	License	1920	90 days
Elmer T. Cunningham	Sales	1920	——
GE & Wireless Specialty Apparatus Co.	Cross-licensing	1921	1945
United Fruit Co.	Cross-licensing	1921	1945

[57] *Ibid.*, p. 52. Competition was to develop later from such firms as Mackay, IT&T. and Federal Telegraph.

TABLE IV (*cont'd*)

Party	*Scope*	*Date*	*Termination* *
The International Radio Telegraph Co.	Sale of I.R.T. Co.	1921	——
GE and Westinghouse	Cross-licensing	1921	1945
Drahtloser Uebersee-Verkehr A.G.	Traffic	1921	1951
Telefunken	License and traffic	1921	1945
Compagnie Générale de Télégraphie sans Fil and Radio France	Traffic	1921	1945
Republic of Poland	Traffic	1921	1951
Compagnie Générale, Brit. Marconi, and Telefunken (South American Consortium)	Traffic and cross-licensing	1921	1945
Federal Telegraph Co. of California	Formation of Federal Telegraph of Delaware	1922	——
Federal Telegraph Co. of California	License to Fed. on heterodyne patents	1922	1930
Postal Telegraph-Cable Co.	Traffic	1922	1927
Kingdom of Sweden	Traffic	1922	1947
Radio Engineering Co. of N.Y. and John Hays Hammond	Cross-license	1923	——
Republic of China (through Federal Telegraph Co. of Delaware)	Traffic and construction	1923	——

* The termination dates given are the dates fixed at the time the agreements were made; in some cases, these dates were subsequently changed. Agreements with parties in enemy countries were terminated by the outbreak of World War II.

† E. T. Cunningham was a tube manufacturer on the Pacific Coast who had developed a substantial tube business. The 90-day license was to allow him to liquidate his stock, with the understanding that he cease manufacturing. He then became a sales agent for RCA tubes. In 1924, RCA purchased a controlling interest in the firm, paying $1,000,000 for "good-will."

Source: Federal Trade Commission, *The Radio Industry, op. cit.*, Exhibits.

regular news bulletins, and Frank Conrad of the Westinghouse company started nightly broadcasts of news and music for amateurs, the interest aroused exceeded the expectations of almost everybody in the industry.

By the 1920's wireless had become the hobby of thousands of young Americans. No other modern industry has been supported by so many ardent participants. It is hard today to recapture the spirit of this period: amateur clubs were started in every state, comprising all types and classes—schoolboys, professors, electricians and ex-servicemen who had operated radios during the war. Radio was a new toy, not only technically interesting, but the means by which people could reach out into unknown regions and communicate with new-found friends.

In Pittsburgh, H. P. Davis, the driving force in the Westinghouse management of the period, was one of the first to capitalize on the imaginative possibilities of radio broadcasting. At the conclusion of the war a Westinghouse engineer, Frank Conrad, reopened the amateur wireless telegraph station which he had built in 1916. He changed over to radio telephony and transmitted many programs which were picked up by widely scattered radio "hams." So much interest was aroused that Conrad announced a regular two-hour broadcast on Wednesday and Saturday nights. The response of the local amateurs in Pittsburgh was so enthusiastic that a department store, the Joseph Horne Company, bought a supply of crystal sets and advertised their sale to the "amateur" public at "$10.00 up." The sets were sold in a few weeks and more were ordered. Observing this response, Vice-President Davis became convinced that regular broadcasting would offer a new and extremely effective method of spreading information and entertainment, and that Conrad's station should be made a regular operating division of the company. Various members of the Westinghouse management set to work immediately to plan what should be done. It was decided to develop, make and sell radio transmitting and receiving equipment—the receivers to be so simple that they could be operated by any housewife.

Westinghouse Station KDKA was officially opened on November 2, 1920. Its initial broadcast of the Harding-Cox election created a sensation.

From then on, radio broadcasting showed a spectacular mushroom growth. Some of the new wireless manufacturing companies which had supplied military equipment started to produce "amateur" sets; and newspapers, department stores, educational institutions, churches and other groups opened their own broadcasting stations.[3] At the end of 1922 there were 30 licensed broadcasting stations in the United States; by 1924, over 500.[4]

Many rushed to establish broadcasting stations because of the widespread belief that the early comers would pre-empt the best positions in the wave spectrum. And when in 1924 Secretary Hoover decided to prevent further overcrowding by refusing to issue new licenses, the established stations did have a definite advantage. The only recourse for a group wishing to broadcast was to buy a station that already possessed a license. Many stations were sold in this way, in some cases at a substantial profit; but most of the early starters met with failure.

Broadcasting grew so rapidly and so unexpectedly that it created many unanticipated problems. The officers of the Telephone company decided that, since broadcasting for entertainment was closely related to radio telephony, they had an important stake in its development.[5] Under the GE cross-licensing agreements, AT&T contended that it had received the exclusive rights to manufacture radio-telephone transmitting equipment.[6] After some internal debating, the Telephone executives decided that this clause covered broadcasting equipment, and that all broadcasting stations should be required to take out licenses under the company's patents.

A royalty rate was fixed at $4.00 per watt of power, with a minimum fee of $500 and a maximum of $3,000.[7] And beginning in 1923 the Telephone company started a campaign to force all

[3] Archer, *History of Radio to 1926, op. cit.*, p. 241.

[4] *Broadcasting Yearbook*, 1946, p. 19.

[5] For an interesting account of the Telephone company's early part in broadcasting and the beginning of network broadcasting, see Banning, *op. cit.*

[6] License agreement, GE–AT&T, Art. V, par. 4, cl. 2, reads: "For the protection of the Telephone company under the licenses herein below granted to it, it is agreed that the General Company has no license to equip wireless telephone receiving apparatus sold under this paragraph with transmitting apparatus, or to sell, lease or otherwise dispose of transmitting apparatus for use in connection with receiving apparatus sold under this paragraph."

[7] F.C.C. *Proposed Report*, p. 459.

munications. Entertainment broadcasting was not then envisaged as an important business. After the war, GE and Westinghouse began to make receiving sets for sale to the general public, but they were not prepared for the tremendous interest aroused and were therefore not able to keep up with the demand for sets. By 1924, there were 300 companies manufacturing radio sets. Many of these were fly-by-night concerns having no patent rights; others were reputable companies which believed they had certain rights. Although the RCA partners controlled the major patents on vacuum-tube sets, it would obviously not have been possible, had they wished to do so, to force all competitive companies out of business. GE, Westinghouse and RCA did succeed, after a lengthy struggle in the 1920's, in substantially reducing the number of manufacturers during these years and requiring those remaining in business to take a license from them. How this was accomplished is an interesting story of the use of patents to dominate an industry.[20]

The majority of the new radio companies started with the production of crystal sets. Such sets were simple to produce and could be manufactured with a small capital investment. Moreover, patents did not represent any serious obstacle.

The first crystal detector had been designed in 1906 by H. H. Dunwoody of the De Forest Wireless Company.[21] It consisted of a crystal of carborundum clamped between two electrodes. About this same time another American inventor, G. W. Pickard, patented a detector of silicon in which a wire was suspended above the crystal and kept in light contact with it. To tune in on different stations the wire could be moved by turning a knob to which it was attached. The patents on the particular crystal combinations of Dunwoody and Pickard found their way into the RCA patent group; but because of the variety of other substances that could be used, the crystal-set manufacturers were not afraid of infringing RCA's patent position.

The Garod Company, one of the first to manufacture these

[20] The relaxation of license control will be described in the next chapter.

[21] Dunwoody had been formerly with the United States Signal Corps and at the time was a vice-president of the De Forest company. His invention was stimulated by the injunction obtained by NESCO against the de Forest electrolytic detector.

crystal sets, may be cited as an illustration. It was started in 1922 by two partners, Gardiner and Rodman. Gardiner had been in the jewelry business; and Rodman was an electrical engineer who had worked with Edison. Under the name "Heliphone" they marketed a small crystal set which was cleverly designed. The set contained two small, compact coils; the tuning was accomplished by sliding one coil over the other. The "cabinet" was a flat wooden box which could be slipped into a coat pocket; it retailed as a novelty for $5.00 and sold very well.[22]

Radio manufacturers soon realized, however, that the future lay in vacuum-tube sets.[23] And here, patent rights proved exceedingly important. The RCA group succeeded in obtaining a key position on all major aspects of the vacuum-tube set—the circuit design, the tube itself, loud speakers and other parts.

The concerns which were later to become household names in radio—Philco, Zenith, Emerson, etc.—did not manufacture the principal parts of the radio sets bearing their brand name. They bought these from outside suppliers and assembled them into a finished product. The only significant patentable item in this process was the design of the circuit connecting the vacuum tubes to the other parts of the set.

In the early stages of vacuum-tube reception, radio engineers had to solve two major circuit problems. The first was to increase the sensitivity of reception through the circuit itself; the second was to prevent continuous oscillation in the circuit, which produced loud squealing noises. A considerable number of inventors worked on these two problems; and the patents on the solutions they offered became the subject of bitter and extensive litigation.

The most important of these circuit designs were the feedback circuit, the neutrodyne circuit, and the superheterodyne circuit.

(a) THE FEEDBACK CIRCUIT

There were four inventors—Armstrong, de Forest, and Langmuir in the United States, and Meissner in Germany[24]—who inde-

[22] *The Radio Industry* (New York, Cornell, Linder and Co., mimeographed, 1928), p. 72.

[23] One of the major weaknesses of crystal detectors was that they had no power of amplification.

[24] This resulted in a four-party interference proceeding in the United States. Round and Franklin in England were also working on this type of circuit.

In the beginning, Montgomery Ward paid this (Davenport, Iowa) office direct for sets manufactured by Briggs and Stratton. They sent down thousands of dollars for sets that had been shipped. They followed that up with hundreds of dollars of credit, red slips for sets that had been refused and sent back, and in about three weeks I was in a maze that no one in the world could ever have crawled out of. I went to Chicago and saw the vice-president and told him it was absolutely imperative to make some other arrangements for payment as I was lost entirely, and we did make arrangements for Montgomery Ward to relieve me of the bookkeeping and send such payments as were due the factory on our order direct to them with the statement and such payments as were due me direct. . . .

I didn't know how to keep a book. I never was a bookkeeper.[41]

In the suit, Westinghouse contended that selling to distributors and jobbers could not be construed as selling to "amateurs," and that a sub-contracting arrangement such as that with Briggs and Stratton was illegal, even though, as was the case, royalties were paid to Westinghouse *on all sets sold*. Tri-City replied that it had been customary to sell to distributors and jobbers since the licenses were first taken out, that Major Armstrong had encouraged this in order to increase the royalty receipts,[42] and that sub-contracting of manufacturing was a general practice in the industry. Both the District Court and the Circuit Court of Appeals upheld Tri-City's rights to sell to distributors and jobbers on the grounds that the original licensor, Armstrong, had in fact encouraged the licensees to sell sets widely to the public and that the Westinghouse company had not even admonished the licensees for their practices from the time the patents were purchased in 1920 until suit was brought in 1923.[43] On the other hand, the court held that the sub-contracting arrangements were beyond the scope of the license agreement.

[41] *Ibid.*, p. 125.

[42] See testimony of Alfred P. Morgan of Adams-Morgan Co., U.S. Circuit Court, *op. cit.*, p. 255. According to Morgan's testimony, his company's arrangements were as follows: "When we sold a set at retail, we were to receive 5 per cent of the retail price and when we sold a set at wholesale, it was to be 5 per cent of the wholesale price." Apparently, at least in the case of this contract, it was clear to both parties from the beginning that as long as the sets were to be sold ultimately to the general public, sales to wholesalers were considered sales to amateurs. *Ibid.*, p. 256.

[43] See oral opinion of the Court. *Ibid.*, pp. 450–451.

When the District Court decision was rendered, however, RCA was ready to release the superheterodyne receiver which eliminated one of the most unsatisfactory features of the feedback circuit—the occasional loud squeals caused by interference from other sets in the neighborhood. It was expected, therefore, that the competition from the Armstrong licensees would be much less significant in the future. In the meantime, a new threat to RCA had developed from a group of radio set manufacturers who believed that they had found a way to circumvent RCA's patent position through the use of the Hazeltine neutrodyne circuit.

(c) THE NEUTRODYNE CIRCUIT

The neutrodyne was the invention of Professor L. A. Hazeltine of Stevens Institute of Technology. A professor of electrical engineering who had become interested in radio problems, he was retained by the Navy as a consultant to develop wireless equipment during the war. He designed for the Navy a new type of vacuum-tube receiver (SE 1420) which was an advance over existing circuit designs.

This receiver was so successful that it appeared to have significant peacetime applications. Hazeltine's patent attorneys were Pennie, Davis, Marvin and Edmonds, who also represented Edwin Armstrong. In addition, this important patent firm was counsel for a group of small radio concerns making crystal sets. Recognizing that the vacuum tube was going to displace the crystal set very shortly, these companies had formed the "Independent Radio Manufacturers, Inc.," to consider ways in which they might get around the apparently iron-clad patent position of the RCA group. They were primarily interested in circuit patents for *tube sets*, since the advent of the feedback receiver had by 1922 brought the business of the crystal manufacturers practically to a standstill.[44]

Willis H. Taylor, Jr., of Pennie, Davis suggested that the Independents might find a solution of their problem through Hazeltine's work. Following this lead, three of the Independents—F. A. D. Andrea (Fada), Freed-Eisemann, and Garod—asked

[44] See testimony of Walter Russ, Independent Radio Manufacturers, Inc. *vs.* Freed-Eisemann, U.S.D.C., E.D.N.Y., Equity 1485.

RCA believed that the De Forest Company was selling these tubes to others beside amateurs, and asked the company to obtain from purchasers an agreement that the apparatus would not be used for commercial radio communication. When the De Forest management refused, RCA brought suit.

In awarding the decision to the De Forest Company, Vice-Chancellor Lewis stated:

> The clear purpose of the provision and the agreement of March 16, 1917, requiring the De Forest Company to obtain from purchasers of this apparatus an agreement that the apparatus should not be used in the transmission or reception of messages for pay, or by others than the original purchasers or for purposes other than radio communication, was to protect the exclusive right of the American Telephone and Telegraph Company in the field of transmission and reception of messages either by wire or radio for pay. The complainant, the Radio Corporation, is not entitled to enforce the covenant for the purpose of protecting the "pay" field. . . .
>
> To compel the De Forest Company to obey the strict letter of the covenant would, in effect, prevent it from doing business at a profit. It would make the investment of the De Forest Company worthless.
>
> And to go back to the first proposition, the covenant will have to be used for a purpose not contemplated by it. It will have to be used to reduce competition in the "amateur" field, whereas the purpose was to prevent competition in the "pay" field.[51]

This decision, however, did not save the De Forest company, which went into bankruptcy in 1926.[52] The receiver in bankruptcy then sued RCA for violating the Clayton Act through a clause in its license contract requiring all set licensees to buy tubes for initial installation from the Radio Corporation. He claimed, further, that the apparatus covered by RCA patents was so extensive that the license agreements prevented the sale of tubes for many other purposes besides radio. Both the district and the circuit courts sustained the claim.[53] As a result of the loss of

[51] Quoted from the testimony of William Priess, F.T.C. *Hearings*, p. 3008 *et seq.*

[52] The receivership was ended shortly, when other interests acquired the company. Later in 1933 RCA purchased its assets for $400,000.

[53] Arthur D. Lord *et al. vs.* Radio Corporation of America *et al.*, 24 F. (2d) 565.

this case, damage suits totalling $47,000,000[54] were filed against GE, Westinghouse and RCA. In settlement, $1,000,000 was paid to the De Forest company in 1931, and smaller amounts to other companies.

After this adverse decision, RCA started to offer licenses for the manufacture of tubes. A considerable number of tube companies besides De Forest had entered the industry after the Fleming patent expired. By 1928 the original patents on the de Forest triode had also expired, and the General Electric and Telephone company patents on high-vacuum had been declared invalid by the district court (1928).[55] But the Telephone company, GE and Westinghouse were the leading centers of research on the vacuum tube, and new types were being developed steadily. The tube companies, of which there were fourteen at this time, therefore decided to take out licenses from RCA. They were primarily small concerns, and only Raytheon had any patent position of its own.

The story of loud speakers was similar. A number of small manufacturers entered the industry in the early 1920's. None of these companies conducted research, and the speakers which they produced were based on a prior art on which the patents had expired. In 1925, however, the General Electric Company brought out a new type of cone loud speaker based on research done by Rice and Kellogg of the Schenectady Laboratories. This represented a very substantial improvement. The seven principal loudspeaker companies therefore applied for licenses from RCA, and these were granted.

By 1928, the RCA group had thus established a strong patent position in all the major branches of the radio industry, and an RCA license was considered essential for the manufacture of any up-to-date set or modern vacuum tube. No one was to challenge this for many years to come.

[54] An amount of $30,000,000 of this was asked in a triple damages suit under the Clayton Act, filed by Grigsby-Grunow in 1930. *Electronics*, July, 1930, p. 163.

[55] This decision was subsequently affirmed by the Supreme Court (1931).

Chapter VII: THE PERENNIAL GALE OF COMPETITION: 1928–1941[1]

The engineer was too often at the mercy of the whims and profit considerations of the management and the opinionated instructions of the sales department. . . . There was no great urgency and little encouragement for radical technical innovations.

—BENJAMIN ABRAMS of Emerson Radio.

WE ARE all painfully aware of the waves of business optimism and pessimism that sweep across the country in periods of prosperity and depression. The ebullient optimism of the 1920's in this country was nowhere more noticeable than in the burst of activity in the radio industry. In seeking a basic explanation for such wavelike movements in business, one of our most distinguished modern economists, Professor Schumpeter, has suggested that the clustering of strategic innovations is a major causal factor. Why, he then asks, do innovators appear in clusters?

> If one or a few have advanced with success, many of the difficulties disappear. Others can then follow these pioneers, as they will clearly do under the stimulus of the success now attainable. . . . The pioneers remove the obstacles for the others, not only in the branch in which they first appear but, owing to the nature of these obstacles, *ipso facto* in other branches too.[2]

In the 1920's the organizational innovation of the Radio Corporation of America and the later development of the National Broadcasting Company was followed by a host of imitative

[1] This monograph discusses the process of invention and innovation up to our entry into World War II. I have made occasional references to subsequent developments but have not attempted to analyze the war and postwar periods, as I regard them as a separate story in themselves.

[2] Joseph A. Schumpeter, *Theory of Economic Development* (Cambridge, Harvard University Press, 1934), pp. 228–229.

developments by other concerns. This movement was so overwhelmingly strong that the original conception of GE and Westinghouse of supplying almost all the radio-set demand was impossible of execution. And although in this period RCA succeeded in obtaining an almost complete patent monopoly on all phases of radio broadcast receivers, it was ultimately forced to offer licenses to a large number of applicants. In the 1930's the strenuous competition of these licensees, together with the onset of the depression, forced RCA's profits nearly to the vanishing point.

1. RCA's Licensing Policies

The managements of RCA, General Electric and Westinghouse must have been aware that *unrestricted* licensing would lead to "excessive" competition.[3] The assembling of radio sets involved a relatively small capital investment, and the technological "know-how" of manufacture was not difficult to acquire. Except for patents, the industry was easy to enter and the profit margins of 1924, 1925 and 1926 were sufficiently high to be tempting to new firms. Nevertheless, the officers of RCA were in a difficult dilemma in 1927, when they succeeded through court action in obtaining a dominant patent position in the industry. The radio companies that had become established since the war were clamoring for licenses.

The question of a suitable licensing policy had been under discussion almost from the inception of RCA.[4] One alternative was to offer licenses with restrictions on output and price. The GE-Westinghouse cross-licensing agreements on lamps offered a precedent: General Electric, controlling the principal lamp patents, offered licenses only for certain types of lamps and limited the licensee to a fixed percentage of General Electric sales. Al-

[3] It was, I assume, to avoid such competition that Westinghouse had brought court action to curb the sales activities of the original Armstrong licensees (since the royalties that Westinghouse was receiving from these licensees were substantial).

[4] See letter of Dec. 7, 1921, from David Sarnoff to President Nally, stating that he regarded the formulation of an industry-licensing policy as one of the most important subjects with which RCA had to deal. From then on various committees of the board of directors studied the problem.

TABLE VI: TURNOVER OF RADIO MANUFACTURING ESTABLISHMENTS 1923–1934

	Existing Firms			New Firms		
		Mortality				
Year	*No.*	*No.*	*Per Cent*	*Established*	*Surviving in 1934*	*Per Cent Surviving*
1923	129	56	43.4	185	11	5.950
1924	172	101	58.6	144	1	0.007
1925	215	215	100.0	258	5	0.019
1926	115	261	227.0	161	1	0.006
1927	72	69	96.0	26	0	0.000
1928	70	18	25.7	16	6	37.500
1929	65	31	47.7	26	5	19.200
1930	83	21	25.3	39	5	12.800
1931	82	87	106.0	86	14	16.300
1932	90	45	50.0	53	8	15.100
1933	75	56	74.8	41	19	46.400
1934	110	0	0.0	35	35	100.000
		960		1,070		

Source: Ralph H. Langley, consulting engineer, New York.

though this practice had been challenged by the Department of Justice, it was upheld by the Supreme Court in 1926.[5]

But there were difficulties in adopting a similar licensing policy on radios. Radio sets were not a homogeneous product on which quotas and prices could be established with the same ease as on lamps. Moreover, the RCA management was perhaps afraid that any such plan would not receive as favorable treatment from the courts as the lamp decision. Quota and price control of lamps had been established since 1912; and General Electric owned outright the major patents. RCA's patent position, by contrast, resulted from cross-licensing agreements among General Electric, Westinghouse, the Telephone company and other groups. The important patents were thus contributed by several companies. In addition, the agreements covered future inventions as well as contemporary patents. These arrangements were currently under

[5] "A patentee in granting a license to another to make and sell the patented article may limit the method of sale and the price, provided the conditions of sale are normally and reasonably adapted to secure pecuniary reward for the patentee's monopoly." U. S. *vs.* General Electric Co., 272 U.S. 476.

attack by the Federal Trade Commission, and RCA was threatened with an anti-trust suit as a result of the practices disclosed.[6] In 1926 also, the RCA group had been sued by Fessenden for alleged violation of the Clayton Act in its use of patents originally issued to him, and the companies had deemed it expedient to settle the case out of court through the payment of $500,000 damages.

The policy that the RCA group adopted in 1927 was to offer licenses to "$100,000 customers," but without quota or price agreements. The royalty rate was fixed at 7½ per cent of the net selling price. The first licenses were for tuned radio frequency receivers only, excluding the much more efficient superheterodyne set which RCA had recently developed and which it reserved to itself. However, RCA was selling less than half of the total sets in the country in 1927, and since its relations with its dealers were not very satisfactory, the licensees were able to persuade the majority of the dealers to push tuned radio frequency and not superheterodyne receivers. By 1928, therefore, RCA was forced to change this particular policy; and in a very short time tuned radio frequency sets disappeared from the market.

Nor did the policy of attempting to restrict licenses to "$100,000 customers" last for long. This minimum royalty rate was never actually assessed, but it had the effect of restricting licenses to the larger companies. Almost immediately the smaller concerns responded by political action. A story is told that Senator Jim Reed of Missouri called one day at the office of Mr. Sarnoff, who was then general manager of RCA, and brought with him the president of a Missouri radio company who had been denied a license.

"I am going to sit in this office until my friend here is given a license," Mr. Reed is reported to have said.

Sarnoff arranged an appointment with General Harboard, president of RCA, and a license was granted.

RCA in fact was faced with a number of difficult problems. The desire to maintain a "healthy industry" free from "cut-throat competition" was not confined to RCA; new licensees,

[6] The Federal Trade Commission dismissed the complaint but the anti-trust suit materialized in 1930 and resulted in a consent decree in 1932.

once having obtained a license, wanted other companies kept out. And RCA itself was suffering from internal growing pains. The idea of forming a company which would concentrate entirely on selling, while its two large and somewhat cumbersome partners, GE and Westinghouse, did all the manufacturing, was not working well. The smaller integrated licensees were much more flexible and able to outmaneuver their big rival in bringing out new models and in salesmanship.

The management of RCA finally decided in 1929 to grant licenses freely to all reputable companies. RCA, according to a *Fortune* "guesstimate," had collected nearly $3,000,000 in royalties in 1927 and over $6,000,000 in 1928.[7] Whatever the exact figures, it soon became clear that, through licensing, the company could obtain very substantial revenues from its investment in patents. The royalty rate, however, was regarded by many companies in the industry as too high, and created considerable antagonism. The rate was reduced in 1932 from 7½ per cent to 5 per cent and a license bureau was established to assist the licensees in their technical performance. The minimum royalty was also reduced to $10,000. The number of licensees rose steadily from 25 in 1928 to 55 in 1941.[8]

Even with the liberalization of its policy, RCA's license control of the industry continued to meet opposition. Manufacturers resented paying a substantial fee to a competitor. They claimed, moreover, that RCA was a "patent octopus" and that the license bureau did not provide adequate service in return.

There was, consequently, a constant struggle between RCA and some of its principal licensees over the question of fees. The most drawn-out and bitter of these took place between RCA and Philco and resulted in a lengthy court suit over the method of calculating royalty rates. Philco finally won in 1939.

This case illustrates the difficulties of RCA's licensing policy.

[7] "Blue Chip," *Fortune*, Sept., 1932, pp. 142–146. According to the government brief in the anti-trust suit of 1930, RCA's royalty receipts were $7,000,000 in 1929. U. S. *vs.* Radio Corp. of America *et al.*, U.S.D.C., Dist. Del., Equity 793, *Petition*, p. 11.

[8] In 1947 the number of set licenses had risen to 186. The royalty rate for domestic receivers was reduced to 2¼ per cent in 1939. And in 1946 the minimum royalty provision was removed.

The Philadelphia Storage Battery Company, founded in 1892,[9] began making battery eliminators for the radio industry in 1924. When the a-c tube made it possible to operate a radio directly from an electric light socket, there was no further demand for battery eliminators. Since RCA was restricting the total number of licenses granted in 1927, the only way to enter the industry was to purchase an existing concern that already had a license. This was done in February, 1928, through the acquisition for $100,000 of the William J. Murdock Company; RCA then accepted the transfer of the license.

There was no open quarrel concerning the initial royalty arrangements. The Philadelphia Storage Battery Company manufactured a receiving set, complete with cabinet, and packaged in a carton for direct sale to the consumer. Original terms called for the payment by the licensees of 7½ per cent of the price of the entire package. Only tuned radio receivers could be manufactured, and the company was required to purchase tubes for its sets from RCA.[10]

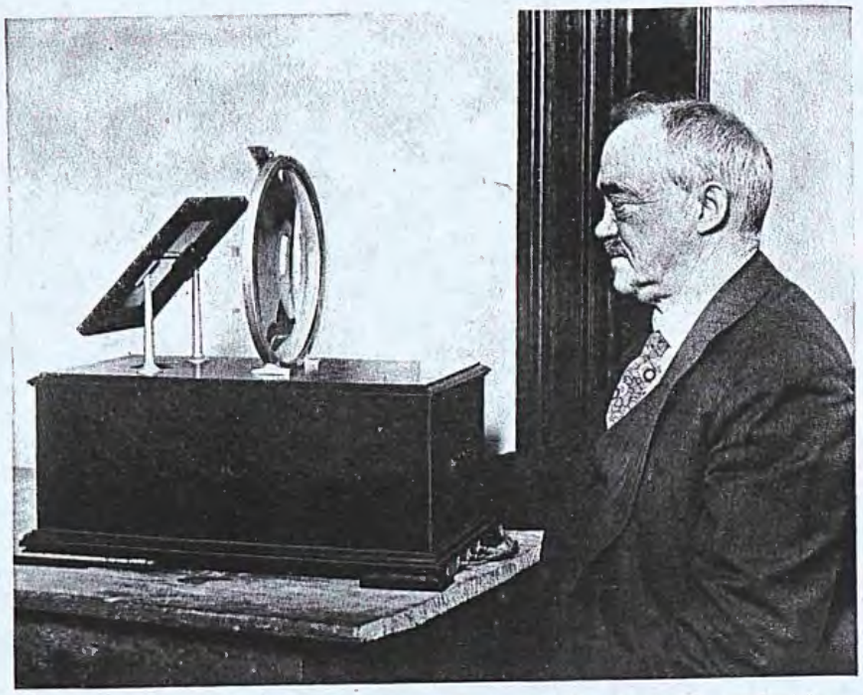
As time passed, these restrictive clauses were relaxed. The royalty on the cabinet was also substantially reduced. RCA had no patents covering cabinets as such, but it was anxious to establish a royalty base on the complete package. One difficulty, however, was that many sets were sold to amateurs without a cabinet. In May, 1929, RCA permitted its licensees to subtract the cost and profits on the cabinet from its rate base and "to add $2.00 in lieu of the deduction for the useful value of the cabinet." [11]

In 1932 RCA reduced the royalty rate to 5 per cent on receivers for domestic use (and 2½ per cent for export products). Yet the royalty payments were still regarded as excessive by most of the licensees and the Philadelphia Storage Battery Company conceived of an ingenious method of reducing them further. Two separate companies were formed in 1932—a manufacturing concern and an engineering and selling organization, the latter under the title of Philco Radio and Television Company. Physi-

[9] As the Helios Electric Company. The name was changed to Philadelphia Storage Battery Company in 1906.

[10] Supreme Court of the State of Delaware, Radio Corporation of America *vs.* Philadelphia Storage Battery Company, *Opinion*, May 13, 1939, pp. 11–12.

[11] *Ibid.*, p. 18.



C. Francis Jenkins with his Radiovisor, 1929. This was the first television receiver for home use. Jenkins' system employed a pair of bevel-edged glass discs whose angle bevel changed continuously around the circumferences. The bevelled edges formed prisms which deflected a beam of light as the discs rotated. By spinning the discs so that one rotated many times faster than the other, the entire surface of an image could be scanned successively by the beam of light. At the receiver, the same prism discs were used. A glow lamp projected a light beam, the brightness of which was modulated by electromagnetic waves sent from the photoelectric cell of the transmitter. (Courtesy G. H. Clark Radio Collection)

TABLE VII: SALES OF HOME RADIO APPARATUS IN THE UNITED STATES
1922–1941

(000 omitted in Number and Value)

	Broadcast Receiving Sets			Radio Broadcast Tubes			
Year	*Number*	*Value*	*Average Unit Price*	*Number*	*Value*	*Average Unit Price*	*Total Sales for Broadcast Reception* *
1922	100	$ 5,000	$ 50	1,000	$ 6,000	$6.00	$ 60,000
1923	550	15,000	27	4,500	12,000	2.67	136,000
1924	1,500	100,000	67	12,000	36,000	3.00	358,000
1925	2,000	165,000	83	20,000	48,000	2.40	430,000
1926	1,750	200,000	114	30,000	58,000	1.93	506,000
1927	1,350	168,000	124	41,200	67,300	1.63	425,600
1928	3,281	400,000	122	50,200	110,250	2.20	690,550
1929	4,428	600,000	136	69,000	172,500	2.50	842,548
1930	3,827	300,000	78	52,000	119,600	2.30	496,432
1931	3,420	225,000	66	53,000	69,550	1.31	300,000
1932	3,000	140,000	47	44,300	48,730	1.10	200,000
1933	3,806	230,099	61	59,000	49,000	.83	300,000
1934	4,084	270,000	66	58,000	36,600	.63	350,000
1935 †	6,027	330,193	55	71,000	50,000	.70	370,000
1936	8,248	450,000	55	98,000	69,000	.70	500,000
1937	8,065	450,000	56	91,000	85,000	.93	537,000
1938	6,000	210,000	35	75,000	93,000	1.00	350,000
1939	10,500	354,000		91,000	114,000		375,000
1940	11,800	450,000		115,000	115,000		584,000
1941	13,000	460,000		130,000	143,000 ‡		610,000

* Includes receiving sets and tubes and such supplementary apparatus as aerials and batteries.

† Figures for value of sets since 1935 include the value of tubes in the receivers.

‡ In recent years, tubes for replacement purposes constitute about 40% of total tube sales.

Sources: *Radio Today*, Jan. 1939, p. 12, and *Broadcasting Yearbook*, 1946, p. 20.

had the desired effect of quieting the opposition, at least for a time.

2. *The Growth of the Licensees*

By the early 1930's the type of competition which, I believe, RCA had hoped to avoid by a restrictive licensing policy had

nevertheless emerged. The RCA–GE–Westinghouse axis was too unwieldly a giant to maintain a dominant position. The new capitalists who entered the industry, in such companies as Philco, Zenith and Emerson, were hard-hitting and aggressive. The managements of these firms were quite different from those in the corporate giants of electrical communications. GE and Westinghouse in the 1920's and 1930's had developed large empires in which stable customer relations were being cultivated. Research and quality were stressed and price competition was avoided. Philco, Zenith and Emerson, by contrast, were dominated by entrepreneurs who were primarily sales-minded. And from 1928 to 1941, sales promotion and production engineering were much more important than research in stimulating demand for the ordinary home radio.[14] The industry had reached a stage where, for a time at least, the major technical developments had taken place. The progress that had occurred in vacuum-tube and circuit designs made it possible to achieve very satisfactory results with known technology. In these circumstances the immediate rewards went to those companies who were most effective in bringing down costs and prices, and in developing a consumer preference for their particular lines based largely on advertising. The next major advances in the industry were frequency modulation and television, but these were not introduced on a significant scale until after World War II.

Under the type of competition that developed in the 1930's, minor "gadgety" improvements were stressed rather than basic engineering innovations. Benjamin Abrams of Emerson Radio has characterized the 1930's in the following terms:

> Each year the advertising and sales departments wanted something new to talk about and each year the engineers obliged. . . . The engineer was too often at the mercy of the whims and profit considerations of the management and the opinionated instructions of the sales department. So long as the public was willing to buy the goods thus

[14] The emphasis has shifted since World War II, and companies like Philco, which had developed a taste for research during the war, have become much more seriously interested in it now than previously. In 1946 RCA signed a license agreement, covering Philco's present and future patents through 1954. At the same time, Philco renewed its license with RCA, extending to the same date.

> devised and manufactured, there was no great urgency and little encouragement for radical technical innovations.[15]

The largest and most successful of the new companies, as we have seen, was Philco. The Philadelphia Storage Battery Company had built up an exceedingly effective merchandising organization in the battery industry, with excellent dealer outlets all over the country. These proved of great assistance when the company entered the radio-set business in 1928. The executives were energetic salesmen and promoters, who made Philco into an important household trade name. By designing sets that appealed to the American public and by skillful advertising, the company was able by 1940 to equal RCA in set volume, in spite of RCA's tremendous head start. Philco's development of the portable set added a new and untapped source of customer demand and proved very popular almost immediately. Philco also pioneered in the sale of battery sets for farms not equipped with electricity, and was one of the earliest promoters of automobile radios. And Philco expanded aggressively into other products to offset the seasonality of its radio sales. In 1938 it began to sell "Philco-York" portable air conditioners; within four years it sold as many units as all other manufacturers combined. Later in 1938 it entered the refrigerator field, and in three years it was in sixth place there. Philco's total sales volume in 1941 was in excess of $75,000,000. This was accomplished in part by substantial promotional expenditures. In five years the company spent $11,000,000 on advertising and an equal amount was spent by dealers. Philco was also the first of the set licensees to place an increased emphasis on research.[16]

Next in importance to Philco was the Zenith Manufacturing Company, formed soon after World War I to assemble amateur radio sets. Gene McDonald, its owner, had been an enthusiastic

[15] *Small Radio* (New York, Emerson Radio and Phonograph Corp., 1943), pp. 51–52. It should be pointed out that, while I think this characterization of the 1930's gives a correct impression, other executives in the industry do not agree with Abrams. Philco, for example, feels that there were many more important contributions to improved radio reception and performance by the set licensees than this statement implies.

[16] This is bearing fruit, particularly in the postwar period. Though not an important pioneer in television, Philco has done a great deal to help perfect a workable commercial system.

TABLE VIII: PHILCO CORPORATION SALES AND EARNINGS CALENDAR YEARS 1928–1941

(000 omitted)

Year	Net Sales *	Net Income after Taxes
1928	$12,472	——
1929	32,737	——
1930	32,034	——
1931	34,697	——
1932	16,607	——
1933	23,207	——
1934	37,492	$1,941
1935	46,740	2,348
1936	56,675	833
1937	51,904	110 (d)
1938	30,528	222 (d)
1939	45,421	1,899
1940	52,311	2,249
1941	77,074	2,514

* In 1941, Philco's dollar sales (except sales for export and tube sales of National Union) were divided as follows:

Home radio receiving sets	47.4%
Automobile radio receiving sets	15.0
Household electric refrigerators	23.0
Single-room air conditioners	1.8
Miscellaneous sales including batteries, radio receiving tubes and parts	12.8
	100.0%

radio amateur. He had a dynamic personality and a flair for promotion. On an Arctic expedition in 1925 he provided one of the first demonstrations of the effectiveness of short-wave communication for great distances by establishing contact with the United States fleet which was then in the South Pacific, 12,000 miles away. McDonald also organized and became the first president of the National Association of Broadcasters. By 1927 Zenith was recognized as a rising company and was the first major concern to obtain a license from RCA. Zenith gradually extended its line until it became one of the principal producers of combination

radio and phonograph sets. It was particularly successful in appealing to a large section of American taste by the design of cabinets which fitted into living-room schemes. In the 1930's Zenith began to invade the low-price field with characteristic aggressiveness. It was quick to discern the possibilities of the portable set, and it has been especially skillful in designing tuning dials that are easy to work and that appeal to the public.[17] The company has also gone extensively into the non-electrified farm market for radio sets. Zenith has confined itself primarily to the radio field, with the exception of hearing aids in which it has become by far the largest producer. From a sales volume of $10,000,000 in 1929 Zenith had expanded to nearly $25,000,000 by 1941.

The quality of Zenith entrepreneurship is suggested in the following excerpt from a *Fortune* article.

> The secret of Zenith's success "can be epitomized by a simple story. One Saturday it occurred to McDonald that hand controls for auto radios were dangerous, and he dictated a memo to his engineering department suggesting ideas for a foot control. On Monday he started a patent search and had his engineers build a rough working model for his own car. On Tuesday he tried it and on Wednesday he sent it to Detroit. On Thursday he went to Detroit and talked up the device to Edsel Ford and George Mason (Nash–Kelvinator). That night he was back in Chicago with Ford and Nash in the bag. Several people doubtless thought of foot controls before McDonald; the point is that McDonald saw its possibilities and lost no time in using them." [18]

The radio company which perhaps more than any other has been responsible for bringing down prices is Emerson. Under the leadership of the Abrams brothers, Emerson has been responsible for the development and promotion of the small table set, an important innovation in the industry. Although Benjamin and Max Abrams started selling radios in 1924, their position in the industry remained insignificant until 1932, when they reached the conclusion that there was an untapped potential demand for the

[17] "Back in 1935 McDonald insisted on building radios with dials the size of school clocks because he was sure that people would go for them." "Commander McDonald of Zenith," *Fortune*, June, 1945, p. 214.

[18] *Ibid.*, p. 141.

TABLE IX: ZENITH RADIO CORPORATION SALES * AND EARNINGS 1929–1942

(000 omitted)

Year Ending April 30	*Net Sales* *	*Net Income after Taxes*
1929	——	$1,110
1930	——	258 (d)
1931	——	483 (d)
1932	——	399 (d)
1933	——	578 (d)
1934	——	50
1935	——	11
1936	$ 8,538	1,213
1937	16,967	1,904
1938	17,299	701
1939	17,980	1,075
1940	20,381	738
1941	23,877	1,236
1942	34,228	1,394

* The company's sales during this period were almost exclusively confined to radio receivers and radio-phonograph combinations.

small, low-priced set.[19] Benjamin Abrams has described this development as follows:

In 1932, when the fortunes of small radios were at their lowest ebb, I found what I was looking for and what later pointed the way to a successful operation. It was a clock, or rather a clock case—handsomely styled as style was understood in those days, and only ten inches wide, six and a half inches high and four inches deep. A few attempts had previously been made to produce a small set . . . but nothing quite so small as that clock case. There were no "standard" speakers, condensers, coils, dials, or tube complements for such a miniature unit and skeptical suppliers showed little enthusiasm about making them. It was a pioneering job.[20]

[19] Price competition and the introduction of "small sets" brought the average set price down from $133 in 1929 to $35 in 1933.

[20] *Small Radio, op. cit.*, p. 31.

The set was offered, when completed, at $25 and proved an immediate success. "For more than a year the demand was far greater than our ability to manufacture. It was not until the latter part of 1933 that production and sales of that one model alone came within balance." [21] Since then the small radio has increased steadily in popularity. By 1941 about 80 per cent of the home sets sold were small radios. Emerson continued to be in the vanguard in producing low-priced models—culminating in a set for $6.95 in 1939. Such prices encouraged the purchase of more than one radio for the home and contributed to the phenomenal growth of the radio listening audience from approximately 12,000,000 people in 1932 to 55,000,000 in 1941. Emerson has shown remarkable skill in production engineering, which has made it possible to manufacture low-priced sets at a profit. Its sales volume in 1941 was $14,000,000.

Another pioneering company which contributed to opening new markets for radios was the Galvin Radio Company [22] of Chicago. This concern was started by Paul Galvin in 1928. Galvin was out of work at the time and looking for something to do. He decided to try to make radios, starting his company with an original investment of $500. The first few years were very difficult, but in the 1930's the company engineered a receiver that would function effectively in an automobile, and merchandised it so successfully that a large demand was created. In the year 1941, there were 2,500,000 radios sold for automobiles, of which Galvin was the largest single producer, with sales of 600,000 sets. In addition, the company sold nearly 400,000 household sets.

Because of the effective competition of these various concerns, RCA gradually lost its major lead in the set industry. It remained clearly the largest producer of radio tubes; but Sylvania, Raytheon and National Union gradually absorbed an increasing proportion of this business. And in loud speakers and other parts, RCA also declined relative to such concerns as Magnavox and Utah Radio Products.

The comparative position of the leading firms in the industry in 1940 is indicated in the following figures:

[21] *Ibid.*, p. 34.

[22] The name was changed to the Motorola Corporation in 1947.

TABLE X: SALES OF SETS BY MAJOR COMPANIES *
1940

RCA	1,700,000
Philco	1,675,000
Zenith	1,050,000
Emerson (mostly midget sets)	1,050,000
Galvin	950,000
Colonial (for Sears Roebuck)	650,000
Belmont	550,000
Noblitt Sparks	400,000
GE	350,000
Crosley	350,000
Stewart-Warner	250,000
Simplex	250,000
Electrical Research Laboratories	250,000
Sonora	200,000
Wells Gardiner (for Montgomery Ward)	200,000
Detrola	175,000
Farnsworth	100,000
Sparks Withington	100,000
All others	1,584,000
Total	11,834,000

* I believe these figures are approximately correct, but there are no official statistics published. The estimates include exports, and I believe that RCA had larger exports than Philco and that Philco outsold RCA in the domestic market.

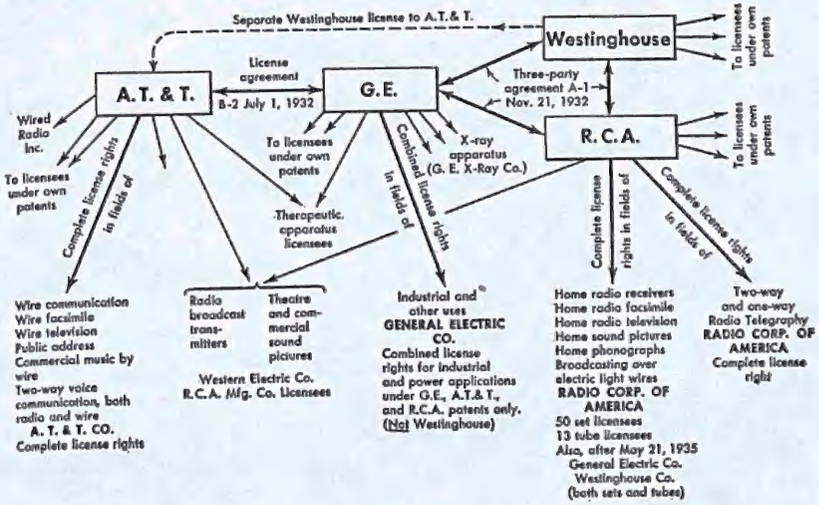
The appearance of General Electric as a separate seller of sets was a result of anti-trust action instituted by the Department of Justice against RCA, GE and Westinghouse in 1930,[23] alleging unlawful combination and conspiracy in restraint of trade in both domestic and foreign commerce. The defendants were said to control more than 4,000 patents on radio apparatus, which enabled them to "dictate by agreement among themselves the terms upon which any competitor or potential competitor may use the patents." [24] After eighteen months of negotiations, and without

[23] United States *vs.* Radio Corp. of America *et al., op. cit.* The original complaint named AT&T and General Motors and their subsidiaries among the defendants, but the case was later dismissed as to these parties.

[24] *Ibid.*, pp. 5, 6.

taking testimony or making any adjudications, the parties accepted a consent decree, by which General Electric and Westinghouse agreed to dispose of their stockholdings and managerial direction of RCA. All of the cross-licensing agreements, as well as foreign traffic and licensing contracts, were made non-ex-

LICENSING ARRANGEMENT UNDER
Patents Applicable to Electron Tubes and Circuits
as of May 21, 1935



Cross licensing of patents relating to circuits and electron tubes among AT&T, GE, RCA, and Westinghouse, following the consent decree. (Courtesy *Electronics*)

clusive.[25] GE and Westinghouse were to refrain from the manufacture and sale of radio apparatus for two and one-half years in order to give RCA time to establish itself independently.[26]

General Electric began in 1935 to sell radio sets, having them manufactured at first by RCA. This proved an unsatisfactory arrangement for GE; and its radio operations were conducted at a loss for several years until it began to manufacture for itself.

[25] U.S. *vs.* Radio Corp. of America *et al., op. cit.*, consent decree, Nov. 21, 1932.

[26] RCA had itself begun manufacturing in 1930, when it acquired the Camden and Harrison plants formerly owned by GE and Westinghouse.

Since World War II, General Electric has entered all phases of the radio manufacturing industry. In recent years Westinghouse has also begun to manufacture home radio receivers.

While Philco, Zenith, Emerson and Galvin were rapidly increasing in importance from 1930 to 1940, other concerns with less efficient sales departments were losing their positions. The three leading radio set manufacturers of 1930, other than RCA, were Atwater Kent, Grigsby-Grunow and Crosley. Grigsby-Grunow had a spectacular rise and fall. It began to manufacture sets in 1928, became the industry leader in 1929 and failed in 1934. Atwater Kent was in the top position in 1930 and withdrew in 1932 because of the depressed economic conditions.[27] Crosley gradually lost ground until its radio manufacturing division was thoroughly reorganized in 1937. After that it expanded again, but by 1940 it was still a much less important factor than in 1930.[28]

A significant development in radio merchandising methods was the rise to prominence, as major sales outlets, of Montgomery Ward, Sears Roebuck and the automobile chain stores—Western Auto and Firestone. Sears Roebuck and Montgomery Ward, in particular, provided a challenge to the growth of the nationally advertised radios like Philco, and forced the pace in bringing down prices and costs.

On the basis of the somewhat scanty information that is available, I have attempted to estimate, as shown below, the sales of some of the major chain outlets in 1941:

TABLE XI: ESTIMATE OF SALES OF RADIO SETS BY MAJOR CHAIN-STORE OUTLETS—1941

Montgomery Ward	900,000
Sears Roebuck	700,000
Firestone	375,000
Western Auto	350,000
Gamble's	250,000
Goodyear	150,000
Total	2,725,000

[27] The company had been extremely prosperous prior to the depression and Mr. Atwater Kent retired a multi-millionaire.

[28] Since World War II it has become increasingly important again.

Although these stores sold radios under their own trade names, they did no manufacturing themselves. A number of the RCA licensees specialized in supplying the chains. Colonial,[29] Continental and Belmont all did a substantial chain-store business as did Noblitt Sparks, Stewart Warner, Farnsworth and Wells Gardiner. RCA, Philco, Zenith, Emerson and Galvin, by contrast, sold primarily under their own trademarks and made no sales to chain stores.

Many chain-store manufacturers produced radios which compared very favorably in quality with the nationally advertised product. But with the exception of Farnsworth, whose major interest was in television, none of the companies which manufactured primarily for the chains undertook research. Profit margins were narrow; and the technical contributions were confined to production engineering.

The emergence of a limited number of major competitors was also taking place in the tube division of the industry. In 1930 there were fifteen tube companies licensed by RCA. Thereafter, the number of tube licensees gradually declined through bankruptcy or merger until there were only eight in 1941.[30]

Next to RCA in importance in the tube industry was Sylvania Electric Products. Sylvania owed its rise primarily to manufacturing skill and low-cost production. Its plants were located in small towns in Pennsylvania and Massachusetts, where labor supply was adequate and not expensive. Sylvania was able to undercut RCA's prices and still sell at a profit, despite substantial royalty payments. Philco and Zenith became its largest customers, both of them being glad to buy from a non-competitor rather than from RCA, as long as the product was well engineered. Although Sylvania carried on relatively little creative research prior

[29] Colonial was controlled by Sears Roebuck until purchased by Sylvania Electric in 1944.

[30] The war brought a great many new companies into the electronics industry for the manufacture of such important war products as radar. Some of these, like Sperry and Bendix, were very large concerns; many others were small. The tremendous increase in the productive capacity of the industry has created a highly competitive postwar condition. In 1947 RCA reported 32 tube and 186 broadcast-receiver licensees. The royalty rate on tubes in effect in mid-1947 was 4 per cent and on sets 2¼ per cent. The royalty rate on tubes was reduced, in November, 1946, from 4 per cent to 2½ per cent.

AITKEN

Japan.[7] Most, however, still used crystal detectors, stable and predictable in performance and perfectly adequate for spark signals but not for continuous wave telegraphy. There was, therefore, an emerging problem in this area that could be solved only by making vacuum tubes more readily available. And that indeed called for some cooperative action by the firms that owned the relevant patents: AT&T and General Electric. But, as regards civilian use, there was no immediate urgency in the matter. What most concerned the Navy was that its own needs for vacuum tube equipment should be met, and this is what led to Hepburn's letter. Stanford Hooper stated the matter frankly in later testimony to Congress. After the war, he said, the Navy was unwilling to grant patent releases to its suppliers because "we were afraid that we were getting in pretty deep." Instead, he and his colleagues tried to devise a scheme "whereby we could buy radio equipment without having to take the patent responsibility; and we suggested that the companies get together and work it out in some way."[8]

That is precisely what "the companies" did, and with such promptness as to suggest that they had been waiting for the right signal. This was hardly remarkable: to do as Hepburn and Hooper requested served their interests no less than the bureau's. Their response, however, went far beyond a mere cross-licensing of tube patents—a straightforward matter that their attorneys could have attended to in a couple of weeks. What emerged from the negotiations was an elaborate protocol designed to govern the future exploitation of continuous wave radio. What began as a plea for the safety of ships at sea ended as a treaty for the allocation of corporate territory. In the process, decisions were taken that had profound consequences for the future of American communications.

[7] Julius Weinberger, research engineer for RCA, stated flatly in March 1920 that "tubes are not available to the mariner at present," and recommended that, in designing direction-finding equipment, RCA produce "a simple set of adjuncts to the regular ship's crystal receiver" rather than the three-step amplifier that the Bureau of Standards had proposed. See Clark Radio Collection, Cl. 5, 1920, Box 65, Weinberger to A. N. Goldsmith, 18 March 1920. Tubes were, however, available to operators who really wanted them. See E. J. Quinby, *Ida was a Tramp* (Hicksville, N.Y., 1975), pp. 43, 48-49, 68-70, and compare *Popular Radio* 2 (October 1922), 143-44. I owe my information on the availability of Japanese tubes to the kindness of Alan Douglas.

[8] "Commission on Communications," *Hearings* before the Committee on Interstate Commerce, United States Senate, 71st Congress, 1st Session, on S.6, A Bill for the Regulation of the Transmission of Intelligence by Wire or Wireless (Washington, D.C., 1930) [hereafter *FCC Hearings*], testimony of Stanford Hooper, p. 315.

Negotiations between GE and the Telephone Company began in early 1920. It proved easy to agree in principle that some cross-licensing of patents was desirable. The tough questions involved how far to go beyond that. How far should the agreements also try to delimit the fields of activity in which each firm should have exclusive rights—exclusive rights, that is, to use its own patents *and* those of the other firm? This was in truth the heart of the matter. RCA and General Electric had already signed a comprehensive cross-licensing agreement, extending to RCA the right to use in radio any of the patents that GE owned or was licensed to use. Negotiations with AT&T were, therefore, carried on in the first instance by GE, but it was understood that extension agreements would be signed by GE with RCA and by AT&T with Western Electric. The desired outcome was, therefore, a situation in which GE and RCA would be free from the competition of AT&T and Western Electric in certain fields, and AT&T and Western Electric free from the competition of GE and RCA in others. When GE negotiated a cross-licensing agreement with AT&T, it intended to stipulate certain fields that it (and by extension RCA) would promise not to invade but would cede to AT&T; and it received in return assurance of other fields that GE and RCA could securely occupy, free from fear of invasion by AT&T and Western Electric. These stipulations and undertakings were written into the terms of the patent licenses.[9]

Now, it is clear that cross-licensing agreements could easily have been negotiated that did not contain these exclusive features. Such agreements would have been tantamount to a literal pooling of radio patents; they would have eliminated any risk of litigation over tube patents in future; and they would have been free of any taint of illegality under the antitrust laws. They would also, of course, have fully satisfied the Navy's request and solved the problem of tube supply about which the Navy had expressed concern. But, for the corporations, that was not the essence of the matter. The essential goal was agreement on the allocation of corporate territory—fields of activity in which each firm could enjoy rights

[9] This statement is not beyond dispute. Thayer, president of AT&T, stated that "As the contract now stands, I have understood it as neither expressing nor implying any obligation on one party to keep out of the field of another, provided getting into that field did not involve the infringement of patent rights of the other." On this David Sarnoff commented, "If the above statement does represent the intention of the parties to the contract, I do not see the purpose or force in each party having ceded to the other, exclusive rights in certain fields under its own patents." Thayer to Gifford, 10 July 1922, and Sarnoff to Harbord, 6 February 1923, both reprinted in Gleason Archer, *Big Business and Radio* (New York, 1939), pp. 74-75.

of exclusive occupancy.[10] Whether such agreements implied restraint of trade was, of course, an important question, to which Young, Thayer, and lawyers on both sides were sensitive. This explains why they took pains to inform the Department of Justice of what they were up to—though all they could elicit from the attorney general was the noncommittal and unarguable comment that it looked like "a good business arrangement."[11] And it explains, too, why it was important to have it on the historical record that the Navy had initiated the process. Neither Young nor Thayer was a novice in antitrust matters; each knew that it was prudent to move carefully.[12]

What kind of compact would the courts uphold? What kind would expose the corporations to antitrust indictment—and, perhaps, to civil suits for triple damages? There was no way to be sure. Where patents and antitrust law overlapped, neither statutes nor the common law nor legal precedent spoke with a certain voice. Every patent, by its very nature, conveyed monopoly rights: the patent laws rewarded an inventor by granting a temporary monopoly that provided insulation from competitive exploitation of the patented art. The essence of a patent was its exclusionary power, and no court in 1920 had ever held that the antitrust laws required a patent-holder to forfeit that exclusionary power the instant it afforded some degree of monopoly in the market. So much at least seemed clear. But there were questions arising now out of the very scale of the affair in contemplation. What if the consolidation of patents and the allocation of exclusive rights were carried to such a length as effectively to eliminate competition and exclude the entry of new firms? Was there a point at which the privileges granted by patents could be abused? What were the implications when patents were used to carve up an industry into exclusive corporate empires?[13]

[10] But note again that this is a question of disputed interpretation; compare Alexanderson Papers, folder 27, "Radio Trial Brief" (1926), p. 7: " . . . the cross licenses (in many cases at least) do not constitute agreements that the parties will not enter into certain fields. They merely convey patent licenses of limited character. The licensees are entirely free to enter the fields not covered by the licenses if they can do so without infringing the patents." This is, of course, a later reading of the agreements, designed to reinforce RCA's defense against antitrust charges.

[11] Case and Case, *Young*, p. 218, citing Young Papers, Box 95, memorandum of meeting with Attorney General Mitchell Palmer, 12 May 1920.

[12] Indeed, Young's initial responsibility when recruited as a vice-president of GE in 1913 had been to monitor compliance with the consent decree of 1911, which had relieved the corporation from the threat of prosecution for restraint of trade in the sale of electrical equipment. Few executives can have been more sensitive, or better informed, on antitrust matters than he.

[13] Compare the remarks of the assistant attorney general in charge of the prosecution of RCA on antitrust charges in 1930-32: "The case presents a conflict between the anti-trust laws enacted to prevent monopoly and the type of monopoly created by the government through the sale of patents." (Case and Case, *Young*, p. 593, citing the *Herald Tribune*, editorial of 23 November 1932) See also "RCA'S Television: Off to a Big Lead," *Fortune* (September 1948), 194. For a useful analytic survey of the economics of the patent system, see F. M. Scherer, *Industrial Market Structure and Economic Performance*, 2nd ed. (Chicago, 1980), chap. 16, pp. 439-58.

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The job of defining exclusive fields began simply enough. Swope's 1918 memorandum clearly intended that, as a general principle, the Telephone Company should confine itself to wired communications and the proposed new company to wireless; but even at that early stage some hint of the complications that lay ahead could be seen in Swope's proviso that the Telephone Company should also have rights in "wireless used in conjunction with wire communication, in the sense that signals pass automatically from one to another."[14] Presumably this referred to short radio links in the wired telephone network, as for instance from the California coast to Catalina Island. Potentially, however, it could have much wider application—for example, to transatlantic radiotelephony. It seemed at first glance a simple enough matter to distinguish between wired and wireless communications and allocate the one field to AT&T and Western Electric, the other to General Electric and RCA, but the more one thought about it, the more blurred the distinctions became. A. G. Davis saw some of the complications when on 5 January 1920—the very day on which the Navy sent its letter to the companies—he gave Owen Young some rough notes to guide him in the negotiations that lay ahead. It was plain what the general rule should be: "Each party free to work in its field under patents of all." But then the complications began: "Each party free to work in other fields for purposes of its own field—exception only where fields collide, as in radio telephony, where must define limits."[15] Radiotelephony was indeed a field in which both groups would want to stake claims.

Davis thought that instances "where fields collide" would be exceptions, but this was not to prove true. Broadcasting was to breed examples every day. Broadcasting was clearly "wireless," but it was also a form

[14] Young Papers, Box 95, Swope to Young, 28 February 1920, enclosing memorandum of 29 May 1918.

[15] Young Papers, Box 95, A. G. Davis to Young, 5 January 1920, enclosing memorandum headed "General Principles." The date of this memorandum makes it clear that negotiations between GE and AT&T were planned before the Navy's letter arrived.

of telephony; and broadcast stations would depend on the wired telephone system for their remote pickups and their network connections. But all this was still in the future when negotiations began, and it was not the kind of thing Davis had in mind. He was concerned that RCA should be able to use wire lines for remote control of its telegraphy stations, just as the Telephone Company executives were concerned about radio links in their phone system. Broadcasting played no important role in the negotiations and was mentioned only in passing in the final document.

Even so, agreement did not prove easy, and the closer the contract got to final form the more complex it became. AT&T spokesmen said later that they would have preferred the exchange of patents to be nonexclusive; if so, they had the support of legal counsel, sensitive to the risk of antitrust action.[16] RCA and GE, however, preferred the definition of exclusive fields to be as specific and concrete as possible; in particular they insisted on exclusive rights to use the patents of the participating companies in radiotelegraphy. But there was no matching disposition to grant to AT&T and Western Electric exclusive rights in radiotelephony, for to do so would have precluded RCA from using voice communications in overseas and coastal radio. The clauses dealing with radiotelephony, in consequence, developed into a tangled thicket of qualifications and provisos that were later to prove sources of acute conflict.

By 12 April 1920 Alexanderson at least was satisfied that GE and RCA had got as good a deal as could be expected. As he interpreted the draft agreement that had been reached by that date, RCA was to have exclusive rights to use the pooled patents in transoceanic telegraphy and ship and aircraft radio. It would also have nonexclusive rights to transoceanic telephony, in cooperation with the Telephone Company, but no rights in radiotelephony over land unless the Telephone Company was unable to supply the service. To the Telephone Company there were to be ceded exclusive rights to "all land radio telephony for toll purpose, or equivalent," while GE would enjoy, as one of its exclusive fields, "broadcasting service, and sale of amateur apparatus, particularly vacuum tubes." The whole agreement, he believed, aimed at "a natural division of fields of activity"; and the only caution he felt it necessary to add was that it should be recognized that, in giving up land telephony, GE and RCA were giving up a large field and were entitled to expect full cooperation from the Telephone Company in return—specifically, in providing connections to RCA's shore stations.[17]

[16] W. S. Gifford to Owen D. Young, 20 April 1925, as reprinted in Archer, *Big Business*, p. 209; compare Case and Case, *Young*, p. 211.

[17] Alexanderson Papers, Alexanderson to A. G. Davis, 12 April 1920.

Alexanderson's comments are revealing. On the one hand he recognized that the Telephone Company was to have exclusive rights to "land radio telephony." On the other, he thought that GE and RCA would have, as one of their exclusive fields, broadcasting service. And between these two provisions he saw neither conflict nor contradiction. Clearly, in his mind, land radio telephony "for toll purposes or equivalent" was something quite different from "broadcasting." His image of radiotelephony was of point-to-point communication for a fee—the analogue of telephony by wires. Broadcasting was something else: it would be a public service, made available without charge, expected to pay for itself, if at all, through revenue from the sale of receivers.[18] Originally both parties to the contract seem to have accepted some such view; the Telephone Company would have exclusive rights to the manufacture of radiotelephone transmitters (including broadcast transmitters) while GE would have exclusive rights to manufacture receivers. Both parties changed their interpretations later, after rights to manufacture transmitters and receivers became very valuable.

A. G. Davis, who did most of the day-to-day negotiating on behalf of GE, was less easily satisfied than Alexanderson. He thought that rights which should be exclusive to GE had been watered down in successive drafts, and he was beginning to worry about broadcasting, partly in response to pressure from David Sarnoff, commercial manager of RCA, who was again advancing his notion of the "radio music box," or radio receiver in the home. The draft agreement granted to GE the right to "establish and maintain . . . stations for transmitting or broadcasting news, music, and entertainment" and to "make, use, sell, and lease wireless telephone receiving apparatus for the reception of such news, music and entertainment."[19] But this was a nonexclusive license, contrary to Alexanderson's opinion; it was not clear how it was to be reconciled with the Telephone Company's exclusive privileges in land radiotelephony for toll; and the right to establish broadcast transmitting stations was not accompanied by the right to manufacture the transmitters themselves. On this last point the license agreement seemed specific: it ceded to GE the right to manufacture radio receivers, but added immediately, "it is agreed that the General Company has no license to equip wireless telephone receiving apparatus . . . with transmitting apparatus, or to sell, lease, or otherwise dispose of transmitting apparatus for use in connection with receiving apparatus sold under this paragraph."[20] If this clause

[18] Compare the attitudes of Young and Sarnoff, as characterized in Case and Case, *Young*, p. 264.

[19] FTC *Report* (1923), pp. 30-39; Case and Case, *Young*, p. 213.

[20] FTC *Report* (1923), p. 134.

meant what it seemed to mean, GE was prohibited from manufacturing radiotelephone transmitters—at least if they were to be used in conjunction with the receivers that it manufactured.

How important were broadcasting rights anyway? The fact was that nobody knew; and most did not greatly care. Of the GE/RCA group, only Sarnoff, it seems, believed that broadcasting might develop into a field with commercial potential. The possibility that GE might develop a "wired wireless" system of transmitting information and entertainment over electric power lines, or that AT&T might try the same thing over the telephone lines, was a source of as much concern. Broadcasting was not, in any case, regarded as a matter of such importance that Young was willing to see the negotiations prolonged in a possibly futile effort to eliminate ambiguities. He had other concerns that made early agreement with the Telephone Company expedient. One of these was the need for a traffic agreement; another was the need for more capital.

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Traffic agreements occupied much of the time and attention of RCA's chief executives during the first few years of the corporation's existence. Most of them were negotiated with foreign governments and telegraph bureaus and were intended to ensure that RCA was designated as the exclusive U.S. agent for the transmission and reception of radio traffic between the United States and the various foreign countries involved. These we shall discuss later in connection with Westinghouse's abortive attempt to break into long-distance radio. A traffic agreement with AT&T, if it could be worked out, had a different purpose. To understand this, we have to know something of RCA's relations with the two domestic wire telegraph companies in the United States: Western Union and Postal Telegraph.

RCA began handling radio traffic between the United States and the rest of the world in March 1920. It soon became apparent that there was a serious lack of balance on the transatlantic circuit between eastbound and westbound traffic. The word-count of messages transmitted to Europe was very much lower than the word-count of messages received, even though the price per word was the same.[21] The reason was

[21] For example, in December 1920 144,224 paid words were transmitted eastbound on the British circuit as compared with 173,004 westbound; on the German service the corresponding figures were 80,025 and 233,014, and on the Scandinavian service 8,193 and 22,104. As a contributing factor, W. A. Winterbottom, RCA's traffic manager, suggested that American equipment was more efficient and permitted a higher average speed of reception than in Europe while the circuits were open. Young suggested that relatively little press traffic moved eastward, and that the reason for this, according to the press associations, was simply that a relatively small amount was used by the foreign press. See the testimony of Winterbottom and Young in *Cable Landing Hearings*, pp. 337-56.

not far to seek. RCA had no network of telegraph offices in the United States where messages to be sent to Europe by radio could be handed in. The only such offices were in New York City and Washington, D.C. If you lived anywhere other than these two cities and wanted to send a telegram to a European country, you would take or telephone your message to your local Western Union office (or to one of the much less numerous Postal Telegraph offices).[22] Western Union, however, would not accept such a message for transmission to Europe "via radio." You were not permitted to specify the mode of transmission to be employed. The reason for this was simple: Western Union held a financial interest in the submarine cables and preferred to channel traffic through them. The only way in which you could send a message to Europe by radio, if for some reason you insisted on using that mode, was to file it with a domestic telegraph company as a normal land message addressed to RCA at 64 Broad Street in New York City, from where (if you had previously established credit facilities) it would be transmitted to Europe by radio. This was inconvenient, and few people did it. The result was that RCA was continually losing eastbound traffic: virtually the only messages to Europe it handled originated in New York or Washington, where they could be handed in directly at RCA offices. The problem did not exist on the transpacific circuit, because neither of the telegraph companies had a financial stake in the transpacific cable; Western Union, for example, would gladly accept a telegram addressed to Tokyo to be forwarded "via radio" by RCA from San Francisco.[23] And it did not exist for incoming traffic from Europe, which RCA forwarded at normal commercial telegraph rates from New York to the ultimate recipient.

The blunt fact was that RCA depended for its domestic "feed" on companies whose stake was in a rival communications system. This was a unique situation. In Europe the agencies that handled long-distance radio were either government departments that also ran the domestic

[22] Western Union had about 26,000 offices in the United States while Postal Telegraph had a little over 3,000. In 1928 Postal Telegraph did between 15 and 16 percent of the total landline telegraph business in the United States. See *FCC Hearings*, pp. 1240 and 1472, testimony of David Sarnoff and Newcomb Carlton.

[23] Hiram L. Jome, *Economics of the Radio Industry* (Chicago and New York, 1925), p. 157; *Wireless Age* 10 (October 1922), 55. For an extended discussion, see the testimony of W. A. Winterbottom in *Cable Landing Hearings*, pp. 340-41 and compare the testimony of O. D. Young, ibid., p. 1094.

preferred was no higher than the investing corporations could have earned by employing the capital in their own businesses. What, then, induced them to transfer such sizable sums to RCA's treasury? The answer, apparently, is that Owen Young would not negotiate on any other basis. The subscriptions were the price of admission to the syndicate—the membership dues in the RCA "club"—and RCA was not willing to cross-license patents without them. Young was doing what he had so often done in the public utility field: putting together a viable organization, assembling the resources necessary for it to function effectively, and making sure that all concerned parties had a stake in its survival and success. RCA, for him, was not only an instrument for asserting the autonomous influence of the United States in world communications; it was also an institution for creating a community of interests domestically.

This, however, speaks only to the question of RCA's purposes, and Young's specifically. Why the Telephone Company acceded to this conception is less obvious, and Thayer's reluctance to agree to a stock subscription to RCA suggests that he would have been content with a much less intimate relationship than Young had in mind. In the short run, what AT&T expected to get out of the deal was freedom from patent conflicts, particularly over vacuum tubes. In the longer run it wanted cooperation with RCA in the development of radiotelephony—and protection for what it regarded as its natural interests in that field. The press release issued by AT&T on 26 August made the points explicitly. It quoted at length the letter from the Navy's Bureau of Engineering, clearly implying that the initiative in bringing the companies together had come from the federal government. It described the exchange of licenses as enabling the Telephone Company to "supplement its wire system with wireless extensions . . . as between shore and ships at sea." And it presented the ultimate outcome of the agreement as bringing into a harmonious relation "the world-wide wireless system of the Radio Corporation and the universal service of the Bell System," so that eventually telephone service could be extended to ships at sea and to foreign countries. In conclusion it noted almost parenthetically that, to better carry out the purposes of the agreement, AT&T had bought a minority interest in RCA, and W. S. Gifford, vice-president of the Telephone Company, had been made one of the radio company's directors.[34]

The "harmonious relation," if it ever existed, did not long endure. Dissension over the interpretation of the cross-licensing agreements, particularly as they applied to transoceanic radiotelephony and the manufacture of broadcast equipment, broke out almost immediately. By the fall of 1923 disagreement was so acute and bargaining positions on both sides had so hardened that further direct negotiation was recognized as futile.[35] Litigation or the use of a neutral arbitrator were seen as the only feasible courses of action and, in the hope that publicity might be avoided and problems resolved in months rather than years, an arbitrator was appointed.[36]

[34] AT&T Press Release, contained in Young Papers, Copybook 802 (Radio), Young to A. G. Davis (telegram), 26 August 1920.

Meanwhile, beginning in February 1922, the Telephone Company proceeded to divest itself of the common and preferred stock it had so recently acquired in RCA, and by the early months of 1923 all these securities had been sold to the general public—the first large block of RCA shares to appear on the market since the company was founded.[37] AT&T's two representatives on RCA's board of directors both resigned in June 1922. It was blandly explained in AT&T's Annual Report for 1922 that ownership of stock in RCA had proved unnecessary for cooperation between the companies and therefore the securities had been disposed of "in line with our general policy to hold permanently only the stocks and securities directly related to a national telephone service." And spokesmen for the company claimed that brokers had been advertising AT&T's stock ownership in order to induce the public to invest in RCA—"which tended to create a moral obligation on this company's part which it did not wish to assume."[38]

Such sensitivity to moral obligations on the part of a large corporation

[35] See below, pp. 482-86. The most comprehensive account of the arbitration proceedings is in Archer, *Big Business*, chaps. 5-9; but see also Leonard Reich, "Research, Patents, and the Struggle to Control Radio: A Study of Big Business and the Uses of Industrial Research," *Business History Review*, 51 (Summer 1977), 208-35.

[36] See J. G. Harbord to Young, 21 September 1923, as reprinted in Archer, *Big Business*, pp. 110-11. Harbord estimated that litigation, taking into account the inevitable appeals, would not yield a decision before three to five years had elapsed. It was also true, of course, that arbitration promised to minimize publicity.

[37] See AT&T, Annual Report for 1922; FCC, Walker Report, p. 21. Some RCA stock held by former shareholders in American Marconi may have changed hands earlier. Furthermore, in June 1922 the directors of RCA voted to offer Young 100,000 shares of RCA common at the special price of sixty cents a share; Young took up the offer and sold the shares on the market between 1922 and 1925. (See Case and Case, *Young*, p. 382) With these exceptions, the sale by AT&T was the first offering of RCA shares to the general public.

[38] Eric Barnouw, *A History of Broadcasting in the United States, Vol. 1, A Tower in Babel* (New York 1966), 1: 123,161.

was no doubt admirable, but skeptical observers widely interpreted the move to mean that AT&T was casting off an alliance that had become distasteful. Any inclination to move in this direction must have been reinforced by the knowledge that, during 1922, the Federal Trade Commission had begun to investigate charges that RCA had been set up by GE and others as a "bogus independent" in an attempt to monopolize the manufacture and sale of radio apparatus, and by the passage of House Resolution No. 568 on 3 March 1923, directing the Federal Trade Commission to investigate whether RCA and its affiliated companies were in violation of the antitrust statutes. The Telephone Company had its own recurrent antitrust headaches and no need to acquire others by too close an association with RCA. Divestiture offered the chance to put a little prudent distance between the two corporations. And prudent it was to prove in 1932 when, with RCA and its associated companies facing antitrust prosecution, AT&T was able to make its separate peace with the Justice Department by calling attention to the fact that it had sold its interest in the radio company many years earlier. Clearly Young's conception of RCA as the integrating focus of American interests in radio was not one the Telephone Company found it possible to share.

Some at least of RCA's staff had hoped for productive cooperation with the Telephone Company at the technical level, but not much came of this. The cross-licensing of patents in itself, of course, brought some benefits. General Electric's work on high-power transmitting tubes, for example, was materially assisted by the work of Houskeeper at Western Electric in perfecting the glass-to-metal seal—one of those seemingly minor achievements in technology that make possible the more dramatic advances.[39] Western Electric benefited, too, from being able to use RCA's transmitting facilities in its long-distance radiotelephone tests, as for example in December 1922 when the first "single sideband" speech transmissions were carried out between RCA's Rocky Point station on Long Island and Western Electric's factory at New Southgate in London, England.[40] But at the day-to-day level there was little technical interchange.

[39] RCA's first major success with tube transmitters in transatlantic radiotelegraph service came in the fall of 1922, when a bank of three 50 kw. kenotrons and six 20 kw. pliotrons operated on two of the RCA circuits to Britain and Germany for a sixteen-hour period, replacing the alternators ordinarily used. These were water-cooled tubes with external anodes, constructed with the Houskeeper glass-to-metal seal. By this date Western Electric had developed a 100 kw. tube. See *Wireless Age* 10 (October 1922), 60 and (November 1922), 55; J. W. Stedenfeld, "William Gibbens Housekeeper [sic]," *The Old Timer's Bulletin* 23 (September 1982), 16-17.

[40] George C. Blake, *History of Radio Telegraphy and Telephony* (London, 1928), pp. 326-27. Single sideband is a technique by which the carrier frequency and one sideband of speech frequencies are filtered out at low power levels before the signal is amplified and transmitted. The carrier is reinserted in the receiver by means of a low power local oscillator, after which the speech information is detected and amplified in the usual way. Besides the obvious economy in power, the technique also takes up less of the radiofrequency spectrum.

Young had given his engineers early warning not to expect too much. Meeting with RCA's technical committee in August 1920, he told them that the agreement with the Telephone Company had been reached only with great difficulty, that "at certain points it almost had to be done by force," and that whether it turned out successfully or not depended above all on the spirit in which it was approached. His advice was to go slowly, not to start any specific project that might depend on cooperation with Western Electric, but rather to try to establish a good working basis for cooperation in the future.[41] This was sound advice but, at the technical level, no such basis for cooperation was ever established. By late 1923 it could be stated as a matter of common knowledge that "cooperation in the matter of research between the two companies . . . has never been realized."[42]

This was hardly remarkable: that kind of technical cooperation could have been achieved only by close person-to-person interaction between the individual members of the two organizations, and that never happened. Indeed, RCA even had difficulty establishing technical cooperation with General Electric—as witness the response when Alfred N. Goldsmith, RCA's research chief, wrote to Alexanderson to ask for a complete file of GE's "design books." Alexanderson replied that, to his knowledge, no such books existed; at GE each department kept its own design data and information was exchanged "only through personal understanding between the design engineers." In fact, Alexanderson commented, it had been found next to impossible to exchange such information by correspondence, and "even when the engineers are working in the same plant, but not in the same building, difficulty is experienced."[43]

If the exchange of technical information between GE and RCA was so difficult, how much more difficult must it have been between RCA and the Telephone Company? There was in fact little interest in close cooperation with RCA on the part of AT&T, except in such instances

[41] Young Papers, Additional Papers, Box 3, Minutes of RCA Technical Committee, 25 August 1920.

[42] J. G. Harbord to Young, 21 September 1923, as reprinted in Archer, *Big Business*, pp. 110-11.

[43] Clark Radio Collection, Cl. 5 (1920) Box 65, Julius Weinberger to Goldsmith, 29 March 1920 and Alexanderson to Goldsmith, 1 April 1920.

for several years. It was no technical breakthrough that created the broadcasting industry almost overnight. What made the KDKA experiment significant—and the experience of station 8MK in the offices of the Detroit *News* was very similar—was its disclosure that a market existed and that it could be reached with a relatively small investment. That market was, initially, the community of radio amateurs, individuals who knew how to string up a wire antenna and tune a crystal set and were delighted to share those skills with their friends, families, and neighbors. But beyond those amateurs was a vast potential audience with an apparently insatiable appetite for news and music whose existence had previously been almost totally unsuspected.

Radio broadcasting, it has been said, captured the popular imagination. It brought news to a news-hungry public, with an oral directness and immediacy that the printed newspaper lacked. And it provided music that was, seemingly, free, with a quality of reproduction at least as good as the phonograph and with none of the nuisance of winding a crank and changing a record every few minutes—or of being restricted to your private collection of recordings.[92] But radio broadcasting also opened up opportunities for profit, and if all the ways in which those profits could be reaped were not immediately apparent, one at least was. To receive radio broadcasts you had to have a receiver. At first it could be very simple: a crystal, a coil wound (often) on an empty Quaker Oats container, and a pair of headphones. That was enough to get started. But as the number of stations increased, so did the need for selectivity and fine tuning. As the habit of "listening in" caught on, so did the desire to hear the weaker or more distant stations, and that meant a requirement for sensitivity. As radio became part of family life, with utilization no longer confined to those conventionally recognized as technically sophisticated, ease of operation became an important consideration, and after a while the tricky "cat's whisker" and crystal were no longer acceptable. Consumers moved up first to regenerative receivers and then, when the squeals of a poorly adjusted "regen" became intolerable, to the more sophisticated "neutrodyne" or "superhet."

It looked, in short, as if money might be made from this newly discovered market, particularly by a corporation with a strong patent position in receiver circuitry. A conspicuous feature of this social innovation, indeed, was the way in which almost from the beginning it was integrated into the price system and the market economy (in contrast to the experience in other countries).[93] Consider, to underline the point, what Frank

[92] Schubert, *Electric Word*, pp. 213-14.

[93] Compare, for example, Asa Briggs, *The History of Broadcasting in the United Kingdom, Vol. 1, The Birth of Broadcasting* (London, 1961).

Conrad did with his amateur license. He played music; he advertised the firm that lent him records, and he engaged in one-way transmissions to listeners he could not identify—that is, he broadcast. For any one of these activities he would, today, have his license suspended by the Federal Communications Commission.[94] This is because there has come into existence an elaborate code of regulations designed precisely to insulate the operation of amateur radio stations from the commercial market. But it was not so in Conrad's day. And that is why it was so easy for amateur stations to make the transition to commercial broadcasting. There was no clear boundary, no perimeter beyond which the enterprising amateur might not go. There was, certainly, the technical challenge, the sheer pleasure of exercising a new skill. But there was also, for some, the knowledge of a market opportunity and the freedom to respond to it.[95]

In Conrad's case what made the difference was the intervention of his employer, the Westinghouse Company. H. P. Davis, vice-president of Westinghouse, saw the newspaper publicity about Conrad's broadcasts and took the initiative in establishing a station explicitly intended for broadcasting at the company's plant in East Pittsburgh. The move has to be seen in the context of the situation in which Westinghouse found itself at that time. It had gone to some expense to acquire the Fessenden and Armstrong-Pupin patents. It had committed itself to purchasing a major interest in International Radio. But it had failed completely to break into telecommunications. The exclusive traffic agreements that served as RCA's defensive ramparts remained intact. The blunt fact of the matter was that, in the early fall of 1920, Westinghouse had failed to establish itself in the only field of radio communications that then offered prospects of commercial profitability. Other options had been explored: demonstrations of radiotelephony for the Fall River Line and for the New York, New Haven and Hartford Railroad, for example. But without success.[96]

In the circumstances, one may admire the promptness and energy with which Westinghouse moved to exploit the first hints of a commercial market for broadcasting and yet consider some reaction of that kind

[94] One-way transmissions are permitted under certain specified conditions—for example, for experimental purposes, for emergency communications, and for the transmission of code practice and official bulletins consisting solely of subject matter having direct interest to the amateur radio service as such. See Federal Communications Commission, *Rules and Regulations*, Pt. 97, Amateur Radio Service, paras. 97.89 and 97.91 (Washington, D.C., various dates).

[95] For a partial list of amateur stations that made the transition to commercial broadcasting, see Barnouw, *History*, 1:82.

[96] Ibid., p. 66.

It can hardly be said, therefore, that RCA and its member companies were caught totally unprepared by the advent of broadcasting. But the matter had never been regarded as pressing, and the sum authorized for Sarnoff's project is a fair indication of the importance attached to it in corporate planning. The events of late 1920 changed all that. It was not inevitable that RCA, GE, or the Telephone Company would choose to follow the example set by Westinghouse and enter broadcasting directly, in the sense of setting up their own stations and organizing their own programs. It was certain, however, that as the demand for broadcasting increased, so would the demand for equipment and particularly the demand for vacuum tubes. This demand could be met only by RCA, in its role as sales agent for GE and the Telephone Company (apart, that is, from tubes sold by de Forest personally and by firms producing tubes with licenses from de Forest or with no license at all). And equipment using tubes, whether receivers or transmitters, could be manufactured only by the member companies of RCA, or by such other firms as they might choose to license. The cross-licensing agreement had, among other clauses, allocated to GE the right to manufacture broadcast receivers and to the Telephone Company the right—the exclusive right, its executives believed—to manufacture radiotelephone transmitters. Broadcasting confronted both companies with an urgent and exponentially growing demand for which neither was prepared. And that demand was of a novel type: it was a demand, not from shipowners, telegraph companies, or government departments, but from local entrepreneurs and homeowners. Any attempt to enforce exclusive rights, to the detriment of consumers or potential competitors, anything that could be construed as deliberate restriction of output, was certain to have grave social and political consequences.

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What Westinghouse had done was demonstrate that a latent demand for broadcasting existed and that it could be served by relatively unsophisticated facilities and a modest investment of capital. This did not mean, however, that Westinghouse, or any other company outside the RCA group, was in a position to serve that market legally. Any transmitter Westinghouse might manufacture was certain to use vacuum tubes and would necessarily infringe patents held by the RCA consortium. So would every receiver beyond the simplest crystal set. By the late fall of 1920 Westinghouse had four different receivers ready for the consumer market;

not one could be sold without inviting legal action.[104] Just as RCA's traffic agreements had kept Westinghouse out of international radio, so now the armory of patents held by RCA and its member companies threatened to exclude it from the domestic market. The Fessenden and Armstrong patents held by Westinghouse were indeed valuable assets. But every regenerative receiver needed at least one vacuum tube; every heterodyne set needed a local oscillator.

As had been true somewhat earlier with AT&T, the pressures for integration could not be ignored. Westinghouse needed access to patents that the RCA group controlled; and similarly RCA, GE, and the Telephone Company needed access to the patents that Westinghouse had acquired. A patent war—as Young had reassuringly told the RCA technical committee in August—was really not probable.[105] There were simpler ways. It was, after all, a question of trading.

In September 1920, after Kintner's abortive mission to Europe and before the establishment of KDKA in Pittsburgh, Owen Young had made Westinghouse what he considered a fair offer: RCA would absorb International Radio; Westinghouse would get 700,000 shares of RCA common and the same number of RCA preferred; and a general exchange of patent licenses in the radio field would be arranged. The offer was refused. On 5 October Westinghouse acquired the Armstrong feedback and superheterodyne patents. On the tenth of that month Young reported to his board that he had raised his offer to one million shares each of RCA common and preferred. There was no immediate response from Westinghouse.

What held up agreement was neither the price Young offered nor the intrinsic desirability of a patent exchange, but rather the tricky question of how the business of radio manufacturing should be divided up. If Westinghouse were to join the group, it would be as a manufacturer of radio equipment for RCA to sell, as was true of General Electric and the Telephone Company. What proportion of RCA's business should go to Westinghouse and what to the other firms? In the case of the Telephone Company the issue had been handled—at least on paper—by specifying fields of activity: in other words, the type of equipment determined which firm would manufacture it.[106] This would not work with Westinghouse, which had every intention of manufacturing broadcast receivers—GE's

[104] Clark Radio Collection, Cl. 14, abstract of manuscript history of radio; Schubert, *Electric Word*, p. 206.

[105] Young Papers, Additional Papers, Box 3, report of RCA technical committee, 25 August 1920.

[106] Case and Case, *Young*, p. 224.

assigned field in the compact with AT&T—and, if it could get away with it, transmitters also.[107] The alternative was a system of quotas: with the exception of those devices explicitly reserved to the Telephone Company, RCA's requirements for equipment covered by patents would be met by GE and Westinghouse, with the business divided between the two in stated proportions.

This, of course, was treading on dangerous ground. In the first place, any such prorating system would greatly increase RCA's vulnerability to antitrust action. This had been of some concern during the negotiations with AT&T; it was a much more sensitive matter when dealing with Westinghouse, traditional competitor of General Electric in the electrical industry. And in this case there was no timely letter from the Navy to rationalize the affair. Secondly, it posed tricky problems in determining the proportions in which output and sales should be divided, for there was little historical record to provide guidance and no obvious basis for setting percentages. A. G. Davis of GE was concerned enough about this issue to question the need to bring Westinghouse into the combine at all: GE and AT&T could get along without the heterodyne and feedback patents, he thought, even if that meant that RCA had to make do with second-best apparatus.[108] And thirdly, any such system was bound to introduce serious inflexibility into RCA's procurement and sales. This might have been of little importance if the company had remained primarily a telecommunications firm. But now it was entering a new industry; it was going to be selling to a different public; and it was certain to be facing a kind of competition it had not met before—competition from a score of small firms hungry for business, not overly scrupulous in their respect for patent rights, and prompt to respond to the shifts of consumer preferences. RCA had already given some evidence of slow corporate reflexes; the arrangement proposed with Westinghouse did not promise to make them faster. How was RCA likely to fare in the fast-paced market for broadcast receivers when it had no manufacturing or design facilities of its own, when reports from retailers and salesmen had to percolate slowly back to the engineers at GE and Westinghouse to have any effect? Sarnoff in particular had reservations on this score; sales experience in the next few years would fully justify them.

But these doubts and uncertainties did not override the pressures for integration. For GE and RCA the Fessenden and Armstrong patents were as near to indispensable as any patents could be. And International Radio, backed by Westinghouse, was a potential source of competition better

[107] Archer, *Big Business*, pp. 27, 98.

[108] Davis to Rice, 8 December 1920, quoted in Case and Case, *Young*, p. 224.

removed. Westinghouse, for its part, despite all its fast footwork in the preceding months, had worked itself into an almost impossible situation. Whatever its future role in radio might be, whether in broadcasting or in telecommunications or in manufacturing, it had to get licenses under the GE-AT&T patents. Consolidation of property rights was essential if the technology was to be effectively used.

Young left most of the negotiating to the two corporate presidents—Edwin Rice for GE and Edwin M. Herr for Westinghouse—and between them they worked out a solution to the only real difficulty that remained: the prorating of output. With the exception of types of equipment explicitly reserved for Western Electric, AT&T's manufacturing subsidiary, RCA would order 60 percent of its requirements of radio equipment from General Electric and 40 percent from Westinghouse.[109] These percentages were based roughly on the two companies' shares of the electrical business of the country.[110] The other clauses were in accordance with Young's offer of the previous October. The International Company was purchased outright. Westinghouse was issued one million shares each of RCA common and preferred. RCA received the $2.5 million that Westinghouse had agreed to subscribe to International. Seats on RCA's board of directors went to representatives of Westinghouse and International. And an agreement was drafted providing for the cross-licensing of radio patents. Young for RCA and Tripp for Westinghouse signed a preliminary agreement on 25 March 1921 and the final contracts were signed on 30 June.

[109] These percentages referred only to equipment covered by patents. For other devices RCA was free to buy from any supplier. To maintain amicable relations with United Fruit, Young urged that its subsidiary, the Wireless Specialty Apparatus Company, be encouraged to compete for RCA's business. See Young Papers, Copybook 802, Young to E. P. Edwards, 27 January 1922.

[110] *FCC Hearings*, p. 1311, testimony of David Sarnoff. This does not imply that, between them, they handled 100 percent; merely that their respective shares were in the ratio of 3 to 2.

charges of monopoly, to the threat of political attack, and to the risk of antitrust indictment. And the evidence of his correspondence and memoranda suggests that he was well aware of these hazards. RCA, as it existed after the entry of Westinghouse, controlled, directly or through its affiliated companies, every American patent of importance in the field of continuous wave radio technology. If any had escaped the net, if there existed outside the control of RCA any residual or personal rights to important radio devices or circuits, it was either through oversight or because licenses had been granted (as for example by de Forest and Armstrong) before the patents themselves had been purchased. With minor and unimportant exceptions, RCA in 1921 and the corporations associated with it controlled continuous wave technology in the United States as it had evolved up to that date. And, beyond this, because it was backed by the formidable scientific and engineering resources of Western Electric, General Electric, and Westinghouse, not to mention the foreign firms such as Marconi, Phillips, and Telefunken with which it had signed patent agreements, this group appeared likely to control developments in the future also.

This consolidation of rights to continuous wave radio technology had been the controlling principle of RCA's creation. Young and his associates were under no illusions about this. And as long as the corporation's primary orientation was toward the outside world, as long as its primary market was international radiotelegraphy and its primary responsibility was to function as the designated instrument of American radio policy, objections and criticisms were muted. RCA had its mandate from the federal government. Without the intervention of the federal government it would never have come into existence. No apologies were offered because none was called for. But broadcasting changed all that.

The Federal Trade Commission inquiry reflected the changed climate of expectations. It had been initiated in 1922 in response to the filing of a complaint to the effect that General Electric and others had set up RCA as a "bogus independent" with the intent of acquiring a monopoly in the manufacture and sale of radio apparatus. Inquiry into that charge was almost complete when the commission received broader instructions from Congress in the form of House Resolution 548, calling for an investigation of the ownership of patents in the radio industry, its pricing practices, and the existence of contracts, leases, or agreements that might tend to convey exclusive rights or privileges in the reception or transmission of messages by radio. Receipt of this resolution led the commission's staff to undertake a more comprehensive inquiry. It had two major foci: the cross-licensing agreements, and RCA's policies in the sale of vacuum tubes.

The commission, it should be noted, was not charged with the task of determining whether any of the facts it might uncover in its investigation might constitute a violation of the antitrust laws. Its responsibility was purely investigative—to provide such facts as might aid the House to determine whether the antitrust statutes had been violated, and whether further legislation might be advisable.[34] Within the limits of this mandate, the commission's investigators performed a creditable balancing act. They had no difficulty in showing that, in radio communications between the United States and foreign countries, RCA did have a monopoly and did refuse to sell or lease apparatus to potential competitors in that field. Nor was it hard to demonstrate that RCA and its affiliated companies did have substantial control of the radio art through their ownership of patents, that this concentration of ownership of patents had been a primary motive for the creation and expansion of RCA, and that it was very difficult if not impossible for any firm to function in the radio industry without licenses under RCA's patents. If, in certain passages, the language of the report seemed somewhat pejorative, this was a characteristic hard to avoid when discussing monopoly and concentrations of economic power. In general the tone was one of professional neutrality. The report itself showed little trace of demagoguery. Its strength lay not in any recommendations for action, for it contained none, but in the way in which it laid out for public inspection the complex network of agreements and contracts through which the radio industry had been reconstructed. Here, reprinted *in extenso,* were all the traffic agreements, all the cross-licensing agreements, all the sales agreements that had gone into the ordering of the American radio industry since the war. And if, to anyone with the patience to read the report and its exhibits, RCA might in the end seem to squat somewhat ominously at the center of this complex network, the image was perhaps not inappropriate.

Against charges that it held a monopoly in external radio communications RCA had ready defenses. It was much more vulnerable to charges of discriminatory practices and suppression of competition internally. Allegations of this nature had led the FTC to undertake the inquiry initially—Section 5 of the Federal Trade Commission Act had specifically outlawed "unfair methods of competition"—and they had generated much of the political heat responsible for House Resolution 548. Here RCA's control of the key vacuum tube and receiver patents placed it in a difficult position. Should it license these patents to others, thus generating competition in markets that it intended to exploit itself? If so, what royalties

[34] FTC *Report* (1923), pp. 7, 10.

should be charged? Given the nature of the market for broadcast receivers, decisions on these issues inevitably had a political dimension.

There was no clear road through these thickets. The complaints filed with the FTC had alleged, among other things, that RCA practiced discrimination in the sale of tubes, urging the company's jobbers not to sell tubes for use in receivers made by other manufacturers and penalizing those who did so. By the end of 1922 there were some two hundred of these independent manufacturers, and they had the larger share of the market: of the $60 million spent on the purchase of radio receivers in that year, only $11 million went to RCA.[35] This was dismal sales performance for a firm that, in terms of its patent portfolio and the engineering resources at its disposal, should have been able to dominate the market. In some cases these independent manufacturers undoubtedly believed that they were not violating RCA patents—for example, those who used the popular "neutrodyne" circuit patented by L. A. Hazeltine of Stevens Institute.[36] Others knew they were infringing but thought they could get away with it. All these sets, however, required vacuum tubes and it was RCA's contention that, apart from sales to amateurs, it was the only legal supplier of tubes. This was the reason for the pressure RCA put on its distributors, dropping those who ordered only tubes (since most of these ended up in receivers made by other firms) and favoring those who carried and pushed the entire RCA line. It was an understandable policy, particularly at a time when the manufacturers were straining to keep up with the demand for tubes and receivers; but it was a highly unpopular one.

It was also of dubious legality. The basic Fleming diode patent expired in 1922, and after that date considerable numbers of new firms entered tube production, despite the fact that the triode patent still had six years to run. Among these was Lee de Forest, relying on the residual rights that allowed him to sell tubes to amateurs. RCA knew very well that de Forest was selling tubes to people who could be called "amateurs" only in the broadest sense of the word, and asked him, in accordance with his original agreement with AT&T in 1917, to get from purchasers an agreement that any tubes they bought from him would not be used for commercial radio communication. When de Forest's company refused, RCA brought suit—and lost, the judge holding that to use the 1917 covenant in this way would be to use it for a purpose for which it was

[35] Barnouw, *History*, 1: 115, citing *Broadcasting*, 1939 Yearbook, p. 11.

[36] Rupert Maclaurin, *Invention and Innovation in the Radio Industry* (New York, 1949) pp. 127-29.

never intended. The result was a flurry of damage suits against RCA which were settled only at considerable expense.[37]

With receiver circuits, loudspeakers, and other components, it was much the same story. Even when what RCA took to be its legal rights could be enforced—which was less often than the company's lawyers tended to believe—this could be done only at considerable cost in terms of public reputation, relations with the rest of the industry, and heightened risk of antitrust indictment. Increasingly, therefore, RCA moved toward a policy of general licensing, accepting the existence of competition in fields that at one time it thought it could control and relying on low license fees and the threat of legal action to keep its competitors in line. The true strength of its position lay not in the arsenal of patents inherited from the past but in the fact that General Electric, Western Electric, and Westinghouse were the leading centers of industrial research in electronics. Through this process the technology of continuous wave radio became generally available to the radio manufacturing industry, despite the fact that the original intention had been to centralize it in RCA and its affiliated firms. For this development the pressure of public opinion, the unexpected weakness of RCA's legal position in certain key instances, and the omnipresent threat of punitive action under the antitrust laws were responsible.

The FTC Report had laid out the corporate structure of RCA in detail. There was no mystery to the cross-licensing contracts and stock ownership that linked GE, AT&T, United Fruit, and Westinghouse to the Radio Corporation, nor to the way in which these contracts allocated exclusive rights and fields of activity. But the report itself had little to say about these matters: its main emphasis was on trade practices. In this respect it reflected the thrust of the Federal Trade Commission Act of 1914 and of the Clayton Act of the same year—indeed, of Wilsonian Progressivism in general—rather than the Sherman Act's suspicion of concentrated economic power as such. In the short run this worked to RCA's benefit: the FTC's formal antitrust complaint, filed in 1924, was dropped in 1928, and the gradual relaxing of RCA's licensing policies quieted some, though by no means all, of the company's most vocal critics. This did not mean, however, that on antitrust issues RCA could breathe freely. The out-of-court settlement of a civil antitrust suit brought by Fessenden in 1926 demonstrated RCA's vulnerability.[38]

[37] Ibid., pp. 129-31.

[38] Ibid., p. 135. Fessenden sued for alleged violation of the Clayton Act in RCA's use of patents originally issued to him. RCA and its affiliated companies settled out of court by payment of $500,000 in damages.

and its associated companies alleging violations of the Sherman Act.[40] The timing struck some observers as too close to be coincidental, and Young for one believed that the indictment had been filed to prevent the unification agreements from going into effect. Certainly he and Sarnoff had underestimated the impression they would make on the public: what from inside RCA looked like a sensible reallocation of functions to the outside world seemed like the ultimate centralization of power in the "radio trust," with perpetual control vested in the giants of the electrical industry, General Electric and Westinghouse.[41] But, although announcement of the unification agreements may have affected the timing of the government's action, the indictment had clearly been in preparation for some time. RCA and the constellation of corporations linked to RCA had from the beginning offered a tempting target for antitrust lawyers, and a documentary record adequate to support a plausible indictment under the Sherman Act had been fully laid out by earlier inquiries. Nevertheless, the spring of 1930, with the financial community still jittery after the market shocks of the previous fall, seemed a strange time for a Republican administration to launch a major attack on big business, and it is probably true that political considerations had their influence. It was highly desirable for the Hoover administration to present itself as able and willing to stand up to the large corporations and defend the rights of the consumer and the small businessman. Owen Young was already being mentioned in knowledgeable circles as a likely Democratic candidate for the presidency and if, by attacking the corporations with which he had been so closely identified, his reputation could be tarnished a little, there might be partisan advantage in that too.

The FTC's investigation of 1922-1923 and its formal complaint filed in 1924 focussed on RCA's business practices, particularly its licensing procedures.[42] The 1930 indictment by the Department of Justice, in contrast, was aimed at RCA's structure. The department had two major objectives: first, to compel RCA to sever its corporate ties with GE and Westinghouse; and second, to eliminate all exclusive features from the cross-licensing agreements. Neither of these features was new: they dated from the corporation's earliest years and had been matters of public knowledge at least since publication of the FTC Report. What led the Justice Department to base an antitrust indictment on them in 1930 was its recent success in a case involving gasoline cracking patents in the oil industry.[43] In that case the lower courts had held that exclusive agreements based on patent pooling and patent licensing could be in violation of the Sherman Act. This was novel doctrine, and of course the decision was appealed. At the time the proceedings against RCA were initiated the appeal had not yet reached the Supreme Court. When it did, the decision was reversed. But in 1930 the attorney general had reason to believe that he had new grounds for an attack on RCA and its associated corporations.

Young put the essential issues succinctly when urging his friend Charles Neave to lead RCA's defense team. The suit was based, he wrote, on the theory that the original integration of patents, carried out during the formation of RCA, violated the Sherman Act because it tended to suppress competition. Further, the subsequent agreements on patent licenses, along with the stock interest held by GE and others in RCA, likewise suppressed competition because they extended the monopolistic effect of the patents beyond their expiration dates. RCA and its associated companies held that the original setup and the cross-licensing agreements were legal; the Justice Department held that they were not.[44]

The situation was a very dangerous one for RCA for a reason that may not be immediately obvious. The Radio Act of 1927, in specifying the powers and responsibilities of the new Federal Radio Commission, had laid it down in Section 13 that no licenses for radio transmission were to be issued to any individual or corporation that had been finally adjudged guilty by a federal court of unlawfully monopolizing or at-

[40] Petition in Equity No. 793, U.S. District Court, Delaware, in *United States of America v. Radio Corporation of America et al.*, (1930). Defendants named in the original petition were AT&T, Western Electric, RCA, General Electric, Westinghouse, RCA Photophone, RCA Radiotron, RCA Victor, the General Motors Radio Corporation, and General Motors itself (which had, with RCA, formed General Motors Radio in 1929 to exploit the market for automobile radios). In the early part of 1932 an amended and supplemented petition was filed which named as additional defendants International General Electric, Westinghouse Electric International Company, National Broadcasting Company, and RCA Communications.

[41] See, for example, the remarks of Senator Clarence Dill, as summarized in Case and Case, *Young*, p. 497.

[42] The FTC complaints were dropped in 1928. Carl Dreher (*Sarnoff: An American Success* [New York, 1970], pp. 134-35) refers to antitrust proceedings against RCA initiated by the Department of Justice in 1924, but this seems to be an error.

[43] Case and Case, *Young*, p. 499.

[44] This represents a drastic summarization of a highly complex issue, but it is hoped that it will suffice for a lay interpretation. For more professionally phrased statements of the legal issues, see Young to Neave (radiogram), 16 May 1930, reprinted in Case and Case, *Young*, p. 500, and FCC, *Walker Report*, Vol. 14 of Exhibits, "Report on Bell System Policies and Practices in Radio Broadcasting," 1 December 1936, pp. 566-68.

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To begin with, the American Marconi Company already had a strangle hold on the business of wireless communications in America. For any group, however soundly supported financially, to start from scratch and attempt to overcome such an adversary might well lead to ruinous competition. There were conditions, however, that complicated matters for the Marconi interests. Most important of all was the fact that responsible officials of the United States Government had decided that if national security were to be served no foreign-controlled corporation could be permitted to dominate wireless communications of the nation.

Another circumstance operated against the Marconi people. The Alexanderson Alternator and the Poulsen Arc, the only types of sending apparatus, except a French invention, that were highly efficient, were the products of American manufacturers. Without one or the other of these machines the Marconi stations would be at great disadvantage.

The patent situation was the greatest obstacle of all. During the war, as previously observed, the Government under its wartime powers had virtually pooled the patents of American inventors by informing them that if rights were considered infringed they should take their grievance to the Court of Claims. The patents were still in the Government bag, but with the official closing of the war the rival manufacturers would be entitled to assert all property rights in patents held by them. The mischief was that no one manufacturer had a complete system. The vacuum tube, for instance, involved patents originally issued to Fleming, deForest, Arnold, Langmuir and others. This was typical of other patent complications. The Marconi companies had purchased the rights of certain inventors; the General Electric Company held very important patents such as the Alexanderson Alternator; but the Westinghouse Electric and Manufacturing Company was also strongly entrenched in the same field. It was later to acquire the heterodyne device of Fessenden and the Armstrong "feed back" improvement on deForest's audion tube. A fourth holder of parts of the great jig-saw puzzle of patent control was the United Fruit Company with its crystal detector and the other patents controlled by it. Each of the four companies held portions without which the puzzle could not be fitted together, but since they were more or less bitter rivals, in litigation with each other except during the war period, the task of bringing their interests together in one company was an appalling one. Owen D. Young has thus described the situation then existing:

"It was utterly impossible for anybody to do anything in radio, any one person or group or company at that time. The Westinghouse Company, the American Tel. & Tel. Company, the United Fruit Company, and the General Electric Company all had patents but nobody had patents enough to make a system. And so there was a complete stalemate." [5]

Yet Owen D. Young, at the conference with Admiral Bullard, undertook to clear up the tangle and to create a great American radio corporation.

Sec. 100. The General Electric Company Offers to Purchase Marconi Interests.

Inasmuch as the United States Government had very effectively pooled the patent resources of the rival companies during the war and had not yet released its control over wireless patents it was natural that Mr. Young and his associates should have endeavored to work out a plan in which the Government could be a quasi partner. Since the idea of an American company had originated with officials of navy communications, Mr. Young's first thought was to proceed under a contract between the Navy Department and the General Electric Company, thus to give the undertaking a semi-official character.

A contract was accordingly drawn up in which it was provided among other things that a representative of the Navy Department should sit on the Board of Directors of the new company. Admiral Bullard and Acting Secretary of the Navy Franklin D. Roosevelt were heartily in accord with the plan. Secretary of the Navy Daniels was to return from France in a few weeks. Official action on so important a matter could not well be taken until the return of Mr. Daniels. The most that Mr. Young and navy officials could do in the interval was to work out details of the scheme.

It was not until May 25th that the plan could officially come before Secretary Daniels. At this conference in Washington Mr. Young laid before the Secretary of the Navy the plans thus far formulated to carry out the suggestions of Admiral Bullard. Mr. Daniels admitted that these plans were logical in view of the request from the Navy Department but expressed his disapproval on the ground that the proposed communications corporation would be in effect a giant monopoly—a trust, and Mr. Daniels abhorred trusts. Owen D. Young countered by pointing out that a cable monopoly already existed in favor of Great Britain and that the only hope of checkmating Britain's domination of all communications, cable and wireless, rested in the possibility of establishing a great wireless corporation owned and controlled by American citizens. He stated his belief that a monopoly is

[5] Testimony of Owen D. Young before Committee on Interstate Commerce, U. S. Senate, December 9, 1929.

J. Nally, former Vice-President, American Marconi Company; Edwin W. Rice, Jr., President, General Electric Company; John W. Griggs, former Attorney-General of the United States, former Governor of New Jersey, former President, American Marconi Company; Owen D. Young, Vice-President, General Electric Company; James R. Sheffield, law firm, Sheffield & Betts, former director, American Marconi Company; Albert G. Davis, Vice-President, General Electric Company; Gordon Abbott, director, General Electric Company; Edward W. Harden, former director, American Marconi Company.

Edward J. Nally now became President of the Radio Corporation and Owen D. Young chairman of the Board of Directors. C. J. Ross, former Secretary of the American Marconi Company, became the first Secretary of the Radio Corporation. The way was now paved for the carrying into effect of the ambitious plans on which Owen D. Young had been working for months past, by which he sought to consolidate the wireless facilities of the nation—to put together the "jig-saw puzzle" of conflicting interests in this great field.

The American Marconi Company on the 20th day of November, 1919, became officially merged with the Radio Corporation of America. To be sure, the corporation continued to exist for legal purposes thereafter in order to wind up its affairs, yet on this date it ceased to function as a communications corporation and RCA stepped into its shoes. Officers and operating personnel as well as the physical assets of the old company now were part and parcel of the new organization.

Sec. 105. The First Cross-Licensing Agreement.

The rapidity with which Mr. Young worked in these hectic days of organization is evidenced by the fact that on the very day when the merger of RCA and the American Marconi Company occurred, the first of the famous cross-licensing agreements was executed. As will be pointed out hereafter the cross-licensing idea—much criticized at a later time for its monopolistic features—did not originate with Owen D. Young. Its real author was apparently Captain Hooper, of the Navy Communications, who had urged it upon his superiors, and who in turn had urged it upon the General Electric Company and RCA, later confirming the same by a formal letter under date of January 5, 1920. The cross-licensing agreement was drafted by A. G. Davis, Vice-President of the General Electric Company, the contracting parties being RCA and the General Electric Company. Since this agreement was to serve as the model for future cross-licensing agreements it is deemed of sufficient importance to be included in the Appendix to this volume.[5]

[5] See Appendix, Exhibit "D."

This license agreement of November 20, 1919, established the rights of the Radio Corporation in the inventions and patents held by the General Electric Company as well as reciprocal rights of the General Electric Company in present or future inventions and patents which the Radio Corporation might own. By the terms of the agreement it was to continue operative for a period of twenty-five years. The importance of this new corporate device cannot be overestimated. True it had all the earmarks of monopoly—the tying of great corporations together in a network of reciprocal agreements. No one could have been more keenly aware of this than Mr. Young himself, yet it was obviously the only way of consolidating the conflicting interests in inventions and patents whereby a great national communications system could hope to function.

It will be remembered that Mr. Young had made definite overtures to the United States Government to participate in the creation and oversight of the Radio Corporation of America. As previously related, Secretary of the Navy Josephus Daniels had declined to approve such a plan, being intent upon his pet project of government ownership and operation of wireless communications. At least four bills were already in the Congressional docket providing for government ownership. While there was every prospect of defeat of the measures the new corporation nevertheless inserted in its by-laws the following provision:

"The corporation may permit a representative of the Government of the United States the right of discussion and presentation in the board of the Government's views and interests concerning matters coming before the board."

Thus was redeemed the pledge made to the Secretary of the Navy by Owen D. Young in his letter of June, 1919, announcing that he and his associates were about to undertake a mobilization of the wireless resources of the nation.

Sec. 106. Problems Confronting RCA.

Having effected a corporate organization, it became necessary to take over the radio stations and physical assets of the American Marconi Company. This was a task of great importance, since it vested in the Radio Corporation of America ownership and management of virtually all the commercial high power wireless stations in the United States. This task would have been much more difficult except for the fact that Edward J. Nally, former Vice-President and General Manager of the American Marconi Company, had been elected President of the Radio Corporation of America. His long experience as an executive and his intimate knowledge of the problems of wireless commu-

CHAPTER SEVENTEEN

Litigation and Rivalries

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Section 158. RCA Attacked as an Unlawful Monopoly.

THE RADIO CORPORATION OF AMERICA had completed but three years of corporate life, yet in that brief period unbelievable developments had occurred. It is not too much to say that at the beginning no official of the company—except David Sarnoff—had really glimpsed the possibilities of radio broadcasting as a feature of RCA's activities. Yet broadcasting sets were now in such demand that RCA was unable to fill the flood of orders that came pouring in. Not only that but this very inability to meet the public demand was causing competitors to arise in a veritable army. Home manufacture of sets was likewise stimulated.

The new President of RCA, who took office January 1, 1923, was Major General James G. Harbord. General Harbord had been a Rough Rider in the Spanish-American War and Chief of Staff under General Pershing in the World War. In the Belleau Wood to Chateau Thierry fighting he had commanded the marine brigade of the Second Division. In 1918 he had been in command of the important department of supplies for the entire A.E.F. Unquestionably RCA had chosen a man of wide experience and great executive ability—a worthy successor to Edward J. Nally.

An event of great significance to the history of radio occurred in February, 1923, an event that necessarily became a closely guarded secret of RCA. For several months Major Edwin H. Armstrong had been working on a radio set of highly original design. He had combined his own ideas with those of another inventor, Harry Houck, and had produced what was later to be known as the Radiola Super-Heterodyne, a set that was destined to revolutionize the radio industry. This was the age of battery sets, and the Armstrong invention was equipped with batteries. It was, nevertheless, so uncanny in its selectivity and sensitiveness that it was possible to operate it without the use of an antenna. It appears that Armstrong first exhibited the device to the astute General Manager of RCA, David Sarnoff. Mr. Sarnoff had just concluded arrangements that involved ordering several million dollars' worth of an improved type of radio that had been devised by RCA engineers. He was so impressed by the Armstrong invention that he at once halted these negotiations, much to the disgust of Westinghouse and General Electric, who were all set for quantity production. It was necessary, however, to convince the Board of Directors of RCA. An interesting incident arose when Major Armstrong took his new radio set to Owen D. Young's apartment for a demonstration, Mr. Young being chairman of the Board of Directors of RCA. When Major Armstrong came out of the elevator he carried the radio in his arms—the radio in full operation with an opera program in progress. This was so astounding an achievement in radio technique that there

was no hesitation about adopting the Armstrong device. Months must elapse, however, before the machine could be offered to the public. It was not until the following summer that RCA announced the new Super-Heterodyne radio set. Not until 1924 was it possible to offer the device to the public in a nation-wide market. To the foresight of Elmer E. Bucher in suggesting the idea and to the genius of Major Armstrong, was due one of the great achievements in the early years of RCA's career.

One of the great problems confronting RCA in the winter of 1923 was that of patent infringement. The Corporation owned or had exclusive licenses under practically all of the important radio patents then outstanding in the United States. It had a legal right to prevent unlicensed manufacturers from producing and selling radio equipment that involved RCA patents. The unforeseen demand for radio sets all over the nation had furnished opportunity for unscrupulous dealers and fly-by-night manufacturers to reap quick harvests to the detriment not only of RCA but also of the multitude who were unfortunate enough to have purchased "bootleg" equipment.

Faced with this dilemma, the board of directors of RCA authorized an appeal to the courts. The test case was apparently that brought against the A. H. Grebe Company, a well-known radio manufacturer, alleging infringement of five patents owned by the plaintiff corporation. An injunction was sought to restrain the Grebe Company from further manufacture of radio equipment involving the patents in question without a license to do so from RCA.

The significance of this suit was at once apparent. If the Grebe Company could be obliged to come under the RCA banner then radio manufacturers all over the United States could be obliged to do likewise. Few of these companies could view the case without dismal forebodings. Each of them had friends in Washington—friends in the Congress of the United States. Does this explain why the mighty hullabaloo at once arose over the iniquitous radio trust? Even the temperate *Radio Broadcast,* published by the conservative Doubleday, Page & Company, at once joined the hue and cry against RCA, as will be seen hereafter.

The embarrassment of a congressional investigation with the necessity of producing all the cross-licensing agreements incidental to the establishment of RCA must have been a severe blow to that great corporation. Seemingly the Congress of the United States is never so happy as when it can summon the great financiers of the nation before an inquisitorial committee. The press is even more joyous. Headlines and yet more headlines spur on congressional crusaders in every trust-busting campaign. The luckless Radio Corporation of America was certainly in a serious predicament. Every cross-licensing agreement in its vaults was at first glance seeming evidence of guilt. In vain Owen D. Young and his associates asserted the rectitude of their intentions in forming the great corporation. An international task undertaken at the urgent request of the Federal Government, they averred, should not subject them to attack from the legislative branch of the same government. The inquisitors retorted that the Federal Government had never contemplated the setting up of a monopoly and accused the founders of RCA of taking advantage of the request from the Navy Department to accomplish purposes of their own. RCA responded by producing evidence that they could not have accomplished the allotted task except by a pooling of patents, just as the Government had done in the World War, except that cross-licensing was their substitute for the war powers of the Government. Thus was begun the long and expensive contest between the Government and RCA that was destined to make headlines for years thereafter.

In the March, 1923, issue of *Radio Broadcast,* Editor Arthur H. Lynch joined the hue and cry with a sizzling editorial entitled "Monopolizing Production of Apparatus." This must have been a blow much like that of Brutus when Caesar was assailed by his erstwhile friends. That *Radio Broadcast,* supposedly familiar with all the alleged extenuating circumstances, could have raised its hand was truly a staggering development. In the course of the editorial Mr. Lynch declared:

"The A. H. Grebe Company, one of the better known radio manufacturers, is now being sued for infringement of five different patents owned by the Radio Corporation—patents issued to deForest, Langmuir, Lowenstein and Mathes over a period reaching from 1902 to 1922, these patents covering tubes and circuits for using tubes. Should the injunction which is sought by the Radio Corporation be granted, it seems that every manufacturer in the country would be put out of business—excepting, of course, the Radio Corporation itself. It seems that a monopoly of the most grinding sort is the object of this firm. . . . To give some idea of the scope and nature of the injunction sought by the Radio Corporation, we quote a part of one sentence of the plaintiff's bill, as affecting the deForest patents. In one paragraph of the complaint on which the Radio Corporation bases its prayer to the Court, it appears that the defendant, A. H. Grebe Company, 'did unlawfully and wrongfully make . . . wireless receiving sets adapted, designed and intended for use in combination with, and useful only in combination with, vacuum detector and amplifier tubes. . . .'

"A radio set must necessarily be used in combination with a detector, crystal or tube, and evidently all radio apparatus, be it coil, condenser, or what-not is 'intended for use in combination with' either tube or crystal. Hence the owners of crystal and tube patents could control everything in the radio field."

aids. A good personality, a musical voice, a power of dramatic gesture have served to cover up baldness of thought and limping phraseology. . . . The radio is even more merciless than the printed report as a conveyor of oratory. . . . It is uncompromising and literal transmission. The listeners follow the speech with one sense only. There is nothing to distract their attention. They do not share in the excitement and movement of the meeting, nor does the personality of the speaker register with them. It is what he says and the words he uses in saying it that count with them. . . . Somehow the spread-eagle sort of thinking and all the familiar phrases and resources of the spellbinder sound very flat and stale over the air. Radio constitutes the severest test for speakers of the rough-and-ready, catch-as-catch-can school, and reputations are going to shrink badly now that the whole nation is listening in. Silver-tongued orators whose fame has been won before sympathetic audiences are going to scale down to their real stature when the verdict comes from radio audiences."

Fifteen days of oratory, of cheer-marathons, of marchings and countermarchings of delegates for this and that candidate, marked the sweltering contest that ended in the selection of a compromise candidate. William G. McAdoo reached his high point on the 69th ballot when he polled 530 votes. But he could not win, nor could Al Smith nor Oscar Underwood. John W. Davis was chosen on the 103d ballot!

Two national heroes had emerged from the grueling contest—U. S. Senator Thomas J. Walsh, the presiding officer of the convention, and Graham McNamee, the radio announcer whose picturesque descriptions of convention scenes and events went out over nineteen great radio broadcasting stations. Major J. Andrew White of WJZ also deserves honorable mention, but his radio audience was insignificant in comparison to the millions of radio listeners who were tuned to the McNamee broadcasts.

In the archives of the National Broadcasting Company is a typewritten statement by Graham McNamee that portrays in vivid manner his impressions at the close of the convention. The following is an extract:

"I wasn't overweight when I started announcing the convention and I lost eight valuable pounds in that little glass enclosed booth. . . . There was plenty of excitement and some of the things that happened will never be forgotten. One of them was that Smith demonstration featuring a four foot siren only three feet away which pumped several horsepower of noise into my ear. . . . 'Twenty-four votes for Oscar Underwood,' is still ringing in my ears. After hearing it more than a hundred times during those eventful fifteen days, I suppose I will be singing that in my sleep forever after. Another picture that remains indelibly stamped in my memory is that vast audience with attention

focused on the thousands of delegates; their changing moods as they were roused to enthusiasm during the great demonstrations and their utter boredom as they took ballot after ballot without material change, and finally the relief that was shared no doubt by the radio audience when they finally did agree upon John W. Davis."

On July 4, 1924, the LaFollette Progressives met in a convention in Cleveland. The expected happened. Democrats and Republicans were denounced in words of burning eloquence. Senator LaFollette was nominated for President and Senator Burton K. Wheeler for Vice-President. The way was now clear for months of oratory from Maine to California. The conventions had served to confuse the country. Nobody knew how many Republican votes would go to LaFollette and nobody was rash enough to predict how the disappointed adherents of McAdoo, Smith and Underwood would react to John W. Davis, already publicly assailed as a corporation lawyer—attorney for Wall Street who had been chosen by delegates exhausted in body and soul and in a mood to choose anybody save the three real leaders of the party. LaFollette based his hopes of success in the relatively colorless personalities of Coolidge and Davis. The issue, he believed, was in the lap of the gods!

Sec. 174. Strife Among the Godfathers of RCA.

The summer of 1924 witnessed an interesting development in the relationship of the giant corporations that had collaborated in the setting up of the Radio Corporation of America. It is well known that each corporation in return for patent rights and privileges had received stock in RCA. This corporation, despite its great earnings, had not yet been able to pay dividends on its common stock and had paid but one dividend on the preferred stock.[6] It was now asserted that the A. T. & T. Company had disposed of its entire holdings of RCA stock,[7] which was construed to mean an intentional casting off of a distasteful alliance. Rumors of impending law suits between Westinghouse and A. T. & T., deForest Radio Telephone and Telegraph Company, and the General Electric Company over patent rights were given credence by *Radio Broadcast*. "The patent involved," writes the editor, "is one for 'an improvement in method and apparatus for pro-

[6] An interesting commentary on current trends was that although the Radio Corporation of America derived its chief sales profits from vacuum tubes, yet on August 5, 1924, it voluntarily reduced the price of Radiotrons to $4.00, making the second $1.00 reduction for the year. The price had been $6.00 but on January 11, 1924 it had been scaled down to $5.

[7] In the Federal Trade Commission investigation the Telephone Company asserted in its answer that on February 1, 1922 it began to sell its RCA common stock and by April 1, 1922 had disposed of the last of it; that on June 24, 1922 it began to sell its preferred stock, completing the sale by January 22, 1923.

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"against claims of any and all kinds" in the carrying out of government contracts, and each was told to use "any patented invention necessarily required." [12] The log jam was broken. Development and production forged ahead.

Such means made possible a vast co-ordinated development of radio technology during World War I. While serving war problems, it set the stage for things unforeseen. It was a development financed by government, co-ordinated largely by the navy. This was its hour. With few restrictions as to funds, it became the inspirer and guiding patron of diverse assembly lines and research laboratories, from huge ones like Western Electric to fledglings like the AMRAD unit at Tufts.

Because a central need was vacuum tubes, the work soon included two great lamp-bulb manufacturers, General Electric and Westinghouse. It would not have occurred to anyone a few years earlier that lamp-bulb factories—like the GE plants at Harrison, N.J., and Cleveland, O.—would soon be war assets. Now they were that. Thus, two more industrial giants entered the world of radio, to play roles not less momentous than that of AT&T. The tube made them radio manufacturers and would eventually make them broadcasters.

The General Electric Company—a product of Edison's work on the electric light and of later mergers—had begun study of De Forest's Audion as early as 1912, at about the same time that AT&T showed interest in it. GE had at that time no right to market the tube, but its research laboratory was dedicated to the notion that its scientists should pursue any mystery that stirred their curiosity. "Are you having any fun?" was the question with which Dr. Willis R. Whitney, director of the laboratory, greeted researchers on his laboratory rounds.[13] This attitude toward research was to pay vast dividends. One of the researchers, Dr. Irving S. Langmuir, had decided to have fun with the Audion. He wanted—like Arnold at AT&T—to study the effects of a more perfect vacuum. (Fleming and De Forest had thought the residual gas was essential.) Within a short time GE had developed a tube that could be used in transmission with far higher voltages than the De Forest Audion. By 1914 daily on-the-air tests were being made between the Schenectady laboratory and the GE plant at Pittsfield, Mass. In these tests the high-vacuum tubes were used in conjunction with the Alexanderson alternator—descendant of the one made for Fessenden,

12. Archer, *History of Radio*, p. 138.
13. Hull, *Reminiscences*, p. 5.

which GE had patented. In the course of the tests the scientists exchanged comments on the research; amateurs within range wrote letters, contributing their own comments and providing needed information. The results were increasingly brilliant. When the war orders began to pour in, GE was ready.

While furthering the high-vacuum tube, the GE tests also focused new attention on the Alexanderson alternator, which gradually placed GE in a position of strategic importance. When Guglielmo Marconi came to the United States in 1915, he went to Schenectady for a look at the alternator. The visit came to have significance for two reasons: first, because it involved a man who had risen to the position of general counsel to GE, and who would make this a step toward a dazzling career in communications diplomacy—Owen D. Young; and second, because the discussions took a prophetic turn.

Marconi was apparently convinced that the alternator was the key to the still unsolved problem of reliable transoceanic communication. A huge deal was discussed: GE to retain exclusive manufacturing rights, the Marconi companies to have exclusive use. To obtain this, the Marconi companies would order a substantial number of alternators, for a purchase price of millions of dollars.

The discussions were cut short by the urgencies of war. As on a previous Marconi visit, he was suddenly needed in Europe, this time by the Italian government. The huge deal was set aside, at least for the moment. But one part went forward: a 50,000-watt Alexanderson alternator was delivered to the Marconi installation at New Brunswick, N. J.—and promptly taken over by the navy. Under navy sponsorship, researchers of GE and American Marconi continued to study and improve it, and marvel at its range.

As the needs of war mounted, GE's involvement grew. In the prewar period, at the GE research laboratory, vacuum tubes had been made one at a time by a glassblower, with other experimenters looking over his shoulder and making suggestions.[14] Not long afterwards they were in mass production. At one point the Signal Corps placed a single order for 80,000 tubes. All were made to exact government specifications, so that identical tubes could be made by other companies, and used with equipment designed and made by various companies—AT&T, GE, Westinghouse, American Marconi. More and more, their fortunes became interlocked by war.

14. White, *Reminiscences*, pp. 15-16.

important. In addition, a strong RCA might in the long run be a more valuable ally to British Marconi than a weak American Marconi. On November 20, 1919, with the approval of the stockholders, American Marconi transferred all its assets and operations to RCA.

Owen D. Young became chairman of the board, Edward J. Nally of American Marconi became RCA president. In January 1920, to no one's surprise, Rear Admiral W. H. G. Bullard was named the government representative who was to sit with the board.

On February 29 the government-held land stations and ship installations formerly owned by American Marconi were turned over to RCA. International wireless telegraphy on a commercial basis was begun by RCA the next day. Messages would go to England at 17 cents a word, in competition with cable rates of 25 cents a word.[3]

Thus RCA from its infancy virtually controlled radio telegraphy in the United States. Now it was ready to face radio telephony—and the deadlock of the vacuum tube.

Within a few months General Electric and the Radio Corporation formed an alliance with the American Telephone and Telegraph Company and its subsidiary, Western Electric. The patents of all would be available to each. These companies staked out areas of interest so that the world of electronic communication, as the conferees viewed it in the early months of 1920, might be developed co-operatively rather than in competition. AT&T, like GE, became owner of a block of RCA stock.

Meanwhile Owen D. Young was already making international moves. English, French, and German wireless interests had won concessions in South America, looking toward development there. Again Young moved with extraordinary rapidity, capitalizing on existing rivalries. There might not be enough business to go around; competition might be destructive to all. A "consortium" was therefore arranged; each would share equally in development costs—and in profits. In the final arrangements it was agreed that an American would be chairman, with important veto rights. This crucial edge, providing a lever of power in South America, was described by Young as an extension of the Monroe Doctrine.[4] Construction of stations began. Meanwhile RCA was already building 200,000-watt alterna-

3. Subsequently cable rates were lowered and RCA rates raised; in 1923 both became 20 cents a word. *Report of the Federal Trade Commission on the Radio Industry*, p. 36.
4. Tarbell, *Owen D. Young*, p. 136.

tors in California and Hawaii and negotiating for rights in China.[5] The general public was scarcely aware of the existence of RCA, but it was already a world force. During 1920 and 1921 the vision was taking shape —and at the same time expanding.

Almost all employees of American Marconi had continued with RCA. Among them was David Sarnoff, who became commercial manager for the new company. If Young had given no thought to broadcasting, Sarnoff had. He had once written an office memorandum about its possibilities; this had been ignored. Now Sarnoff mentioned it to his new boss, Owen D. Young. But by now, others were moving along similar paths.

FERMENT

After restrictions on amateurs were lifted in 1919 many experimenters—amateur and otherwise—became busy again. We have noted that Charles Herrold of San Jose, and Harold Power of Medford Hillside, were among those who prepared to go back on the air.

Similarly in Madison, at the University of Wisconsin, Professor Earle M. Terry was busy with station 9XM. In 1917 this station had started sending by Morse code daily weather bulletins supplied by the Weather Bureau, and several hundred listeners in farm areas around Madison seemed to value the service. The daily weather bulletins were resumed in 1919—again in code. But Professor Terry was anxious to shift to voice, which he had experimented with during the war. With vacuum tubes made in the university laboratory—none were on the market—he began voice tests in 1919 and continued throughout 1920. That fall occasional musical programs were heard over wide areas. During this period, a campus tradition tells us, the experimenters decided that Hawaiian music was especially suitable for radio, because it twanged anyway.[1] Professor Terry was surrounded by an ardent group that once again included Malcolm P. Hanson, back from overseas. By the end of the year, test broadcasts by 9XM were being heard in Texas. Beginning January 3, 1921, weather forecasts were given by voice every day, still supplemented by Morse code bulletins.[2]

In Detroit, publisher William E. Scripps of the Detroit *News* thought it

5. *Report of the Federal Trade Commission on the Radio Industry*, pp. 60-67.
1. McCarty, "WHA, Wisconsin's Radio Pioneer," *Wisconsin Blue Book 1937*.
2. Hanson, *Papers*. See especially letter to Professor Andrew W. Hopkins, November 12, 1923, reviewing the development of the station.

for friends or relatives, or going into business by starting radio shops. The assembling of sets became a national preoccupation. Complete sets were promised for sale in the near future and impatiently awaited. Newspaper bulletins on the subject were frequent. In the press KDKA programs were continuously discussed; columns of radio news and comment appeared. Plans for new stations were widely publicized. The Department of Commerce began to receive a wave of applications for "broadcasting" licenses; within a year it would become a tidal wave. Many were from amateur stations which wished to convert to a regular, scheduled broadcasting operation and asked for new wave lengths and call letters.

One effect of KDKA occurred in a Pittsburgh suburb. Edgar S. Love, an amateur we have already mentioned, had been operating for years in a coal shed behind his house in Etna, Pa., often with frost-bitten fingers. In 1920 he began getting Frank Conrad from the Wilkinsburg garage. When KDKA started Edgar's father let him bring the set into the house "and actually put up a good antenna." [18] The family started listening with him. Radio had entered the home.

After KDKA, circumstances changed dramatically for Westinghouse. In mid-1920 it had seemed about to be left behind as the GE-RCA-AT&T alliance swept forward. Then, late in October, Westinghouse had acquired control of the Armstrong-Pupin patents; a week later came the KDKA debut, and each moment of its reverberating success dramatized the value of those patents. The future of radio suddenly looked quite different.

On June 30, 1921, the epic of high radio diplomacy reached a fitting climax. The cross-licensing empire fashioned by Owen D. Young took in a new partner—Westinghouse. It became a GE-RCA-AT&T-Westinghouse alliance; an additional company, United Fruit, had also been invited to join because it owned patents on crystal detectors and a loop antenna. Now about two thousand patents were in the pool.[19]

Each of the partners acquired representation on the RCA board of directors.

Thus, within eight months after the KDKA premiere, the Owen D. Young creation reached completion. The allied companies, all pre-eminent in their own spheres, had readjusted their division of the new world of radio. The details of that division would begin to come to light before long.

18. Love, *Reminiscences*, pp. 4-5.
19. *Report of the Federal Trade Commission on the Radio Industry*, p. 3.

The patent allies became owners of RCA stock in the following proportions:[20]

	COMMON	PREFERRED	TOTAL	PER CENT
GE	2,364,826	620,800	2,985,626	30.1%
Westinghouse	1,000,000	1,000,000 (to be issued)	2,000,000	20.6%
AT&T	500,000	500,000	1,000,000	10.3%
United Fruit	200,000	200,000	400,000	4.1%
	4,064,826	2,320,800	6,385,626	65.1%
Others	1,667,174	1,635,174	3,302,348	34.9%
Total shares outstanding	5,732,000	3,955,974	9,687,974	100. %

Though designed for other ends, the alliance now seemed ready to take control of the broadcasting boom. For the moment, the group seemed powerful beyond challenge. Yet its very power made it a target—for competitors and government trustbusters. For although RCA and the alliance behind it had been formed with the active prodding of a few highly placed government officials, this could not exempt it from the watchfulness of those charged with responsibilities under the Sherman and Clayton anti-trust acts. Anti-monopoly rumblings stirred again, and grew.

Owen D. Young, writing in a later period, when RCA and big business in general were under sharp attack, expressed his views on the American capitalist:

> He works less for luxury than for power. His aim is primarily achievement. He will give away his money to universities and hospitals, but the power to embark on great enterprises he will not give away. And so I say to his critics, if this be materialism, make the most of it.[21]

Young had embarked on great enterprises and had achieved. He had created power. Power for what? He did not say. And the power would more and more be exercised by others.

While the KDKA venture brought the alliance to completion, it had a jolting effect on each of the allies. At the General Electric research laboratory William C. White found himself "amazed at our blindness . . . We

20. Archer, *Big Business and Radio*, p. 8.
21. *Saturday Evening Post*, November 15, 1929.

macy, was not ready to believe. Sarnoff was pushing something unrelated to their main preoccupation. They decided to appropriate $2000 so that he could produce a model of the kind of receiver he had in mind. This got the matter off the agenda momentarily. Then the success of KDKA put it right back on. RCA had, in effect, missed the boat. Within weeks the national excitement was boiling in a way that could not be ignored. Early in 1921 the reorientation within RCA was under way. In April, David Sarnoff, aged thirty, became general manager, and within months RCA president Edward Nally, confused by the new developments, began to talk to Owen D. Young about withdrawing from the leadership.

Sarnoff meanwhile kept on the move. Production plans for home radios were being hurried in the alliance group. Sarnoff felt that RCA must at the same time put itself dramatically into broadcasting. Among the most discussed coming events was the heavyweight championship prizefight scheduled for July 2 at Boyle's Thirty Acres in Jersey City, between champion Jack Dempsey, the "Manassa Mauler," and Georges Carpentier, champion of France. Sarnoff arranged to borrow a portable transmitter made by General Electric for the navy and not delivered. Submitting a license application, he recruited Major J. Andrew White, editor of *Wireless Age*, to organize the premiere. White with two electricians set out for New Jersey and persuaded the Lackawanna Railroad to let them use its property. An antenna was strung between railroad towers. Equipment was set up in a galvanized iron hut used by Pullman porters to change into their uniforms. Because the porters objected to the invasion, technician J. O. Smith slept in the hut to guard the equipment. A telephone line was run to the arena. There on July 2, with Sarnoff at his side, Major J. Andrew White did a blow-by-blow description that launched a new career for him but which, curiously enough, was not broadcast. In the railroad hut the information was jotted down and spoken into the microphone by technician J. O. Smith. Only Smith's voice reached the listener. Meanwhile the transmitter was operating at more than its intended power; shortly after Dempsey's victory by a fourth-round knockout, the overheated equipment became virtually a "molten mass." So went the debut—and temporary suspension—of WJY.[9]

For Sarnoff the entire venture, especially in its behind-the-scenes ramifications, was another triumph. He had won the co-operation of Tex Rickard, promoter of the fight, and they had arranged for radio sets and loud-

9. Goldsmith and Lescarboura, *This Thing Called Broadcasting*, pp. 210-11.

speakers to be set up at theaters, lodge halls, ballrooms, and barns throughout the eastern United States. About a hundred such gatherings had been organized as charity affairs, and an admission charge made for "aid to devastated France." Vigorous promotion had been provided under a sponsoring committee headed by Franklin D. Roosevelt. Also participating were the Elks, Masons, and Knights of Columbus. Amateur wireless groups had been enlisted to set up the equipment at the gatherings; the volunteer amateurs got certificates signed by Tex Rickard, Georges Carpentier, Anne Morgan, Franklin D. Roosevelt. Thus sports excitement, interest in radio, patriotism, and humanitarianism were all skillfully channeled into a formidable promotion for the age of broadcasting. As many as 300,000 people were estimated to have heard the broadcast.[10] The pot that KDKA had set cooking was kept boiling vigorously by RCA. Tubes and other parts carrying the RCA trademark were beginning to move into electrical stores; within a few months radio sets would follow. A demand was assured.

There was now no doubt who was in charge. David Sarnoff, the immigrant boy, the speed telegrapher with the great fist, the aggressive worker who would tackle the hard jobs, was running things. As he surveyed the scene for RCA and its allies, the outlook was brilliant. With two thousand patents, they were strong and well fortified.

Yet there were loopholes—totally unforeseen—that now came to plague the life of David Sarnoff.

One had to do with "amateurs."

Under the GE-RCA-AT&T-Westinghouse agreements, an effort had been made to allocate everything. The making of receivers and parts would be done by GE and Westinghouse; the marketing of these receivers and parts would be done through RCA under RCA trademarks. RCA would assign 60 per cent of all manufacturing to GE, 40 per cent to Westinghouse. The sale of transmitters would be mainly an AT&T concern. Telephony as a service, or involving any business aspect, belonged to AT&T, whether wired or wireless. RCA had limited rights in wireless telephony and the chief role in international communication. Government orders were exempted from the provisions of these agreements; any of the companies could fill government contracts in any field. There were innumerable additional provisos and reservations, but in general the radio world had been divided along these lines—*except for the amateurs.*

10. Archer, *History of Radio*, p. 215.

GE and Westinghouse could make—for sale via RCA—radio parts for the use of amateurs, for receiving or sending, and could transmit to them. But so could others. It will be recalled that De Forest and Armstrong had reserved certain rights in the amateur field. What did these rights amount to? And just who was an amateur?

All over the country amateurs—they now numbered tens of thousands—were buying parts and putting sets together. People wanted to buy these, so the amateurs sold them and got more parts and made more sets. Amateurs were also making transmitters, often using one or more parts sold by RCA. In many cases they then decided to use these transmitters for regular broadcasting and applied for new call letters and wave lengths. Thus 8MK became WWJ, Detroit; 9XM became WHA, Madison; 9CT became WDAP, Chicago; 1XZ became WCN, Worcester; 6ADZ became KNX, Hollywood; 9ZJ became WLK, Indianapolis; W9CNF became KWCR, Cedar Rapids. The amateur-made transmitters were leaving garages and attics and were, in many cases, appearing on the buildings of newspapers, department stores, hotels. AT&T was up in arms. These transmitters were not being used for amateur purposes but—said AT&T—for telephony as a service, in many cases with a business purpose. The terms of the alliance were being violated, said AT&T. GE and Westinghouse were also upset. All over the country sets were being assembled and sold, using parts covered by patents of the alliance. These companies likewise considered the terms of the alliance violated. The pressure was on Sarnoff to crack down on the "amateurs."

The upstart competition, though stemming from amateur beginnings, was rapidly turning into a sizable industry. Suddenly several hundred companies were at work. A number of entrepreneurs were turning out sets under Armstrong licenses, using his feedback circuit. Most were tube sets complete except for the tubes. Distributor or dealer or customer could insert the needed tube or tubes—generally RCA tubes sold for amateur use. Why not? Wasn't a radio listener an amateur?

The carefully built alliance of the titans, dividing the world, seemed to be crumbling. In the words of Lawrence Lessing, biographer of Armstrong, "A raggle-taggle mob of free enterprisers was running away with the business." The term "amateur" had come to cover "nearly everyone in the country." [11]

11. Lessing, *Man of High Fidelity*, pp. 132-4.

Herbert Hoover, Secretary of Commerce, discussing the boom that was inundating his office with paper, took note of the same phenomenon but in different terms. This boom, he said, had been created by "the genius of the American boy." [12] It was this genius that Sarnoff was now called on to chastise, and bring to book. It couldn't possibly be a popular move, but Sarnoff was a company man. The agreements had to be upheld. Patent rights must be respected. As RCA prepared to market radio sets it also girded for battle, while the mania mounted.

UP A LADDER IN NEWARK

Westinghouse had won a headstart in broadcasting and hoped to keep it. On the roof of the Westinghouse plant at Orange and Plane streets, Newark, a shack was being built. A transmitter had arrived from Pittsburgh—one of the duplicates of the KDKA transmitter. A staff was being assembled.

We come now to a time when broadcasting talent—producer and performer—began to develop as a separate entity. Heretofore the inventor had been impresario and often chief entertainer. Fessenden had played the violin, De Forest had read election returns, Conrad had introduced records. As broadcasting became corporate enterprise, specialization began.

Thomas H. Cowan—everyone called him "Tommy"—was a product of northern New Jersey. He got his first job with Thomas Edison in West Orange. From there he went to the Remington plant in Hoboken, which in 1916 was making ammunition for the armies of imperial Russia. The following year the Russian Revolution brought unemployment to Hoboken, but the Westinghouse plant in Newark was busy with United States war work so Tommy moved there and stayed on after the war. On a day in 1921 Tommy was told to go up to the roof, to the shack. They were going to try to "make this thing talk." [1]

Years before, staying with his aunt in New York at the age of fourteen. he had been an extra in the Metropolitan Opera, dressed as a child. The episode had clung to him and had now apparently caused his assignment

12. *Radio Broadcast*, May 1922.

1. Cowan, *Reminiscences*, pp. 1-10. He eventually became studio manager of WNYC, New York.

lines were being rejected. WJZ, asking for phone lines to broadcast the 1922 World Series—the New York Giants and the New York Yankees were again involved—received a flat refusal. In earlier days the Westinghouse stations had sometimes found the telephone people co-operative; in 1921 KDKA had broadcast a speech by Secretary Hoover from Pittsburgh's Duquesne Club via lines of the local company. But later AT&T instructed its local affiliates to discontinue co-operation of this sort and told Westinghouse that the alliance agreements ruled out pickups of this sort by Westinghouse.[23] RCA and GE received similar pronouncements. That is why their stations—and others—were struggling with lower-quality Western Union and Postal Telegraph lines, never intended for voice transmission. In time AT&T would introduce exceptions into this policy, but in 1922-23 applied it rigidly to give advantage to WEAF, New York, and presently to WCAP, Washington—second station in the toll system, launched in 1923.

As 1923 began, few other stations had thoughts of following in WEAF's footsteps. The Westinghouse stations—KDKA, Pittsburgh; WJZ, New York; KYW, Chicago: WBZ, Springfield—were not selling time nor planning to. Nor was WLW, Cincinnati, the already potent station started by Powel Crosley, Jr., to promote his Crosley radios. Nor were the leading newspaper-owned stations such as WWJ, Detroit; WMAQ, Chicago; WDAF, Kansas City.

But as whispers of success issued from the phone booth, as WEAF set new standards in technical excellence, especially in remote broadcasts, and as AT&T stepped up its investments in staff, programming, and promotion, all stations would feel the pressure.

The year 1923 therefore opened on a different note. A question about the financial structure of broadcasting had been raised. The discussion was on. A dispute was in the air.

Suddenly it was one of many.

DISCORD

The exuberance of 1922 carried into 1923 and beyond, and the boom went on. Sales of radio sets and parts had reached $60,000,000 in 1922 and went up to $136,000,000 in 1923.[1] The building of stations continued. Radio

23. *Ibid.* p. 58.
1. *Broadcasting*, 1939 Yearbook, p. 11.

columns, supplements, magazines expanded. Technical advances were made. New program ideas enlivened station schedules. Important subject matter was added. Professionalism developed.

But the excitement of 1923 was less child-like, and now there was a counterpoint of other sounds. Of some of the developing disputes the public was scarcely aware. Some would not reach a climax for decades. Yet a number of conflicts were already generating anger and bitterness. The dominance of the patent allies was a main source of conflict. It centered largely upon RCA and AT&T.

Of the $60,000,000 spent by Americans on receiving equipment in 1922, $11,000,000 was taken in by RCA as sales agent for General Electric and Westinghouse equipment.[2] It was a smashing sum and made the broadcasting field the chief source of RCA income, far exceeding marine and transoceanic communication. It strengthened David Sarnoff's position in the company.

But Sarnoff himself—and the allies generally—felt that the group had not obtained a sufficient share of the $60,000,000 total. They felt patent rights had been grossly violated. They were determined to improve their position.

Among the thousands of companies that were by now participating in the making of equipment, some two hundred were selling tube sets which were complete except for the tubes. Almost all these sets were eventually operated with RCA tubes—which had an effective monopoly.

During 1922 RCA sold 1,583,021 tubes. The company *had* to sell separate tubes to replace worn tubes in RCA sets, and also to serve amateur needs. But apparently most of the tubes sold were not going to these uses but were finding their way, through one channel or another, into sets assembled for sale by the two hundred companies.[3] These set-makers were thus boosting sales of RCA tubes, which might have been considered helpful to RCA and its suppliers, GE and Westinghouse. On the other hand, they were also taking the major share of the receiving-set market away from RCA, GE, and Westinghouse. The set-makers in question were of the opinion that they were not violating patent rights in making tube sets complete except for the tubes. RCA and its allies, however, insisted they were.

2. *Ibid.*
3. *Report of the Federal Trade Commission on the Radio Industry*, pp. 6, 82.

Undoubtedly the companies accused of infringement found safety in the large number of companies so accused. But, in spite of the numbers, RCA and its allies were determined to do battle.

In August 1922 an RCA patent policy committee, in a meeting attended by Sarnoff as general manager, recommended:

> That suits be brought . . . but that great pains be taken not to have a multiplicity of suits. Pains should, however, be taken to bring enough suits so that if one defendant goes out of business, time will not be lost.[4]

RCA also began to put increasing pressure on its distributors. It dropped distributors who ordered only tubes and favored those who pushed "the entire Radio Corporation line." Sometimes it allocated tubes to them in proportion to the number of complete sets ordered. For a time it required distributors to send, with an order for certain new tubes, an equal supply of burned-out tubes.[5]

At the same time the tube buyer was warned by a message on the tube carton that he was not authorized to use it "as an element or part of any combination" except as set forth in the RCA catalogue. This catalogue—if he found a copy and read it—told him that he was not to use an RCA tube with non-RCA components, "assembled or partially assembled." [6]

To the numerous set-makers the RCA moves were ominous and meant that the allies were determined to translate their tube monopoly into a monopoly in set manufacture and sale. The set-makers began to go to their congressmen. The "radio trust" became a burning issue on Capitol Hill.

A number of congressmen regarded concentrations of power—always a cause for watchfulness—as especially troublesome where the flow of information was involved. They were aware that the makers and sellers of equipment dominated the air. The large ones had been the first to enter broadcasting and had later won favored channels. Many other set-makers, including comparatively small firms, were also going on the air. They included, for example, A. H. Grebe, one of the first to place a set on the market, who had recently launched WAHG, New York.[7] This same A. H. Grebe had been chosen by RCA as one of the first targets for litigation.

4. *Ibid.* p. 90.
5. *Ibid.* pp. 83-5.
6. *Ibid.* pp. 72-3. Also *Radio Enters the Home,* title page.
7. Later named WABC and WCBS.

If RCA and its allies drove such competitors out of set manufacture, it would presumably also drive them off the air. The situation was therefore seen as more than a merchandising conflict.

On March 3, 1923, Congress requested the Federal Trade Commission to investigate the radio industry to ascertain whether patents were being used to gain control over "reception and transmission," and whether there was a possible violation of anti-trust laws. The FTC was not asked to make a judgment but to report all relevant facts. Thus an industry scarcely a year old had its first monopoly inquiry. Through months to come this would hover in the background.

While RCA was claiming infringement of patents by numerous set-makers, AT&T was making similarly sweeping claims about transmitters. During 1922 it asked all regional telephone companies of the Bell System to keep the parent company abreast of local radio matters. It told the regional affiliates that transmitters not made by Western Electric represented "in practically every case . . . an infringement of our patent rights." [8]

In February 1923, AT&T held a policy meeting to map action against infringers. Although almost six hundred stations were on the air, only thirty-five had bought Western Electric ($8500-$10,500) transmitters.[9] Another six stations had been equipped by AT&T's patent allies, who under the agreements were conceded the right to make transmitters for their own use but not for sale. Of the remaining five hundred-odd stations, virtually all were regarded by AT&T as violators of its patent rights.

William Peck Banning, AT&T executive who later wrote a company-sponsored history of the birth of toll broadcasting, explains that the wide sale of vacuum tubes "for amateur experimentation" made it easy for "local radio enthusiasts" to assemble transmitters. "If, however, such assembled transmitters were then used for broadcasts of entertainment and news, there was," Banning tells us, "an infringement of the American Company's patent rights." [10]

That AT&T regarded them as patent infringers was a surprise to several hundred stations. They had been so unaware of the problem that they had, in increasing numbers, been asking the Bell System for wires for remote pickups.

8. Banning, *Commercial Broadcasting Pioneer,* pp. 74-5.
9. *Ibid.* p. 134.
10. *Ibid.* p. 136.

> Perhaps you open your hearts and homes to them each week—Goldy and Dusty, the Gold Dust Twins, who come to "brighten the corner where you are," and perhaps you have written them of your pleasure, or perhaps you have delayed. Won't you then do it tonight? Notes of encouragement from the audiences of WEAF, New York; WGR, Buffalo; WEEI, Boston; WFI, Philadelphia; and WEAR, Cleveland, serve to brighten these dusky entertainers. Address the Gold Dust Twins, care of station WEAF, 195 Broadway, New York City, or the station through which this program has reached you.[67]

The letters came in a flood.

WEAF with its growing hookups and budgets became a mecca for artists. They were now less available for free performances. If stations everywhere felt the pressure of these developments, it was sensed especially by RCA's New York outlets, WJZ and WJY. RCA, still trying to program its stations on modest budgets and still fighting off ASCAP, resented WEAF's escalation of radio finances. WJZ too began to pay artists, and at the same time stepped up its campaign to persuade other companies to share the cost. Offering free time—and publicity—to companies willing to finance programs, WJZ was in essence giving away what WEAF was trying to sell. This was in turn resented by WEAF and its parent AT&T. They felt RCA was jeopardizing the toll venture. AT&T also claimed that RCA had no right, under the terms of the cross-licensing alliance, to use its station for such business purposes.

This was one element—the one clearly visible element—in the growing feud between AT&T on the one hand and RCA and its manufacturing partners on the other. Another issue between them was that of pickup and network lines, still withheld from RCA by AT&T. But a far more crucial issue was now appearing.

WASHINGTON GIFTS

During 1923 RCA had found increasing evidence that the AT&T subsidiary, Western Electric, was preparing to put a receiving set on the market. At RCA, GE, and Westinghouse this brought consternation. The alliance agreements were reread and protests conveyed to AT&T. This field, they

67. Banning, *Commercial Broadcasting Pioneer*, p. 262. On early chain broadcasts all interconnected stations were mentioned. According to Phillips Carlin, "McNamee and I used to vie with each other to see who could give the list of cities in one breath." The list finally grew too long. Carlin, *Reminiscences*, pp. 23-4.

warned, was out of bounds for the telephone company. Not so, said AT&T; its allies must have misunderstood the agreements.

At the start of 1924, RCA sets and parts, made by GE and Westinghouse, were selling at the rate of $50,000,000 a year—double the rate of the previous year. Was AT&T, while claiming sole right to broadcast for toll and to sell transmitters, also eying a slice of this $50,000,000 pie? What would such competition mean to RCA? Could its cumbersome arrangements, under which it had to co-ordinate GE and Westinghouse assembly lines, compete with the telephone colossus? Major General Harbord wrote to Owen D. Young: "It would possibly put us out of business." [1] They had ample respect for the prowess of AT&T.

RCA was in a state of alarm. A Washington episode added a note of fury. Early in 1924 RCA arranged to present a new radio to the White House for presidential use. While awaiting the setting of a presentation date, RCA learned that another set had been delivered to the White House —a superheterodyne donated by AT&T. Spies reported that it was large, magnificent, and much admired by the recipient.

The alliance agreements provided an arbitration machinery. Even before the White House incident the allies—AT&T, RCA, GE, Westinghouse, United Fruit, and subsidiaries—had agreed to arbitrate their conflicting interpretations of the alliance agreements, rather than air them in public. The machinery had been set in motion. In highest secrecy, with billions of dollars in expected revenue at stake, the case was to be argued in New York City before a single referee. His sole decision, said the arbitration agreement,

> shall constitute an adjudication binding upon each party hereto as finally and conclusively as an adjudication of a court having jurisdiction. . . . Each party hereto agrees that it will accept and conform to such determination, and after such determination has been made will not take any proceedings intended either to modify it or set it aside. . . .[2]

In January 1924, as the parties were submitting preliminary statements to referee Roland W. Boyden, they were startled by a bombshell from Washington. The Federal Trade Commission, which had recently completed its study of radio—*Report of the Federal Trade Commission on the Radio Industry*—and submitted it to Congress, now followed this with a formal

1. Archer, *Big Business and Radio*, p. 112.
2. *Ibid.* pp. 128-9.

complaint. It charged that the allies—AT&T, RCA, GE, Westinghouse, United Fruit, and subsidiaries—had "combined and conspired for the purpose of, and with the effect of, restraining competition and creating a monopoly in the manufacture, purchase and sale in interstate commerce of radio devices . . . and in domestic and transoceanic communication and broadcasting." [3] FTC hearings would look further into their agreements and competitive practices.

The FTC, like the public, seems to have been totally unaware of the behind-closed-doors arbitration launched in New York, in which the division of empire was being reviewed. The irony of the timing could therefore be appreciated by very few people.

The FTC action produced anxiety, especially in RCA. Its program of litigation was now held in abeyance as FTC developments were awaited and watched. But the highly secret arbitration was even more feared. Here the status quo faced an imminent, decisive threat.

In the arbitration the presentation of testimony began in May 1924. The FTC hearings did not begin until October of the following year. Both moved with agonizing deliberateness, and in time would converge with still other struggles. As the 1920's approached their midpoint, radio would be gripped by converging crises—in courts, Congress, Federal Trade Commission, secret arbitration. From these crises would come a new structure in American broadcasting.

Meanwhile the boom went on—in broadcasting, manufacture, set-buying. Business failures increased in number, but new entrepreneurs plunged in. The deluge of programs continued.

DEAR, DEAR FRIENDS

Christmas in 1924 was widely advertised as a "radio Christmas." In the December issue of *Radio Broadcast* more than two hundred companies advertised their equipment. They vied for attention with scores of brand names, a number of which would not face another Christmas. Among pages of slogans and promises the reader could learn about RCA's Radiola radios and Radiotron tubes and also about the De Forest Radiophone ("how many radio miles did you go last night?"), the Golden-Leutz Pliodyne-6 ("the 'perfect' receiver"), the Newport radio ("makes every day a

3. New York *Times*, January 28, 1965.

Christmas"), the Dynergy ("authorities agree on the Dynergy"), the Splitdorf 5-tube radio ("coast-to-coast with Splitdorf"), the Crosley ("of course it's a Crosley"), the Freed-Eisemann ("the difference is—finesse"), the Timmons ("housed in cabinets of rare beauty"), the Brandola ("one dial"), the Mercury ("the Stradivarius of radio"), the Sherma-Flex ("shipped on approval—send no money"), the Melco Supreme ("Aladdin had his lamp, you have the Melco Supreme"), the Marshall ("embodying a marvelous new, non-oscillating principle"), Magnavox ("the utmost in quality and value"), the Kennedy ("ask Santa to bring you a Kennedy"), not to mention such items as Na-Ald sockets and dials, the Bel-Canto loudspeaker, and the Danziger-Jones Kit of a Thousand Possibilities.[1]

What was America hearing, as 1925 began, on this profusion of equipment? Much was as it had been a year or two earlier, but there was a crucial new factor.

In its first years broadcasting had been dominated by anonymous personalities. The only people on the air regularly, the announcers, were largely nameless. In this respect as in others, early radio resembled early film, with its "Biograph girl" and other stirring mysteries. Aside from the announcers, most performers made such fleeting appearances that few became fixed in public consciousness. The announcers, anonymous or not, became recognizable.

In the first months at WJZ, Tommy Cowan adopted the practice of identifying himself with a set of initials—ACN. *A* stood for announcer, *C* for Cowan, *N* for Newark (later New York). The practice was considered an echo of wireless, and continued at WJZ until 1925. Each new announcer and each "operator"—another wireless echo—received a set of initials, starting either with *A* for announcer or *O* for operator. Because Cowan had preempted *C*, Milton J. Cross became AJN.[2] Because Bertha Brainard was ABN, Norman Brokenshire became AON. The policy apparently appealed to management for a reason that had also operated in the early film field: the fear that performers, if identified, might become unmanageable celebrities. There was basis for the fear. As voices became familiar, listeners developed a compulsive curiosity about the people behind them. Everywhere stations received innumerable queries about them. At WHAS, Louisville, these were answered with a form letter:

1. *Radio Broadcast*, December 1924.
2. Popenoe, *WJZ*, p. 16.

on, the engineer dashed off. As Bryson finished reading his talk, no engineer was in sight. Bryson ad libbed twelve minutes until the engineer returned.[26]

While new stations still sprouted, others prepared to follow. In North Carolina, Governor Angus Wilton McLean was campaigning vigorously for a high-powered station to be operated by the state as an educational service to rural areas. He argued that such stations should have priority over private stations in channel assignments.[27]

Listeners, too, were still multiplying. Purchases of sets and parts had slackened during the chaos, then shot up again:[28]

1925	$430,000,000
1926	506,000,000
1927	425,600,000
1928	650,550,000

Sets operated on house current were becoming common in 1927—Zenith was a leader in this—but battery sets remained important in rural areas. In a curious way radio and automobile, whose stocks were leaders in the stock market rise, also swept jointly through the countryside. "We would always sell the farmers the battery sets," recalled an Atwater Kent salesman who rode the West Virginia hills, first on horseback and later, as he grew prosperous, in an automobile. "If they had a Ford car, why, we'd put a Ford battery on their radio. If they had a Chevrolet, we put a Chevrolet battery, so that when the battery on the radio ran down, they'd switch it with the one in the car and get it recharged."[29] Also in 1927, car radios began to appear. Philco was a leader in this.

As radio still pushed in all directions, television moved ahead. Early in 1927 Philo Farnsworth patented a "dissector tube" that proved an important link in the development of all-electronic television. Meanwhile experiments using a mechanical scanning system also looked promising. In Schenectady, Ernst F. W. Alexanderson began experimental telecasts. In Pittsburgh, Edgar S. Love, a seasoned amateur, built himself a television set and picked up the Schenectady experiments—mostly silhouettes.[30] Also in Pittsburgh, Vladimir Zworykin pushed forward with his experiments. In

26. Bryson, *Reminiscences*, p. 108. He became Educational Counselor, Columbia Broadcasting System.
27. Wallace, *Development of Broadcasting in North Carolina*, pp. 123-6.
28. *Broadcasting*, 1939 Yearbook, p. 11.
29. Robinson, *Interview*, p. 3.
30. Love, *Reminiscences*, p. 6. Alexanderson, *Reminiscences*, p. 40.

New York AT&T held public television demonstrations. A magazine called *Television* appeared in New York. One of its advertisements said:

> I Thought Radio was a Plaything
> But Now My Eyes Are Opened, And
> I'm Making Over $100 a Week.[31]

There were others on the "get in on the ground floor" theme. Television fever was spreading.

Over this spectrum of nation-wide activity and its hopes and fears, the Federal Radio Commission now assumed supervision.

BIRTH OF THE FRC

In almost every respect the career of the Federal Radio Commission was weird, to the point of straining belief. It belongs in the annals of politics but had a fateful impact on broadcasting.

"Probably no quasi-judicial body was ever subject to so much congressional pressure as the Federal Radio Commission," said a Brookings Institution monograph.[1] The stakes were high.

The list of five FRC appointees drawn up by Secretary of Commerce Hoover and sent by President Coolidge to the Senate for confirmation was made up of Admiral W. H. G. Bullard (chairman), Colonel John F. Dillon, Eugene O. Sykes, Henry A. Bellows, and Orestes H. Caldwell. The first three were confirmed March 4, 1927, just before the 69th Congress adjourned and went home. However, one of them, Admiral Bullard, was in China at the time and died soon after his return. Another, Colonel Dillon, had cancer and also died within a few months. Until the following spring the FRC had only one confirmed member—Eugene O. Sykes, former Mississippi supreme court justice.

Meanwhile Henry Bellows and Orestes Caldwell, both unconfirmed, could not receive government salaries, but stayed on. During much of 1927 they carried the burden of the work and made crucial reallocations.[2] Bellows, still unconfirmed and still not on the government payroll, resigned in October and went back to Minneapolis, where he had been a broadcaster.

31. *Television*, Fall 1927. A magazine of the same title appeared at about the same time in Britain, where parallel television experimentation was in progress.

1. Schmeckebier, *The Federal Radio Commission*, p. 55.
2. Caldwell, *Reminiscences*, p. 10.

GE and Westinghouse would be reimbursed via additional blocks of RCA stock—and, in the long run, larger revenues.

As Sarnoff assumed the RCA presidency—with Major General Harbord moving up to become chairman of the board—the unification plan was going forward. Then there came a jolting interruption. In May 1930, the U. S. Department of Justice brought an anti-trust suit against RCA, GE, Westinghouse, and AT&T. It demanded the dissolution of the 1919-21 patent agreements. It also demanded that the companies disentangle themselves from each other. The interlocking of directorates was to end.

To some, this action seemed beyond belief. Conferences were held with the Justice Department, which held to its point. Settlement without trial would require divorcement of the tangled companies. In place of the patent agreements there was to be an open patent pool.

A year went by. So intricate were the interrelationships that the problems seemed to defy solution. Fruitless meetings were held, one after another.

Finally, an eight-page letter, dated October 1, 1931, came from Owen D. Young to the Department of Justice. He called attention to the "unprecedented economic and industrial crisis" of the nation. Much of this was caused by "ruinous competition . . . destructive rivalry." [21] The action of the Justice Department, it was implied, would destroy what stability there was in the radio industry, and lead to further catastrophes.

There were further meetings and letters, but the Justice Department was not persuaded. AT&T moved to make peace with the Department of Justice. No longer holding RCA stock nor board membership, it could readily do so. Late in 1931, under the cancelation clause in the cross-licensing agreements, it served three years' notice of termination.

As RCA, GE, and Westinghouse faced their perilous decision, business conditions worsened. In September 1931, Britain went off the gold standard. Repercussions were felt throughout the world. During that month 305 American banks closed; during the next month, 522 closed. Adding to the sense of international disintegration, Japan began overrunning Manchuria.

If the Justice Department anti-trust suit were to go to trial and were lost by the defendants, the antimonopoly clauses in the Radio Act of 1927 would come into play. Radio licenses of incalculable value—KDKA, WJZ, WBZ, KYW, WEAF, WGY, KOA, KGO, WMAQ, WTAM—were imperiled by the suit. If the defendants had hopes of a more lenient political climate, the news of the moment dispelled them.

21. Archer, *Big Business and Radio*, p. 358.

As 1932 began, most estimates of unemployment in the United States stood at ten million or more. In every city countless stores stood boarded up, empty. The sound of riveting had almost vanished. People combed through city dumps. More than a million people were thought to be roaming from place to place, often sleeping in boxcars; along every railroad track campfires flickered. Bitterness increased. Farmers began to resist evictions with pitchforks and shotguns.

It was an election year. Both parties prepared for June conventions in Chicago. It would be President Hoover for the Republicans. Among the Democrats the name Franklin Delano Roosevelt was heard most often. What was known of his views was not reassuring to the patent allies.

Against this background GE, Westinghouse, and RCA sat down in 1932 to work out a divorcement plan to stave off trial. A date for trial had been set: November 15, 1932, a week after election.

As the rumblings of the election campaign built to a roar, there were long, innumerable GE-Westinghouse-RCA meetings.

GHOSTS

Did it all make sense? Why did the Department of Justice, after years of off-again-on-again hearings by various agencies, launch this suit in the depth of an economic slump? To many in the broadcasting industry, intent on other interests, the development was completely baffling. In Washington reasons seemed clearer. To those with memories or a taste for history, the answer was clear enough. In the annals of communication, monopoly had long been held one of the most corrupting of influences.

In the decades after the Civil War the Western Union Company, by buying, swallowing, or crushing smaller companies, achieved a monopoly position. By 1873 its wires reached into thirty-seven states and nine territories and comprised the only nation-wide web. It was a key to wealth and power in many ways. Representative Charles A. Sumner of California charged in 1875 that sudden changes in market prices were repeatedly withheld from San Francisco until insiders made a killing. Control of the flow of information netted vaster fortunes than the profits from telegraph service; and this, monopoly-priced, made fortunes by itself.[1]

1. Harlow, *Old Wires and New Waves*, pp. 333-4.

To break the monopoly power by creating an alternative channel, bills for a government telegraph service linking the nation's post offices were introduced in Congress in 1869, 1870, 1872, 1874, 1875, 1881, 1884, 1890. But Western Union could muster crushing opposition. It worked in close alliance with the old Associated Press, which used only Western Union. Newspapers aspiring to national or international coverage lived at the mercy of these allies. Newspapers backing postal telegraph proposals found their rates raised or service ended. Publishers, editors, reporters knew this topic was out of bounds.[2]

Press control was matched in importance by other persuasive pressures. Congressmen, as well as state legislators, received franks—free telegraph privileges—in apparently unlimited quantity. A Western Union official wrote to a New York politician shortly before a convention:

> Dear Mr. ————:
>
> I enclose another book of franks, of which I have extended the limits to cover all Western Union lines.
> I hope they may help you make a good nomination. Please use them freely on political messages, and telegraph me when you want a fresh supply.[3]

The company was equally generous with both major political parties: it took no undue risks. The company's affairs and prosperity, President Orton of Western Union informed his board of directors in 1873, were subject to governmental action at all levels, and the franks had saved revenue "many times the money value of the free service." [4]

The power exercised by Western Union was used with increasing ruthlessness when it came under control of Jay Gould. In the 1880's the fury aroused by Gould's machinations—via his hold over railroads, telegraph, press, politicians—found vent in song:

> We'll hang Jay Gould on a sour apple tree
> And bring to grief the plotters of a base monopoly! [5]

After 1885 the growth of the AT&T web of wires ended Western Union's monopoly position and even permitted the rise of Postal Telegraph, a private company choosing a name that had become a sort of freedom banner.

2. *Ibid.* pp. 334, 338. John Wanamaker as Postmaster General under President Benjamin Harrison was among those who backed postal telegraph proposals.
3. *Ibid.* p. 337.
4. Western Union *Annual Report*, 1873. Quoted, *ibid.* p. 336.
5. *Ibid.* p. 405.

And the rise of United Press began to limit the power of the Associated Press.

These old battles were not quite forgotten in Washington; their echoes mingled curiously with new struggles.

The growing importance of networks in the field of news, their involvement in world-wide events and crucial issues, were welcomed by many. These could be seen as signs of growing maturity and responsibility. But they raised all the more compellingly the question: should the largest networks be controlled by the largest electrical companies, closely linked with mammoth utilities, who were among the most active lobbyists?

The generosity to President, congressmen, cabinet members, and other government officials—"worth," as NBC reported to the FRC in statistics for the year 1931, $2,047,200 "at regular rates" [6]—was welcomed. Reports on stewardship were surely needed in a democracy, and were a logical use of the air. But was there in this also something reminiscent of the Western Union franks? Did it likewise protect company revenues?

If fretful ghosts of yesterday were heard in an anti-monopoly chorus, so were living voices. A number of newspapers, staggered by the slump and radio inroads on advertising, were pressing the issue. So were RCA competitors. Month by month, smaller radio manufacturers were going into bankruptcy. Larger competitors were also being heard.

In 1930 B. J. Grigsby, president of the substantial Grigsby-Grunow, maker of Majestic radios, gave the Senate committee on interstate commerce an impassioned recital of the difficulties of competing with RCA. His company had entered radio manufacture in 1924, first making loudspeakers and other parts, later complete sets. In 1928 it had sought an RCA license. RCA was unwilling at that time to license more than twenty-five companies; Majestic entered the field by buying out a licensee who was on the point of collapse. Since then Majestic had paid RCA $5,302,879 in royalties. The RCA license did not tell the licensee what patents were covered. Perhaps this was because some patents were still in litigation. Majestic could not therefore know, said Grigsby, what it was buying for its five million dollars, other than immunity from suit by RCA. In fact, it did not believe it needed any patent of the patent group.

> But the radio combine had so terrorized the industry and the dealers and jobbers everywhere that they were afraid to handle what they called "unlicensed" sets. Our bankers said they would not finance us

6. *Commercial Radio Advertising*, p. 17.

unless we took out a license. They said they would not finance a patent fight against such a monopoly. . . . The merits of the patents were never examined by the bankers. The merits of the patents had nothing to do with it.[7]

The terrorizing referred to consisted of letters such as the following, sent to New York jobbers in December 1929:

Dear Sirs: We are advised that you are engaged in the manufacture, use, and sale of radio tubes which infringe each of the following United States Letters Patent, viz:

Arnold	1456528	Langmuir	1558437
Nicholson	1459412	Schottky	1537708
Langmuir (reissue)	15278	Seibt	1696103

. . . In behalf of our clients, the Radio Corporation of America, the American Telephone & Telegraph Co., and the General Electric Co., we hereby request that you refrain from further infringement of any of the above letters patent and that you account for all damages and all profit occasioned by reason of past infringements.

Yours very truly,
Fish, Richardson, & Neave[8]

Such letters, according to independent manufacturers, made jobbers afraid to handle anything but RCA-licensed equipment.

The RCA licenses required payment of a 7½ per cent royalty, based on wholesale costs. "No licensee," said Grigsby, "can long pay 7½% royalty to its competitor. Another grievance was the "tube-grab clause," so called because it required RCA licensees to buy RCA tubes and no others. Indignation over such issues helped foment the Justice Department suit, and also found expression in civil suits, which took RCA close to disaster.

The original tube patents of Fleming and De Forest, key elements in the formation of the patent alliance, had expired during the 1920's. To maintain their position the allies relied on later patents including those of Langmuir and Arnold, who had developed tubes with a more perfect vacuum. But in May 1931 the U. S. Supreme Court ruled that these refinements were not inventions and not patentable.[9]

A more serious threat was meanwhile developing. After expiration of the original patents, De Forest had re-entered tube manufacture, but his company found RCA's tube-grab clause an obstacle to marketing, and went bankrupt. The receiver, Arthur D. Lord, sued RCA, charging that its practices violated the Clayton Act. The U. S. District Court in Delaware agreed, and its ruling was upheld on appeal.[10] Did this require the Federal Radio Commission to strip RCA of its broadcasting licenses, under the 1927 Radio Act? In 1931, as RCA station licenses came up for renewal, the FRC had to face this issue. Two commissioners felt that the law—Section 13[11]—required them to void the licenses. The three others disagreed, arguing that the monopolistic practices had involved equipment only, not "communication." By this 3-2 decision RCA retained its licenses. But under the combined onslaught of civil suit, injunction, and Justice Department action, an overhauling of RCA practices was under way. RCA began making its patents available to all, and reducing royalties; the tube-grab clause passed into oblivion. All this was still not enough. The unraveling of RCA-GE-Westinghouse had to begin. The deadline was near.

7. *Commission on Communications*, pp. 1769-70.
8. *Commission on Communications*, p. 1870.
9. *De Forest* v. *General Electric*, 283 U.S. 664 (1931).

ARENA

The fear that the Radio Act of 1927 might be upset in court "before we would get a system going" affected—among others—Senator Clarence C. Dill, co-author of the law. As suits began and wound their way upward through appeal, he worried that "the judges might not know very much about this subject." He decided to get in touch with Chief Justice William Howard Taft of the U. S. Supreme Court.

. . . so I called him up on a Saturday morning at his home and I said, "I would like to come up and talk to you for a few minutes about a matter that I think is of some importance to you." "Well," he said, "Come on up." So I went up there, and he took me in his study, and he said, "What are you thinking about?" And I said, "Well, before I tell you, I want to say to you that I realize that I am going to discuss a case that is before the Court and—I have no interest in it personally, only the general public interest—and I, if I overstep my bounds, in the legislative body, talking to you as a judge, I want you to call my attention to it." And, "Well," he said, "I don't think the Court will be hurt in any way, and what is it?" [1]

10. *Lord* v. *RCA*, 24 F.(2nd) 565, affirmed 28 F.(2nd) 257.
11. See Appendix B, The Radio Act of 1927.
1. Dill, *Interview*, pp. 13-14.

De Forest demonstrates radio at San Francisco World's Fair, receiving Herrold broadcasts from San Jose.
AMRAD organized at Medford Hillside, Mass.
Marconi negotiates with General Electric for purchase of Alexanderson alternators.

1916 De Forest broadcasts music and election returns in New York.
David Sarnoff urges American Marconi to market radio music box.
Court decision leaves neither AT&T nor Marconi interests in control of Audion; patent stalemate develops.

1917 After United States declaration of war on Germany, radio equipment—commercial and amateur—is sealed or taken over by navy.
Patent struggles shelved for war production, by government order.

1918 Alexanderson alternator broadcasts President Wilson's Fourteen Points throughout Europe from New Brunswick, N.J.
Alexanderson alternator plays role in peace negotiations.
Navy seeks permanent control of radio in the United States; rebuffed by Congress.
Marconi renews negotiation for Alexanderson alternators; navy officials urge American monopoly.

1919 GE forms Radio Corporation of America to take over assets of American Marconi.
Amateurs resume activity.
Vladimir Zworykin conducts television experiments at Westinghouse.

1920 AT&T becomes RCA partner; AT&T-GE-RCA cross-licensing agreement.
Amateur stations broadcasting in many parts of United States.
Detroit *News* station 8MK broadcasts primary and election returns.
Westinghouse buys Armstrong and Pupin patents.
Westinghouse station KDKA broadcasts election returns.

1921 WHA, WJZ, KYW, WBZ, and other stations broadcasting on announced schedules.
Westinghouse and United Fruit become RCA partners, join cross-licensing pact.

1922 More than 500 broadcasting stations licensed during year.
First Washington Radio Conference.
AT&T builds WBAY and WEAF, introduces "toll" broadcasting.
ASCAP demands royalties from radio stations for use of music.
WGY Players launch radio drama.
WGY and WJZ linked for World Series via telegraph line.

1923 Federal Trade Commission starts radio-monopoly investigation.
WEAF linked with WNAC, then WMAF and WJAR, via telephone lines.
Westinghouse pushes short-wave experiments as alternative to wire network.
WEAF signs ASCAP agreement.
NAB formed to resist ASCAP.
Second Washington Radio Conference.

Dr. John R. Brinkley starts KFKB.
Eveready Hour launched.
Radio helps locate kidnapped son of Alexanderson.
Plans for first coast-to-coast hookup halted by death of President Harding.
Opening of Congress broadcast for first time.
Zworykin demonstrates partly electronic television system.

1924 WEAF drops Kaltenborn under State Department pressure.
AT&T and "radio group" begin secret arbitration.
FTC files monopoly complaint against patent allies.
Broadcasts of political conventions spur set sales.
Third Washington Radio Conference.
Coolidge campaign speech on 26-station coast-to-coast hookup.

1925 RCA permits announcers to use names.
Fourth Washington Radio Conference.
Department of Commerce halts licensing, permits station sales; traffic in licenses develops.
Sale of time increasing.
Thirty-seven educational stations give up.
WGN broadcasts from Scopes trial.

1926 GE, Westinghouse, RCA organize National Broadcasting Company.
NBC buys WEAF for $1,000,000; contracts for use of AT&T wires.
Government defeat in *U.S. v. Zenith* leads to period of "wave piracy."
Arthur Judson, seeking NBC contract, forms Judson Radio Program Corporation.

1927 Two NBC networks, "red" and "blue," in operation.
"Silent Night" abandoned.
NBC moves headquarters to 711 Fifth Avenue.
Judson and others form Columbia Phonograph Broadcasting System—later CBS.
Farnsworth applies for patent on electronic television system.
Radio Act of 1927 passed; Federal Radio Commission formed.
Jazz Singer debut brings hasty conversion of film industry to sound.

1928 FRC shifts most stations, abolishes eighty-three.
Twenty-three educational stations give up.
William Paley takes over CBS.
GE presents *The Queen's Messenger*, first television drama, in Schenectady.
RKO formed by GE-Westinghouse-RCA and film interests.

1929 *Amos 'n' Andy* becomes NBC network series.
Paramount buys 49 per cent of CBS.
RCA buys Victor Talking Machine Company.
Wall Street boom—with spectacular rise of RCA stock—followed by crash.

1930 Collapse of vaudeville brings radio vaudeville era.

Start of "Crossley" ratings, based on telephone calls.
Naval conference broadcasts from London lead to further international programming.
David Sarnoff becomes RCA president.
United States anti-trust suit against RCA and patent allies.
FRC terminates Dr. Brinkley's license for KFKB.

1931 Increase in commercial announcements, contests, premiums, merchandising schemes.
Shaw, Mussolini, Pope Pius XI, Gandhi broadcast to United States.
AT&T withdraws from patent alliance.
Educators campaign for Fess bill, to reserve channels for education.
March of Time begins over CBS.

1932 GE-Westinghouse-RCA divorce plan brings consent decree, terminates anti-trust suit.
NBC becomes wholly owned RCA subsidiary.
Eddie Cantor takes lead in "Crossley" ratings.
NBC starts television station in Empire State Building.
Paley buys back Paramount holdings in CBS.
Radio City under construction.
Increased tension between radio and press, film.

1933 Banking crisis leads to first Fireside Chat.

APPENDIX B / LAWS

The Radio Act of 1912

Public Law No. 264, August 13, 1912, 62d Congress. An Act to regulate radio communication.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,
That a person, company, or corporation within the jurisdiction of the United States shall not use or operate any apparatus for radio communication as a means of commercial intercourse among the several States, or with foreign nations, or upon any vessel of the United States engaged in interstate or foreign commerce, or for the transmission of radiograms or signals the effect of which extends beyond the jurisdiction of the State or Territory in which the same are made, or where interference would be caused thereby with the receipt of messages or signals from beyond the jurisdiction of the said State or Territory, except under and in accordance with a license, revocable for cause, in that behalf granted by the Secretary of Commerce and Labor upon application therefor; but nothing in this Act shall be construed to apply to the transmission and exchange of radiograms or signals between points situated in the same State: *Provided*, That the effect thereof shall not extend beyond the jurisdiction of the said State or interfere with the reception of radiograms or signals from beyond said jurisdiction; and a license shall not be required for the transmission or exchange of radiograms or signals by or on behalf of the Government of the United States, but every Government station on land or sea shall have special call letters designated and published in the list of radio stations of the United States by the Department of Commerce and Labor. Any person, company, or corporation that shall use or operate any apparatus for radio communication in violation of this section, or knowingly aid or abet an-

General Order 40

The Beginning of Broadcast Regulation in the Twentieth Century

by MARVIN R. BENSMAN

McFarland & Company, Inc., Publishers
Jefferson, North Carolina, and London

have an exclusive frequency but had to share its wavelength with at least one other.

The ten kHz separation required that the stations accurately maintain their position. Heterodyne action between two station frequencies producing whistling interference diminished during 1926-1927. There was also an improvement in the sensitivity of receiving apparatus to discriminate between stations operating close to each other. But, delays in the implementation of legislation and the inability of the Department of Commerce to control the number of new stations created the conditions for further deterioration of reception even with technical advances. From July 1926 to February 1927, 181 broadcast stations were licensed by the Bureau of Navigation. This made a total of 716 stations operating on February 7, 1927. Only seven months earlier there were 528 active broadcasting stations.[6] It was reported in *Radio Broadcast* that between July 1, 1926, and January 15, 1927:[7]

181 new stations were operating
148 stations were being built
280 stations were being planned
150 stations had increased power
70 stations had requested higher power
104 stations had changed wavelength

The Bureau of Navigation reported that from July 1926 to March 1927, "more than 200 stations have begun operating using any wavelength they might select which has resulted in a great deal of interference."[8] The sheer numerical increase was bringing about a chaotic situation. More stations were operating where previously there were only one or two stations. To make matters worse, some of these stations squeezed between assigned frequencies. This interposition of stations disrupted the entire system. When the newly appointed Federal Radio Commission met March 15, 1927, there was a total of 733 broadcasting stations.[9]

Reception improved in many cities because stations increased their power enough to drown out stations operating near or on the same frequency but from some distance away. Long distance reception retrogressed as a result of the frequency assignment problems, power increases and "in some places, the Chicago district being a notable example, stations are so numerous and the frequencies so close together that even the reception of local stations was impaired."[10] The beginning of network broadcasting brought a variety of better quality programs to local stations decreasing the listeners' dependence on distance listening for satisfaction.

The Department of Commerce published a report showing that the use of crystal receiving sets and headphones was decreasing rapidly because of the enormous increase in the number of tube receiving sets with loud speakers. The

newest receiving sets employed radio-frequency amplification and the super-heterodyne circuit. The super-het set had enough sensitivity and did not require an outside antenna or ground connection. More sets were of the uni-control type, and tubes had improved giving stronger output without distortion.[11]

Percent Increase-Decrease (-) Between 1923 and 1925

Loudspeakers:	Number	2,606,866	318%
	Value	$ 19,162,591	242
Headsets:	Number	1,397	-22
	Value	$ 2,264,527	-38
Receiving sets (tube type):	Number	2,180,622	1045
	Value	$ 88,800,538	566
Transmitting sets:	Number	112,656	-50
	Value	$ 1,355,430	-49
Transformers:	Number	3,413,933	117
	Value	$ 7,457,805	90
Rheostats:	Number	3,531,871	226
	Value	$ 2,084,188	118
Lightning Arrestors:	Number	2,971,379	69
	Value	$ 506,034	20
Radio Tubes:	Number	23,934,658	411
	Value	$ 20,437,283	108
Miscellaneous parts:		$ 27,978,097	115
TOTAL VALUE		$170,390,572*	215%

**Values given: manufacturers' wholesale prices*

This two-year period witnessed the breakdown of regulation, the passage of the Radio Act of 1927, and the transfer of control to the Federal Radio Commission. However, the Department of Commerce's involvement with radio regulation continued beyond this turbulent period.

I. The Breakdown of Regulation

Assistant Commissioner of Navigation Tyrer announced that as of January 25, 1926, the Bureau of Navigation had "89 broadcasting wavelengths, with an average of six stations to the wavelength. In addition, we have pending before the Department over 300 applications for new stations."[12] There

achieved by keeping the crystal at a constant temperature in a heated container (oven). The Federal Radio Commission was then able to order all stations to maintain frequency within one-half of a kilocycle.[122]

Receivers that could not reject signals from nearby sources also caused problems. One of many typical reports:

> The Bureau is informed that Notley resides within two blocks of F. K. Bridgeman's station [WFKB] and it is but natural that on any other receiver but the most selective set that interference would be created over a fairly broad wave band when the receiving apparatus is located within five blocks of a 500 watt transmitter.[123]

In another case the Department of Commerce found that a station license held by *The Principal*, a Missouri church school, was not actually operating its own radio station but was sharing equipment and frequency with another. They operated, under the call letters KFQA, a studio connected by land lines to KMOX ([K]irkwood, [MO] [X]mas). The church wanted to use distinctive call letters so as to not lose their identity:

> Moreover, the management of KMOX is equally desirous of having us use our own call letters in sponsoring our programs, since they often consist of church services and KMOX, being owned by many organizations, cannot well afford to sponsor any one church or religious program. Therefore, it is to our mutual interest to retain the respective identities of the two stations, with separate staff, call letters and announcers.[124]

The Department of Commerce allowed the KFQA call letters to be used in this manner pending further consideration.[125]

Increases in power created interference problems as much as the unauthorized switching of frequencies. A few stations were authorized an increase in power following the Zenith case. These occurred only because a supervisor had begun the approval process prior to the WJAZ decision. Permission to change facilities would not have been granted, "had this indication not been made by the Supervisor...."[126] RCA's WJZ (New Jersey) had been given permission to perform experiments with "high" power up to 50 kilowatts but it caused a great deal of interference over a wide area. RCA officials attempted to overcome the public's anger and "they were satisfied a great many of the complaints had been settled and that they were actively engaged with a large force of experts in visiting each party who filed a complaint for the purpose of overcoming their difficulty."[127] Nevertheless, on February 16, 1926, the New Jersey State Senate adopted a resolution directed specifically at WJZ's operations, asking Congress to empower the Secretary of Commerce to control radio stations and to control nuisances.[128] The Department of Commerce did not order WJZ's power to be reduced because the Zenith case had convinced them that they had no right to regulate power increases after April 1926.

III. The Passage of Legislation

H. R. 5589. Many, including Hoover, felt that the only way to prevent chaos was for Congress to immediately pass one of the bills it had under consideration. January 18, 1926, had been tentatively set as the date for hearings in the House on the White Bill (H. R. 5589). Senators Dill and Howell were scheduling their hearings for January 8. When Rep. White heard of this, he had his hearing advanced to January 6. He hoped this move would allow time for the passage of his bill and its transfer to the Senate before the Senate could pass its own bill sending that to the House. Rep. White's anxieties seemed unwarranted because the majority of the senators expressed little interest in the bills. Senate discussion devoted to broadcasting was primarily concerned with the question of monopoly. In contrast, action in the House came quickly.[129]

At the House hearings Secretary Hoover said:

> The primary condition that makes legislation necessary is the congestion in broadcasting. This situation has existed for some time. I have hoped that natural laws, working with scientific and mechanical advance, would themselves solve the problem without legislative intervention. But such has not been the case. Inventive genius has not been able yet to furnish us with more broadcasting channels. The desire to broadcast daily becomes more widespread, the demand for licenses steadily increases, we have today more powerful stations in operation and more applications that cannot be granted than ever before. The law has imposed the duty of providing for every applicant so far as possible, with the result that we now have too much crowding together, unscientific geographical distribution, overlapping confusion. The interference between stations has become so great as to greatly minimize their public service....
>
> I think, therefore, that in discussing this bill, we may take three facts as settled: first, radio legislation is absolutely and immediately essential if we wish to prevent chaos in radio communication, especially broadcasting; second, the bill now proposed has already received substantial approval and third, the principles declared in this bill have received the approbation of both the radio industry and the radio public.
>
> The distinctive features of this draft, which I consider of the greatest importance, are as follows:
>
> First: The bill affirmatively asserts and assumes jurisdiction in the Federal Government over all phases of radio communication in so far as such communication constitutes or affects interstate or foreign commerce. I believe that Federal supremacy is absolutely essential if this system of communication is to be preserved and advanced. There can be little question of the interstate character of this service. Every word broadcasted traverses state lines.

Telecommunications, Mass Media, and Democracy

The Battle for the Control of U.S. Broadcasting, 1928–1935

ROBERT W. McCHESNEY

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General Order 40 and the Emergence of Commercial Broadcasting, 1925–1930

The roots of the battle for the control of U.S. broadcasting lay in the 1920s. This chapter reviews the major developments of this decade, first looking at the nature of U.S. broadcasting as it emerged in the years 1920–1927, and then discussing the deliberations surrounding the passage of the Radio Act of 1927. The chapter concludes by evaluating the important general reallocation of the airwaves instituted by the Federal Radio Commission (FRC) in 1928, which effectively laid the foundation for the future of U.S. AM radio broadcasting. The general reallocation also provided the spark to the movement that arose to do battle with commercial broadcasting in the United States in the early 1930s.

American Broadcasting Through the Passage of the Radio Act of 1927

Most histories of U.S. broadcasting in the 1920s agree on a few basic points. First, almost all research emphasizes the manner in which radio communication was dominated by a handful of enormous corporations, most notably RCA, which was established in 1919 under the auspices of the U.S. government. RCA was partially owned by General Electric (GE) and Westinghouse. By the early 1920s the radio industry—indeed, the entire communications industry—had been carefully divided through patent agreements among the large firms. RCA and Westinghouse each launched a handful of radio broadcasting stations in the early and mid-1920s, although the scholarship tends to emphasize the American Telephone & Telegraph (AT&T) Company's WEAF of New York because it was the first station to regularly sell airtime to commercial interests as a means of making itself self-sufficient.

on the path to an advertising-based radio broadcasting system.[1]

Second, most scholarship highlights the role played by Secretary of Commerce Herbert Hoover, who assumed the regulation of broadcasting under the Radio Act of 1912, which had been passed to coordinate point-to-point communication and did not anticipate the emergence of broadcasting. Hoover issued broadcast licenses and assigned frequency wavelengths until the passage of the Radio Act of 1927, thus establishing himself as a figure of paramount importance in the development of the industry. Adamant in his belief in the superiority of having broadcasting "in the hands of private enterprise," Hoover believed that "those directly engaged in radio, particularly in broadcasting, should be able, to a very large extent, to regulate and govern themselves." Hoover accordingly convened four radio conferences between 1922 and 1925, mostly of broadcasters and radio manufacturers, to provide him direction as he regulated the burgeoning industry. These conferences were also intended to provide the broadcasters with an opportunity to develop self-regulation, which Hoover argued would quite properly minimize the role of government radio regulation. In 1925 RCA's chief engineer wrote to Hoover:

> It is a duty as well as a pleasure, to work with a division of government which shows so complete an understanding of the needs of the radio industry and so strong a determination to assist in guiding the industry to intelligent solutions of its various problems.[2]

Third, the scholarship emphasizes that the general public, to the extent it considered the policy issues surrounding this new technology, was generally in concert with the preceding developments, and certainly was not opposed in principle to what was transpiring. Radio broadcasting, Hoover noted, provided "one of the few instances that I know of when the whole industry and country is praying for more regulation."[3] Moreover, research acknowledges how the development of broadcasting as a capitalist industry was effectively unavoidable in view of the historically unprecedented high esteem accorded private enterprise in U.S. political culture in the 1920s. In sum, the scholarship emphasizes how the loosely regulated, private, for-profit, network-dominated, advertising-supported basis of U.S. broadcasting was implicit to the system from its beginning, with public support if not outright enthusiasm. The passage of the Radio Act of 1927, which established the FRC, effectively codified these developments and removed the issues from public and congressional contemplation thereafter.

There is an element of truth to each of the preceding statements. Left alone, however, they present a distorted picture of U.S. broadcasting in the 1920s, one that makes it almost impossible to comprehend the events between

1928 and 1935. It was true, for example, that there was agreement that broadcasting should not be owned or controlled by the government in virtually all public discussions of broadcasting; this matter was seemingly closed, to the extent it was ever open, with Secretary of the Navy Josephus Daniels's failed attempt in 1918 and 1919 to have the radio communications industry nationalized.[4] There was little sense prior to 1927, however, that private control meant broadcasting should be dominated by networks, guided solely by the profit motive, and supported by advertising revenues.[5] Indeed, in several important respects, the nature of U.S. broadcasting prior to 1927 was markedly different from the system that would emerge by the end of the decade. A more accurate picture may result from examining these differences in addition to emphasizing the similarities.

For example, although RCA, GE, AT&T, Westinghouse, and a few other corporations effectively dominated most aspects of the radio industry, broadcasting eluded the corporate net for much of the decade. The first national network, the National Broadcasting Company (NBC), was established in late 1926 by RCA when it purchased AT&T's broadcasting properties. The other major network, the Columbia Broadcasting System (CBS), was not created until 1927. In retrospect, it is clear that when launched the two networks and their affiliated stations were the dynamic component of U.S. broadcasting. Prior to the late 1920s, however, network broadcasting was rudimentary at best, consisting of a small portion of U.S. radio stations and was barely commented upon.

So what was the nature of U.S. broadcasting in the mid–1920s? A significant percentage of the stations were operated by nonprofit organizations like religious groups, civic organizations, labor unions, and, in particular, colleges and universities. One hundred seventy-six broadcast licenses were issued to colleges and universities between 1921 and 1925; in 1925 there were 128 active college broadcasting stations. Almost as many broadcasters were affiliated with the other types of nonprofit organizations. Nonprofit broadcasters played a distinct and notable role in U.S. broadcasting throughout the 1920s; one scholar has gone so far as to term them the "true pioneers" of American broadcasting.[6] "It is too often overlooked," commented C. M. Jansky, Jr., one of the leading radio engineers of the period, that "in the general scheme of broadcasting in the United States our educational institutions were at the start of things distinctly in on the ground floor."[7]

Even those private broadcasters that were operated by for-profit enterprises were not "professional" broadcasters in the modern sense. Newspapers, department stores, power companies, automobile dealerships, and other private concerns owned and operated most of these stations. Their raison d'être was to generate favorable publicity for the owner's primary enterprise, not to generate profits in their own right. There was little sense that broadcasting could be profitable throughout the 1920s. As the American Bar Association

(ABA) observed regarding broadcasting in the mid-1920s: "The conception of broadcasting as a business, with sale of time as its economic basis, was held by only a few."[8] The unprofitable status of broadcasting was emphasized by the FRC and the networks themselves as late as 1928 and 1929.[9] An AT&T survey of U.S. broadcasting in 1926 determined that approximately one-half of U.S stations were operated to generate publicity for the owner's primary enterprise, while one-third were operated by nonprofit groups for eleemosynary purposes. Only 4.3 percent of U.S. stations were characterized as being "commercial broadcasters," while a mere one-quarter of U.S. stations permitted the public to purchase airtime for its own use.[10]

In fact, the economic instability of radio broadcasting was its overriding feature in the mid-1920s. For example, the number of stations affiliated with colleges and universities fell from 128 to 95 between 1925 and 1927, due almost entirely to a lack of funds.[11] Throughout these years, discussion centered on how to make radio broadcasting self-sufficient. On more than one occasion, RCA executive David Sarnoff called for broadcasting to be conducted by a national nonprofit and noncommercial network, to be subsidized by "those who derive profits" from radio set manufacturing and related industries.[12] A contest conducted by trade publication *Radio Broadcast* in 1925 to determine how best to support broadcasting awarded first prize to a plan to have the federal government administer a fund collected from an annual radio set fee, à la Britain, to subsidize noncommercial broadcasting.[13] Even AT&T was unconvinced that its "toll" program was workable; in 1924, it briefly attempted to support its activities by having WEAF solicit listeners for direct donations to subsidize the programming.[14] As one observer noted in 1925, "the broadcasters and the manufacturers are as much at sea as anybody else as to the future."[15]

It is striking how infrequently direct advertising is mentioned as an acceptable source for revenues. Indeed, commercial advertising in the modern sense of the term was almost nonexistent prior to 1928. In 1925 the advertising representative of General Mills called upon twenty large broadcasters and was unable to purchase time from any of them. In 1927 the American Newspaper Publishers Association (ANPA) even assured its members, "Fortunately, direct advertising by radio is well-nigh an impossibility."[16] The toll broadcasting of AT&T restricted the firms that purchased airtime "to giving their name and the name of their product." AT&T's ability to sell its airtime was undermined by the willingness of the other stations, including those owned by RCA and Westinghouse, to give time away for free.[17] The basis upon which AT&T attempted to make toll broadcasting attractive was not that it would directly stimulate sales, but rather that it would bring "good will publicity" to the sponsor and "humanize" their relations with their customers. This "indirect" notion of radio advertising was held by all observers until 1927 or 1928.[18] Moreover, there was widespread antipathy to

the very notion of permitting commercial advertisers access to the airwaves; even the relatively less intrusive indirect form of the early and mid-1920s met with controversy. As late as 1929, NBC presented itself first and foremost as a public service corporation that would only sell that amount of advertising necessary to subsidize first-rate noncommercial programming, "the finer things which are not sponsored commercially," as NBC President Merlin Aylesworth phrased it.[19]

Finally, during his reign as secretary of commerce (1921–1929), Hoover did not set out exclusively or even primarily to enhance the capitalist development of the ether, although when the hegemony of the networks was challenged during his presidency (1929–1933) he resolutely avoided antagonizing the commercial broadcasters.

As emphatic as he was concerning the need for private ownership, Hoover equally stressed the duty of the government to regulate this "great public service" in the interests of the listener. He insisted that radio broadcasters had a public service obligation beyond that of maximizing profits and he opposed having the ether become dominated by a handful of corporations. He also repeatedly criticized the large role of "amusement" in radio programming to the exclusion of public affairs and educational fare.[20] Although a staunch advocate of advertising per se, Hoover argued that broadcasters should minimize its role on the air since a radio listener, unlike a reader, could not "ignore advertising in which he is not interested." Otherwise, he argued, "there lies within it the possibility of great harm and even vital danger to the entire broadcasting structure." Hoover also commended college radio stations as "a step toward the realization of the true mission of radio." With little recognition of, or taste for, the eventual role assumed by advertising, Hoover pondered how broadcasting could become economically viable. In 1924 he solicited major foundations to subsidize educational programming. In the same year Hoover also called for a 2 percent tax on radio set sales to "pay for daily programs of the best skill and talent."[21]

This was the context of U.S. broadcasting in the mid-1920s. After the Fourth National Radio Conference in 1925, Hoover argued permanent legislation regulating broadcasting was now necessary for the industry to break through its impasse. Seven different bills to provide permanent regulation had been introduced since 1923, but none of them could gather enough support. A major stumbling block was partisan concerns about whether broadcast regulation should be housed in an independent administrative agency or remain in the Department of Commerce.[22] When Congress failed to pass legislation in 1926, Hoover requested that the attorney general give him an opinion whether the existing licensing of stations by the Department of Commerce was constitutional. The attorney general replied that it was not, and a test case also ruled the existing regulation unconstitutional since the Radio Act of 1912 had provided no criteria for licensing. Hoover then discontinued all regulation, thus ushering in what came to be termed the "breakdown of the law" period; within six months more than 200 new broadcasters began to operate, increasing the total wattage from 378,000 to 647,000, and many did not respect the frequencies being used by others.[23] The ether had become chaotic. Congress then moved quickly, as Hoover imagined it would, to pass the Radio Act of 1927.

The committee deliberations concerning the Radio Act of 1927 and the overall debate in Congress were what one might expect for emergency legislation. The NAB and the commercial broadcasters were instrumental in getting the legislation passed; educators and nonprofit broadcasters, on the other hand, played almost no role in its drafting. There was certainly no general sense of alarm that the bill was being passed against the interests of nonprofit broadcasting. Educational and nonprofit broadcasters who would eventually oppose commercial broadcasting contacted members of Congress to urge the Radio Act's passage in order to bring stability to the ether. To many, the purpose of the legislation was to preserve the ether as a public domain and to prevent "a monopoly in the air" by RCA and the other major radio corporations. This was, in fact, the progressive spirit in which the legislation was presented by Senator C. C. Dill (D-Wash.), its primary sponsor, as well as Secretary Hoover.[24]

The committee hearings were dominated by concerns over the short-term business problems of the broadcasters, while the entire congressional debate over the Radio Act of 1927 ignored any discussion of fundamental broadcasting policy. One scholar concluded his exhaustive research on the debate over the Radio Act of 1927 by stating: "The 1927 radio debates stimulated only limited speculation as to the future of commercial broadcasting." Erik Barnouw has noted that while it had become clear by the early 1930s that U.S. broadcasting was a network-dominated and commercially supported system: "This system had never been formally adopted. There had never been a moment when Congress confronted the question: Shall we have a nationwide broadcasting system financed by advertising?" Moreover, few members of Congress had any sense of the issues involved at the time; the legislation was the product of but a few members of Congress, most notably Senator Dill.[25]

At the time, however, this lack of discussion was understandable; the Radio Act of 1927, which passed Congress in February, was to provide temporary regulation to correct the immediate problem. As a compromise between those who wanted an independent agency and those who wanted to keep regulation in the Commerce Department, the Radio Act established the five-member FRC on an interim, one-year basis to assign broadcast license and bring order to the air. Certain non–policy-related functions were kept in the Commerce Department. As Secretary Hoover remarked upon the Radio Act's passage, it was now "possible to eventually clear up the chaos of

interference and howls in radio reception."[26] There was a general consensus that the FRC would have to reduce the total number of broadcasters so that the remaining stations would be able to broadcast effectively. The FRC would be renewed annually until 1929, when it was extended indefinitely, but the matter was not considered settled by anyone at the time. Indeed, the permanent regulation of broadcasting was an issue before congressional committees in every session until the passage of the Communications Act of 1934.

The Radio Act of 1927 did not provide specific guidelines for the FRC to use in evaluating the contending applicants for the limited number of frequencies. Rather, the legislation called for the FRC to allocate licenses on the basis of which prospective broadcaster best served the "public interest, convenience, or necessity," a phrase adopted from public utilities law. Although the phrase may well have had a distinct meaning with regard to articulating the nature of the relationship between the government and industry, Congress clearly had no particular notion as to how the term should be applied to the thorny problems of broadcasting. If nothing else, the inclusion of this phrase was thought necessary to render the FRC's licensing powers constitutional.[27] Senator Dill made it clear that he thought it best to grant the FRC broad powers and tremendous leeway in dealing with the difficult and controversial issue of license allocation and regulation: "Congress would find it extremely difficult, if not impossible, to legislate on all the situations and conditions that develop from time to time. For this reason, the radio law granted the Federal Radio Commission, which it established, extremely broad powers." For the regulatory body to successfully fulfill this function, Dill argued, it would require "men of big ability and big vision."[28]

The FRC and the Reallocation of the Airwaves

The new FRC proceeded expeditiously to fulfill its mandate. On March 17, FRC member Eugene O. Sykes spoke to the nation over the radio to "acquaint" the public with the FRC and "its general plan of work." Sykes stated that the FRC would act as "traffic cops" in bringing order to the spectrum:

> Our hope is to interfere with the legitimate traffic as little as we can, and still eliminate the danger of accident. We are counting on the drivers, which means the broadcasters, to help us, because it is they who in the long run are the worst sufferers from the accidents.

In short, the FRC planned to continue along the lines followed by Hoover. It would allow the industry to determine the nature of broadcast regulation as much as possible, regarding it as an ally. Almost immediately, some

nonprofit broadcasters sensed that the FRC's definition of "broadcaster" referred solely to large commercial broadcasters, rendering their existence marginal. If this is the sentiment of the new FRC, one university station radio engineer wrote, "then the broadcasting stations of the educational institutions may as well close up."[29]

Following the Hoover precedent, the FRC convened four days of hearings between March 29 and April 1 to hear how broadcasters believed the FRC could best regulate broadcasting. All but a few of the fifty or so witnesses were representatives of commercial broadcasters, radio manufacturers, or some other commercial enterprise. The agenda for the hearings was structured around engineering concerns and the sessions were dominated by the testimony of corporate-affiliated radio engineers. The tenor of the conclave was congenial and industry-oriented, with the FRC seemingly regarding the profit-orientation of the industry as a given. As one newspaper account noted, the large broadcasters revealed a "smug confidence" toward the hearings, "content for the most part to sit silent" as the FRC was regarded as working in their interests. There was little indication that the FRC regarded itself as responsible for major policy decisions regarding the future of U.S. broadcasting. The sole "policy"-type opinion that was presented with little criticism was the opinion of one Department of Commerce official that "the success of radio broadcasting lay in doing away with small and unimportant stations."[30]

The few noncommercial voices that appeared at the hearings took exception to this sentiment and urged the FRC to consider whether its seeming acceptance of the domination of the profit motive fulfilled the "public interest" charter of the Radio Act. Edward Nockels, a representative of the Chicago Federation of Labor (CFL), who managed the CFL's radio station WCFL, stated that radio should not be "left open to exploitation for profit," and that stations should be operated on a nonprofit basis with the direct support of their listeners. Morris Ernst of the American Civil Liberties Union (ACLU) noted that the power vested in the FRC "is the greatest power ever vested in the history of mankind by legislative act in any group of citizens." After acknowledging that his opinion would "not be popular with the gentlemen in the room," he argued that radio as a "public utility is not entirely consistent with a motive of profitmaking." Ernst called for the FRC to give preference to nonprofit broadcasters in its assignment of frequencies in order to protect the diversity of opinion necessary for democracy. Both Ernst and Nockels were received politely, although after Nockels's presentation one FRC member noted that his topic "was not in accordance with our program."[31]

In any case, the FRC did not accomplish its mandate in its first year, which scholars have termed "a nightmare for all concerned." Two of the five prospective FRC commissioners, who had been handpicked by Hoover, failed to gain Senate approval because they were caught in the partisan

political crossfire between Hoover's allies and congressional leaders, and between Republicans and Democrats. Then, coincidentally, two of the three that did get approved died almost immediately thereafter. In addition, Congress failed to approve the FRC's budget, leaving the active members without salary and encouraging one of them, Henry A. Bellows, to resign in November to accept a position as a vice-president at CBS. The FRC abandoned the initial program adopted at its April 29, 1927, meeting to develop a plan to completely reallocate the airwaves and sharply reduce the number of broadcasters.[32] Instead, the FRC simply attempted to accommodate all the existing 733 stations through the sharing of the ninety frequencies. In addition, the FRC made limited efforts to set aside *clear channels,* frequencies that would have only one broadcaster operating at very high power on a nationwide basis. During the FRC's first year, the beneficiaries of the ad hoc allocation process were the largest stations, generally affiliated with the networks, while the smaller and nonprofit broadcasters continued to struggle to survive.[33]

Congress was far from satisfied with either the FRC's performance during this first year or with the emerging contours of U.S. broadcasting. During the hearings before congressional committees to extend the FRC's tenure an additional year in January and February 1928, members of the FRC were repeatedly questioned about the unchecked and stunningly rapid emergence of "chain" broadcasting to its position of near dominance as well as the sharp decline in the role of nonprofit broadcasting. "A lot of the colleges are not satisfied with the places they have" on the broadcast spectrum, acknowledged the FRC's Sykes to the House Committee on the Merchant Marine and Fisheries in January 1928. "We are trying now and working to give a lot of the colleges a more satisfactory place on the broadcast spectrum."[34]

Of the first twenty-five stations set aside for clear channels by the FRC, twenty-three had been licensed to broadcasters affiliated with NBC. This generated considerable alarm for Congress, particularly as large portions of the country were receiving the same chain program simultaneously on most of the stations available to any given area. "I am receiving letters every day from all over the country protesting bitterly," stated Representative Ewin Davis (D-Tenn.) in his interrogation of FRC member Orestes H. Caldwell. "Was that action taken because the commission believed the people of this country wanted all of the choice stations given to the chain stations?" Caldwell acknowledged that this was clearly not the intent of Congress nor of the Radio Act of 1927, but he defended the FRC's actions as being made in the best interest of the listeners.[35]

In similar questioning by Representative Clay Briggs (D-Tex.), Sykes, like Caldwell, defended the FRC's actions and stated that the FRC, unlike

Congress, had received more letters in favor of the chains than opposed to them. Nonetheless, he acknowledged that to "fulfill our duty" to provide listeners with "as much diversity as we can" it would be imperative for the FRC to permit nonprofit broadcasters access to some of the high-power cleared channels. FRC member Harold Lafount assured a hostile Senator Dill in hearings before the Senate Committee on Interstate Commerce in February 1928 that "I am against chain broadcasting in the sense that they might occupy all of the cleared channels."[36] "It seems the chains are being the object of attack," the president of the NAB despondently wrote to the FRC's Lafount in January 1928, "by all of Congress."[37]

In January and February 1928, key figures in the Senate, including Dill, threatened to block the extension of the FRC for an additional year unless Congress also passed complementary legislation that would require the FRC to break up the emerging "chain dominance," to reduce the maximum power allowances so less capitalized stations could compete, and to turn over more of the prime clear channels to independent and educational broadcasters. Working assiduously, the radio lobby and the FRC members were able to remove much of the "sting" from these proposals, but not all.[38] Congress ultimately voted to maintain the FRC for another year, but instead of allowing the FRC complete discretion to determine its own plan of action, it passed the Davis Amendment, so-called after its sponsor Rep. Davis, in March 1928. This required the FRC to make a complete reallocation of the airwaves in order to equalize the number of stations among five geographic "zones." This measure had considerable support among southerners and westerners who felt, with justification, that the broadcast spectrum was dominated by stations from the eastern seaboard and the industrial Midwest. In spirit, the Davis Amendment was also meant as an attack on chain domination, which explains why the networks and their allies were so opposed to it. With its passage, the FRC was forced to generate a permanent and general reallocation plan that would necessitate a complete reshuffling of stations and frequency assignments. The NAB and the networks reacted with alarm and began lobbying the FRC to permit the "natural evolution" of U.S. broadcasting with a minimum of "disturbance in present broadcasting . . . rather than radical sweeping changes."[39]

Any concerns that the reallocation would threaten the emerging contours of commercial broadcasting would prove unfounded. Immediately after the passage of the Davis Amendment, the FRC created an allocating committee of Commissioners Caldwell and Sam Pickard to "consult with experts" and work out a general "reallocation which will comply with the legislation just passed by Congress." Lafount met with the allocating committee and served as an informal member throughout the spring and summer of 1928.[40] Prior to joining the FRC, Lafount had served as a director for several radio man-

ufacturing firms and had been in the process of opening his own commercial radio station. Upon leaving the FRC in the early 1930s, Lafount embarked upon a twenty-year career as a commercial broadcasting executive.[41]

Caldwell, a trained electrical engineer, had served as an editor for McGraw-Hill and had edited such trade publications as *Electrical World, Electrical Merchandising,* and *Radio Retailing*. He viewed his tenure at the FRC as a temporary "loan" of his services to the government by his employer, and he returned to his post at McGraw-Hill in 1929. NBC President Aylesworth had been a leading sponsor of Caldwell's appointment to the FRC, and the trade publication editor brought a genuine enthusiasm for commercial broadcasting to Washington, D.C. In a speech to the NAB annual convention in September 1927, he implored his "broadcasting friends" to "extend the number of radio listeners until we put a set in every home." Caldwell promised the assistance of the FRC to "put radio where it really belongs." As the only trained engineer on the FRC, Caldwell played a particularly large role in the development of the reallocation in 1928. "Mr. Caldwell," Lafount noted in 1931, is "wholly responsible for the present system of broadcasting in this country."[42] Pickard, too, had a short tenure on the FRC. He would leave the FRC in 1929 to become a vice-president at CBS, where he was in charge of expanding the CBS network from some forty-seven affiliated stations in February 1929 to seventy-six stations in 1931 and ninety-one affiliates in 1933.[43]

Although the initial confidential memorandum on the reallocation acknowledged that the FRC would determine "which stations or group of stations shall have the assignments" and which would not, the allocating committee explicitly regarded reallocation as strictly an "engineering" problem. The allocating committee accordingly met several times with a group of radio engineers to establish reallocation criteria because the FRC did not have its own staff engineer until the autumn of 1928, when the reallocation was put into effect. These experts were selected by the chief radio engineer for AT&T, and all of the engineers were employed by the government, radio manufacturers, or commercial broadcasters. The press and members of Congress were invited to one open meeting, but the balance of the sessions were closed and unpublicized. Given the emphasis on engineering and technical criteria for making the reallocation, and the secrecy of the meetings, the process was devoid of controversy.[44]

The tentative report of this group of engineers was presented to the FRC on April 11 and stated that the one fundamental change that was necessary was the creation of a "considerable number" of high-powered clear channels "upon which only one station operates" nationally. Developing a large number of these "clear channel" stations was also a high priority for the networks and the large commercial broadcasters; they were the broadcasters best equipped with the capital and resources necessary to broadcast on such

a basis. The confusion regarding the appropriate course for U.S. broadcasting that had engulfed even the largest broadcasters as recently as 1926 had disappeared by 1928, at least in their private communications. One NBC executive wrote to the FRC's Caldwell in January 1928 that "the only plan" for successful radio broadcasting that "holds promise of any degree of success is the development of network systems for national advertising purposes." Nevertheless, in presenting the report, the AT&T engineer stated that there was no self-interest behind the engineers' recommendations: "The reason for this is a purely physical fact."[45]

This is not to suggest any "conspiracy" by these engineers on behalf of their present or potential future employers. The FRC had specifically instructed the engineers to regard the reallocation as an engineering—not a policy—problem. In addition, the eventual opponents of the reallocation were largely oblivious to the existence of these proceedings in the spring of 1928, and they seemed to be ignorant of their general significance. There was little controversy in the air. Most important, radio engineers were arguably more dependent upon the dominant radio corporations than were their colleagues in other branches of engineering. In the first two decades of the century they had responded to the oligopolization of the radio industry by abandoning efforts to be independent "out of frustration and survival instinct." As David Noble observes, they "flocked to corporate employment in exchange for security."[46] The 1920s were halcyon days for corporate radio engineers. In June 1928 RCA's chief engineer informed the Institute of Radio Engineers, of which he also served as president, that the cooperative relationship between the radio industry and radio engineers filled "a fundamental need" and was "a provider of rich rewards both in public esteem and commercial success." The radio engineers could have thoroughly internalized the commercial basis of broadcasting as being synonymous with the highest possible "service of radio to the public." Engineering plans that turned over the best slots to the best capitalized stations appeared as common sense, and efforts to interfere with commercial domination were routinely dismissed as a violation of sound engineering principles in radio regulation.[47]

At the same time, it would be difficult to exaggerate the harmonious and extensive relationship that had developed between the FRC on the one hand and NBC, CBS, and the NAB on the other hand. This relationship is all the more striking given the near total lack of contact the FRC had with nonprofit broadcasters, public interest groups that might have an interest in broadcast policy, and even members of Congress. The allocating committee was in constant touch with commercial broadcasting executives, and CBS Vice-President (and former FRC member) Bellows assisted the FRC throughout 1928 as it put together the reallocation plan. The FRC granted the NAB and the networks as well as the radio manufacturers a chance to respond to the report of the radio engineer's committee in a special hearing two weeks after

it had been released.[48] The FRC's attitude toward the commercial networks was evident in a May 1928 letter from Caldwell to Aylesworth in which he saluted NBC for its "wonderful public service." Caldwell concluded that "the fact that demagogues have a chance to attack you is due solely to lack of understanding on the part of the public of the full measure of your great contributions."[49] When Caldwell was attacked by members of Congress for being overly friendly to the "radio trust," he responded that radio had become a "football for politicians" who provided "sophistries" on the topic to win votes, but who would be best to stay away from broadcasting policy as they were uninformed on the topic.[50] Any notion that the FRC saw its role as that of protecting the "public interest" from the selfish aims of the commercial broadcasters is almost entirely absent from the records; if anything, the exact opposite was the case.

Accordingly, the FRC's reallocation clearly had the look of one that would be sensitive to the needs of the fledgling commercial broadcasting industry. In short, it would recognize, crystallize, and further encourage the dominant trends within broadcasting over the previous two or three years and make no effort to counteract these developments through public policy.

By early summer a consensus on the FRC and in the broadcasting industry emerged in favor of establishing a large number of clear channels for high-powered broadcasting in addition to having a number of regional channels that several broadcasters could use simultaneously at lower power, much like the engineers' committee had recommended in April. The engineers and commercial broadcasters favored a sharp reduction in the total number of broadcasters and, if that was not politically feasible, it was recommended that several broadcasters might share the same channel but each be assigned different times of day to broadcast. During the summer the FRC debated specific proposals to implement the reallocation and attempted to "sell" the idea behind the reallocation among the broadcasters. In addition, before the final decisions were made about which stations to favor and which to disfavor in the reallocation, the allocating committee contacted a handful of major radio editors to receive their input regarding which were the most popular stations in their communities.[51]

The final measure the FRC took before implementing the reallocation was to hire Louis G. Caldwell as its first general counsel in the summer of 1928. The need for a general counsel became evident when the FRC's attempt to remove 164 marginal broadcasters through General Order 32 in May 1928 had been ineffectual and had proven a procedural disaster.[52] Caldwell, no relation to FRC member Orestes H. Caldwell, was by all accounts a brilliant and visionary commercial broadcasting attorney. He had worked for Colonel Robert McCormick's *Chicago Tribune* and the *Tribune*'s radio station, WGN, in Chicago. Caldwell had been sent to Washington specifically to protect the *Tribune*'s radio interests and to assist in the development of broadcast legislation and regulation. Louis Caldwell was also the chairman of the Standing Committee on Communications of the American Bar Association, which was producing extensive semi-official annual reports on broadcasting policy during this period. He was a proponent of the commercial and chain development of the ether. Louis Caldwell was selected for the position of general counsel, among other reasons, because he had written a forty-two-page reallocation plan that incorporated most of the ideas of the radio engineers and commercial broadcasters. Within a few weeks as FRC counsel, Caldwell had effectively taken over the implementation of the reallocation and was making policy decisions that he acknowledged were "not strictly within the scope of the duties of the general counsel." Shortly after the implementation of the reallocation, in February 1929, Caldwell resigned as general counsel and returned to his practice as a commercial broadcasting attorney.[53]

The FRC announced its reallocation plan in August 1928. Called General Order 40, it went into effect in November. In addition to forty clear channels and thirty-four regional channels, the plan called for the remaining frequencies to be low-power local channels that would accommodate thirty broadcasters in each zone. A full 94 percent of the broadcasters had their frequency assignments altered by the reallocation. (The 6 percent that were unaffected were chain owned or affiliated stations on clear channels.) Louis Caldwell's former employer, WGN, received a clear channel license to broadcast at the maximum 50,000 watts. The FRC's newly appointed chief engineer defended the reallocation plan as "the only reasonable solution of this dilemma."[54] In its statement accompanying the announcement of General Order 40, the FRC acknowledged that Congress had given it no indication as how to determine the meaning of public interest, convenience, or necessity. The statement asserted that the FRC had interpreted the phrase as meaning that the FRC should strive "to bring about the best possible broadcasting reception conditions throughout the United States," and thus favor those broadcasters with the best technical equipment. The FRC statement also noted that "broadcasting stations are not given these great privileges by the United States government for the primary benefit of advertisers," adding that "advertising is usually offensive to the listening public."[55]

To lower the number of stations, the FRC utilized its process whereby anybody could challenge an existing broadcaster for its frequency assignment at the end of the three-month term accorded each license. In general, the FRC would have the various applicants for a particular frequency ultimately share its usage (unless there was a successful commercial broadcaster already in place, in which case its status was effectively unchallengable) and allocate the majority of the hours to the station it deemed most worthy. In the long run, the station accorded the fewest hours on a shared channel often found it very difficult to stay on the air. Needless to say, this direct head-to-head competition for the scarce broadcast channels created great antipathy between

the contending applicants, particularly, as was often the case, when commercial broadcasters successfully challenged nonprofit broadcasters for the use of their frequencies. Indeed, in one case, hearings between nonprofit WEVD and commercial WFOX of New York had to end prematurely because the attorneys for the two sides began to engage in a fistfight. In any case, without having to actually turn down the license renewal applications of very many broadcasters, there were 100 fewer stations on the air within a year of the implementation of General Order 40.[56]

In this context, the precise criteria by which the FRC elected to interpret the term public interest, convenience, or necessity would go a long way toward determining which of the various broadcasters would be favored in the general reallocation and which would be under constant pressure simply to maintain their licenses or their totals of assigned broadcast hours in the cases of shared frequencies. The FRC had to spell out its interpretation of this term in the numerous hearings, appeals, and court challenges that followed in the wake of the reallocation; it published its interpretation of public interest, convenience, or necessity in the FRC's *Third Annual Report,* which was published in 1929. The sketchy criteria touched on in the August 1928 FRC statement that accompanied the announcement of General Order 40 did not provide a strong enough fortress from which to defend the licensing decisions made in the reallocation.

Indeed, the 1929 FRC stated position regarding the meaning of public interest, convenience or necessity maintained little of the tenor of the comments regarding the meaning of the term that had been expressed in the FRC's 1928 statement. For example, the FRC only made brief mention of the need to favor stations with the best capitalization and the highest quality transmitting equipment in its legal defense of the reallocation. This explanation of the reallocation would again be offered commonly before Congress and in public forums by members of the FRC and advocates of commercial broadcasting in the years that followed, and it had a certain unimpeachable, if circular, logic. Having created forty national clear channel slots and many more relatively high-power regional assignments, the FRC argued that it was obviously in the public interest to assign these channels to broadcasters who had the equipment to take advantage of these slots. In the immediate aftermath of General Order 40, however, this defense was of partial value as some of the disfavored nonprofit broadcasters had more sizable capital investments and operations than the upstart capitalist broadcasters who were vying for the use of their broadcast channels. Hence the need to justify the policy on other grounds. Similarly, the 1929 legal defense of General Order 40 dropped the acknowledgment of the public antipathy toward advertising, as its emergence was the most immediately recognizable consequence of the reallocation.

The FRC opinion in this matter was written by Louis Caldwell and it

mirrors his comments on the subject in the ABA Standing Committee on Communications 1929 report.[57] Based upon the testimony of FRC members to Congressional committees in 1929, it seems apparent that none of them had developed their positions on this matter to the extent of Caldwell. As this interpretation of the public interest, convenience, or necessity has played such a pivotal role in U.S. broadcast policy, it merits some elaboration.

First, the FRC stated that broadcasting was not a common carrier in the sense of the other public utilities (i.e., that each station would be required to permit anybody who so desired access to their facilities if they were willing to pay a fair price). Rather, the FRC argued that broadcasters were not licensed to serve *users,* but rather to serve *listeners*. Therefore, the criteria public interest, convenience, or necessity meant that the FRC would favor broadcasters who seemed the most inclined toward serving the public and who were the least inclined toward promoting their own "private or selfish interests." The only exception to this criteria was commercial advertising, which the FRC conceded was conducted for selfish interests, "because advertising furnishes the economic support for the service and thus makes it possible." Although the excesses of advertising needed to be regulated, the FRC made it clear that it had no interest in inhibiting the financial support it brought to the industry. "Without advertising, broadcasting would not exist," the FRC stated, with apparent disregard for the several score noncommercial stations still in operation.[58]

Second, the FRC determined that the stations that best served the public interest were those that attempted to serve the "entire listening public within the listening area of the station." To do this the broadcaster needed to provide "a well-rounded program" of entertainment as well as cultural programming. The FRC was not particularly interested in delineating the specifics of what constituted "well-rounded" programming. Rather, the marketplace would serve as the arbiter: "The commission has great confidence in the sound judgment of the listening public . . . as to what type of programs are in its own best interest." The FRC termed these broadcasters *general public service* stations.

The type of stations that earned the FRC's disfavor, in contrast to the general public service stations, were termed *propaganda* stations. It emphasized that the term was not meant derogatorily but, rather, to stress that these broadcasters were more interested in spreading their particular viewpoint than in reaching the broadcast possible audience with whatever programming was most attractive. It observed, "There is not room in the broadcast band for every school of thought, religious, political, social, and economic, each to have its separate broadcasting station, its mouthpiece in the ether."[59] Consequently, since every group could not have its own "mouthpiece," then, according to the FRC, *no* such group should be entitled to have the privilege of a broadcast license. Hence, ownership by any group not primarily moti-

vated by profit automatically earmarked a station to the FRC as one with propaganda inclinations. Moreover, by the FRC's interpretation, commercial advertising is deemed the *only* legitimate form of financial support for a broadcaster, as by definition any other form of support had propaganda strings attached.

This interpretation of the public interest, convenience, or necessity was a clear endorsement of the private commercial development of the airwaves. The FRC's *Third Annual Report* stated baldly that a general public service broadcaster has "a claim of preference over a propaganda station," when they contended for access to the same channel. Even if propaganda stations attempted to "accompany their messages with entertainment and other program features of interest to the public," the FRC asserted they did not merit the same treatment as general public service stations that did the same things since, among other things, the propaganda stations would be "constantly subject to the very human temptation not to be fair to opposing schools of thought."[60]

Numerous nonprofit stations would fall victim to this logic and see their hours reduced and the time turned over to capitalist broadcasters, often affiliated with one of the two networks. As the FRC informed WCFL, the nonprofit "Voice of Labor" affiliated with the CFL, when it lost its hearing for more hours to the *Chicago Tribune*'s WGN: "There are numerous groups of the general public that might similarly demand the exclusive use of a frequency for their benefit. There are nearly five million Masons in the United States and about as many Odd Fellows."[61] By the FRC's logic, if the public desired the type of programming offered by the propaganda stations, it would make this interest known through the marketplace and the general public service broadcasters would find it in their interest to provide such programming. Hence, it would be best for educators and other nonprofit broadcasters to learn to work through the facilities of the general public service stations, rather than to attempt to develop and maintain their own facilities.

In the *Third Annual Report*, the FRC argued that its interpretation of the public interest, convenience, or necessity would best serve the interests of free speech and the desire for a balanced presentation of political views. None of the propaganda stations could be expected to bring balance so their reduction or elimination only boded well for the discussion of public issues. Furthermore, the general public service broadcasters, according to the FRC, since they had no selfish propaganda aims, tacitly recognized their "broader duty" to open and balanced debate. Indeed, the FRC proclaimed that the "great majority" of the broadcasters were going far beyond the letter of the law in their presentation of differing viewpoints on social issues.[62]

Nevertheless, the FRC concluded its interpretation of the public interest, convenience, or necessity by addressing the concern that its policies would leave the listening public "at the mercy of the broadcaster." It argued that

this was an unfounded fear for two reasons. First, the listener could shift away from stations he or she did not like and the market would act as a corrective on recalcitrant broadcasters. Second, the FRC stated that the efforts of the networks to establish "advisory boards" of prominent citizens to monitor their public affairs programming seemed to be very effective. Thus the marketplace and self-regulation rendered extensive government intervention in the public interest unnecessary.

The Emerging Status Quo and the Reaction of the Immediate Parties

Following the implementation of General Order 40, U.S. broadcasting rapidly crystallized as a system dominated by two nationwide chains supported by commercial advertising. Whereas NBC had twenty-eight affiliates and CBS had sixteen for a combined 6.4 percent of the broadcast stations in 1927, they combined to account for 30 percent of the stations within four years. This, alone, understates their emergence, as all but three of the forty clear channels were soon owned or affiliated with one of the two networks and approximately one-half of the remaining 70 percent of the stations were low-power independent broadcasters operating with limited hours on shared frequencies. Within two years the average independent station had a power of 566 watts, while one of NBC's seventy-four stations averaged over 10,000 watts. By 1935 only four of the sixty-two stations that broadcast at 5,000 or more watts did not have a network affiliation. When hours on the air and the level of power are factored into the equation, NBC and CBS accounted for nearly 70 percent of American broadcasting by 1931. One study estimated that by the mid–1930s some 97 percent of total nighttime broadcasting, when smaller stations were often not licensed to broadcast, was conducted by NBC, CBS, or their affiliates. NBC was the larger of the two, operating two distinct national networks, the red network and the blue network.[63]

Network expansion was accompanied by the dramatic emergence of direct commercial advertising to a position of prominence in U.S. broadcasting. GE's Owen D. Young, founder of RCA and a guiding force behind the creation of NBC, blamed the degeneration of NBC from its "public service" origins to becoming a conduit for commercialism upon the greed of national advertisers. They came "posthaste," Young's biographers noted, "with fistfuls of money, to buy air time."[64] The evidence suggests that it was more the networks and the NAB who actively promoted the use of radio for direct advertising. (Accordingly, when radio advertising came under severe attack in the early 1930s, it was the broadcasters and not the advertising community that rallied to its defense.) For example, the NAB established a commercial committee in 1928 that was responsible for working with the American

Association of Advertising Agencies (AAAA) to establish a coherent set of guidelines and to promote the use of radio. NBC hired long-time advertising executive Frank Arnold specifically to promote radio before the advertising community and to corporate executives. Arnold noted that, with only a few exceptions, "the door of every advertising agency was closed to solicitors for radio" when he began his work in 1927. Such was not the case for long; by the end of the decade most major New York agencies had radio departments. Perhaps most important, NBC President Merlin Aylesworth personally called on many major national accounts to sell airtime on the new network. With a tremendous gift for sales, Aylesworth accomplished his mission, as one aide recalls, "with tremendous rapidity."[65]

Radio advertising, therefore, which was a marginal phenomenon in 1927 with barely any national component whatsoever, accounted for $100 million in 1930 alone. By 1934 annual national advertising expenditures alone approached $75 million, and that was during an economic depression no less. CBS had a sixfold increase in advertising sales in fiscal 1929 alone and unabashedly proclaimed broadcasting was "the greatest media development in the history of advertising" in its 1929–1930 promotional literature.[66] One study conducted by the trade publication *Radio Retailing* in 1931 determined that, on average, fifteen minutes of every hour were turned over to explicit sales messages. The *Christian Science Monitor* estimated explicit sales talks at twelve minutes per hour. The networks shortly abandoned much of the task of producing programming to advertising agencies, which provided the shows that surrounded their clients's sales messages, thus rendering the distinction between advertising and nonadvertising time of limited value. The growth of the networks and the emergence of advertising, though distinct, were mutually reinforcing. One study has found that 80 percent of radio advertising revenue in 1929 went to 20 percent of the stations, all network-owned or affiliated.[67]

Philip Rosen hardly exaggerates when he describes the period between 1928 and 1933 as one of "prosperous, almost triumphant expansion" for commercial broadcasters. Erik Barnouw has noted that in the brief period between 1928 and 1933, "almost all forms of enterprise that would dominate radio and television in decades to come had taken shape." Nor is this an assessment that requires hindsight. In reviewing the growth of the two networks, one observer concluded in 1930 that "nothing in American history has paralleled this mushroom growth."[68]

The other side of the same coin, however, was reflected in the equally dramatic decline in the role played by nonprofit broadcasters in the U.S. The number of broadcasting stations affiliated with colleges and universities declined from ninety-five in 1927 to less than half that figure in 1930. The number of overall nonprofit broadcasters would decline from over 200 in 1927 to some sixty-five in 1934, almost all of which were marginal in terms

of power and impact. By 1934 nonprofit broadcasting accounted for only 2 percent of total U.S. broadcast time.[69] For most Americans, it effectively did not exist.

Most nonprofit broadcasters, who had been hard-pressed to raise funds to subsidize their efforts before General Order 40, found themselves in a "vicious cycle" where the FRC lowered their hours and power to the benefit of well-capitalized or soon-to-be well-capitalized capitalist broadcasters, and thus made it all that much more difficult for the nonprofit broadcasters to generate the funds from their governing bodies necessary to be successful. This was the scenario for most of the educational and nonprofit stations that went off the air in the late 1920s and early 1930s. The director of the soon-to-be extinct University of Arkansas station wrote:

> Now the Federal Radio Commission has come along and taken away all of the hours that are worth anything and has left us with hours that are absolutely no good either for commercial programs or for educational programs. The Commission may boast that it has never cut an educational station off the air. It merely cuts off our head, our arms, and our legs, and then allows us to die a natural death.

Even the most established of the university stations, the University of Wisconsin's WHA, found itself in a struggle before the FRC to keep its hours and power.[70]

Adding to the crisis facing nonprofit broadcasters was that much of what money they could raise had to be applied to pay for expenses to defend their licenses every three months before the FRC in Washington, D.C. "Ever since the new broadcast structure was put in effect in the fall of 1928," the director of the University of Illinois radio station wrote to a congressman in 1930, "we practically wasted all of the money that the university has put into our broadcasting efforts" defending the station license before the FRC, so that "it has been impossible for the people of the state, who own the University and consequently this station, to benefit from the educational features which we have attempted to give them." Another educator criticized the FRC for letting "the commercial stations compel the college stations to spend their scanty funds in sending representatives to Washington" in seemingly endless license hearings. In short, there was considerable outrage among many of the nonprofit broadcasters expressed toward the FRC during this period. One prominent educational broadcaster wrote that the FRC was giving the educational broadcasters "a very raw deal," and termed the FRC as "belonging heart and soul to the big commercial interests."[71]

To many educators and nonprofit broadcasters, the problem with the FRC stemmed from its strictly commercial interpretation of public interest, convenience, or necessity. As one observed,

> Under that philosophy the educational station is being tolerated rather than accepted and encouraged by the regulatory body of the government. That philosophy is a purely commercial one which compels all stations to operate according to commercial standards. If such a basis of operation were to be applied to education generally the colleges and universities of the United States could not justify their existence.

"It is unfair," one college president complained, "to leave educators in a position where they have to compete against clowns." "The Federal Radio Commission," one college station manager complained, seems to believe that an "educational station ought to die" if it could not compete with capitalist broadcasters, "just as a kitten that is thrown under the feet of an elephant ought to die, if it cannot avoid being trampled to death."[72]

Even those not connected with nonprofit broadcasting were not especially impressed by the FRC as a policymaking and regulatory body. The tenor of the congressional hearings to renew the FRC in early 1929 was as antagonistic as they had been prior to the passage of the Davis amendment. "The great feeling about radio in this country," stated Senator Dill, "is that it will be monopolized by the few wealthy interests." Moreover, the concern was not simply with network domination, but with the striking emergence of advertising. After hearing Orestes Caldwell defend advertising as the only conceivable method of financing the clear channel stations, "because the expense of operating such a station is very large," one congressman, Charles Gifford (D-Mass.), reacted angrily and asked Caldwell some fundamental questions. Do you "approve of giving over the radio to the advertisers' whims in operating these stations?" he asked. "Do you not think the principle of radio is tremendously broader than that?" Caldwell defended advertising, stating "there seems to be no other way to finance these wonderful programs," and added that the topic of advertising was "one of the broader problems Congress should take up." "The broader problems," Gifford responded, "are what I think we made a commission for."[73]

The FRC's second general counsel had similar disdain for the commission. Bethuel M. Webster, Jr., replaced Louis Caldwell as general counsel for the FRC early in 1929 and then quit in disgust before the end of the year. Webster was unimpressed with the reallocation; in his view the FRC "gave away valuable public channels without getting anything in return." Webster regarded the major radio corporations as having undue influence over the FRC. By the early 1930s, he would become active in the ACLU's efforts to establish a coherent U.S. broadcasting policy. Webster characterized the FRC as an institution of "unparalleled mediocrity and ineptitude" whose members "knew little or nothing about radio or the law." To Webster, the FRC was comprised of "semi-retired sailors, soldiers or lawyers, men lacking the vision or energy to undertake departures from established notions and routine." Hence, the "tendency, if not the deliberate policy, of the licensing

authority has been to crystallize the status quo."[74] Few observers at the time characterized the body as anything remotely close to the "philosopher kings" that Senator Dill had envisioned. Except for the appreciation displayed by the commercial broadcasting industry, the FRC was a largely unpopular body throughout its seven-year history.

As much as the nonprofit broadcasters were hostile toward the FRC, they were every bit as hostile toward the networks and the commercial broadcasting industry. The format whereby capitalist broadcasters applied directly for frequencies occupied by nonprofit broadcasters and attempted to establish to the FRC their superiority at serving the "public interest" certainly did not lay the groundwork for cordial relations. To many educators, it seemed that commercial broadcasters would not be satisfied until all the educational broadcasters had been driven from the air. "On all fronts the commercial radio interests advanced their lines," observed the NCER, the leading educational radio organization, as it reviewed the developments between 1928 and 1930. "The two powerful chains, NBC and CBS, trained their heaviest artillery, ruthlessly ignoring protestations of smaller stations, crushing educational stations under a broad heel, spiked with hobnails of commerce."[75]

Most nonprofit broadcasters had approved of the passage of the Radio Act of 1927, albeit without any great enthusiasm, and had regarded the FRC, at least initially, as a step toward stabilizing U.S. broadcasting, nonprofit and otherwise. In its earlier versions, the legislation that became the Radio Act of 1927 had included wording that would have required the FRC to *favor* nonprofit broadcasters in the allocation of broadcast licenses, but this wording was withdrawn in committee because, it was argued, such a mandate was already implicit in the term public interest, convenience, or necessity.[76] The Congress followed the leadership of Senator Dill, whose belief in giving the FRC free reign was cited earlier. Louis Caldwell had likewise approved of Congress granting the FRC carte blanche to interpret public interest, convenience, or necessity as it saw fit without any additional congressional "encroachment." "While this phrase may seem broad and vague," he wrote, "any more specific test would have been dangerous." Given this sort of almost arbitrary authority, some proponents of nonprofit broadcasting had hoped and even expected the new FRC to enact, as one proponent noted, "radical changes in the radio structure by way of correcting mistakes which had developed in its haphazard growth."[77]

Any hopes along these lines were dashed with the implementation of General Order 40. "The battle was begun in earnest," wrote the NCER, "in the summer of 1928 soon after the enactment of the Commission's General Order 40." WCFL's Nockels termed General Order 40 "infamous" and noted that with its implementation, "the radio air has been monopolized so that the Big Power interests, Big Business, and the Big Newspaper interests have gotten all the cleared radio channels and nobody else has a 'peep-in.' "

To: Susan Burgess
From: Wendell Bartnick
Date: February 27, 2007
Re: Analyzing Radio Broadcast Power Levels in Major Cities in 1928

This memo summarizes data that resides in an accompanying spreadsheet which is inserted below. The memo analyzes data for the largest 56 U.S. cities ("large cities") as well as the cities outside the top 56 ("smaller cities") with at least one 1000 watt or greater broadcast stations ("high powered stations"). By coincidence, the number of small cities in this data set is also 56.

The data seems to indicate that generally the large cities have more stations and more powerful stations. However, generally the number and power-level of stations does not follow directly with population. Beyond the top 11 most populated cities, the stations and their powers are mixed throughout city populations without a clear trend toward highly populated cities getting more high powered stations.

First, all large cities combined had about the same number of high powered stations (59) as all smaller cities combined (58). Even the number of 5000 watt or greater broadcast stations was about the same in each set of cities. Therefore, it was just as likely that a powerful broadcast station existed in a large city as within a smaller city. However, New York City and Chicago easily had the largest number of high powered stations, especially the really high powered stations, i.e. those above 2500 watts. So while the FCC may have given these two cities more high powered stations, taking these outliers out of the data set makes the argument even stronger that the FCC did not match the number and power of stations with city population.

Second, smaller cities power per capita was about 9 times higher than in large cities, .09 watts/person in smaller cities compared to .01 watts/person for large cities. In

fact, basically every smaller city had more power per capita than the average power per capita of the large cities. Even New York City and Chicago, which had the most high powered stations had power per capita near the average for large cities. A third interesting metric is that on average smaller cities had a total power level in their cities 50% more than large cities, approximately 2700 watts/smaller city as opposed to 1550 watts/large city. These results again indicate that the FCC did not automatically assign power levels commensurate with the population of the area.

Data Collection

Data was transcribed from the following two sources:

- Third Annual Report of Federal Radio Commission to Congress in 1929. Appendix G(1) – Assignments on Sept. 1, 1928. Available at http://www.fcc.gov/fcc-bin/assemble?docno=291101 and a clearer version of Appendix G(1) available at http://www.eliillinois.org/00001_00/pdf/1081157/file10.pdf.
- Volume 1 of the 1930 U.S. census. This census data is the nearest to 1928 as the prior census was conducted in 1920. Available at http://www.census.gov/prod/www/abs/decennial/1930.htm

Description of Excel Worksheets

- Worksheet 1 – All Assigned Stations
  - Lists all assigned broadcast radio stations in the U.S. including their territories, including: state or territory, city, power, station call-letters, and the city's population in 1930.
- Worksheet 2 – 56 Most Populated U.S. cities in 1930
  - Lists the 56 largest U.S. cities, their populations, the distribution of station powers, and related computations.
- Worksheet 3 – All Cities Less Populated than 56 Most Populated U.S. Cities with at least one assigned broadcast radio station broadcasting with at least 1000 watts. in 1930 that had at least a 1000 watt station
  - Lists all cities smaller than 56 largest U.S. cities, their populations, the distribution of station powers, and related computations.
- Worksheet 4 – All Cities Smaller than 56 Largest U.S. Cities with No assigned broadcast radio stations broadcasting with at least 1000 watts.
  - Basically includes all the cities not included in Worksheets 2 or 3.
  - Lists those cities, their populations, the distribution of station powers, and related computations.
- Worksheet 5 – Assignments By City

How did Wendell choose 56 as cut off #?

- Includes all of the data from Worksheets 2-4.

1928_power_city_data.xls

not an absolute standard when applied to broadcasting stations. Since the number of channels is limited and the number of persons desiring to broadcast is far greater than can be accommodated, the commission must determine from among the applicants before it which of them will, if licensed, best serve the public. In a measure, perhaps, all of them give more or less service. Those who give the least, however, must be sacrificed for those who give the most. The emphasis must be first and foremost on the interest, the convenience, and the necessity of the listening public, and not on the interest, convenience, or necessity of the individual broadcaster or the advertiser.

APPENDIX G (1)

List of radio broadcasting stations, arranged by States, showing assignment made September 10, 1928, and under new allocation effective November 11, 1928. (Revised by appended statements marked G–1a and G–1b)

FEDERAL RADIO COMMISSION,
Washington, D. C., September 10, 1928.

List of radio broadcasting stations, arranged according to States, showing their power and frequencies as of September 1, 1928, and the new allocation so that comparisons can be made easily. This new allocation is to be effective at 3 a. m., eastern standard time, on November 11, 1928.

List of radio broadcasting stations, arranged by States, etc.

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	ALABAMA							
				Watts			*Watts*	
WAPI	Auburn	Alabama Polytechnic Institute	WJAX	1,000	880	WJAX	[1] 1,000	1,140
WBRC	Birmingham	Birmingham Broadcasting Co		250	990		500	930
WKBC	do	H. L. Ansley		10	1,370		10	1,310
WJBY	Gadsden	Electric Construction Co		50	1,280		50	1,210
WIBZ	Montgomery	Alexander D. Trum		15	1,300		15	1,500
	ALASKA							
KFQD	Anchorage	Anchorage Radio Club		100	870		100	900
KFIU	Juneau	Alaska Electric Light & Power Co		10	1,330		10	1,310
KGBU	Ketchikan	Alaska Radio Service Co. (Inc.)		500	750		500	610
	ARIZONA							
KFXY	Flagstaff	Mary M. Costigan		100	1,460		100	1,420
KFAD	Phoenix	Electrical Equipment Co		500	930		500	620
KFCB	do	Nielsen Radio Supply Co		[2] 125	1,230		100	1,310
KGAR	Tucson	Citizen Publishing Co		100	1,280		100	1,370
KPJM	Prescott	Frank Wilburn		[3] 15	1,400		15	1,500
	ARKANSAS							
KLCN	Blytheville	Daily Courier News		[3] 50	1,050		[3] 50	1,290
KUOA	Fayetteville	University of Arkansas		1,000	1,010	KLRA	1,000	1,250
KTHS	Hot Springs	Arlington Hotel Co	WBAP	1,000	600	WBAP	[1] 1,000	800
KLRA	Little Rock	Arkansas Broadcasting Co		50	1,470	KUOA	1,000	1,250
KGHI	do	Berean Bible Class		15	1,150		15	1,500
KGJF	do	First Church of the Nazarene		250	1,080		100	1,370
KGHG	McGehee	Charles W. McCollum		50	1,350		50	1,370
KFPW	Sulphur Springs	Rev. Lannie W. Stewart		50	1,140		[3] 50	1,340

[1] Construction permit for 5,000 watts issued.
[2] Construction permit for 250 watts, daytime only, issued.
[3] Daytime.

List of radio broadcasting stations, arranged by States, etc.—Continued

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	CALIFORNIA			Watts			Watts	
KFWO	Avalon	Lawrence Mott		[4] 250	1,000	KWTC	100	1,500
KRE	Berkeley	First Congregational Church of Berkeley	KZM	100	1,300	KFQU-KGTT	100	1,500
KEJK	Beverly Hills	R. S. MacMillan (Ltd.)	KFSG	250	1,190	KFON	500	1,250
KELW	Burbank	Earl L. White		500	1,310	KNRC	500	780
KFVD	Culver City	W. J. & C. I. McWhinnie	KGER	250	1,390		[4] 250	700
KGEN	El Centro	Irey & Bowles		100	1,330		100	1,200
KMJ	Fresno	The Fresno Bee		[3] 50	820		100	1,200
KGFH	Glendale	Fred Robinson	KGEF	[4] 250	1,140		[4] 250	1,000
KZM	Hayward	Leon P. Tenney	KRE	100	1,300	KJBS	100	1,370
KFQZ	Hollywood	Taft Radio & Broadcasting Co		250	1,290		[4] 250	850
KFWB	do	Warner Bros. Broadcasting Corporation		1,000	830	KPSN	1,000	950
KNX	do	Western Broadcasting Co		[1] 500	890		5,000	1,050
KMTR	do	KMTR Radio Corporation		500	580	KPLA	1,000	570
KFQU	Holy City	W. E. Riker	KGTT	100	1,360	KRE-KGTT	100	1,500
KMIC	Inglewood	James R. Fouch		250	1,340	KFSG	500	1,120
KGER	Long Beach	C. Merwin Dobyn	KFVD	100	1,390		100	1,370
KFON	do	Nichols & Warinner (Inc.)		1,000	1,240	KEJK	1,000	1,250
KFI	Los Angeles	Earle C. Anthony (Inc.)		[6] 500	640		[6] 5,000	640
KFSG	Los Angeles	Echo Park Evangelical Association	KEJK	[4] 500	1,190	KMIC	500	1,120
KGEF	do	Trinity Methodist Church	KGFH	[4] 1,000	1,140	KTBI	1,000	1,300
KGFJ	do	Ben S. McGlashan		100	1,410		100	1,420
KHJ	do	Don Lee (Inc.)		1,000	750		1,000	900
KTBI	do	Bible Institute of Los Angeles	KFBK	[4] 1,000	1,090	KGEF	1,000	1,300
KPLA	do	Pacific Development Radio Co		500	1,040	KMTR	1,000	570
KLX	Oakland	Tribune Publishing Co		500	590	KTAB	500	1,270
KGO	do	General Electric Co		[7] 5,000	780		10,000	790
KTAB	do	Associated Broadcasters		500	1,070	KLX	500	1,270
KFWM	do	Oakland Educational Society		[5] 500	1,270	KFWI	500	930
KLS	do	Warner Brothers	KJBS	250	1,220	KWG	100	1,420
KFWC	Ontario	James R. Fouch	KGB	100	1,210	KPPC	100	1,200
KPPC	Pasadena	Pasadena Presbyterian Church	KPSN	50	950	KFWC	50	1,200
KPSN	do	Pasadena Star-News Publishing Co	KPPC	1,000	950	KFWB	1,000	950
KFSD	San Diego	Airfan Radio Corporation		500	680		500	600

KGB	do	Southwestern Broadcasting Corporation	KFWC	[9] 100	1,210		250	1,340
KFRC	San Francisco	Don Lee (Inc.)		1,000	660		1,000	610
KQTT	do	Glad Tidings Temple and Bible Institute.	KFQU	50	1,360	KFQU-KRE	50	1,500
KFWI	do	Radio Entertainments (Inc.)		500	1,120	KFWM	500	930
KJBS	do	J. Brunton & Sons Co	KLS	100	1,220	KZM	100	1,370
KPO	do	Hale Bros. & Chronicle		1,000	710		5,000	680
KYA	do	Pacific Broadcasting Corporation		1,000	850		1,000	1,220
KFBK	Sacramento	Kimball-Upson Co	KTBI	[4] 100	1,090		100	1,310
KQW	San Jose	First Baptist Church		500	1,010		500	1,010
KWTC	Santa Ana	Pacific Broadcasting Federation	KSMR	100	1,100	KFWO	100	1,500
KFCR	Santa Barbara	Santa Barbara Broadcasting Co		100	1,420		100	1,500
KSMR	Santa Maria	Santa Maria Valley R. R. Co	KWTC	100	1,100		100	1,200
KNRC	Santa Monica	Pickwick Broadcasting Corporation		500	800	KELW	500	780
KWG	Stockton	Portable Wireless Tel. Co		100	870	KLS	100	1,420
KGDM	do	E. F. Peffer		10	1,380		[3] 50	1,150
	COLORADO							
KFUM	Colorado Springs	W. D. Corley	KFBU	1,000	620	KOW	1,000	1,390
KPOF	Denver	Pillar of Fire (Inc.)		500	1,490	KFKA	500	1,010
KOW	do	Associated Industries (Inc.) Broadcasting.	KGEW	250	1,370	KFUM	500	1,390
KFUP	do	Fitzsimmons General Hospital	KFEL	100	1,320	KFXJ	100	1,500
KFEL	do	E. P. O'Fallon (Inc.)	KFUP	250	1,320	KFXF	250	1,120
KFXJ	Edgewater	R. G. Howell	KGHF	50	1,430	KFUP	50	1,500
KGEW	Fort Morgan	City of Fort Morgan	KOW	[9] 100	1,370	KGEK	100	1,200
KFKA	Greeley	Colorado State Teachers' College	KFHA	[8] 500	1,200	KPOF	500	1,010
KFHA	Gunnison	Western State College of Colorado	KFKA	50	1,200		50	1,200
KFXF	Denver	Pikes Peak Broadcasting Co		250	1,000	KFEL	250	1,120
KOA	do	General Electric Co		5,000	920		12,500	830
KLZ	Dupont	Reynolds Radio Co		1,000	850		1,000	560
KGDP	Pueblo	Boy Scouts of America (Pueblo Council)		10	1,340		10	1,210
KGHF	do	Ritchie & Finch	KFXJ	250	1,430		250	1,320
KGEK	Yuma	Beehler Electrical Equipment Co		[3] 50	1,140	KGEW	50	1,200
	CONNECTICUT							
WICC	Easton	Bridgeport Broadcasting Station (Inc.)		500	1,130	WBRL	500	1,430
WTIC	Hartford	Travelers Insurance Co	WCAC	500	560	WBAL	[6] 500	1,060
WDRC	New Haven	Doolittle Radio Corporation		500	1,060	WCAC	500	1,330
WCAC	Mansfield	Connecticut Agricultural College	WTIC	500	560	WDRC	500	1,330
	DELAWARE							
WDEL	Wilmington	WDEL (Inc.)		250	1,010	WMAL	250	630

[1] Construction permit for 5,000 watts issued.
[2] Daytime.
[4] Limited time.
[5] Limited to 12 p. m.
[6] Construction permit for 50,000 watts issued.
[7] Construction permit for 10,000 watts issued.
[8] 1,000 watts in daytime only.
[9] 200 watts in daytime only.

List of radio broadcasting stations, arranged by States, etc.—Continued

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	DISTRICT OF COLUMBIA							
				Watts			*Watts*	
WRHF	Washington	American Broadcasting Co		[3] 150	930		[3] 150	1,270
WMAL	do	M. A. Leese Co		500	1,240	WDEL	250	630
WRC	do	Radio Corporation of America		500	640		500	950
	FLORIDA							
WFLA-WSUN	Clearwater	Clearwater Chamber of Commerce and St. Petersburg Chamber of Commerce.		750	580		1,000	900
WRUF	Gainesville	University of Florida (construction permit only).	WTFF	5,000	1,480	KFJF	5,000	1,470
WJAX	Jacksonville	City of Jacksonville	WAPI	1,000	880	WAPI	1,000	1,140
WMBL	Lakeland	Benford's Radio Studios		100	1,310		100	1,310
WQAM	Miami	Electrical Equipment Co	WMBF	750	780	WIOD	750	1,240
WMBF	Miami Beach	Fleetwood Hotel Corporation	WQAM	500	780		500	560
WIOD	do	Isle of Dreams Broadcasting Co		1,000	1,210	WQAM	1,000	1,240
WDBO	Orlando	Rollins College (Inc.)		[6] 500	1,040	WDAE	1,000	620
WCOA	Pensacola	City of Pensacola		500	1,200		500	1,120
WJBB	Sarasota	Financial Journal (Inc.)		250	1,260		100	1,370
WDAE	Tampa	Tampa Publishing Co		500	1,120	WDBO	1,000	620
WMBR	do	F. J. Reynolds		100	1,190		100	1,210
	GEORGIA							
WGST	Atlanta	Georgia School of Technology	WMAZ	500	1,110	WMAZ	500	890
WSB	do	Atlanta Journal Co		1,000	630		[1] 1,000	740
WTHS	do	Atlanta Technical High School		200	1,320	WRBI	100	1,310
WMAZ	Macon	Mercer University	WGST	500	1,110	WGST	500	890
WRBL	Columbus	Roy E. Martin		50	1,170		50	1,200
WRBI	Tifton	Kents furniture and music store		[3] 20	1,350	WTHS	20	1,310
WTFI	Toccoa	Toccoa Falls Institute		500	1,430		500	1,450
	HAWAII							
KGU	Honolulu	Marion A. Mulrony		500	1,110		500	940
KGHB	do	Radio Sales Co		250	1,320		250	1,320

	IDAHO							
KFAU	Boise City	Independent school district of Boise City.		[10] 2,000	1,050	KDYL	1,000	1,230
KFXD	Jerome	Service Radio Co		[11] 15	1,470		50	1,420
KFEY	Kellogg	Union High School		10	1,290		10	1,370
KSEI	Pocatello	KSEI Broadcasting Association		250	900		250	1,320
	ILLINOIS							
WMAQ	Chicago	Chicago Daily News (Inc.)	WQJ	5,000	670		5,000	670
WMBI	do	Moody Bible Institute	WJAZ	5,000	1,140	WOWO-KTNT-WCBD	5,000	1,160
WORD	Batavaia	Peoples Pulpit Association		[12] 5,000	1,190	WJAZ-WHT-WIBO	5,000	1,450
WCAZ	Carthage	Carthage College		50	1,200	WDZ	[3] 100	1,070
KFKX-KYW	Chicago	Westinghouse Electric & Manufacturing Co.		2,500	570		5,000	1,000
WAAF	do	Drovers Journal Publishing Co	WBBM-WJBT	500	770		[3] 500	940
WCFL	do	Chicago Federation of Labor	WEMC	1,500	620	WJJD-WRM	1,000	620
WEDC	do	Emil Denemark (Inc.)	WGES	100	1,240	WCRW-WSBC	100	1,210
WENR-WBCN	do	Great Lakes Radio Broadcasting Co		5,000	1,040	WLS	5,000	870
WGES	do	Oak Leaves Broadcasting Corporation	WEDC	500	1,240	WJKS-WPCC	500	1,360
WHFC	do	Goodson & Wilson (Inc.)	WKBI-WEHS	100	1,390	WEHS-WCLS-WKBB-WKBI.	100	1,310
WJBT	See WBBM-WJBT.							
WKBI	Chicago	Fred Schoenwolf	WHFC-WEHS	50	1,390	WEHS-WCLS-WKBB-WHFC.	50	1,310
WPCC	do	North Shore Congregational Church	WCRW	500	1,340	WJKS-WGES	500	1,360
WSBC	do	World Battery Co	WJKS	100	1,290	WEDC-WCRW	100	1,210
WLS	Crete	Sears, Roebuck & Co	WCBD	5,000	870	WENR-WBCN	5,000	870
WBAO	Decatur	Jas. Millikin University		100	1,120		[3] 100	1,120
WJBL	do	Gushard Dry Goods Co		250	1,410	WJBC	100	1,200
WIBO	Desplaines	WIBO Broadcasting (Inc.)	WHT	5,000	980	WJAZ-WHT-WORD	5,000	1,480
WGN-WTAS-WLIB	Chicago	Tribune Co		15,000	720		15,000	720
WCRW	do	Clinton R. White	WPCC	100	1,340	WEDC-WSBC	100	1,210
WEHS	Evanston	Victor C. Carlson	WHFC-WKBI	100	1,390	WHFC-WCLS-WKBB-WKBI.	100	1,310
WKBS	Galesburg	Permil N. Nelson	WLBO	100	1,380	WLBO	100	1,310
WLBO	do	Fred. A. Trebbe, jr	WKBS	100	1,380	WKBS	100	1,310
WBBM-WJBT	Chicago	Atlas Investment Co	WJBT-WAAF	5,000	770	KFAB	10,000	770
WEBQ	Harrisburg	Tate Radio Co		15	1,340	KFVS	50	1,210
WCLS	Joliet	WCLS (Inc.)	WKBB	150	1,390	WEHS-WKBB-WKBI-WHFC.	100	1,310
WKBB	do	Sanders Bros. (Inc.)	WCLS	150	1,390	WEHS-WCLS-WKBI-WHFC.	100	1,310
WJBC	La Salle	Hummer Furniture Co	WCLO-WWAE	100	1,320	WJBL	100	1,200
WJJD	Mooseheart	Supreme Lodge of World, Loyal Order of Moose.	WEBH	{1,000 / [5] 5,000}	820	WCFL-WRM	1,000	620

[1] Construction permit for 5,000 watts issued.
[3] Daytime.
[6] Construction permit for 50,000 watts issued.
[8] 1,000 watts in daytime only.
[10] 4,000 watts in daytime only.
[11] 50 watts in daytime only.
[12] One-fourth time only.

List of radio broadcasting stations, arranged by States, etc.—Continued

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	ILLINOIS—continued							
				Watts			*Watts*	
WJAZ	Mount Prospect	Zenith Radio Corporation	WMBI	5,000	1,140	WORD-WIBO-WHT	5,000	1,480
WMBD	Peoria Heights	Peoria Heights Radio Laboratory		250	1,460	WTAD	500	1,440
WTAD	Quincy	Illinois Stock Medicine Broadcasting Corporation.		250 [3] 500	1,270	WMBD	500	1,440
KFLV	Rockford	Swedish Evangelical Mission Church		100	1,120	WHDI=WDGY-KFEQ	500	1,410
WHBF	Rock Island	Beardsley Specialty Co		100	1,350		100	1,210
WCBS	Springfield	Dewing & Messter		100 [3] 250	1,430	WTAX	100	1,210
WTAX	Streator	Williams Hardware Co		50	1,210	WCBS	50	1,210
WHT	Deerfield	Radiophone Broadcasting Corporation	WIBO	5,000	980	WJAZ-WORD-WIBO	5,000	1,480
WDZ	Tuscola	James L. Bush		[3] 100	[3] 1,080	WCAZ	[3] 100	[3] 1,070
WRM	Urbana	University of Illinois	WBAA	500 [1] 1,000	1,100	WJJD-WCFL	500	620
WCBD	Zion	Wilbur Glenn Voliva	WLS	5,000	870	WOWO-KTNT-WMBI	5,000	1,160
	INDIANA							
WHBU	Anderson	Citizens Bank		15	1,360		100	1,210
WCMA	Culver	Culver Military Academy	WOOD	500	1,150	WBAA-WKBF	500	1,400
WGBF	Evansville	Evansville on the Air (Inc.)		250	1,270	WOS-KFRU	500	630
WCWK	Fort Wayne	Chester W. Keen		100	1,400		[3] 500	[3] 1,320
WOWO	do	Main Auto Supply Co		2,500 [3] 5,000	1,310	KTNT-WCBD-WMBI	5,000	1,160
WJKS	Gary	Johnson Kennedy Radio Corporation	WSBC	500	1,290	WGES-WPCC	500	1,360
WWAE	Hammond	Dr. George F. Courrier	WCLO-WJBC	500	1,320	WRAF	100	1,200
				CP				
WFBM	Indianapolis	Indianapolis Power & Light Co	WTAS	1,000	1,090	WSBT	1,000	920
WKBF	do	Noble Butler Watson		250	1,190	WBAA-WCMA	500	1,400
WJAK	Kokomo	J. A. Kautz (Kokomo Tribune)		50	1,280	WLBC	50	1,310
WBAA	Lafayette	Purdue University	WRM	500	1,100	WCMA-WKBF	500	1,400
WRAF	La Porte	Radio Club (Inc.)		100	1,440	WWAE	100	1,200
WLBC	Muncie	Donald A. Burton		50	1,430	WJAK	50	1,310
WSBT	South Bend	South Bend Tribune	WEAR-WTAM	500	750	WFBM	500	920

WBOW	Terre Haute	Banks of Wabash Broadcasting Association.		100	1,440		100	1,310
WRBC	Valparaiso	Immanuel Lutheran Church		250	1,260		[3] 500	[3] 1,240
WKBV	Brookville	Knox Battery & Electric Co.		100	1,370		100	1,500
		IOWA						
WOI	Ames	Iowa State College		[2] 2,500 [3] 5,000	1,130	WHO [4]	5,000	1,050
KFGQ	Boone	Boone Biblical College		10	1,430		10	1,310
KWCR	Cedar Rapids	Harry F. Paar	WJAM	100	1,250	KFJY	100	1,310
KSO	Clarinda	Berry Seed Co.		500	1,320	WKBH-WHBL	1,000	1,380
KOIL	Council Bluffs	Mona Motor Oil Co.	KFAB	5,000	940		1,000	1,260
WOC	Davenport	Palmer School of Chiropractic		5,000	800	WSUI [4]	5,000	970
KGCA	Decorah	Charles W. Greenley	KWLC	10	1,210	KWLC [3]	50	1,270
KWLC	do	Luther College	KGCA	50	1,210	KGCA [4]	50	1,270
WHO	Des Moines	Bankers Life Co.		5,000	560	WOI [4]	5,000	1,050
KFJY	Fort Dodge	C. S. Tunwall		100	1,290	KWCR	100	1,310
WSUI	Iowa City	State University of Iowa		[3] 500	[3] 630	WOC [4]	500	970
KFJB	Marshalltown	Marshall Electric Co.		100 [3] 250	1,210	WJAM	100	1,200
KTNT	Muscatine	Norman Baker		2,000	1,170	WOWO-WCBD-WMBI	5,000	1,160
WIAS	Ottumwa	Poling Electric Co.	KICK	[3] 100	[3] 930	KICK [3]	100	560
KICK	Red Oak	Atlantic Automobile Co., Red Oak Radio Corporation (lessee).	WIAS	[3] 100	[3] 930	WIAS	[3] 100	[3] 560
KFNF	Shenandoah	Henry Field Seed Co.		[3] 2,000	[3] 650	WNAX-KUSD	500	890
KMA	do	May Seed & Nursery Co.	KWKH	1,000	760	KGBZ	500	930
KSCJ	Sioux City	Perkins Bros. Co.		[3] 500 [9] 1,000	1,230	WTAQ	1,000	1,330
WJAM	Waterloo	Waterloo Broadcasting Co.	KWCR	250	1,250	KFJB	100	1,200
		KANSAS						
KGCN	Concordia	Concordia Broadcasting Co.		50	1,440		50	1,420
WLBF	Kansas City	Everett L. Dillard		50	1,430		100	1,200
KFKU	Lawrence	University of Kansas	WREN	500	1,180	KSAC-WREN	500	1,010
WREN	do	Jenny Wren Co.	KFKU	750	1,180	KFKU-KSAC	500	1,010
KSAC	Manhattan	Kansas State Agriculture College		500	900	KFKU-WREN	500	1,010
KFKB	Milford	John R. Brinkley, M. D.		[1] 1,500 [12] 2,500	1,240		[4] 5,000	[4] 1,130
WIBW	Topeka	C. L. Carrell		250	1,470	KFH	1,000	1,300
KFH	Wichita	Hotel Lassen		500	1,220	WIBW	500	1,300
		KENTUCKY						
WFIW	Hopkinsville	Acme Mills (Inc.)		1,000	1,150		1,000	940
WHAS	Louisville	Courier-Journal and the Louisville Times Co.		[1] 500	930	WWVA	[7] 5,000	1,020
WLAP	Okalona	American Broadcasting Corporation of Kentucky.		[12] 30	1,120		30	1,200

[1] Construction permit for 5,000 watts issued.
[3] Daytime.
[4] Limited time.
[7] Construction permit for 10,000 watts issued.
[9] 1,000 watts daytime only.
[12] Construction permit for 500 watts issued; 100 watts daytime only.

List of radio broadcasting stations, arranged by States, etc.—Continued

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	LOUISIANA			*Watts*			*Watts*	
KGGH	Cedar Grove	Bates Radio & Electric Co	KWEA	50	1,410	KWEA	50	1,370
KWKH	Kennonwood	W. K. Henderson	KMA	3,500	760	WWL	5,000	850
WDSU	New Orleans	Jos. H. Uhalt		250	1,320		1,000	1,270
WABZ	do	Coliseum Place Baptist Church	WJBW	50	1,260	WJBW	50	1,200
WJBO	do	Valdemar Jensen		100	1,140		100	1,370
WJBW	do	Chas. C. Carlson, jr	WABZ	30	1,260	WABZ	30	1,200
WKBT	do	First Baptist Church		50	1,190		50	1,420
WSMB	do	Saenger Theatres (Inc.), Maison Blanche Co.		750	1,010		750	1,320
WWL	do	Loyola University		500	1,220	KWKH	[1] 500	850
KFDX	Shreveport	First Baptist Church		250	1,270	KRMD	100	1,200
KRMD	do	Robt. M. Dean		[4] 50	[4] 1,360	KFDX	50	1,200
KWEA	do	William B. Antony	KGGH	250	1,410	KGGH	100	1,370
KSBA	do	W. G. Patterson		1,000	1,120		1,000	1,450
	MAINE							
WABI	Bangor	First Universalist Church (Sunday)		100	770		100	1,200
WLBZ	Dover-Foxcroft	Thompson L. Guernsey		250	1,440		250	570
WCSH	Portland	Congress Square Hotel Co		[1] 500	1,400		500	940
	MARYLAND							
WCAO	Baltimore	Monumental Radio (Inc.)	WFBR	250	1,230		250	600
WCBM	do	Hotel Chateau		100	1,330		100	1,370
WFBR	do	Baltimore Radio Show (Inc.)	WCAO	[14] 250	1,230		250	1,120
WBAL	do	Consolidated Gas Electric Light & Power Co.		5,000	1,050	WTIC	5,000	1,060
WSMD	Salisbury	Tom F. Little		100	1,130		100	1,310
	MASSACHUSETTS							
WBZA	Boston	Westinghouse Electric & Manufacturing Co.		500	900	WBZ	500	990

WBIS-WNAC	do	The Shepard Stores		500	650		500	1,230
WEEI	do	Edison Electric Illuminating Co		500	590		500	590
WMES	do	Massachusetts Educational Society	WLOE	50	1,420	WLOE	50	1,500
WSSH	do	Tremont Temple Baptist Church	WBET	100	1,040	WLEX	100	1,420
WLOE	Chelsea	William S. Pote	WMES	100	1,420	WMES	100	1,500
WMAF	South Dartmouth	Round Hills Radio Corporation		[13] 500	[15] 700	WBET	500	1,320
WSAR	Fall River	Doughty & Welch Electric Co. (Inc.)		250	1,410	WNBH	250	1,450
WEPS	Gloucester	Matheson Radio Co. (Inc.)		100	1,010	WKBE	100	1,200
WLEX	Lexington	Lexington Air Station		15	1,390	WSSH	50	1,420
WBET	Boston	Boston Transcript Co	WSSH	500	1,040	WMAF	500	1,320
WNBH	New Bedford	New Bedford Broadcasting Co		250	1,150	WSAR	250	1,450
WBZ	East Springfield	Westinghouse Electric & Manufacturing Co.		15,000	900	WBZA	15,000	990
WKBE	Webster	K. & B. Electric Co		100	1,310	WEPS	100	1,200
WBSO	Wellesley Hills	Babson's Statistical Organization (Inc.)		100	780		[3] 100	[3] 780
WTAG	Worcester	Worcester Telegram Publishing Co. (Inc.).		250	580		250	580
	MICHIGAN							
WKBP	Battle Creek	Enquirer-News Co		50	1,410		50	1,420
WSKC	Bay City	World's Star Knitting Co	WFDF	250	1,100		500	1,410
WEMC	Berrien Springs	Emmanuel Missionary Colony	WCFL	1,000	620		[3] 1,000	[3] 680
WWJ	Detroit	Detroit News		1,000	850		1,000	820
WMBC	do	Michigan Broadcasting Co. (Inc.)		100	1,230	WAFD	100	1,420
WBMH	do	Braun's Music House		100	1,420	WAGM	100	1,310
WAFD	do	Albert B. Parfet Co		100	1,300	WMBC	100	1,420
WKAR	East Lansing	Michigan State College	WGHP	[8] 500	1,080		[3] 500	[3] 1,040
WFDF	Flint	Frank D. Fallain	WSKC	100	1,100	WMPC	100	1,310
WGHP	Fraser	George Harrison Phelps (Inc.)	WKAR	750	1,080		750	1,220
WOOD	Grand Rapids	Walter B. Stiles (Inc.)	WCMA	500	1,150	WASH	500	1,270
WASH	do	Baxter Laundries (Inc.)		250	1,170	WOOD	250	1,270
WIBM	Jackson	C. L. Carrell		100	1,490		100	1,370
WMPC	Lapeer	First Methodist Episcopal Church		30	1,280	WFDF	30	1,310
WKBZ	Ludington	K. L. Ashbacker		15	1,500		50	1,500
WJR-WCX	Pontiac	WJR (Inc.)		5,000	680		5,000	750
WAGM	Royal Oak	Robert L. Miller		50	1,330	WBMH	50	1,310
WJBK	Ypsilanti	Ernest F. Goodwin		15	1,360		50	1,370
	MINNESOTA							
KGDE	Barrett	Jaren Drug Co		50	1,460		50	1,200
WFBJ	Collegeville	St. John's University		100	1,100		100	1,370
WRHM	Fridley	Rosedale Hospital Co. (Inc.)		1,000	1,150	WCAL-KFMX-WLB	1,000	1,230
KGFK	Hallock	Kittson County Enterprise		50	1,340		50	1,200
WDGY	Minneapolis	Dr. George W. Young	WCAL	500	1,050	WHDI-KFLV-KFEQ	500	1,410
WHDI	do	W. Dunwoody Industrial Institute	WLB	500	1,220	WDGY-KFEQ-KFLV	500	1,410
WLB-WGMS	do	University of Minnesota	WHDI	500	1,220	WCAL-KFMX-WRHM	1,000	1,230
WCCO	do	Washburn-Crosby Co		[16] 5,000	740		10,000	810

[1] Construction permit for 5,000 watts issued.
[3] Daytime.
[4] Limited time.
[8] 1,000 watts in daytime only.
[13] 500 watts in daytime only.
[15] Summer.
[16] 7,500 watts in daytime only.

List of radio broadcasting stations, arranged by States, etc.—Continued

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	MINNESOTA—contd.							
				Watts			*Watts*	
KFMX	Northfield	Carleton College		500	1,270	WCAL-WRHM-WLB	1,000	1,230
WCAL	do	St. Olaf College	WDGY	500	1,050	KFMX-WRHM-WLB	1,000	1,230
KSTP	Westcott	National Battery Broadcasting Co		5,000	1,360		10,000	1,460
	MISSISSIPPI							
WCOC	Columbus	Crystal Oil Co		500	1,300		500	880
WRBQ	Greenville	J. Pat Scully		[3] 100	[3] 1,090		100	1,200
WGCM	Gulfport	Gulf Coast Music Co		[34] 15	1,350		15	1,370
WRBJ	Hattiesburg	Woodruff Furniture Co		10	1,200		10	1,500
WQBC	Utica	Utica Chamber of Commerce (Inc.)		[17] 225	[17] 1,390		100	1,210
	MISSOURI							
KFVS	Cape Girardeau	Hirsch Battery & Radio Co		50	1,340	WEBQ	50	1,210
KFRU	Columbia	Stephens College		500	1,200	WOS-WGBF	500	630
KMBC-KLDS	Independence	Midland Broadcasting Co		1,500	1,110	WHB	[4] 1,000	[4] 950
WOS	Jefferson City	State Marketing Bureau		500	710	KFRU-WGBF	500	630
WMBH	Joplin	Edwin D. Aber		100	1,470		100	1,210
KWKC	Kansas City	Wilson Duncan Broadcasting Co		100	1,350		100	1,370
WDAF	do	Kansas City Star Co		1,000	810	WOQ	1,000	610
WHB	do	Sweeney Automobile School Co	WOQ	500	880	KMBC-KLDS	1,000	950
WOQ	do	Unity School of Christianity	WHB	500	880	WDAF	1,000	610
KFKZ	Kirksville	Northeast Missouri State Teachers College.		15	1,330		50	1,210
KFEQ	St. Joseph	Scroggin & Co. Bank		[18] 1,000	1,300	WHDI-WDGY-KFLV	500	1,410
KFUO	St. Louis	Concordia Theological Seminary	KSD	[19] 1,000	550	KSD	500	550
KGBX	St. Joseph	Foster-Hall Tire Co		100	1,040		100	1,210
KMOX	St. Louis	Voice of St. Louis (Inc.)		5,000	1,000		5,000	1,090
KWK	do	Greater St. Louis Broadcasting Corporation.	WMAY	[18] 1,000	1,280	WIL	1,000	1,350
KFWF	do	St. Louis Truth Center (Inc.)		100	1,400	WMAY	100	1,200
KSD	do	Pulitzer Publishing Co	KFUO	500	550	KFUO	500	550
WEW	do	St. Louis University		[3] 1,000	[3] 850		[3] 1,000	[3] 760

WIL	do	Missouri Broadcasting Co		250	1,160	KWK	1,000	1,350
WMAY	do	Kingshighway Presbyterian Church	KWK	100	1,280	KFWF	100	1,200
	MONTANA							
KGHL	Billings	Northwestern Auto Supply Co. (Inc.)		250	1,350		500	950
KFBB	Havre	F. A. Buttrey Co		50	1,090		100	1,200
KGEZ	Kalispell	Flathead Broadcasting Association		100	1,020		100	1,310
KUOM	Missoula	State University of Montana		500	650	KHQ	500	920
KGHD	do	Elmore-Nash Broadcasting Corporation		[3] 5	[3] 1,290		5	1,420
KGCX	Vida	First State Bank of Vida		10	1,230		10	1,370
	NEBRASKA							
KMMJ	Clay Center	M. M. Johnson Co	WJAG	250	1,050		[3] 1,000	[3] 740
KFOR	Lincoln	Howard A. Shuman		100	1,380		100	1,210
KFAB	do	Nebraska Buick Auto Co	KOIL	5,000	940	WBBM-WJBT	5,000	770
WCAJ	do	Nebraska Wesleyan University		[3] 500	[3] 790	WOW-WJAG	500	590
WJAG	Norfolk	Norfolk Daily News	KMMJ	[14] 250	1,050	WCAJ-WOW	[3] 500	[3] 590
WAAW	Omaha	Omaha Grain Exchange		[3] 500	[3] 680		[3] 500	[3] 660
WOW	do	WOW Life Insurance Association		1,000•	590	WJAG-WCAJ	1,000	590
KGFW	Ravenna	Otto F. Sothman		10	1,010		50	1,420
KGBZ[20]	York	Federal Live Stock Remedy Co		100	1,410	KMA	500	930
	NEW HAMPSHIRE							
WKAV	Laconia	Laconia Radio Club		50	1,340		50	1,310
WBRL	Tilton	Booth Radio Laboratories		500	1,290	WICC	500	1,430
	NEW JERSEY							
WCAP	Asbury Park	Radio Industries Broadcasting Co	WOAX	[3] 500	1,250	WCAM-WOAX	500	1,280
WPG	Atlantic City	Municipality of Atlantic City		5,000	1,100	WLWL	5,000	1,100
WCAM	Camden	City of Camden	WFAM	500	1,340	WCAP-WOAX	500	1,280
WHAP	Carlstadt	See New York.						
WCDA	Cliffside Park	See New York.						
WPAP-WQAO	do	See New York.						
WRNY	Coytesville	See New York.						
WIBS	Elizabeth	New Jersey Broadcasting Corporation	WLBX-WMBQ	250	1,470	WNJ - WBMS - WAAT - WKBO.	250	1,450
WHPP	Englewood Cliffs	See New York.						
WMCA	Hoboken	See New York.						
WPCH	do	See New York.						
WAAT	Jersey City	Bremer Broadcasting Corporation	WGBB-WEVD	300	1,220	WBMS - WIBS - WKBO - WNJ.	250	1,450
WKBO	do	Camith Corporation	WKBQ-WCGU	250	1,370	WBMS - WAAT - WIBS - WNJ.	250	1,450

[3] Daytime.
[4] Limited time.
[5] 1,000 watts in daytime only.
[14] 500 watts in daytime only.
[17] Week days.
[18] 2,000 watts in daytime only.
[19] 1,500 watts in daytime only.
[20] Stations KGES, KGBY, KGCH, KGEO, KGDW to combine as KGBZ.
[33] Construction permit for 100 watts issued.

List of radio broadcasting stations, arranged by States, etc.—Continued

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	NEW JERSEY—contd.							
				Watts			*Watts*	
WLWL	Kearny	See New York.		5,000	710		5,000	710
WOR	Newark	L. Bamberger & Co	WGCP-WNJ	250	1,120	WGCP-WODA	500	1,250
WAAM	do	WAAM (Inc.)	WAAM-WNJ	250	1,120	WODA-WAAM	250	1,250
WGCP	do	May Radio Broadcasting Corporation	WGCP-WAAM	250	1,120	WAAT-WIBS-WKBO-WBMS.	250	1,450
WNJ	do	Herman Lubinsky						
WODA	Paterson	Richard E. O'Dea	WOV	1,000	1,020	WGCP-WAAM	1,000	1,250
WJBI	Red Bank	Robert S. Johnson	WEAM	100	1,140	WGBB-WINR-WCOH	100	1,210
WOV	Secaucus	See New York.						
WOAX	Trenton	Franklyn J. Wolff	WCAP	500	1,250	WCAM-WCAP	500	1,280
WBMS	Union City	WMBS Broadcasting Corporation	WWRL-WCLB	100	1,500	WAAT-WIBS-WKBO-WNJ.	100	1,450
	NEW MEXICO							
KOB	State College	New Mexico College of Agriculture	KWSC-KTW	[21] 5,000	760	KEX	5,000	1,180
KGFL	Raton	N. L. Cotter		50	1,350		50	1,210
KGGM	Albuquerque	Jay Peters		100	1,470		100	1,420
	NEW YORK							
WKBW	Buffalo	Churchill Evangelic Association		5,000	1,380	WKEN	5,000	1,470
WGBS	Astoria	Gimbel Bros. (Inc.)	WIP-WOO	500	860		[4] 500	[4] 1,180
WMBO	Auburn	Radio Service Laboratories		100	1,360		100	1,370
WINR	Bay Shore	Radiotel Manufacturing Co. (Inc.)	WCDA-WCOH	150	1,420	WJBI-WGBB-WCOH	100	1,210
WEAF	Bellmore	National Broadcasting Co. (Inc.)		50,000	610		[23]50,000	660
WBBC	Brooklyn	Brooklyn Broadcasting Corporation	WSGH-WSDA	500	1,320	WCGU-WLTH-WSGH-WSDA.	500	1,400
				CP-250				
WLTH	do	Voice of Brooklyn (Inc.)	WBBR-WEBJ	250	1,170	WCGU-WBBC-WSGH-WSDA.	250	1,400
WMBQ	do	Paul J. Gollhofer	WIBS-WLBX	100	1,470	WLBX-WCLB-WWRL	100	1,500
WSGH-WSDA	do	Amateur Radio Specialty Co	WBBC	500	1,320	WCGU-WLTH-WBBC	500	1,400
WEBR	Buffalo	H. H. Howell		200	1,240		100	1,310
WGR	do	Federal Radio Corporation		750	990	WSYR	750	550

WKEN	do	WKEN (Inc.)	WSVS	750	1,470	WKBW	750	1,470
WSVS	do	Seneca Vocational School	WKEN	50	1,470		50	1,370
WCAD	Canton	St. Lawrence University		[3] 500	1,230		[5] 300	1,220
WMAC	Cazenovia	Clive B. Meredith		500	1,330	WHEC-WABO-WOKO	500	1,440
WCGU	Coney Island	United States Broadcast Corporation	WKBO-WKBQ	500	1,370	WSGH-WSDA-WLTH-WBBC.	500	1,400
WNBF	Endicott	Howitt-Wood Radio Co		50	1,450		50	1,500
WLBH	Farmingdale	Joseph J. Lombardi		30	1,290	WHPP-WMRJ	30	1,420
WGBB	Freeport	Harry H. Carman	WAAT-WEVD	150	1,220	WJBI-WINR-WCOH	100	1,210
WCOH	Greenville	Westchester Broadcasting Corporation	WINR-WCDA	250	1,420	WJBI-WGBB-WINR	100	1,210
WLCI	Ithaca	Lutheran Association of Ithaca		50	1,210		50	1,210
WMRJ	Jamaica	Peter J. Prinz	WHPP	10	1,450	WLBH-WHPP	10	1,420
WOCL	Jamestown	A. E. Newton		25	1,340		25	1,210
WCLB	Long Beach	Arthur Faske	WBMS-WWRL	100	1,500	WMBQ-WLBX-WWRL	100	1,500
WLBX	Long Island City	John N. Brahy	WIBS-WMBQ	250	1,470	WMBQ-WCLB-WWRL	100	1,500
WMAK	Martinsville	WMAK Broadcasting System (Inc.)		750	550	WFBL	750	[4] 900
WOKO	Peekskill	Harold E. Smith		500	1,390	WHEC-WABO-WMAC	500	1,440
WBNY	New York	Baruchrome Corporation	WMSG-WHAP	500	1,270	WMSG-WCDA-WKBQ	250	1,350
WHN	do	George Schubel	WQAO-WPAP	500	760	WQAO-WPAP-WRNY	250	1,010
WKBQ	do	Standard Cahill Co. (Inc.)	WKBO-WCGU	250	1,370	WBNY-WMSG-WCDA	250	1,350
WNYC	do	Department of Plant and Structures		500	570	WMCA	500	570
WMSG	do	Madison Square Garden Broadcasting Corporation.	WHAP-WBNY	500	1,270	WBNY-WCDA-WKBQ	250	1,350
WABC-WBOQ	do	Atlantic Broadcasting Corporation (old assignment for WBOQ, 500 watts and 970 kilocycles shared with WABC).	WBOQ	[22] 2,500	970		5,000	860
WHEC-WABO	Rochester	Hickson Electric Co		[14] 250	1,180	WMAC-WOKO	250	1,440
WNBQ	do	Gordon P. Brown		15	1,460		15	1,500
WBBR	Rossville	Peoples Pulpit Association	WEBJ-WLTH	1,000	1,170	WHAP-WEVD-WHAZ	1,000	1,300
WNBZ	Saranac Lake	Smith & Mace		[3] 10	1,290		[3] 10	1,290
WGY	Schenectady	General Electric Co		50,000	790		[23] 50,000	790
WFBL	Syracuse	Onondaga Co. (Inc.)		750	1,160	WMAK	750	900
WSYR	do	Clive B. Meredith		500	1,020	WGR	500	550
WHAZ	Troy	Rensselaer Polytechnic Institute		[24] 500	980	WBBR-WHAP-WEVD	500	1,300
WIBX	Utica	WIBX (Inc.)		[25] 150	1,260		100	1,310
WHAM	Rochester	Stromberg-Carlson Telephone manufacturing Co.		5,000	1,070		5,000	1,150
WEVD	Woodhaven	Debs Memorial Radio Fund	WATT-WGBB	500	1,220	WBBR-WHAP-WHAZ	500	1,300
WWRL	Woodside	William H. Reuman	WCLB-WBMS	100	1,500	WMBQ-WLBX-WCLB	100	1,500

[3] Daytime.
[4] Limited time.
[5] 1,000 watts daily.
[8] 1,000 watts in daytime only.
[14] 500 watts in daytime only.
[21] 10,000 watts in daytime only.
[22] See General Order No. 42.
[23] Construction permit for 5,000 watts issued; 5,000 watts daytime only.
[24] Mondays and Tuesdays.
[25] 300 watts in daytime only.

List of radio broadcasting stations, arranged by States, etc.—Continued

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	NEW YORK—contd.			Watts			Watts	
WCDA*	New York	Italian Educational Broadcasting Co	WINR-WCOH	250	1,410	WBNY-WMSG-WKBQ	250	1,350
WHAP*	do	Defenders of Truth Society (Inc.)	WBNY-WMSG	1,000	1,270	WBBR-WEVD-WHAZ	1,000	1,300
WPAP-WQAO*	do	Calvary Baptist Church	WHN	500	760	WRNY-WHN	250	1,010
WRNY*	do	Experimenter Publishing Co	WPCH	500	920	WQAO-WPAP-WHN	250	1,010
WHPP*	do	Bronx Broadcasting Co	WMRJ-WTRL	10	1,450	WLBH-WMRJ	10	1,420
WPCH*	do	Concourse Radio Corporation	WRNY	500	920		[3] 500	810
WLWL*	do	Missionary Society of St. Paul, the Apostle.	WMCA	5,000	810	WPG	[3] 5,000	1,100
WOV*	do	International Broadcasting Corporation	WODA	1,000	1,020		[3] 1,000	1,130
WJZ*	do	Radio Corporation of America		30,000	660		[22] 30,000	760
WMCA*	do	Greeley Square Hotel Co	WLWL	500	810	WNYC	500	570
	NORTH CAROLINA							
WWNC	Asheville	Chamber of Commerce		1,000	1,010		1,000	570
WBT	Charlotte	C. C. Coddington		[1] 1,000	1,160	WPTF	[7] 5,000	1,080
WRBU	Gastonia	A. J. Kirby Music Co		50			50	1,210
WNRC	Greensboro	Wayne M. Nelson		500	1,340		500	1,440
WPTF	Raleigh	Durham Life Insurance Co		1,000	550	WBT	[7] 5,000	1,080
WRBT	Wilmington	Wilmington Radio Association		50	1,320		50	1,370
	NORTH DAKOTA							
KFYR	Bismarck	Hoskins-Meyer		[14] 250	1,200	KFDY-KFJM	500	550
KDLR	Devils Lake	Radio-Electric Co		15	1,300		100	1,210
WDAY	Fargo	WDAY (Inc.)	KFDY	250	550	WEBC	1,000	1,280
KFJM	Grand Forks	University of North Dakota		100	900	KFDY-KFYR	500	550
KGCU	Mandan	Mandan Radio Association		100	1,250		100	1,200
	OHIO							
WADC	Akron	Allen T. Simmons		1,000	1,260	WFJC	1,000	1,340
WFJC	do	W. F. Jones Broadcasting Co. (Inc.)	WJAY	500	1,320	WADC	500	1,340

WHBD	Bellefontaine	First Presbyterian Church		10	1,210		10	1,210
WEBE	Cambridge	Roy W. Waller		10	1,210		10	1,210
WHBC	Canton	St. John's Catholic Church		10	1,270		10	1,200
WAAD	Cincinnati	Ohio Mechanics Institute		25	1,300		25	1,370
WKRC	do	Kodel Radio Corporation	WFBE	500	1,220		500	550
WFBE	do	Park View Hotel	WKRC	250	1,220		100	1,200
WJAY	Cleveland	Cleveland Radio Broadcasting Corporation.	WFJC	500	1,320	WHK	500	1,390
WHK	do	Radio Air Service Corporation		[8] 500	1,130	WJAY	500	1,390
WTAM	do	WTAM & WEAR (Inc.)	WEAR-WSBT	3,500	750	WEAR	3,500	1,070
WEAR	do	do	WTAM-WSBT	1,000	750	WTAM	1,000	1,070
WAIU	Columbus	American Insurance Union	WEAO	5,000	1,060	WEAO	[4] 5,000	640
WCAH	do	Commercial Radio Service Co	WMAN	250	1,280	WSPD	250	1,450
WEAO	do	Ohio State University	WAIU	750	1,060	WAIU	[4] 750	640
WMAN	do	W. E. Hoskitt	WCAH	50	1,280		50	1,210
WSMK	Dayton	Stanley M. Krohn, jr		200	1,010		200	570
WRK	Hamilton	Doron & Slade		100	1,460		100	1,420
WLW	Harrison	Crosley Radio Corporation		5,000	700	WSAI	5,000	700
WLBV	Mansfield	Mansfield Broadcasing Association		50	1,450		100	1,210
WSAI	Mason	Crosley Radio Corporation (lessee)		5,000	830	WLW	5,000	700
WSRO	Middletown	Harry W. Fahrlander		100	1,270		100	1,420
WCSO	Springfield	Wittenberg College		500	1,170	KQV	500	1,380
WIBR	Steubenville	Thurman A. Owings		50	1,200		50	1,200
WSPD	Toledo	Toledo Broadcasting Co		250	1,250	WCAH	250	1,450
WKBN	Youngstown	W. P. Williamson, jr	WMBW	50	1,400	WMBS	500	1,430
	OKLAHOMA							
KGFF	Alva	Earl L. Hampshire		25	1,460		100	1,420
KOCW	Chickasha	Oklahoma College for Women		250	1,190		100	1,420
KGCB	Enid	Wallace Radio Institute	KGFG	50	1,390		50	1,210
WNAD	Norman	University of Oklahoma		500	1,250	KGGF	500	580
KFJF	Oklahoma City	National Radio Manufacturing Co		[1] 1,000	1,100	WRUF	5,000	1,470
KFXR	do	Exchange Avenue Baptist Church		50	1,340		50	1,310
KGFG	do	Full Gospel Church	KGCB	50	1,390		50	1,370
WKY	do	WKY Radiophone Co		150	1,040		1,000	900
KGGF	Picher	D. L. Connell, M. D		100	1,450	WNAD	500	580
WBBZ	Ponca City	C. L. Carrell		100	1,470		100	1,200
KVOO	Tulsa	Southwestern Sales Corporation		[1] 1,000	860	WNOX	1,000	560
	OREGON							
KFJI	Astoria	George Kincaid	KWJJ	50	1,200	KFEC	50	1,370
KOAC	Corvallis	Oregon State Agricultural College	KMED	[4] [26] 500	1,110	KXL	1,000	1,250
KORE	Eugene	Eugene Broadcast Station	KUJ-KWBS	50	1,500		100	1,420
KMED	Medford	W. J. Virgin	KOAC	[4] 50	1,110		50	1,420
KEX	Portland	Western Broadcasting Co		2,500	1,080	KOB	5,000	1,180

[8] Station transferred from New Jersey to conform to the amendment to the radio act. [1] Construction permit for 5,000 watts issued. [3] Daytime. [4] Limited time.
[7] Construction permit for 10,000 watts issued. [5] 1,000 watts in daytime only. [14] 500 watts in daytime only. [22] See General Order No. 42. [26] Construction permit for 1,000 watts issued.

List of radio broadcasting stations, arranged by States, etc.—Continued

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	OREGON—contd.			Watts			Watts	
KFEC	Portland	Meier & Frank Co		[4] 50	1,400	KFJI	100	1,370
KFIF	do	Bensen Polytechnic School	KTBR	50	1,310		50	1,420
KFJR	do	Ashley C. Dixon & Son		500	1,250	KTBR	500	1,300
KTBR	do	M. E. Brown	KFIF	500	1,310	KFJR	500	1,300
KGW	do	Oregonian Publishing Co		1,000	610		1,000	590
KWBS	do	Schaeffer Radio Co	KORE-KUJ	15	1,500		15	1,500
KWJJ	do	Wilbur Jerman	KFJI	50	1,200		50	1,500
KXL	do	KXL Broadcasters (Inc.)		250	1,360	KOAC	500	1,250
KOIN	do	KOIN (Inc.)		1,000	940		1,000	940
	PENNSYLVANIA							
WCBA	Allentown	B. Bryan Musselman	WSAN	100	1,350	WSAN	100	1,500
WSAN	do	Allentown Call Publishing Co. (Inc.)	WCBA	100	1,350	WCBA	100	1,500
WFBG	Altoona	Wm. F. Gable Co		100	1,120	WHBP	100	1,310
WNBW	Carbondale	Home Cut Glass & China Co		5	1,500		5	1,200
WIBG	Elkins Park	St. Pauls Protestant Episcopal Church		[27] 50	680		[3] 50	930
WEDH	Erie	Erie Dispatch Cummins Herald Broadcasting Corp		30	1,440		30	1,420
WRAK	do	C. R. Cummins		30	1,370		50	1,370
WFKD	Frankford	Foulkrod Radio Engineering Co	WABY	50	1,210		50	1,310
WSAJ	Grove City	Grove City College		250	1,340		100	1,310
WBAK	Harrisburg	Pennsylvania State Police (Ltd.)	WPSC	500	1,000		[3] 500	1,120
WPRC	do	Wilson Printing & Radio Co		100	1,430		100	1,200
WHBP	Johnstown	Johnstown Automobile Co		[14] 250	1,310	WFBG	100	1,310
WABF	Kingston	Markle Broadcasting Corporation		250	1,460	WRAX	250	1,440
WGAL	Lancaster	Lancaster Electrical Supply & Construction Co.	WKJC	15	1,190	WRAW-WKJC	15	1,310
WKJC	do	Kirk-Johnson Co	WGAL	50	1,190	WRAW-WGAL	50	1,310
WMBS	Lamoyne	Mack's Battery Co		250	1,280	WKBN	250	1,430
WJBU	Lewisburg	Buchnell University		100	1,400		100	1,210
WLBW	Oil City	Petroleum Telephone Co		500	1,020		500	1,260
WFAN	Philadelphia	Keystone Broadcasting Co. (Inc.)	WCAM	500	1,340	WIP	500	610

WABY	do	John Magaldi, jr	WFKD	50	1,210	WIAD-WNAT	50	1,310
WFI	do	Strawbridge & Clothier	WLIT	500	740	WLIT	500	560
WCAU	do	University Broadcasting Co		1,000	1,150		[28] 5,000	1,170
WHBW	do	Dr. R. Kienzle		100	1,360	WALK-WOO-WPSW	100	1,500
WIAD	do	Howard R. Miller	WNAT	100	1,040	WABY-WNAT	100	1,310
WIP	do	Gimbel Bros. (Inc.)	WOO-WGBS	500	860	WFAN	500	610
WLIT	do	Lit Brothers	WFI	500	740	WFI	500	560
WNAT	do	Lennig Bros. Co	WIAD	100	1,040	WIAD-WABY	100	1,310
WOO	do	John Wanamaker	WIP-WGBS	500	860	WPSW-WHBW-WALK	100	1,500
WRAX	do	Berachah Church (Inc.)		250	1,410	WABF	250	1,420
KQV	Pittsburgh	Doubleday Hill Electric	WJAS	500	1,110	WCSO	500	1,380
WCAE	do	Kaufmann & Baer Co		500	650		500	1,240
WJAS	do	Pittsburgh Radio Supply	KQV	500	1,110		500	1,290
KDKA	do	Westinghouse Electric & Manufacturing Co.		50,000	950		[22] 50,000	980
WRAW	Reading	Avenue Radio and Electric Shop		100	1,260	WGAL-WKJC	100	1,310
WGBI	Scranton	Scranton Broadcasters (Inc.)	WQAN	250	1,300	WQAN	250	880
WQAN	do	The Scranton Times	WGBI	250	1,300	WGBI	[3] 250	880
WPSW	Philadelphia	Philadelphia School Wireless Telegraphy.		50	1,450	WALK-WHBW-WQO	50	1,500
WPSC	State College	Pennsylvania State College	WBAK	[4] 500	1,000		[3] 500	1,230
WNBO	Washington	John Brownlee Spriggs		15	1,420		15	1,200
WBAX	Wilkes-Barre	John H. Stenger, jr	WBRE	100	1,200		100	1,210
WALK	Willow Grove	Albert A. Walker		50	1,490	WHBW-WOO-WPSW	50	1,500
WBRE	Wilkes-Barre	Louis G. Baltimore	WBAX	100	1,200		100	1,310
	PORTO RICO							
WKAQ	San Juan	Radio Corporation of Porto Rico		500	930		500	580
	RHODE ISLAND							
WDWF-WLSI	Cranston	D. W. Flint and Lincoln Studios		250	1,210	WFCI	100	1,370
WMBA	Newport	Leroy J. Beebe		100	1,470		100	1,500
WFCI	Pawtucket	Frank Brook (Inc.)	WNBX	100	1,240	WDWF-WLSI	100	1,370
WEAN	Providence	Shepard Co		500	1,090		[3] 500	1,160
WJAR	do	The Outlet Co		500	620		250	890
	SOUTH CAROLINA							
WBBY	Charleston	Washington Light Infantry		75	1,200		75	1,200
WRBW	Columbia	Paul S. Pearce		[28] 15			15	1,310
	SOUTH DAKOTA							
KFDY	Brookings	South Dakota State College	WDAY	500	550	KFYR-KFJM	500	550
KGCR	do	Cutler's Radio Broadcasting Service		15	1,440		100	1,210
KGDA	Dell Rapids	Home Auto Co		[3] 15	1,180		15	1,210
KGDY	Oldham	J. Albert Loesch		15	1,450		15	1,200

[3] Daytime.
[4] Limited time.
[16] 500 watts in daytime only.
[22] See General Order No. 42.
[27] Daytime (Sunday only).
[28] Construction permit only.

List of radio broadcasting stations, arranged by States, etc.—Continued

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	SOUTH DAKOTA—con.			Watts			Watts	
KGFX	Pierre	Dana McNeil		[3] 200	1,180		[3] 200	580
KSOO	Sioux Falls	Sioux Falls Broadcasting Association		[14] 250	1,430		[3] 1,000	990
KUSD	Vermillion	University of South Dakota		250	620	WNAX-KFNF	500	890
WCAT	Rapid City	South Dakota State School of Mines		100	1,210		100	1,200
WNAX	Yankton	Gurney Seed & Nursery Co. and Dakota Radio Apparatus Co.		[4] 1,000	990	KUSD-KFNF	500	890
	TENNESSEE							
WFBC	Knoxville	First Baptist Church		50	1,280		50	1,200
WNBJ	do	Lonsdale Baptist Church		50	1,450		50	1,310
WNOX	do	Sterchi Bros		1,000	1,130	KVOO	1,000	560
WOAN	Lawrenceburg	Church of Nazarene and Vaughan School of Music.	WBAW	500	1,250	WREC	500	600
WGBC	Memphis	First Baptist Church	WNBR	15	1,310	WNBR	[19] 500	1,430
WHBQ	do	Broadcasting Station WHBQ (Inc.)		100	1,290		100	1,370
WMBM	do	Seventh Day Adventist Church		10	1,430		10	1,500
WMC	do	Memphis Commercial Appeal (Inc.)		[1] 500	580		500	780
WNBR	do	John Ulrich	WGBC	100	1,310	WGBC	500	1,430
WBAW	Nashville	Waldrum Drug Co	WOAN	5,000	1,250	WLAC	5,000	1,490
WLAC	do	Life & Casualty Insurance Co		[1] 1,000	1,330	WBAW	5,000	1,490
WSM	do	National Life & Accident Insurance		5,000	890		[6] 5,000	650
WSIX	Springfield	Six-thirty-eight Tire & Vulcanizing Co	WREC	150	1,200	WREC	100	1,210
WOBT	Union City	Titsworth's Radio and Music Shop		15	1,460		15	1,310
WREC	Whitehaven	WREC (Inc.)	WSIX	500	1,200	WOAN	500	600
WDOD	Chattanooga	Chattanooga Radio Co. (Inc.)		500	1,230		1,000	1,280
	TEXAS							
KGRS	Amarillo	Gish Radio Service		[14] 250 [3] 500	1,230	WDAG	1,000	1,410
WDAG	do	J. Laurence Martin		[20] 250	1,140	KGRS	1,000	1,410
KUT	Austin	University of Texas		500	1,290	WTAW	500	1,120
KFDM	Beaumont	Magnolia Petroleum Co	WTAW	500	620	KPRC	500	550

KFYO	Breckenridge	Kirksey Bros. Battery & Electric Co		100	1,420		100	1,420
KWWG	Brownsville	Chamber of Commerce		500	1,080	KRGV	500	1,010
WTAW	College Station	Agricultural and Mechanical College of Texas.	KFDM	500	620	KUT	500	1,120
KRLD	Dallas	KRLD (Inc.)	WRR	500	650	WFAA	[7] 5,000	1,040
WFAA	do	Dallas Morning News		500	550	KRLD	[22] [6] 5,000	1,040
WRR	do	City of Dallas	KRLD	500	650	WOAI	(1)	1,190
KFPL	Dublin	C. C. Baxter		15	1,090		15	1,370
WDAH	El Paso	Trinity Methodist Church		100	1,280		100	1,310
KFJZ	Fort Worth	Henry C. Allison		50	1,200		100	1,370
WBAP	do	Carter Publications (Inc.)	KTHS	5,000	970	KTHS	[6] 5,000	800
KFQB	do	W. B. Fishburn (Inc.)	WJAD	1,000	900	WJAD	1,000	1,240
KFLX	Galveston	George Roy Clough		100	1,110		100	1,210
KFUL	do	Will H. Ford		500	1,160	KTSA	500	1,290
KGKL	Georgetown	M. L. Cates		100	1,290		100	1,370
KGKB	Goldthwaite	Eagle Publishing Co		50	1,070		100	1,500
KFPM	Greenville	New Furniture Co		15	1,300		15	1,310
KRGV	Harlingen	Harlingen Music Co		100	1,270	KWWG	500	1,010
KPRC	Houston	Houston Printing Co		[20] 500	1,020	KFDM	1,000	550
KTUE	do	Uhalt Electric		5	1,410		5	1,370
KGHX	Richmond	Fort Bend County School Board		[28] 50			50	1,500
KGFI	San Angelo	San Angelo Broadcasting Co		15	1,360		15	1,310
KGCI	San Antonio	Liberto Radio Sales	KGRC	250	1,360		100	1,370
KGDR	do	Joe B. McShane		[18] 15	1,450		100	1,500
KGRC	do	Eugene J. Roth	KGCI	[31] 100	1,360		100	1,310
KTSA	do	Alamo Broadcast Co		2,000	1,130	KFUL	1,000	1,290
KTAP	do	Robert B. Bridge		[31] 20	1,310		100	1,210
WOAI	do	Southern Equipment Co		5,000	1,070	WRR	5,000	1,190
WJAD	Waco	Frank P. Jackson	KFQB	500	900	KFQB	1,000	1,240
KGKO	Wichita Falls	Highland Heights Christian Church		250	1,350		100	1,370
		UTAH						
KFUR	Ogden	Peery Building Co		50	1,330		50	1,310
KDYL	Salt Lake City	Intermountain Broadcasting Corporation.		[33] 100	1,280	KFAU	1,000	1,230
KSL	do	Radio Service Corporation of Utah		[1] 1,000	990		[1] [18] 1,130	1,130
		VERMONT						
WCAX	Burlington	University of Vermont		100	1,180	WNBX	100	1,200
WNBX	Springfield	First Congregational Church Corporation.	WFCI	10	1,240	WCAX	10	1,200

[1] Construction permit for 5,000 watts issued.
[3] Daytime.
[4] Limited time.
[6] Construction permit for 50,000 watts issued.
[7] Construction permit for 10,000 watts issued.
[18] 500 watts in daytime only.
[22] See General Order No. 42.
[28] Construction permit for 1,000 watts issued.
[29] Construction permit only.
[29] Sunday only.
[30] 30 watts in daytime only.
[31] Construction permit for 250 watts issued.
[33] Construction permit for 500 watts issued.

List of radio broadcasting stations, arranged by States, etc.—Continued

Station	Location	Owner	Assignments					
			Former			New		
			Shared with—	Power	Kilocycles	Shared with—	Power	Kilocycles
	VIRGINIA			Watts			Watts	
WTAZ	Richmond	W. Reynolds, jr., and Thomas J. McQuire.	WMBG	[28] 15	1,360	WMBG	[28] 15	1,210
WNEW	Newport News	Virginia Broadcasting Co. (Inc.)		[28] 100	1,430		100	1,310
WTFF	Mount Vernon Hills	Independent Publishing Co	WRUF	10,000	1,480		10,000	1,460
WTAR-WPOR	Norfolk	Reliance Electric Co. (Inc.)	WBBW	500	1,270	WSEA	500	780
WBBW	do	Ruffner Junior High School	WTAR-WPOR	100	1,270		100	1,200
WLBG	Petersburg	Robert Allen Gamble		[22] 100	1,400		100	1,200
WRVA	Richmond	Larus & Bro. Co. (Inc.)		1,000	1,180		[1] 1,000	1,110
WMBG	do	Havens & Martin (Inc.)	WTAZ	15	1,360	WTAZ	100	1,210
WBBL	do	Grace Covenant Presbyterian Church		100	1,200		100	1,370
WRBX	Roanoke	Richmond Development Corporation		[24] 250		WDBJ	250	930
WDBJ	do	Richardson-Wayland Electric Co		250	1,300	WRBX	250	930
WSEA	Portsmouth	Virginia Broadcasting Co. (Inc.)		500	1,140	WTAR-WPOR	500	780
	WASHINGTON							
KXRO	Aberdeen	KXRO (Inc.)	KFBL	50	1,340		50	1,210
KVOS	Bellingham	L. Kessler		250	1,430	KWSC-KXA	250	670
KFBL	Everett	Leese Bros	KXRO	50	1,340	KUJ-KVL	50	1,500
KGY	Lacey	St. Martin's College	KFPY-KFRO	50	1,220	KKP-KFQW	50	1,420
KUJ	Longview	Fred. W. Lovejoy and R. W. Kerfoot	KORE-KWBS	10	1,500	KFBL-KVL	10	1,500
KWSC	Pullman	State College of Washington	KTW-KOB	500	760	KXA-KVOS	500	570
KFOA	Seattle	Rhodes Department Store		1,000	670	KTW	1,000	1,280
KFQW	do	KFQW (Inc.)		100	1,380	KGY-KKP	100	1,420
KPQ	do	Archie Taft and Louis Wasmer	KPCB	100	1,300	KPCB	100	1,210
KVL	do	Arthur C. Dailey	KKP-KRSC	100	1,100	KFBL-KUJ	100	1,500
KJR	do	Northwestern Radio Service Co		2,500	860		5,000	970
KKP	do	City of Seattle (harbor department)	KRSC-KVL	15	1,100	KGY-KFQW	15	1,420
KOMO	do	Fisher's Blend Station (Inc.)		1,000	970		1,000	620
KPCB	do	Pacific Coast Biscuit Co	KPQ	100	1,300	KPQ	100	1,210
KRSC	do	Radio Sales Corporation	KVL-KKP	50	1,100		[2] 50	1,120
KTW	do	First Presbyterian Church	KWSC-KOB	1,000	760	KFOA	1,000	1,280

KFIO	Spokane	North Central High School	KFPY-KGY	100	1,220		[3] 100	1,220
KFPY	do	Symons Investment Co	KGY-KFIO	250	1,220		100	1,210
KGA	do	Northwestern Radio Service Co		2,000	1,150		5,000	1,470
KMO	Tacoma	KMO (Inc.)		500	1,180	KVI	500	1,340
KVI	do	Puget Sound Radio Broadcasting Co. (Ltd.).		250	1,060	KMO	1,000	1,340
KHQ	Spokane	Louis Wasmer (Inc.)		1,000	810	KUOM	1,000	920
	WEST VIRGINIA							
WOBU	Charleston	Charleston Radio Broadcasting Co		250	1,120	WSAZ	250	580
WQBJ	Clarksburg	John Raikes		[22] 65	1,250		[21] 65	1,200
WQBZ	Weirton	J. H. Thompson		60	1,200		60	1,200
WSAZ	Huntington	McKellar Electric Co		100	1,200	WOBU	250	580
WWVA	Wheeling	West Virginia Broadcasting Corporation.		250	580	WHAS	[1] 250	1,020
	WISCONSIN							
WEBW	Beloit	Beloit College		500	1,160		[1] 250	600
WTMJ	Brookfield	Milwaukee Journal		1,000	1,020	WHA	1,000	570
WTAQ	Eau Claire	Clyde S. Van Gorden		500	1,180	KSCJ	1,000	1,330
KFIZ	Fond du Lac	Fond du Lac Commonwealth Reporter		100	1,120		100	1,420
WCLO	Kenosha	C. E. Whitemore	WJBC-WWAE	100	1,320	WRJN	100	1,200
WKBH	La Crosse	Callaway Music Co		500	1,300	KSO-WHBL	1,000	1,380
WIBA	Madison	Capital Times Strand Theater Station		100	1,250		100	1,210
WHA	do	University of Wisconsin	WLBL	750	900	WTMJ	750	570
WOMT	Manitowoc	Mikadow Theater		100	1,350		100	1,210
WHAD	Milwaukee	Marquette University	WISM-WGWB	500	1,110	WISN	250	1,120
WISN	do	Evening Wisconsin Co	WGWB-WHAD	250	1,110	WHAD	250	1,120
WIBU	Poynette	The Electric Farm		20	1,380		100	1,310
WRJN	Racine	Racine Broadcasting Corporation		50	1,210	WCLO	100	1,200
WHBL	Sheboygan	Press Publishing Co. and C. L. Carrell		[14] 250	1,470	WKBH-KSO	1,000	1,380
WEBC	Superior	Head of Lakes Broadcasting Co		[1] 250	1,240	WDAY	1,000	1,280
WLBL	Stevens Point	Wisconsin Department of Markets	WHA	[13] 1,000	900		[2] 1,000	900
WHBY	West De Pere	St. Norbert's College		50	1,200		50	1,200
	WYOMING							
KFBU	Laramie	Bishop N. S. Thomas	KFUM	500	620		500	600

[1] Construction permit for 5,000 watts issued.
[2] Daytime.
[3] 1,000 watts in daytime only.
[14] 500 watts in daytime only.
[18] 2,000 watts in daytime only.
[21] Construction permit only.
[22] Construction permit for 500 watts issued.

APPENDIX G–1A

FEDERAL RADIO COMMISSION,
Washington, D. C., October 16, 1928.

The commission has found it necessary to make certain changes in the allocation announced September 10, 1928, effective November 11, 1928. These changes are due in part to the fact that extensive checking has revealed possibilities for deriving greater service to the public on certain channels and for more economical use of daytime hours; in part to the desire to remedy certain injustices to particular stations and certain sections of the country without the expense of a hearing; and in part to the necessity of correcting a few sources of interference.

Licenses are being issued and mailed to the stations in accordance with the assignments indicated on the list. These licenses will be effective on November 11, 1928, at 3 o'clock a. m., eastern standard time, and will expire on February 1, 1929, at the same hour.

All stations dissatisfied with their assignments under the revised allocation should follow the procedure set forth in the commission's statement of September 11, 1928. Applications must be on forms provided by the commission; these may be obtained from the radio supervisors or from the secretary of the commission. All such applications must specify what frequency, power, and/or hours of operation are desired by the applicant. No one application may specify more than one frequency. If one applicant files two or more applications for different frequencies only one of the applications will be set for hearing, and consideration of the others will be postponed until the one heard is disposed of; if such an applicant fails to designate which application he desires to be heard first, the commission will select such application.

CHANGES FOR STATIONS ON CLEAR AND REGIONAL CHANNELS FROM THE LIST OF SEPTEMBER 8, 1928, EFFECTIVE NOVEMBER 11, 1928

WAAF, Chicago, Ill., Drovers Journal Publishing Co. Formerly 500 watts, 940 kilocycles, daylight; changed to 500 watts, 920 kilocycles, daylight.

WAAM, Newark, N. J., WAAM (Inc.) (WGCP, WODA). Formerly 500 watts, 1,250 kilocycles; changed to 250 watts, 1,250 kilocycles.

WAAT, Jersey City, N. J., Bremer Broadcasting Corporation (WBMS and WNJ and WIBS and WKBO). Formerly 250 watts, 1,450 kilocycles; changed to 300 watts, 1,070 kilocycles, operating until 6 p. m., but not after sunset at Cleveland.

WADC, Akron, Ohio, Allen T. Simmons (WFJC). Formerly 1,000 watts, 1,340 kilocycles; changed to unlimited time, 1,320 kilocycles.

WAIU, Columbus, Ohio, American Insurance Union (WEAO). Formerly 500 watts, 640 kilocycles; changed to not sharing, but limited time.

WAPI, Auburn, Ala., Alabama Polytechnic Institute (WJAX). Formerly 1,000 watts, 1,140 kilocycles; changed to sharing with KVOO (construction permit for 5,000 watts).

WBAL, Baltimore, Md., temporarily assigned full time on 1,060 kilocycles, pending completion of WTIC's 50,000-watt transmitter (estimated date, June, 1929).

WBBM-WJBT, Glenview, Ill., Atlas Investment Co. (KFAB). Formerly 10,000 watts, 770 kilocycles; given construction permit for 25,000 watts.

WBET, Medford, Mass., Boston Transcript Co. (WMAF). Formerly 500 watts, 1,320 kilocycles; changed to 500 watts, 1,360 kilocycles.

WBMS, Union City, N. J., WBMS Broadcasting Corporation (sharing with WNJ, WAAT, WIBS, and WKBO). Formerly 100 watts, 1,450 kilocycles; changed to 250 watts, 1,450 kilocycles, sharing with WNJ, WIBS, and WKBO.

WBT, Charlotte, N. C., C. C. Coddington (WPTF). Formerly 5,000 watts, 1,080 kilocycles; changed to full time (formerly construction permit for 10,000 watts).

WCAE, Pittsburgh, Pa., Kauffman & Baer Co. Formerly 500 watts, 1,240 kilocycles; changed to 500 watts, 1,220 kilocycles.

WCAH, Columbus, Ohio, Commercial Radio Service Co. (WSPD). Formerly 250 watts, 1,450 kilocycles; changed to sharing with WMBS, 250 watts, 1,430 kilocycles.

WCAJ, Lincoln, Nebr., Nebraska Wesleyan University (WJAG and WOW). Formerly 500 watts, 590 kilocycles; changed to sharing with WOW only.

WCAL, Northfield, Minn., St. Olaf College (sharing with KFMX and WRHM and WLB). Formerly 1,000 watts, 1,230 kilocycles; changed to (dividing as before) 100 watts, 1,250 kilocycles.

WCAZ, Carthage, Ill., Carthage College (WDZ). Formerly 100 watts, 1,070 kilocycles, daylight; changed to not sharing, daylight time.

WCBD, Zion, Ill., Wilbur Glenn Voliva (WOWO and KTNT). Formerly 500 watts, 1,160 kilocycles; changed to sharing WMBI (daylight) 5,000 watts, 1,080 kilocycles.

WCFL, Chicago, Ill., Chicago Federation of Labor (sharing WJJD and WRM). Formerly 1,000 watts 620 kilocycles; changed to (construction permit issued), 50,000 watts, 970 kilocycles, limited time.

WCWK, Fort Wayne, Ind., Chester W. Keen. Formerly 500 watts, 1,320 kilocycles, daylight; changed to sharing WSBT–WFBM, 500 watts, 1,230 kilocycles.

WDBJ, Roanoke, Va., Richardson-Wayland Electric Corporation (WRBX). Formerly 250 watts, 930 kilocycles; changed to full time, 500 watts, daylight.

WDEL, Wilmington, Del., WDEL (Inc.) (WMAL). Formerly 250 watts, 630 kilocycles; changed to full time, 250 watts, 1,410 kilocycles.

WDGY, Minneapolis, Minn., Dr. George W. Young (sharing KFLV, WHDI, and KFEQ). Formerly 500 watts, 1,410 kilocycles; changed to sharing with KFLV, WHDI, and WHBL, same power and kilocycles.

WDZ, Tuscola, Ill., James L. Bush (WCAZ). Formerly 100 watts, 1,070 kilocycles, daylight; changed to full time.

WEAI, Ithaca, N. Y., Cornell University (this station is an addition to September 8, 1928, list), 1,000 watts, 740 kilocycles, daylight.

WEAO, Columbus, Ohio, Ohio State University (WAIU). Formerly 750 watts, 640 kilocycles, limited time; changed to sharing with WKRC, 750 watts, 550 kilocycles.

WFBM, Indianapolis, Ind., Indianapolis Power & Light Co. Construction permit, 25,000 watts, 1,050 kilocycles, limited time.

WFBM, Indianapolis, Ind., Indianapolis Power & Light Co. (Sharing WSBT). Formerly 1,000 watts, 920 kilocycles; changed to sharing (WSBT, WCWK), 500 watts, 1,230 kilocycles.

WFJC, Akron, Ohio, W. F. Jones Broadcasting (Inc.) (WADC). Formerly 500 watts, 1,340 kilocycles; changed to share with WJAY, 500 watts, 1,450 kilocycles.

WFLA-WSUN, Clearwater, Fla., Clearwater Chamber of Commerce and St. Petersburg Chamber of Commerce (sharing with WMBE). Formerly 1,000 watts, 560 kilocycles; changed to not sharing, 1,000 watts, 900 kilocycles.

WGCP, Newark, N. J., May Radio Broadcast Corporation (sharing with WODA-WAAM). Formerly 250 watts, 1,250 kilocycles; changed to 500 watts, 1,250 kilocycles.

WGHP, Fraser, Mich., Geo. Harrison Phelps (Inc.). Formerly 750 watts, 1,220 kilocycles; changed to 750 watts, 1,240 kilocycles.

WGR, Buffalo, N. Y., Federal Radio Corporation (WYSR). Formerly 750 watts, 550 kilocycles; changed to not sharing.

WHAD, Milwaukee, Wis., Marquette University (WISN). Formerly 250 watts, 1,120 kilocycles; changed to sharing with WLBL, 500 watts, 900 kilocycles, daylight.

WHAS, Louisville, Ky., the Courier Journal Co. and the Louisville Times Co. (WWVA), formerly 5,000 watts, 1,020 kilocycles (construction permit for 10,000); changed to not sharing, 5,000 watts, 820 kilocycles. (construction permit for 10,000).

WHBL, Sheboygan, Wis., Press Publishing Co. and C. L. Carrell (sharing with KSO, WKBH). Formerly 1,000 watts, 1,380 kilocycles; changed to sharing with WDGY, KFLV, WHDI, 500 watts, 1,410 kilocycles.

WHDI, Minneapolis, Minn., William Hood Dunwoody Industrial Institute (WDGY, KFEQ, KFLV). Formely 500 watts, 1,410 kilocycles; changed to sharing with WDGY, WHBL, KFLV, same power and kilocycles.

WHEC–WABO, Rochester, N. Y., Hickson Electric Co. (Inc.) (WMAC, WOKO). Formerly 250 watts, 1,440 kilocycles; changed to 500 watts, 1,440 kilocycles.

WHK, Cleveland, Ohio, Radio Air Service Corporation (WJAY). Formerly 500 watts, 1,390 kilocycles; changed to 1,000 watts, 1,390 kilocycles.

WHO, Des Moines, Iowa, Bankers Life Co. (WOI). Formerly 5,000 watts, 1,050 kilocycles; changed to sharing with WOC, 5,000 watts, 1,000 kilocycles.

WIBS, Elizabeth, N. J., N. J. Broadcasting Corporation (WBMS, WNJ, WAAT, WKBO). Formerly 250 watts, 1,450 kilocycles; changed to share with WBMS, WNJ, WKBO, 250 watts, 1,450 kilocycles.

WISN, Milwaukee, Wis., Evening Wisconsin Co. (WHAD). Formerly 250 watts, 1,120 kilocycles; changed to full time.

WJAG, Norfolk, Nebr., Norfolk Daily News (WCAJ, WOW). Formerly 500 watts, 590 kilocycles, daylight; changed to limited time, 500 watts, 1,060 kilocycles.

WJAS, Pittsburgh Radio Supply House. Formerly 500 watts, 1,290 kilocycles; changed to 1,000 watts, 1,290 kilocycles.

WJAX, Jacksonville, Fla., City of Jacksonville (WAPI). Formerly 1,000 watts, 1,140 kilocycles; changed to 1,000 watts, 1,260 kilocycles.

WJAY, Cleveland, Ohio, Cleveland Radio Broadcasting Corporation (WHK), 500 watts, 1,390 kilocycles; changed to sharing with WFJC, 500 watts, 1,450 kilocycles.

WJBB, Sarasota, Fla., Financial Journal (Inc.). Formerly 100 watts, 1,370 kilocycles; changed to 250 watts, 1,010 kilocycles.

WJJD, Loyal Order of Moose, Moosehart, Ill. (WCFL, WRM). Formerly 1,000 watts, 620 kilocycles; changed to (construction permit) 20,000 watts, 830 kilocycles, limited time.

WJKS, Gary, Ind., Johnson-Kennedy Radio Corporation, formerly sharing WGES, WPCC, 500 watts, 1,360 kilocycles; changed to sharing WGES, 500 watts, 1,360 kilocycles.

WKBH, La Crosse, Wis., Callaway Music Co. (KSO, WHBL). Formerly 1,000 watts, 1,380 kilocycles; changed to sharing with KSO only, same power and kilocycles.

WKBN, Youngstown, Ohio, W. P. Williamson, jr. (WMBS). Formerly 500 watts, 1,430 kilocycles; changed to share with WSMK, 500 watts, 570 kilocycles.

WKBO, Jersey City, N. J., Camith Corporation (WBMS, WNJ, WAAT, WIBS), 250 watts, 1,450 kilocycles; changed to share with WBMS, WNJ, WIBS.

WKBW, Amherst, N. Y., Churchill Evangelistic Association (WKEN), 5,000 watts, 1,470 kilocycles; changed to not sharing.

WKEN, Grand Island, N. Y., WKEN (Inc.) (WKBW), 750 watts, 1,470 kilocycles; changed to limited time, 750 watts, 1,040 kilocycles.

WKRC, Cincinnati, Ohio, Kodel Radio Corporation, 500 watts, 550 kilocycles; changed to share with WEAO, 500 watts, 550 kilocycles.

WLB, WGMS, Minneapolis, Minn., University of Minnesota. Formerly 1,000 watts, 1,230 kilocycles; call WGMS, used by WCCO, when broadcasting over WLB (WCAL, KFMX, WRHM), dividing as before, 1,000 watts, 1,250 kilocycles.

WLBL, Stevens Port, Wis., Wisconsin Department of Markets. Formerly 1,000 watts, 900 kilocycles; changed to share with WHAD, same power and kilocycles.

WLBZ, Dover-Foxcroft, Me., Thompson L. Guernsey. Formerly 250 watts, 570 kilocycles; changed to construction permit for 500 watts, 620 kilocycles.

WLTH, Brooklyn, N. Y., Voice of Brooklyn (Inc.), formerly (WCGU, WSGH, WSDA, WBBC); 250 watts, 1,400 kilocycles; no change in time division, 500 watts, 1,400 kilocycles.

WLW, Mason, Ohio, Crosley Radio Corporation (WSAI); 5,000 watts, 700 kilocycles; changed to full time, construction permit for 5,000 watts, 700 kilocycles.

WLWL, Kearney, N. J., Missionary Society of St. Paul the Apostle (WPG); 5,000 watts, 1,100 kilocycles; changed to daylight, sharing WPG, 5,000 watts, 1,100 kilocycles.

WMAF, S. Dartmouth, Mass., Round Hills Radio Corporation (WBET); 500 watts, 1,320 kilocycles; changed to 500 watts, 1,360 kilocycles.

WMAL, Washington, D. C., M. A. Leese Co. (WDEL); 250 watts, 630 kilocycles; changed to full time.

WMBF, Miami Beach, Fla., Fleetwood Hotel Corporation (WFLA, WSUN); 500 watts, 560 kilocycles; changed to not sharing.

WMBI, Addison, Ill., Moody Bible Institute, formerly sharing WOWO, KTNT, and WCBD; 5,000 watts, 1,160 kilocycles; changed sharing WCBD, day, 5,000 watts, 1,080 kilocycles, day.

WMBS, Lemoyne, Pa., Mack's Battery Co. (WKBN); 250 watts, 1,430 kilocycles; changed to sharing WCAH, 500 watts, 1,430 kilocycles.

WMMN, Fairmont, W. Va., Holt Rowe Novelty Co. (new station); night, 250 watts, 890 kilocycles; daytime, 500 watts.

WNAD, Norman, Okla., University of Oklahoma (KGGF); 500 watts, 580 kilocycles; changed to sharing KGGF, 500 watts, 1,010 kilocycles.

WNJ, Newark, N. J., Radio Investment Co. (WBMS, WAAT, WIBS, WKBO); 250 watts, 1,450 kilocycles; changed to share WBMS, WIBS, WKBO, same power and kilocycles.

WNOX, Knoxville, Tenn., Sterchi Bros. (KVOO); 1,000 watts, 560 kilocycles; changed to not sharing KVOO.

WOC, Davenport, Iowa, Palmer School of Chiropractic (WSUI); former limited time, 5,000 watts, 970 kilocycles; changed to share with WHO, 5,000 watts, 1,000 kilocycles.

WOI, Ames, Iowa, Iowa State College (WHO); formerly limited time, 5,000 watts, 1,050 kilocycles; changed, dividing KFEQ, daylight, 3,500 watts, 560 kilocycles.

WOW, Omaha, Nebr., Woodmen of the World (WJAG, WCAJ); 1,000 watts, 590 kilocycles; changed to sharing WCAJ, same power and kilocycles.

WOWO, Fort Wayne, Ind., Main Auto Supply Co. (KTNT, WCBD, WMBI); 5,000 watts, 1,160 kilocycles; changed to sharing WWVA.

WPCC, Chicago, Ill., North Shore Congregational Church (WJKS, WGES); 500 watts, 1,360 kilocycles; changed to share WRM, WHA, 500 watts, 570 kilocycles.

WPTF, Raleigh, N. C., Durham Life Insurance Co. (WBT); 5,000 watts, 1,080 kilocycles; changed to not sharing, construction permit for 10,000 watts, 680 kilocycles, limited time.

WQBC, Utica, Miss., Chamber of Commerce (Inc.); 100 watts, 1,210 kilocycles; changed to 300 watts, 1,360 kilocycles.

WRBX, Roanoke, Va., Richmond Development Co. (WDBJ); 250 watts, 930 kilocycles; changed to construction permit canceled.

WREN, Lawrence, Kans., Jenny Wren Co. (KSAC, KFKU); 500 watts, 1,010 kilocycles; changed to share KFKU, 1,000 watts, 1,220 kilocycles.

WRHM, Fridley, Minn., Rosedale Hospital Co. (Inc.) (WCAL, KFMX, WLB); 1,000 watts, 1,230 kilocycles; changed to sharing as before, 1,000 watts, 1,250 kilocycles.

WRM, Urbana, Ill., University of Illinois (WJJD, WCFL); 500 watts, 620 kilocycles; changed to sharing WPCC, WIIA, 500 watts, 570 kilocycles.

WRUF, Gainesville, Fla., University of Florida (KFJF); 5,000 watts, 1,470 kilocycles; changed to unlimited time.

WSAI, Mason, Ohio, Crosley Radio Corporation (lessee) sharing WLW. Formerly 5,000 watts, 700 kilocycles; changed to full time not sharing with WLW, 5,000 watts, 800 kilocycles.

WSB, Atlanta, Ga., Atlanta Journal Co. Formerly 1,000 watts, 740 kilocycles; construction permit for 5,000 watts; changed to construction permit for 10,000 watts.

WSBT, South Bend, Ind., South Bend Tribune (WFBM). Formerly 500 watts, 920 kilocycles; changed to sharing WFBM and WCWK, 500 watts, 1,230 kilocycles.

WSMK, Dayton, Ohio, Stanley M. Krohn, jr. Formerly 200 watts, 570 kilocycles; changed to sharing WKBN, same power and kilocycles.

WSPD, Toledo, Ohio, Toledo Broadcasting Co. (WCAH). Formerly 250 watts, 1,450 kilocycles; changed to full time, 500 watts 1,340 kilocycles.

WSUI, Iowa City, Iowa, State University of Iowa (WOC). Formerly 500 watts, 970 kilocycles; limited time; changed to sharing KSAC, 500 watts, 580 kilocycles.

WSYR, Syracuse, N. Y., Clive B. Meredith (WGR). Formerly 500 watts, 550 kilocycles; changed to full time, 250 watts, 570 kilocycles.

WTIC, Hartford, Conn., temporary operation on 600 kilocycles, 250 watts, full time, pending completion of 50,000-watt transmitter which will be assigned half time on 1,060 kilocycles.

WWJ, Detroit, Mich., the Detroit News. Formerly 1,000 watts, 820 kilocycles; changed to 1,000 watts, 920 kilocycles.

WWVA, Wheeling, W. Va., West Virginia Broadcasting Corporation (WTAS). Formerly 250 watts, 1,020 kilocycles, construction permit for 5,000 watts; changed to sharing with WOWO, 250 watts, 1,160 kilocycles, construction permit for 5,000 watts.

KDYL, Salt Lake, Utah, Intermountain Broadcasting Corporation (KFAU). Formerly construction permit 1,000 watts, 1,230 kilocycles; changed to full time, construction permit for 1,000 watts, 1,200 kilocycles.

KFAU, Boise, Idaho, Independent School District of Boise City (KDYL). Formerly 1,000 watts, 1,230 kilocycles; changed to sharing with KXL, 1,000 watts, 1,250 kilocycles.

KFBB, Havre, Mont., F. A. Buttrey Co. Formerly 100 watts, 1,200 kilocycles; changed to Buttrey Broadcast (Inc.), sharing with KGIR, construction permit 250 watts, 1,360 kilocycles, 500 watts, daylight.

KFDM, Beaumont, Tex., Magnolia Petroleum Co. (KPRC). Formerly 500 watts, 550 kilocycles; changed to full time, 500 watts, 560 kilocycles.

KFEL, Denver, Colo., Eugene P. O'Fallon (Inc.) (KFXF). Formerly 250 watts, 1,120 kilocycles; changed to 250 watts, 940 kilocycles.

KFEQ, St. Joseph, Mo., Scroggin & Co. Bank (WHDI, WDGY, and KFLV). Formerly 2,500 watts, 1,410 kilocycles; changed to sharing WOI, 2,500 watts, 560 kilocycles, daylight.

KFH, Wichita, Kans., Hotel Lassen (WIBW). Formerly 500 watts, 1,300 kilocycles; changed to (dividing as before) 1,000 watts, 1,300 kilocycles.

KFFIO, Spokane, Wash., North Central High School. Formerly 100 watts, 1,220 kilocycles, daylight; changed to 100 watts, 1,230 kilocycles, daylight.

KFJF, Oklahoma City, Okla., National Radio Manufacturing Co. (WRUF); 5,000 watts, 1,470 kilocycles; changed to full time.

KFKA, Greeley, Colo., Colorado State Teachers College (KPOF); 500 watts, 1,010 kilocycles; changed to 500 watts, 880 kilocycles.

KFKU, Lawrence, Kans., University of Kansas (KSAC, WREN); 500 watts, 1,010 kilocycles; changed to sharing with WREN, 1,000 watts, 1,220 kilocycles.

KFLV, Rockford, Ill., A. T. Frykman (WHDI, WDGY, KFEQ); 500 watts, 1,410 kilocycles; changed to sharing with WHDI, WDGY, WHBL.

KFMX, Northfield, Minn., Carleton College (WCAL, WRHM, WLB); 1,000 watts, 1,230 kilocycles; changed to (dividing as before) 1,000 watts, 1,250 kilocycles.

KFOA, Seattle, Wash., Rhodes Department Store (KTW). Formerly 1,000 watts, 1,280 kilocycles; changed to 1,000 watts, 1,270 kilocycles.

KFPY, Spokane, Wash., Symons Investment Co. Formerly 100 watts, 1,210 kilocycles; changed to sharing KWSC, 500 watts, 1,390 kilocycles.

KFQD, Anchorage, Alaska, Anchorage Radio Club. Formerly 100 watts, 900 kilocycles; changed to 100 watts, 1,230 kilocycles.

KFSD, San Diego, Calif., Airfan Radio Corporation. Formerly 500 watts, 600 kilocycles; changed to 1,000 watts (day), 500 watts (night), 600 kilocycles.

KFUM, Colorado Springs, Colo., W. D. Corley (KOW). Formerly 1,000 watts, 1,390 kilocycles; changed to full time, 1,000 wats, 1,270 kilocycles.

KFXF, Denver, Colo., Pikes Peak Broadcasting Co. (KFEL). Formerly 250 watts, 1,120 kilocycles; changed to 250 watts, 940 kilocycles.

KGB, San Diego, Calif., Southwestern Broadcasting Corporation. Formerly 250 watts, 1,340 kilocycles; changed to 250 watts, 1,360 kilocycles.

KGBU, Ketchikan, Alaska, Alaska Radio & Service Co. Formerly 500 watts, 610 kilocycles; changed to 500 watts, 900 kilocycles.

KGGF, Picher, Okla., D. L. Connell, M. D. (WNAD). Formerly 500 watts, 580 kilocycles; changed to 500 watts 1,010 kilocycles.

KGIO, Idaho Falls, Idaho, Jack W. Duckworth, jr (KGIQ). This station is an addition to the list of September 8, 1928; 250 watts, 1,320 kilocycles.

KGIQ, Twin Falls, Idaho, Stanley M. Soule (KGIO). This station is an addition to the list of September 8, 1928; 250 watts, 1,320 kilocycles.

KGIR, Butte, Mont., Symons Broadcasting Co. (KFBB). This station is an addition to the list of September 8, 1928; 250 watts, 1,360 kilocycles.

KGJF, Little Rock, Ark., First Church of the Nazarene. Formerly 100 watts, 1,370 kilocycles; changed to 250 watts, 890 kilocycles.

KGKO, Wichita Falls, Tex., Highland Heights Christian Church; 100 watts, 1,370 kilocycles; changed to 250 watts, 570 kilocycles.

KGW, Portland, Oreg., Oregonian Publishing Co. Formerly 1,000 watts, 590 kilocycles; changed to 1,000 watts, 620 kilocycles.

KHQ, Spokane, Wash., Louis Wasmer (Inc.) (KUOM). Formerly 1,000 watts, 920 kilocycles; changed to full time, 1,000 watts, 590 kilocycles.

KJBS, San Francisco, Calif., Julius Brunton & Sons Co. (KZM); 100 watts, 1,370 kilocycles; changed to daylight time not sharing with KZM, 100 watts, 1,100 kilocycles.

KLRA, Little Rock, Ark., Arkansas Broadcasting Co. (KUOA); 1,000 watts, 1,250 kilocycles; changed to 1,000 watts, 1,390 kilocycles.

KLX, Oakland, Calif., Tribune Publishing Co. (KTAB). Formerly 500 watts, 1,270 kilocycles; changed to full time, 500 watts, 880 kilocycles.

KOAC, Corvallis, Oreg., Oregon State Agricultural College (KXL); 1,000 watts, 1,250 kilocycles; changed to full time, 1,000 watts, 560 kilocycles.

KOB, State College, N. Mex., New Mexico College of Agriculture and formerly Mechanical Arts (KEX); 5,000 watts, 1,180 kilocycles; changed to 10,000 watts, 1,180 kilocycles.

KOMO, Seattle, Wash., Fisher's Blend Station (Inc.); 1,000 watts, 620 kilocycles; changed to 1,000 watts, 920 kilocycles.

KOW, Denver, Colo., Associated Industries (Inc.) Broadcasting (KFUM); 500 watts, 1,390 kilocycles; changed to full time.

KPOF, Denver, Colo., Pillar of Fire (Inc.) (KFKA); 500 watts, 1,010 kilocycles; changed to (KFKA) 500 watts, 880 kilocycles.

KPRC, Houston, Tex., Houston Printing Co. (KFDM); 1,000 watts, 550 kilocycles; changed to full time, 1,000 watts, 920 kilocycles.

KRGV, Harlingen, Tex., Harlingen Music Co. (KWWG); 500 watts, 1,010 kilocycles; changed to 500 watts, 1,260 kilocycles.

KSAC, Manhattan, Kans., Kansas State Agricultural College (WREN-KFKU); 500 watts, 1,010 kilocycles; changed to sharing with WSUI, 500 watts, 580 kilocycles.

KSEI, Pocatello, Idaho, KSEI Broadcasting Association; 250 watts, 1,320 kilocycles; changed to 250 watts, 900 kilocycles.

KSOO, Sioux Falls, S. Dak., Sioux Falls Broadcast Association; 1,000 watts, 990 kilocycles daylight; changed to 1,000 watts, 1,110 kilocycles limited time.

KSO, Clarinda, Iowa, Berry Seed Co. (WKBH, WHBL); 1,000 watts, 1,380 kilocycles; changed to sharing with WKBH.

KTAB, Oakland, Calif., Associated Broadcasters (KLX); 500 watts, 1,270 kilocycles; changed to full time, 500 watts, 1,280 kilocycles.

KTNT, Muscatine, Iowa, Norman Baker (WOWO, WGBD, WMBI); 5,000 watts, 1,100 kilocycles; changed to full time daylight hours, 5,000 watts, 1,170 kilocycles daylight.

KTW, Seattle, Wash., First Presbyterian Church (KFOA); 1,000 watts, 1,280 kilocycles; changed to sharing (KFOA), 1,000 watts, 1,270 kilocycles.

KUOA, Fayetteville, Ark., University of Arkansas (KLRA); 1,000 watts, 1,250 kilocycles; changed to sharing (KLRA), 1,000 watts, 1,390 kilocycles.

KUOM, Missoula, Mont., State University of Montana (KHQ); 500 watts, 920 kilocycles; changed to sharing with KXA, 500 watts, 570 kilocycles.

KVOO, Tulsa, Okla., Southwestern Sales Corporation (WNOX); 1,000 watts, 560 kilocycles; changed to sharing with WAPI, construction permit 5,000 watts, 1,140 kilocycles.

KWJJ, Portland, Oreg., Wilbur Jerman; 50 watts, 1,500 kilocycles; changed to 500 watts, 1,060 kilocycles (limited time).

KWKH, Kennonwood, La., W. K. Henderson (WWL); construction permit for 20,000 watts, 850 kilocycles.

KWSC, Pullman, Wash., State College of Washington (KXA, KVOS); 500 watts, 570 kilocycles; changed to sharing with KFPY, 500 watts, 1,390 kilocycles.

KWWG, Brownsville, Tex., Chamber of Commerce (KRGV); 500 watts, 1,010 kilocycles; changed to 500 watts, 1,260 kilocycles.

KXA, Seattle, Wash., American Radio Telegraph Co. (KWSC, KVOS); 500 watts, 570 kilocycles; changed to sharing with KUOM, 500 watts, 570 kilocycles.

KXL, Portland, Oreg., KXL Broadcasters (Inc.) (KOAC); 500 watts, 1,250 kilocycles; changed to sharing with KFAU.

KYA, San Francisco, Calif., Pacific Broadcasting Corporation; 1,000 watts, 1,220 kilocycles; changed to 1,000 watts, 1,230 kilocycles.

KYW-KFKX, Chicago, Ill., Westinghouse Electric & Manufacturing Co.; 5,000 watts, 1,000 kilocycles; changed to 5,000 watts, 1,020 kilocycles.

APPENDIX G–1B

FEDERAL RADIO COMMISSION,
Washington, D. C., October 19, 1928.

Changes in assignments for local stations from the list of September 8, 1928, effective November 11, 1928:

FIRST ZONE

Station WIBX, Utica, N. Y., WIBX (Inc.), changed from 1,310 kilocycles with 100 watts to 1,200 kilocycles with 100 watts.

Station WFCI, Pawtucket, R. I., Frank Crook (Inc.), changed from sharing with WDWF on 1,370 kilocycles with 100 watts to sharing with WDWF on 1,210 kilocycles with 100 watts.

Station WDWF, Cranston, R. I., Dutee W. Flint and the Lincoln Studios (Inc.), changed from 1,370 kilocycles with 100 watts to sharing with WFCI on 1,210 kilocycles with 100 watts.

SECOND ZONE

Station WKJC, Lancaster, Pa., Kirk Johnson & Co., changed from sharing with WRAW and WGAL on 1,310 kilocycles with 50 watts to sharing with WPRC on 1,200 kilocycles with 50 watts.

Station WRK, Hamilton, Ohio, S. W. Doron and John C. Slade, changed from 1,420 kilocycles with 100 watts to 1,310 kilocycles with 100 watts.

Station WQBZ, Weirton, W. Va., J. H. Thompson, changed from 1,200 kilocycles with 60 watts to sharing with WIBR on 1,420 kilocycles with 60 watts.

Station WIBR, Steubenville, Ohio, Thurman A. Owings, changed from 1,200 kilocycles with 50 watts to sharing with WQBZ on 1,420 kilocycles with 50 watts.

Station WAAD, Cincinnati, Ohio, Ohio Mechanics Institution, changed from 1,370 kilocycles with 25 watts to sharing with WSRO on 1,420 kilocycles with 25 watts.

Station WAFD, Detroit, Mich., Albert B. Parfet Co., changed from sharing with WMBC on 1,420 kilocycles with 100 watts to 1,500 kilocycles with 100 watts.

THIRD ZONE

Station KFDX, Shreveport, La., First Baptist Church, changed from sharing with KRMD on 1,200 kilocycles with 100 watts to sharing with KWEA on 1,210 kilocycles with 100 watts.

Station KWEA, Shreveport, La., William E. Anthony, changed from sharing with KGGH on 1,370 kilocycles with 100 watts to sharing with KFDX on 1,210 kilocycles with 100 watts.

Station WRBQ, Greenville, Miss., J. Pat Scully, changed from 1,200 kilocycles with 100 watts to 1,210 kilocycles with 100 watts.

Station WGCM, Gulfport, Miss., Gulf Coast Music Co. (Inc.), changed from 1,370 kilocycles with 15 watts to 1,210 kilocycles with 100 watts.

Station KRMD, Shreveport, La., Robert M. Dean, changed from sharing with KFDX on 1,200 kilocycles with 50 watts to sharing with KGGH on 1,310 kilocycles with 50 watts.

Station KGGH, Cedar Grove, La., Bates Radio & Electric Co., changed from sharing with KWEA on 1,370 kilocycles with 50 watts to sharing with KRMD on 1,310 kilocycles with 50 watts.

Station KFPL, Dublin, Tex., C. C. Baxter, changed from 1,370 kilocycles with 15 watts to 1,310 kilocycles with 15 watts.

Station KGHG, McGeehee, Ark., Chas. W. McCollum, changed from 1,370 kilocycles with 50 watts to 1,310 kilocycles with 50 watts.

FOURTH ZONE

Station KFKZ, Kirksville, Mo., Northeast Missouri State Teachers College, changed from 1,210 kilocycles with 50 watts to 1,200 kilocycles with 50 watts.

Station KGDA, Dell Rapids, S. Dak., Home Auto Co., changed from 1,210 kilocycles with 15 watts to 1,370 kilocycles with 15 watts.

Station KGBX, St. Joseph, Mo., Foster-Hall Tire Co., changed from 1,210 kilocycles with 100 watts to sharing with KWKC on 1,370 kilocycles with 100 watts.

Station KICK, Red Oak, Iowa, Atlantic Automobile Co., Red Oak Radio Corporation, lessee, changed from daytime on 560 kilocycles with 100 watts to sharing with WIAS on 1,420 kilocycles with 100 watts.

Station WLBF, Kansas City, Kans., Everett L. Dillard, changed from 1,200 kilocycles with 100 watts to 1,420 kilocycles with 100 watts.

Station WMBH, Joplin, Mo., Edwin Dudley Aber, changed from 1,210 kilocycles with 100 watts to 1,420 kilocycles with 100 watts.

Station WIAS, Ottumwa, Iowa, Poling Electric Co., changed from sharing with KICK on 560 kilocycles with 100 watts daytime to 1,420 kilocycles with 100 watts.

FIFTH ZONE

Station KWG, Stockton, Calif., Portable Wireless Telegraph Co., changed from sharing with KLS on 1,420 kilocycles with 100 watts to 1,200 kilocycles with 100 watts.

Station KFEY, Kellogg, Idaho, Union High School, changed from 1,370 kilocycles with 10 watts to 1,210 kilocycles with 10 watts.

Station KRE, Berkeley, Calif., First Congregational Church, changed from sharing with KFQU and KGTT on 1,500 kilocycles with 100 watts to sharing with KZM on 1,370 kilocycles with 100 watts.

Station KGFL, Raton, N. Mex., N. L. Cotter, changed from 1,210 kilocycles with 50 watts to 1,370 kilocycles with 50 watts.

Station KFUR, Ogden, Utah, Peery Building Co., changed from 1,310 kilocycles with 50 watts to 1,370 kilocycles with 50 watts.

Station KGGM, Albuquerque, N. Mex., Jay Peters, changed from 1,420 kilocycles with 100 watts to 1,370 kilocycles with 100 watts.

Station KXRO, Aberdeen, Wash., KXRO (Inc.), changed from 1,210 kilocycles with 50 watts to 1,420 kilocycles with 50 watts.

Station KFQU, Holy City, Calif., W. E. Riker, changed from sharing with KGTT and KRE with 1,500 kilocycles with 100 watts to sharing with KGTT on 1,420 kilocycles with 100 watts.

Station KGTT, San Francisco, Calif., Glad Tidings Temple and Bible Institute, changed from sharing with KFQU and KRE on 1,500 kilocycles with 50 watts to sharing with KFQU on 1,420 kilocycles with 50 watts.

Station KGCX, Vida, Mont., First State Bank of Vita, changed from 1,370 kilocycles with 10 watts to 1,420 kilocycles with 10 watts.

Station KLS, Oakland, Calif., Warner Bros., changed from sharing with KWG on 1,420 kilocycles with 100 watts to daylight on 1,440 kilocycles with 250 watts.

Station KGY, Lacey, Wash., St. Martin's College, changed from sharing with KKP and KFQV on 1,420 kilocycles with 50 watts to daylight on 1,440 kilocycles with 50 watts.

APPENDIX G (2)

Revised list of broadcasting stations, arranged by frequencies, effective November 11, 1928, with letter of transmittal

FEDERAL RADIO COMMISSION,
Washington, D. C., October 25, 1928.

To all persons holding licenses to broadcast:

The commission has found it necessary to make certain changes in the allocation announced September 10, 1928, effective November 11, 1928. These changes are due in part to the fact that extensive checking has revealed possibilities for deriving greater service to the public on certain channels and for more economical use of daytime hours; in part to the desire to remedy certain injustices to particular stations and certain sections of the country without the expense of a hearing; and in part to the necessity of correcting a few sources of interference. The changes thus made are incorporated in a revised list of stations, a copy of which accompanies this statement. The new list also incorporates such increases of power for existing stations as have been authorized by the commission since the publication of the first list.

Licenses are being issued and mailed to the stations in accordance with the assignments indicated on the list. These licenses will be effective on November 11, 1928, at 3 o'clock a. m., eastern standard time, and will expire on February 1, 1929, at the same hour.

All stations dissatisfied with their assignments under the revised allocation should follow the procedure set forth in the commission's statement of September 11, 1928. Applications must be on forms provided by the commission; these may be obtained from the radio supervisors or from the secretary of the commission. All such applications must specify what frequency, power, and/or

hours of operation are desired by the applicant. No one application may specify more than one frequency. If one applicant files two or more applications for different frequencies, only one of the applications will be set for hearing and consideration of the others will be postponed until the one heard is disposed of; if such an applicant fails to designate which application he desires to be heard first, the commtssion will select such application.

FEDERAL RADIO COMMISSION,
By CARL H. BUTMAN, *Secretary.*

Revised list of broadcasting stations, by frequencies, effective 3 a. m., November 11, 1928, eastern standard time

[This list supersedes the list dated September 8, 1928]

Call letters	Location	Owner	Divides time with	Power
	550 kilocycles			*Watts*
WGR	Buffalo, N. Y	Federal Radio Corporation		750
WEAO	Columbus, Ohio	Ohio State University	WKRC	750
WKRC	Cincinnati, Ohio	Kodel Radio Corporation	WEAO	500
KFUO	St. Louis, Mo	Concordia Theological Seminary	KSD	500
KSD	do	Pulitzer Publishing Co	KFUO	500
KFDY	Brookings, S. Dak	South Dakota State College	KFYR-KFJM	500
KFJM	Grand Forks, N. Dak	University of North Dakota	KFDY-KFYR	500
	560 kilocycles			
WLIT	Philadelphia, Pa	Lit Bros	WFI	500
WFI	do	Strawbridge & Clothier	WLIT	500
KFDM	Beaumont, Tex	Magnolia Petroleum Co		500
WMBF	Miami Beach, Fla	Fleetwood Hotel Corporation		500
WNOX	Knoxville, Tenn	Sterchi Bros		1,000
WOI	Ames, Iowa	Iowa State College (daylight)	KFEQ	3,500
KFEQ	St. Joseph, Mo	Scroggin Company Bank (daylight).	WOI	2,500
KOAC	Corvallis, Oreg	Oregon State Agricultural College.		1,000
KIZ	Dupont, Colo	Reynolds Radio Co. (Inc.)		1,000
	570 kilocycles			
WNYC	New York City	Department Plant and Structure	WMCA	500
WMCA	do	Greeley Square Hotel Co	WNYC	500
WSYR	Syracuse, N. Y	Clive B. Meredith		250
WSMK	Dayton, Ohio	Stanley M. Krohn, jr	WKBN	200
WKBN	Youngstown, Ohio	W. P. Williamson, jr	WSMK	500
WWNC	Asheville, N. C	Chamber of Commerce		1,000
KGKO	Wichita Falls, Tex	Wichita Falls Broadcasting Co		250
WHA	Madison, Wis	University of Wisconsin	WPCC-WRM	750
WPCC	Chicago, Ill	North Shore Congregational Church.	WRM-WHA	500
WRM	Urbana, Ill	University of Illinois	WPCC-WHA	500
KUOM	Missoula, Mont	State University of Montana	KXA	500
KMTR	Hollywood, Calif	KMTR Radio Corporation	KPLA	1,000
KPLA	Los Angeles, Calif	Pacific Development Radio Co	KMTR	1,000
KXA	Seattle, Wash	American Radio Telegraph Co	KUOM	500
	580 kilocycles (Canadian shared)			
WTAG	Worcester, Mass	Worcester Telegram Publishing Co.		250
WKAQ	San Juan, P. R	Radio Corporation of Porto Rico		500
WOBU	Charleston, W. Va	Charleston Radio Broadcasting Co.	WSAZ	250
WSAZ	Huntington, W. Va	McKellar Electric Co	WOBU	250
KGFX	Pierre, S. Dak	Dana McNeill (daylight)		200
KSAC	Manhattan, Kans	Kansas State Agricultural College.	WSUI	500
WSUI	Iowa City, Iowa	State University of Iowa	KSAC	500
	590 kilocycles			
WEEI	Boston, Mass	Edison Electric Illuminating Co		500
WEMC	Berrien Springs, Mich	Emanuel Missionary College (daylight).		1,000
WCAJ	Lincoln, Nebr	Nebraska Wesleyan University	WOW	500
WOW	Omaha, Nebr	Woodmen of the World Life Insurance Association.	WCAJ	1,000
KHQ	Spokane, Wash	Louis Wasmer (Inc.)		1,000

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	600 kilocycles (Canadian shared)			*Watts*
WTIC	Hartford, Conn	Travellers Insurance Co. (temporary assignment pending completion of new 50,000 watt station.)		250
WCAO	Baltimore, Md	Monumental Radio (Inc.)		250
WREC	Whitehaven, Tenn	WREC (Inc.)	WOAN	500
WOAN	Lawrenceburg, Tenn	Church of the Nazarene, and Vaughan School of Music.	WREC	500
WEBW	Beloit, Wis	Beloit College (daylight)		250
KFSD	San Diego, Calif	Airfan Radio Corporation (1,000 day).		500
KFBU	Laramie, Wyo	Bishop N. S. Thomas		500
	610 kilocycles			
WFAN	Philadelphia, Pa	Keystone Broadcasting Co	WIP	500
WIP	do	Gimbel Bros. (Inc.)	WFAN	500
WDAF	Kansas City, Mo	Kansas City Star Co	WOQ	1,000
WOQ	do	Unity School of Christianity	WDAF	1,000
KFRC	San Francisco, Calif	Don Lee (Inc.)		1,000
	620 kilocycles			
WLBZ	Dover-Foxcroft, Mo	Thompson L. Guernsey		500
WDBO	Orlando, Fla	Rollins College (Inc.)	WDAE	1,000
WDAE	Tampa, Fla	Tampa Publishing Co	WDBO	1,000
WTMJ	Brookfield, Wis	The Journal Co		1,000
KGW	Portland, Oreg	Oregonian Publishing Co		1,000
KFAD	Phoenix, Ariz	Electrical Equipment Co		500
	630 kilocycles (Canadian shared)			
WMAL	Washington, D. C	M. A. Leese Co		250
WOS	Jefferson City, Mo	State Marketing Bureau	WGBF-KFRU	500
KFRU	Columbia, Mo	Stephens College	WOS-WGBF	500
WGBF	Evansville, Ind	Evansville on the Air (Inc.)	WOS-KFRU	500
	640 kilocycles			
WAIU	Columbus, Ohio	American Insurance Union (limited time).		5,000
KFI [1]	Los Angeles, Calif	Earl C. Anthony (Inc.) (construction permit issued for 50,000 watts).		5,000
	650 kilocycles			
WSM [1]	Nashville, Tenn	National Life & Accident Insurance Co. (construction permit issued for 50,000 watts).		5,000
	660 kilocycles			
WEAF [1]	Bellmore, N. Y	National Broadcasting Co. (Inc.)		50,000
WAAW	Omaha, Nebr	Omaha Grain Exchange (daylight).		500
	670 kilocycles			
WMAQ	Chicago, Ill	Chicago Daily News (Inc.)		5,000
	680 kilocycles			
WPTF	Raleigh, N. C	Durham Life Insurance Co. (construction permit issued for 10,000 watts).		
KPO	San Francisco, Calif	Hales Bros. and the Chronicle		5,000
	690 kilocycles (Canadian exclusive)			
	700 kilocycles			
WLW	Mason, Ohio	Crosley Radio Corporation		50,000
KFVD	Culver city, Calif	W. J. & C. I. McWhinnie (limited time).		250

[1] See General Order No. 42.

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	710 kilocycles			*Watts*
WOR	Newark, N. J.	L. Bamberger & Co.		5,000
	720 kilocycles			
WGN-WLIB	Chicago, Ill.	The Tribune Co.		15,000
	730 kilocycles (Canadian exclusive)			
	740 kilocycles			
WSB	Atlanta, Ga.	Atlanta Journal Co.		10,000
KMMJ	Clay Center, Nebr.	The M. M. Johnson Co. (limited time).		1,000
	750 kilocycles			
WJR-WCX	Pontiac, Mich.	WJR (Inc.)		5,000
	760 kilocycles			
WJZ [1]	New York, N. Y.	Radio Corporation of America		30,000
WEW	St. Louis, Mo.	St. Louis University (daylight).		1,000
	770 kilocycles			
KFAB	Lincoln, Nebr.	Nebraska Buick Auto Co.	WBBM	5,000
WBBM-WJBT [1]	Chicago, Ill.	Atlas Investment Co.	KFAB	25,000
	780 kilocycles (Canadian shared)			
WBSO	Wellesley Hills, Mass.	Babson's Statistical Organ (Inc.) (daylight).		100
WSEA	Portsmouth, Va.	Virginia Broadcasting Co. (Inc.).	WTAR-WPOR	500
WTAR-WPOR	Norfolk, Va.	Reliance Electric Co. (Inc.).	WSEA	500
WMC	Memphis, Tenn.	Memphis Commercial Appeal (Inc.).		500
KELW	Burbank, Calif.	Earl L. White	KNRC	500
KNRC	Santa Monica, Calif.	Pickwick Broadcasting Corporation.	KELW	500
	790 kilocycles			
WGY [1]	Schenectady, N. Y.	General Electric Co. (limited time).		50,000
KGO	Oakland, Calif.	do		10,000
	800 kilocycles			
WSAI	Mason, Ohio	Crosley Radio Corporation (Lessee) (limited time).		5,000
WBAP [1]	Fort Worth, Tex.	Carter Publications (Inc.)	KTHS	50,000
KTHS	Hot Springs, Ark.	Hot Springs Chamber of Commerce (construction permit issued).	WBAP	5,000
	810 kilocycles			
WPCH	New York, N. Y.	Concourse Radio Corporation (daylight).		500
WCCO	Minneapolis, Minn.	Washburn-Crosby Co.		10,000
	820 kilocycles			
WHAS	Louisville, Ky.	The Courier Journal Co. and the Louisville Times Co. (construction permit issued).		10,000
	830 kilocycles			
KOA	Denver, Colo.	General Electric Co.		12,500
	840 kilocycles (Canadian exclusive)			
	850 kilocycles			
KWKH	Kennonwood, La.	W. K. Henderson	WWL	20,000
WWL	New Orleans, La.	Loyola University (construction permit issued).	KWKH	5,000
KFQZ	Hollywood, Calif.	Taft Radio and Broadcasting Co. (Inc.) (limited time).		1,000

[1] See General Order No. 42.

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	860 kilocycles			*Watts*
WABC-WBOQ	New York, N. Y.	Atlantic Broadcasting Corporation.		5,000
	870 kilocycles			
WLS	Crete, Ill.	Sears-Roebuck & Co.	WENR-WBCN	5,000
WENR-WBCN*	Chicago, Ill.	Great Lakes Radio Broadcasting Co.	WLS	5,000
	880 kilocycles (Canadian shared)			
WQAN	Scranton, Pa.	Scranton Times	WGBI	250
WGBI	do	Scranton Broadcasters (Inc.)	WQAN	250
WCOC	Columbus, Miss.	Crystal Oil Co.		500
KLX	Oakland, Calif.	Tribune Publishing Co.		500
KPOF	Denver, Colo.	Pillar of Fire (Inc.)	KFKA	500
KFKA	Greeley, Colo.	Colorado State Teachers' College.	KPOF	500
	890 kilocycles (Canadian shared)			
WJAR	Providence, R. I.	The Outlet Co.		250
WMMN	Fairmont, W. Va.	Holt Rome Novelty Co. (daylight).		(1)
WMAZ	Macon, Ga.	Mercer University	WGST	(2)
WGST	Atlanta, Ga.	Georgia School of Technology	WMAZ	(2)
KGJF	Little Rock, Ark.	First Church of Nazarene		250
WNAX	Yankton, S. Dak.	Gurney Seed & Nursery Co. and Radio Apparatus Co.	KFNF-KUSD	500
KUSD	Vermillion, S. Dak.	University of South Dakota	WNAX-KFNF	500
KFNF	Shenandoah, Iowa	Henry Field Seed Co.	WNAX-KUSD	500
	900 kilocycles			
WFBL	Syracuse, N. Y.	The Onondaga Co. (Inc.)	WMAK	750
WMAK	Martinsville, N. Y.	WMAK Broadcasting System (Inc.).	WFBL	750
WKY	Oklahoma City, Okla.	WKY Radiophone Co.		1,000
WFLA-WSUN	Clearwater, Fla.	Clearwater Chamber of Commerce and St. Petersburg Chamber of Commerce.		1,000
WLBL	Stevens Point, Wis.	Wisconsin Department of Markets (daylight).		5,000
KHJ	Los Angeles, Calif.	Don Lee (Inc.)		1,000
KSEI	Pocatello, Idaho	KSEI Broadcasting Association		250
KGBU	Ketchikan, Alaska	Alaska Radio & Service Co.		500
	910 kilocycles (Canadian exclusive)			
	920 kilocycles			
WWJ	Detroit, Mich.	The Detroit News		1,000
KPRC	Houston, Tex.	Houston Printing Co.		1,000
WAAF	Chicago, Ill.	Drovers Journal Publishing Co. (daylight).		500
KOMO	Seattle, Wash.	Fisher's Blend Station (Inc.)		1,000
	930 kilocycles (Canadian shared)			
WIBG	Elkins Park, Pa.	St. Pauls Protestant Episcopal Church (daylight).		50
WDBJ	Roanoke, Va.	Richardson-Wayland Electric Corporation.		(3)
WBRC	Birmingham, Ala.	Birmingham Broadcasting Co. (Inc.).		500
KGBZ[4]	York, Nebr.	George R. Miller (construction permit issued).	KMA	500
KMA	Shenandoah, Iowa	May Seed & Nursery Co.	KGBZ	500
KFWM	Oakland, Calif.	Oakland Educational Society	KFWI	500
KFWI	San Francisco, Calif.	Radio Entertainments, (Inc.)	KFWM	500

[1] See General Order No. 42.
[2] 500 watts daylight, 250 watts night.
[4] Stations KGES, KOBY, KGCH, KGEO, and KGDW to combine as KGBZ.

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	940 kilocycles			*Watts*
WCSH	Portland, Me	Congress Square Hotel Co		500
WFIW	Hopkinsville, Ky	The Acme Mills (Inc.)		1,000
KOIN	Portland, Oreg	KOIN, (Inc.)		1,000
KGU	Honolulu, Hawaii	Marion A. Mulrony		500
KFEL	Denver, Colo	Eugene P. O'Fallon, (Inc.)	KFXF	250
KFXF	do	Pikes Peak Broadcasting Co	KFEL	250
	950 kilocycles			
WRC	Washington, D. C	Radio Corporation of America		500
KMBC-KLDS	Independence, Mo	Midland Broadcasting Co. and the Reorganized church of Jesus Christ of Latter Day Saints (limited to 9 p. m.)	WHB	1,000
WHB	Kansas City, Mo	Sweeney Automobile School Co.	KMBC-KLDS	1,000
KFWB	Los Angeles, Calif	Warner Brothers Broadcasting Corporation.	KPSN	1,000
KPSN	Pasadena, Calif	Pasadena Star-News Publishing Co.	KFWB	1,000
KGHL	Billings, Mont	Northwestern Auto Supply Co. (Inc.).		500
	960 kilocycles (Canadian exclusive)			
	970 kilocycles			
WCFL [1]	Chicago, Ill	Chicago Federation of Labor (construction permit issued for limited time).		50,000
KJR	Seattle, Wash	Northwest Radio Service Co		5,000
	980 kilocycles			
KDKA [1]	Pittsburgh, Pa	Westinghouse Electric & Manufacturing Co.		50,000
	990 kilocycles			
WBZ	East Springfield, Mass	do	WBZA	15,000
WBZA	Boston, Mass	do	WBZ	500
	1,000 kilocycles			
KGFH	Glendale, Calif	Frederick Robinson (Ltd.)		250
WHO	Des Moines, Iowa	Bankers Life Co	WOC	5,000
WOC	Davenport, Iowa	Palmer School of Chiropractic	WHO	5,000
	1,010 kilocycles (Canadian shared)			
WQAO-WPAP	New York, N. Y	Calvary Baptist Church	WHN-WRNY-	250
WHN	do	George Schubel	WQAO-WPAP-WRNY.	250
WRNY	do	Experimenter Publishing Co	WQAO-WPAP-WHN.	250
KGGF	Picker, Okla	D. L. Connell, M. D	WNAD	500
WNAD	Norman, Okla	University of Oklahoma	KGGF	500
WJBB	Sarasota, Fla	Sarasota County Chamber of Commerce.		250
KQW	San Jose, Calif	First Baptist Church		500
	1,020 kilocycles			
KYW-KFKX	Chicago, Ill	Westinghouse Electric & Manufacturing Co.		5,000
	1,030 kilocycles (Canadian exclusive)			
	1,040 kilocycles			
WKEN	Buffalo, N. Y	Radio Station WKEN (Inc.) (limited time).		1,000

[1] See General Order No. 42.

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	1,040 kilocycles—Contd.			*Watts*
WKAR	East Lansing, Mich.	Michigan State College (daylight).		500
WFAA [1]	Dallas, Tex.	Dallas Morning News (construction permit issued for 50,000 watts).	KRLD	5,000
KRLD	do	KRLD (Inc.)	WFAA [1]	10,000
	1050 kilocycles			
WFBM [1]	Indianapolis, Ind.	Indianapolis Power & Light Co. (construction permit issued for limited time).		25,000
KNX	Hollywood, Calif.	Western Broadcast Co.		5,000
	1060 kilocycles			
WBAL	Baltimore, Md.	Consolidated Gas, Electric Light & Power Co.	WTIC	5,000
WTIC	Hartford, Conn.	Travelers Insurance Co. (temporarily assigned to 600 kilocycles, 250 watts, pending completion of transmitter).		(4)
WJAG	Norfolk, Nebr.	Norfolk Daily News (limited time).		500
KWJJ	Portland, Oreg.	Wilbur Jerman (limited time)		500
	1070 kilocycles			
WAAT	Jersey City, N. J.			(3)
WTAM	Cleveland, Ohio	WTAM & WEAR (Inc.)	WEAR	3,500
WEAR	do	do	WTAM	1,000
WCAZ	Carthage, Ill.	Carthage College (daylight)		100
WDZ	Tuscola, Ill.	James L. Bush (daylight)		100
	1080 kilocycles			
WBT	Charlotte, N. C.	C. C. Coddington (construction permit issued).		10,000
WCBD	Zion, Ill.	Wilbur Glenn Voliva (limited time).	WMBI	5,000
WMBI	Chicago, Ill.	The Moody Bible Institute of Chicago (limited time).	WCBD	5,000
	1,090 kilocycles			
KMOX-KFQA	St. Louis, Mo.	Voice of St. Louis (Inc.)		5,000
	1,100 kilocycles			
WPG	Atlantic City, N. J.	Municipality of Atlantic City	WLWL	5,000
WLWL	New York, N. Y.	Missionary Society of St. Paul the Apostle (6 p. m. to 8 p. m.).	WPG	5,000
KJBS	San Francisco, Calif.	Julius Brunton & Sons Co. (daylight).		100
	1,110 kilocycles			
WRVA	Richmond, Va.	Larus & Bro. Co. (Inc.) (construction permit issued).		5,000
KSOO	Sioux Falls, S. Dak.	Sioux Falls Broadcasting Association (limited time).		1,000
	1,120 kilocycles			
WFBR	Baltimore, Md.	Baltimore Radio Show (Inc.)		250
WBAK	Harrisburg, Pa.	Pennsylvania State Police (daylight).		500
WCOA	Pensacola, Fla.	City of Pensacola		500
WTAW	College Station, Tex.	Agricultural and Mechanical College of Texas.	KUT	500
KUT	Austin, Tex.	University of Texas	WTAW	500
WISN	Milwaukee, Wis.	Evening Wisconsin Co.	WHAD	250
WHAD	do	Marquette University	WISN	250
KFSG	Los Angeles, Calif.	Echo Park Evangelical Association.	KMIC	500
KMIC	Inglewood, Calif.	James R. Fouch	KFSG	500
KRSC	Seattle, Wash.	Radio Sales Corporation (daylight).		50

[1] See General Order No. 42.
[4] Construction permit issued for 50,000 watts. See General Order No. 42.
[3] 300 days till 6 p. m., but not after sunset at Cleveland, Ohio.

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	1,130 kilocycles			*Watts*
WOV	New York, N. Y.	International Broadcasting Corporation (daylight to 6 p. m.).		1,000
KFKB	Milford, Kans.	The KFKB Broadcasting Association (limited time).		5,000
KSL	Salt Lake City, Utah	Radio Service Corporation of Utah (construction permit issued).		5,000
	1,140 kilocycles			
WAPI	Auburn, Ala.	Alabama Ploytechnic Institute (construction permit issued).	KVOO	5,000
KVOO	Tulsa, Okla.	Southwestern Sales Corporation (construction permit issued).	WAPI	5,000
	1,150 kilocycles			
WHAM	Rochester, N. Y.	Stromberg-Carlson Telephone Manufacturing Co.		5,000
KGDM	Stockton, Calif.	E. F. Peffer (daylight)		50
	1,160 kilocycles			
WEAN	Providence, R. I.	The Shepard Co. (daylight)		500
WWVA	Wheeling, W. Va.	West Virginia Broadcasting Corporation.	WOWO	5,000
WOWO	Fort Wayne, Ind.	Main Auto Supply Co.	WWVA	5,000
	1,170 kilocycles			
WCAU	Philadelphia, Pa.	Universal Broadcasting Co. (construction permit issued).		5,000
KTNT	Muscatine, Iowa	Norman Baker (limited time)		5,000
	1,180 kilocycles			
WGBS	Astoria, L. I.	Gimbel Bros., (Inc.) (limited time).		500
WJJD	Mooseheart, Ill.	Supreme Lodge of the World, Loyal Order of Moose (construction permit issued; limited time).		20,000
KEX	Portland, Oreg.	Western Broadcasting Co.	KOB	5,000
KOB	State College, N. Mex.	New Mexico College Agriculture and Mechanic Arts.	KEX	10,000
	1,190 kilocycles			
WRR	Dallas, Tex.	City of Dallas (construction permit issued).	WOAI	5,000
WOAI	San Antonio, Tex.	Southern Equipment Co.	WRR	5,000
	1,200 kilocycles (local)			
WABI	Bangor, Me.	First Universalist Church		100
WCAX	Burlington, Vt.	University of Vermont	WNBX	100
WEPS	Gloucester, Mass.	Matheson Radio Co. (Inc.)	WKBE	100
WIBX	Utica, N. Y.	WIBX (Inc.)		100
WKBE	Webster, Mass.	K. & B. Electric Co.	WEPS	100
WNBX	Springfield, Vt.	First Congregational Church Corporation.	WCAX	10
WBBW	Norfolk, Va.	Ruffner Junior High School		100
WFBE	Cincinnati, Ohio	Parkview Hotel		100
WHBC	Canton, Ohio	St. John's Catholic Church		10
WLAP	Okalona, Ky.	American Broadcasting Corporation of Kentucky.		30
WLBG	Petersburg, Va.	Robert Allen Gamble		100
WNBO	Washington, Pa.	John Brownlee Spriggs		15
WNBW	Carbondale, Pa.	Home Cut Glass & China Co.		5
WPRC	Harrisburg, Pa.	Wilson Printing & Radio Co.	WKJC	100
WKJC	Lancaster, Pa.	Kirk Johnson & Co.	WPRC	100
WQBJ	Clarkesburg, W. Va.	John Raikes (construction permit issued).		65
WABZ	New Orleans, La.	Coliseum Place Baptist Church	WJBW	100
WJBW	do	C. Carlson, jr.	WABZ	30
WBBZ	Ponca City, Okla.	C. L. Carrell		100
WFBC	Knoxville, Tenn.	First Baptist Church		50
WRBL	Columbus, Ga.	R. E. Martin		50
KGCU	Mandan, N. Dak.	Mandan Radio Association		100
WJBC	La Salle, Ill.	Hummer Furniture Co.	WJBL	100
WJBL	Decatur, Ill.	William Gushard Dry Goods Co.	WJBC	100

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	1,200 kilocycles—Contd.			*Watts*
WWAE	Hammond, Ind	Dr. George F. Courrier	WRAF	100
WRAF	La Porte, Ind	The Radio Club (Inc.)	WWAE	100
WJAM	Waterloo, Iowa	Waterloo Broadcasting Co	KFJB	100
KFJB	Marshalltown, Iowa	Marshall Electric Co	WJAM	100
WCAT	Rapid City, S. Dak	South Dakota State School of Mines.		100
KGDY	Oldham, S. Dak	J. Albert Loesch		15
WMAY	St. Louis, Mo	Kingshighway Presbyterian Church.	KFWF	100
KFWF	do	St. Louis Truth Center (Inc.)	WMAY	100
KFKZ	Kirksville, Mo	Northeast Missouri State Teachers College.		50
KGDE	Barrett, Minn	Jaren Drug Co		50
KGFK	Hallock, Minn	Kittson County Enterprise		50
WCLO	Kenosha, Wis	C. E. Whitmore	WRJN	100
WHBY	West De Pere, Wis	St. Norbert's College		50
WRJN	Racine, Wis	Racine Broadcasting Corporation.	WCLO	100
KFWC	Ontario, Calif	James R. Fouch	KPPC	100
KPPC	Pasadena, Calif	Pasadena Presbyterian Church	KFWC	50
KGEN	El Centro, Calif	E. R. Irey and F. M. Bowles		100
KMJ	Fresno, Calif	The Fresno Bee		100
KSMR	Santa Maria, Calif	Santa Maria Valley R. R. Co		100
KWG	Stockton, Calif	Portable Wireless Telephone Co		100
KGEK	Yuma, Colo	Beehler Electric Equipment Co	KGEW	50
KGEW	Fort Morgan, Colo	City of Fort Morgan	KGEK	100
KFHA	Gunnison, Colo	Western State College of Colorado.		50
KVOS	Bellingham, Wash	L. Kessler		100
KGY	Lacey, Wash	St. Martin's College (50-day; night).		10
	1,210 kilocycles			
WJBI	Redbank, N. J	Robert S. Johnson	WCOH-WGBB-WINR.	100
WGBB	Freeport, N. Y	Harry H. Carman	WCOH-WJBI-WINR.	100
WINR	Bayshore, N. Y	Radiotel Manufacturing Co. (Inc.)	WCOH-WJBI-WGBB.	100
WCOH	Greenville, N. Y	Westchester Broadcasting Corporation.	WJBL-WGBB-WINR.	100
WOCL	Jamestown, N. Y	A. E. Newton		25
WLCI	Ithaca, N. Y	Lutheran Association of Ithaca		50
WFCI	Pawtucket, R. I	Frank Crook (Inc.)	WDWF-WLSI.	100
WDWF-WLSI	Cranston, R. I	Dutee W. Flint and the Lincoln Studies (Inc.).	WFCI	100
WMAN	Columbus, Ohio	W. E. Hoskitt		50
WLBV	Mansfield, Ohio	Mansfield Broadcasting Association.		100
WEBE	Cambridge, Ohio	Roy W. Waller		100
WBAX	Wilkes-Barre, Pa	John H. Stenger, jr	WJBU	100
WJBU	Lewisburg, Pa	Bucknell University	WBAX	100
WTAZ	Richmond, Va	W. Reynolds, jr. and T. J. McGuire.	WMBG	150
WMBG	do	Havens & Martin (Inc.)	WTAZ	100
WSIX	Springfield, Tenn	638 Tire & Vulcanizing Co		100
WRBU	Gastonia, N. C	A. J. Kirby Music Co		100
WJBY	Gadsden, Ala	Electric Consolidated Co		50
WMBR	Tampa, Fla	F. J. Reynolds		100
WRBQ	Greenville, Miss	J. Pat Scully		100
WGCM	Gulfport, Miss	Golf Coast Music Co. (Inc.)		100
KFDX	Shreveport, La	First Baptist Church	KWEA	100
KWEA	do	William E. Antony	KFDX	100
KDLR	Devils Lake, N. Dak	Radio Electric Co		100
KGCR	Brookings, S. Dak	Cutler's Broadcasting Service		100
KFOR	Lincoln, Nebr	Howard A. Shuman		100
WHBU	Anderson, Ind	Citizens Bank		100
KFVS	Cape Girardeau, Mo	Hirsch Battery & Radio Co	WEBQ	100
WEBQ	Harrisburg, Ill	Tate Radio Co	KFVS	50
WSBC	Chicago, Ill	World Battery Co	WEDC-WCRW	100
WCRW	do	Clinton R. White	WEDC-WSBC.	100
WEDC	do	Emil Denemark (Inc.)	WSBC-WCRW	100
WCBS	Springfield, Ill	Harold L. Dewing and Charles Messter.	WTAX	100
WTAX	Streator, Ill	Williams Hardware Co	WCBS	50
WHBF	Rock Island, Ill	Beardsley Specialty Co		100
WIBA	Madison, Wis	Capital Times-Strand Theater Station.		100
WOMT	Manitowoc, Wis	Mikadow Theater		100

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	[illegible]			*Watts*
KGDP	Pueblo, Colo.	Pueblo Council, Boy Scouts of America.		10
KFEY	Kellogg, Idaho	Union High School		10
KPQ	Seattle, Wash.	Archie Taft and Louis Wasmer	KPCB	100
KPCB	do	Pacific Coast Biscuit Co.	KPQ	100
	1,220 kilocycles			
WCAD	Canton, N. Y.	St. Lawrence University (daylight).		500
WCAE	Pittsburgh, Pa.	Kaufman & Baer Co.		500
WREN	Lawrence, Kans.	Jenny Wren Co.	KFKU	1,000
KFKU	do	University of Kansas	WREN	1,000
	1,230 kilocycles			
WNAC-WBIS	Boston, Mass.	The Shepard Stores		500
WPSC	State College, Pa.	Pennsylvania State College (daylight).		500
WSBT	South Bend, Ind.	South Bend Tribune	WFBM-WCWK	500
WFBM	Indianapolis, Ind.	Indianapolis Power & Light Co.	WCWK-WSBT	500
WCWK	Fort Wayne, Ind.	Chester, W. Keen	WFBM-WSBT	500
KYA	San Francisco, Calif.	Pacific Broadcasting Corporation		1,000
KFIO	Spokane, Wash.	North Central High School (daylight).		100
KFQD	Anchorage, Alaska	Anchorage Radio Club		100
	1,240 kilocycles			
WGHP	Fraser, Mich.	Geo. Harrison Phelps (Inc.)		750
KFQB	Fort Worth, Tex.	W. B. Fishburn (Inc.)	WJAD	1,000
WJAD	Waco, Tex.	Frank P. Jackson	KFQB	1,000
WQAM	Miami, Fla.	Electric Equipment Co.	WIOD	750
WIOD	Miami Beach, Fla.	Isle of Dreams Broadcasting Co.	WQAM	1,000
WRBC	Valparaiso, Ind.	Immanuel Lutheran Church (daylight).		500
	1,250 kilocycles			
WGCP	Newark, N. J.	May Radio Broadcasting Corporation.	WODA-WAAM	500
WODA	Paterson, N. J.	Richard R. O'Dea	WAAM-WGCP	1,000
WAAM	Newark, N. J.	WAAM (Inc.)	WODA-WGCP	250
WLB-GMS	Minneapolis, Minn.	University of Minnesota	WRHM-KFMX-WCAL	1,000
WRHM	Fridley, Minn.	Rosedale Hospital Co. (Inc.)	WLB-KFMX-WCAL	1,000
KEMX	Northfield, Minn.	Carleton College	WLB-WRHM-WCAL	1,000
WCAL	do	St. Olaf College	WLB-WRHM-KFMX	1,000
KFON	Long Beach, Calif.	Nichols & Warinner (Inc.)	KEJK	1,000
KEJK	Beverly Hills, Calif.	R. S. Macmillan	KFON	500
KXL	Portland, Oreg.	KXL Broadcasters (Inc.)	KFAU	500
KFAU	Boise, Idaho	Frank L. Hill and C. G. Phillips, D/B as Boise Broadcast Station.	KXL	1,000
	1,260 kilocycles			
WLBW	Oil City, Pa.	Petroleum Telephone Co.		500
WJAX	Jacksonville, Fla.	City of Jacksonville		1,000
KWWG	Brownsville, Tex.	Chamber of Commerce	KRGV	500
KRGV	Harlingen, Tex.	Harlingen Music Co.	KWWG	500
KOIL	Council Bluffs, Iowa	Mona Motor Oil Co.		1,000
	1,270 kilocycles			
WRHF	Washington, D. C.	American Broadcasting Co. (daylight).		150
WEAI	Ithaca, N. Y.	Cornell University (daylight)		500
WASH	Grand Rapids, Mich.	Baxter Laundries (Inc.)	WOOD	250
WOOD	do	Walter B. Stiles (Inc.)	WASH	500
WDSU	New Orleans, La.	Joseph H. Uhalt		1,000
KWLC	Decorah, Iowa	Luther College (daylight)	KGCA	50
KGCA	do	Chas. W. Greenley (daylight)	KWLC	50
KTW	Seattle, Wash.	[illegible]		[illegible]
KFOA	do	Rhodes Department Stores	KTW	1,000
KFUM	Colorado Springs, Colo.	W. D. Corley		1,000

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	1,220 kilocycles			*Watts*
WCAM	Camden, N. J.	City of Camden	WOAX-WCAP	500
WCAP	Asbury Park, N. J.	Radio Industries Broadcasting Co.	WCAM-WOAX	500
WOAX	Trenton, N. J.	Franklyn J. Wolff	WCAM-WCAP	500
WDOD	Chattanooga, Tenn.	Chattanooga Radio Co. (Inc.)		1,000
WDAY	Fargo, N. Dak.	WDAY (Inc.)	WEBC	1,000
WEBC	Superior, Wis.	Head of the Lakes Broadcasting Co.	WDAY	1,000
KTAB	Oakland, Calif.	Associated Broadcasters		500
	1,290 kilocycles			
WNBZ	Saranac Lake, N. Y.	Smith & Mace (daylight)		10
WJAS	Pittsburgh, Pa.	Pittsburgh Radio Supply House		1,000
KTSA	San Antonio, Tex.	Lone Star Broadcast Co. (Inc.)	KFUL	1,000
KFUL	Galveston, Tex.	Will H. Ford (daylight)	KTSA	500
				1,000
KLCN	Blytheville, Ark.	Daily Courier News (daylight)		50
KDYL	Salt Lake City, Utah	Intermountain Broadcasting Corporation.		1,000
	1,300 kilocycles			
WBBR	Rossville, N. Y.	Peoples Pulpit Association	WHAP-WEVD-WHAZ.	1,000
WHAP	New York, N. Y.	Defenders of Truth Association (Inc.).	WBBR-WEVD-WHAZ.	1,000
WEVD	Woodhaven, N. Y.	Debs Memorial Radio Fund	WBBR-WHAP-WHAZ.	500
WHAZ	Troy, N. Y.	Rensselaer Polytechnic Institute.	WBBR-WHAP-WEVD.	500
KFH	Wichita, Kans.	Hotel Lassen	WIBW	1,000
WIBW	Topeka, Kans.	C. L. Carrell	KFH	1,000
KGEF	Los Angeles, Calif.	Trinity Methodist Church	KTBI	1,000
KTBI	do	Bible Institute of Los Angeles	KGEF	1,000
KFJR	Portland, Oreg.	Ashley C. Dixon & Son	KTBR	500
KTBR	do	M. E. Brown	KFJR	500
	1,310 kilocycles			
WKAV	Laconia, N. H.	Laconia Radio Club		50
WEBR	Buffalo, N. Y.	H. H. Howell		100
WSMD	Salisbury, Md.	Tom F. Little		100
WNBH	New Bedford, Mass.	New Bedford Broadcasting Co.		100
WNEW	Newport News, Va.	Virginia Broadcasting Co. (Inc.)		100
WRK	Hamilton, Ohio	S. W. Doran and John C. Slade		100
WAGM	Royal Oak, Mich.	Robert L. Miller	WBMH	50
WBMH	Detroit, Mich.	Braun's Music House	WAGM	100
WFDF	Flint, Mich.	Frank D. Fallain		100
WNAT	Philadelphia, Pa.	Lennig Bros. Co.	WFKD-WABY	100
WABY	do	John Magnaldi, jr.	WFKD-WNAT	50
WFKD	Frankford, Pa.	Foulkrod Radio Engineering Co.	WNAT-WABY	50
WHBP	Johnstown, Pa.	Johnstown Auto Co.	WFBG	100
WFBG	Altoona, Pa.	William F. Gable Co.	WHBP	100
WRAW	Reading, Pa.	Avenue Radio & Electric Shop	WGAL	100
WGAL	Lancaster, Pa.	Lancaster Electrical Supply & Construction Co.	WRAW	15
WSAJ	Grove City, Pa.	Grove City College		100
WBRE	Wilkes-Barre, Pa.	Louis G. Baltimore		100
WMBL	Lakeland, Fla.	Benford's Radio Studios		100
WKBC	Birmingham, Ala.	H. L. Ansley		10
WRBW	Columbia, S. C.	Paul S. Pearce		100
KGHG	McGeehee, Ark.	Charles W. McCollum		50
WTHS	Atlanta, Ga.	Atlanta Technical High School	WRBI	100
WRBI	Tifton, Ga.	Kents Furniture and Music Store.	WTHS	20
WOBT	Union City, Tenn.	Tittsworth's Radio and Music Shop.		15
WNBJ	Knoxville, Tenn.	Lonsdale Baptist Church		50
KRMD	Shreveport, La.	Robert M. Dean	KGGH	50
KGGH	Cedar Grove, La.	Bates Radio & Electric Co.	KRMD	50
KFPM	Greenville, Tex.	The New Furniture Co.		15
WDAH	El Paso, Tex.	Trinity Methodist Church		100
KGFI	San Angelo, Tex.	San Angelo Broadcasting Co.		100
KFPL	Dublin, Tex.	C. C. Baxter		15
KFXR	Oklahoma City, Okla.	Exchange Avenue Baptist Church.		100
WKBS	Galesburg, Ill.	Permil N. Nelson	WLBO	100
WLBO	do	Fred A. Trebbe, jr.	WKBS	100

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	1,310 kilocycles—Contd.			*Watts*
WEHS	Evanston, Ill	Victor C. Carlson	WCLS-WKBB-WKBI-WHFC	100
WCLS	Joliet, Ill	WCLS (Inc.)	WEHS-WKBB-WKBI-WHFC	100
WKBB	do	Sanders Bros	WEHS-WCLS-WKBI-WHFC	100
WKBI	Chicago, Ill	Fred Schoenwolf	WEHS-WCLS-WKBB-WHFC	50
WHFC	do	Goodson & Wilson (Inc.)	WEHS-WCLS-WKBB-WKBI	100
KWCR	Cedar Rapids, Iowa	Harry F. Paar	KFJY	100
KFJY	Fort Dodge, Iowa	C. S. Tunwall	KWCR	100
KFGQ	Boone, Iowa	Boone Biblical College		10
WBOW	Terre Haute, Ind	Banks of Wabash Broadcasting Association.		100
WJAK	Kokomo, Ind	J. A. Kautz (Kokomo Tribune)	WLBC	50
WIBC	Muncie, Ind	Donald A. Burton	WJAK	50
WIBU	Poynette, Wis	William C. Forrest		100
KFBK	Sacramento, Calif	Kimball-Upson Co		100
KFCB	Phoenix, Ariz	Nielson Radio Supply Co		100
KFIU	Juneau, Alaska	Alaska Electric Light & Power Co.		10
KGEZ	Kalispell, Mont	Flathead Broadcasting Association.		100
KFXJ	Edgewater, Colo	R. G. Howell	KFUP	50
KFUP	Denver, Colo	Fitzsimmons General Hospital	KFXJ	100
	1,320 kilocycles			
WADC	Akron, Ohio	Allen T. Simmons		1,000
WSMB	New Orleans, La	Saenger Theatres (Inc.) and Maison Blanche Co.		750
KGIO	Idaho Falls, Idaho	Jack W. Duckworth, jr	KGIQ	250
KGIQ	Twin Falls, Idaho	Stanley M. Soule	KGIO	250
KGHF	Pueblo, Colo	Curtis P. Ritchie and Joe E. Finch.		250
KGHB	Honolulu, Hawaii	Radio Sales Co		250
	1,330 kilocycles			
WDRC	New Haven, Conn	Doolittle Radio Corporation	WCAC	500
WCAC	Storrs, Conn	Connecticut Agricultural College	WDRC	500
WTAQ	Eau Claire, Wis	Gillette Rubber Co	KSCJ	1,000
KSCJ	Sioux City, Iowa	Perkins Bros. Co	WTAQ	1,000
	1,340 kilocycles			
WSPD	Toledo, Ohio	Toledo Broadcasting Co		500
KFPW	Siloam Springs, Ark	Rev. Lannie P. Stewart (daylight.)		50
KMO	Tacoma, Wash	KMO (Inc.)	KVI	500
KVI	Near Des Moines, Wash	Puget Sound Radio Broadcasting Co.	KMO	1,000
	1,350 kilocycles			
WBNY	New York, N. Y	Baruchrome Corporation	WMSG-WCDA-WKBQ.	250
WMSG	do	Madison Square Garden Broadcasting Corporation.	WBNY-WCDA-WKBQ.	250
WCDA	do	Italian Educational Broadcasting Co	WBNY-WMSG-WKBQ.	250
WKBQ	do	Standard Cahill Co. (Inc.)	WBNY-WMSG-WCDA.	250
KWK	St. Louis, Mo	Greater St. Louis Broadcasting Corporation.	WIL	1,000
WIL	do	Missouri Broadcasting Corporation.	KWK	1,000
	1,360 kilocycles			
WBET	Medford, Mass	Boston Transcript Co	WMAF	500
WMAF	South Dartmouth, Mass	Round Hills Radio Corporation	WBET	500
WQBC	Utica, Miss	Utica Chamber of Commerce (Inc.).		300
WJKS	Gary, Ind	Johnson-Kennedy Radio Corporation.	WGES	500
WGES	Chicago, Ill	Oak Leaves Broadcasting Corporation (Inc.).	WJKS	500
KFBB	Havre, Mont	Buttrey Broadcast (Inc.)	KGIR	(1)
KGIR	Butte, Mont	Symons Broadcasting Co	KFBB	250
KGB	San Diego, Calif	Southwestern Broadcasting Corporation.		250

[1] 500 daylight, 250 night.

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	1,370 kilocycles			*Watts*
WMBO	Auburn, N. Y.	Radio Service Laboratories		1,00
WSVS	Buffalo, N. Y.	Seneca Vocational School		50
WCBM	Baltimore, Md.	Hotel Chateau		100
WEAM	Plainfield, N. J.	W. J. Buttfield	WIAD	100
WBBL	Richmond, Va.	Grace Covenant Presbyterian		100
[illegible]	[illegible]	Ernest F. Goodwin	WIBM	50
WIBM	Jackson, Mich.	C. L. Carrell	WJBK	100
WRAK	Erie, Pa.	C. R. Cummins		50
WIAD	Philadelphia, Pa.	Howard R. Miller	WEAM	100
WJBO	New Orleans, La.	Valdemar Jenson		100
WHBQ	Memphis, Tenn.	Broadcasting Station WHBQ (Inc.).		100
WRBT	Wilmington, N. C.	Wilmington Radio Association		50
KGFG	Oklahoma City, Okla.	Faith Tabernacle Association (Inc.).	KGCB	50
KGCB	Enid, Okla.	Wallace Radio Institute	KGFG	100
KGCI	San Antonio, Tex.	Liberto Radio Sales	KGRC	100
KGRC	do	Eugene J. Roth	KGCI	100
KFJZ	Fort Worth, Tex.	Henry Clay Allison		100
KGKL	Georgetown, Tex.	M. L. Cates		100
KFLX	Galveston, Tex.	George Roy Clough		100
WFBJ	Collegeville, Minn.	St. Johns University		100
KGDA	Dell Rapids, S. Dak.	Home Auto Co.		15
KWKC	Kansas City, Mo.	Wilson Duncan Broadcasting Co.	KGBX	100
KGBX	St. Joseph, Mo.	Foster-Hall Tire Co.	KWKC	100
KGAR	Tucson, Ariz.	Citizens Publishing Co.		100
KFUB	Ogden, Utah	Peery Building Co.		50
KOH	Reno, Nev.	Jay Peters (Inc.)		100
KRE	Berkeley, Calif.	First Congregational Church	KZM	100
KGER	Long Beach, Calif.	C. Marwin Dobynes		100
KFBL	Everett, Wash.	Leese Bros.	KVL	50
KFEC	Portland, Oreg.	Meir & Frank Co.	KFJI	100
KVL	Seattle, Wash.	Arthur C. Baily	KFBL	100
KFJI	Astoria, Oreg.	George Kincaid	KFEC	50
KGFL	Raton, N. Mex.	Lamont A. Hubbard		50
KGGM	Albuquerque, N. Mex.	Jay Peters		100
	1,380 kilocycles			
WCSO	Springfield, Ohio	Wittenberg College	KQV	500
KQV	Pittsburgh, Pa.	Doubleday-Hill Electric Co.	WCSO	500
KSO	Clarinda, Iowa	Berry Seed Co.	WKBH	1,000
WKBH	La Crosse, Wis.	Callaway Music Co.	KSO	1,000
	1,390 kilocycles			
WHK	Cleveland, Ohio	Radio Air Service Corporation		1,000
KLRA	Little Rock, Ark.	Arkansas Broadcasting Co.	KUOA	1,000
KUOA	Fayetteville, Ark.	University of Arkansas	KLRA	1,000
KOW	Denver, Colo.	Associated Industries, Broadcasting (Inc.).		500
KWSC	Pullman, Wash.	State College of Washington	KFPY	500
KFPY	Spokane, Wash.	Symons Investment Co.	KWSC	500
	1,400 kilocycles			
WCGU	Coney Island, N. Y.	United States Broadcasting Corporation.	WSGH-WSDA-WLTH-WBBC	500
WSGH-WSDA	Brooklyn, N. Y.	Amateur Radio Specialties Co.	WCGU-WLTH-WBBC	500
WLTH	do	Voice of Brooklyn (Inc.)	WCGU-WSGH-WSDA-WBBC	500
WBBC	do	Brooklyn Broadcasting Corporation.	WCGU-WSGH-WSDA-WLTH	500
WBAA	La Fayette, Ind.	Purdue University	WCMA-WKBF	500
WCMA	Culver, Ind.	Culver Military Academy	WBAA-WKBF	500
WKBF	Indianapolis, Ind.	Noble Butler Watson	WBAA-WCMA	500
	1,410 kilocycles			
WDEL	Wilmington, Del.	WDEL (Inc.)		500
WSKC	Bay City, Mich.	James E. Davidson		500
KGRS	Amarillo, Tex.	Gish Radio Service	WDAG	1,000

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	1,410 kilocycles—Contd.			*Watts*
WDAG	Amarillo, Tex	J. Laurence Martin	KGRS	1,000
WHDI	Minneapolis, Minn	William Hood Dunwoody Industrial Institute.	WDGY-KFLV-WHBL.	500
WDGY	do	Dr. George W. Young	WHDI-KFLV-WHBL	500
KFLV	Rockford, Ill	A. T. Frykman	WHDI-WDGY-WHBL.	500
WHBL	Sheboygan, Wis	Press Publishing Co. and C. L. Carrell.	KFLV-WDGY-WHDI.	500
	1,420 kilocycles			
KFXY	Flagstaff, Ariz	Mary M. Costigan		100
KGFJ	Los Angeles, Calif	Ben S. McGlashan		100
KFQU	Holy City, Calif	W. E. Riker	KGTT	100
KGTT	San Francisco, Calif	Glad Tidings Temple and Bible Institute.	KFQU	50
KFXD	Jerome, Idaho	Service Radio Co		50
KGHD	Missoula, Mont	Elmore Nash Broadcasting Corporation.		50
KGCX	Vida, Mont	First State Bank of Vida		10
KFIF	Portland, Oreg	Benson Polytechnic School		50
KMED	Medford, Oreg	W. J. Virgin		50
KORE	Eugene, Oreg	Eugene Broadcast Station		100
KKP	Seattle, Wash	City of Seattle Harbor Department.	KFQW	15
KFQW	do	KFQW (Inc.)	KKP	100
KXRO	Aberdeen, Wash	KXRO (Inc.)		75
WLBH	Farmingdale, N. Y	Joseph J. Lombardi	WHPP-WMRJ	30
WHPP	New York, N. Y	Bronx Broadcasting Co	WLBH-WMRJ	10
WMRJ	Jamaica, N. Y	Peter J. Prinz	WLBH-WHPP	10
WLEX	Lexington, Mass	Lexington Air Station (250-day)	WSSH	100
WTBO	Cumberland, Md	Cumberland Electric Co		50
WSSH	Boston, Mass	Tremont Temple Baptist Church.	WLEX	100
WSRO	Middletown, Ohio	Harry W. Farhlander	WAAD	100
WIBR	Steubenville, Ohio	Thurman A. Owings	WQBZ	50
WAAD	Cincinnati, Ohio	Ohio Mechanics Institute	WSRO	25
WEDH	Erie, Pa	Erie Dispatch Herald		30
WMBC	Detroit, Mich	Michigan Broadcasting Co. (Inc.).		100
WKBP	Battle Creek, Mich	Enquirer News Co		50
WQBZ	Weirton, W. Va	J. H. Thompson	WIBR	60
KGFF	Alva, Okla	Earl E. Hampshire		100
KOCW	Chickasha, Okla	Chickasha Broadcasting Co		100
WKBT	New Orleans, La	First Baptist Church		50
KTAP	San Antonio, Tex	Robert B. Bridge		100
KTUE	Houston, Tex	Uhalt Electric		5
KFYO	Breckenridge, Tex	Kirksey Bros. Battery & Electric Co.		100
KICK	Red Oak, Iowa	Atlantic Automobile Co., Red Oak Radio Corporation lessee.		100
WIAS	Ottumwa, Iowa	Poling Electric Co		100
KGCN	Concordia, Kans	Concordia Broadcasting Co		50
WLBF	Kansas City, Kans	Everett L. Dillard		100
WMBH	Joplin, Mo	Edwin Dudley Aber		100
KGFW	Ravenna, Nebr	Otto F. Sothman		50
KFIZ	Fond du Lac, Wis	Fond du Lac Commonwealth Reporter.		100
	1,430 kilocycles			
WICC	Easton, Conn	Bridgeport Broadcasting Station, (Inc.).	WBRL	500
WBRL	Tilton, N. H	Booth Radio Laboratories	WICC	500
WMBS	Lemoyne, Pa	Mack's Battery Co	WCAH	500
WCAH	Columbus, Ohio	Commercial Radio Service Co	WMBS	250
WGBC	Memphis, Tenn	First Baptist Church (Sunday only).	WNBR	500
WNBR	do	John Ulrich	WGBC	500
	1,440 kilocycles			
WHEC-WABO	Rochester, N. Y	Hickson Electric Co. (Inc.)	WMAC-WOKO	500
WMAC	Cazenovia, N. Y	Clive B. Meredith	WOKO-WHEC-WABO.	500
WOKO	Mount Beacon, N. Y	Harold E. Smith	WHEC-WABO-WMAC.	500
WABF	Kingston, Pa	Markle Broadcasting Corporation.	WRAX	250
WRAX	Philadelphia, Pa	Berachah Church (Inc.)	WABF	250

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	1,440 kilocycles—Contd.			*Watts*
WNRC	Greensboro, N. C.	Wayne M. Nelson		500
WTAD	Quincy, Ill.	Illinois Stock Medicine Broadcasting Corporation.	WMBD	500
WMBD	Peoria Heights, Ill.	Peoria Heights Radio Laboratory.	WTAD	500
KLS	Oakland, Calif.	Warner Bros. (day)		250
	1,450 kilocycles			
WBMS	Union City, N. J.	WBMS Broadcasting Corporation.	(1)	250
WNJ	Newark, N. J.	Radio Investment Co.	(1)	250
WIBS	Elizabeth, N. J.	New Jersey Broadcasting Co.	(1)	250
WKBO	Jersey City, N. J.	Camith Corporation	(1)	250
WSAR	Fall River, Mass.	Doughty & Welch Electric Co. (Inc.).		250
WJAY	Cleveland, Ohio	Cleveland Radio Broadcasting Corporation.	WFJC	500
WFJC	Akron, Ohio	W. F. Jones Broadcasting, (Inc.)	WJAY	500
KSBA	Shreveport, La.	W. G. Patterson		1,000
WTFI	Toccoa, Ga.	Toccoa Falls Institute		500
	1,460 kilocycles			
WTFF	Mount Vernon Hills, Va.	Independent Publishing Co.		10,000
KSTP	Westcott, Minn.	National Battery Broadcasting Co.		10,000
	1,470 kilocycles			
WKBW	Amherst, N. Y.	Churchill Evangelical Association (Inc.).		5,000
KFJF	Oklahoma City, Okla.	National Radio Manufacturing Co.		5,000
WRUF	Gainesville, Fla.	University Radio Service Co.		5,000
KGA	Spokane, Wash.	Northwest Radio Service Co.		5,000
	1,480 kilocycles			
WJAZ	Mount Prospect, Ill.	Zenith Radio Corporation	WHT-WORD-WIBO.	5,000
WHT	Deerfield, Ill.	Radiophone Broadcasting Corporation.	WJAZ-WORD-WIBO.	5,000
WORD	Batavia, Ill.	Peoples Pulpit Association	WJAZ-WHT-WIBO.	5,000
WIBO	Desplaines, Ill.	Nelson Bros. Bond & Mortgage Co.	WJAZ-WHT-WORD.	5,000
	1,490 kilocycles			
WBAW	Nashville, Tenn.	Waldrum Drug Co.	WLAC	5,000
WLAC	do	Life & Casualty Insurance Co.	WBAW	5,000
	1,500 kilocycles			
WMBA	Newport, R. I.	LeRoy Joseph Beebe		100
WLOE	Chelsea, Mass.	William S. Pote	WMES	100
WMES	Boston, Mass.	Massachusetts Educational Society.	WLOE	50
WNBQ	Rochester, N. Y.	Gordon P. Brown		15
WNBF	Endicott, N. Y.	Howitt-Wood Radio Co.		50
WMBQ	Brooklyn, N. Y.	Paul J. Gollhofer	WLBX-WCLB-WWRL.	100
WLBX	Long Island City, N. Y.	John N. Brahy	WMBQ-WCLB-WWRL.	100
WCLB	Long Beach, N. Y.	Arthur Faske	WMBQ-WLBX-WWRL.	100
WWRL	Woodside, N. Y.	William H. Reuman	WMBQ-WLBX-WCLB.	100
WTBQ	Wilmington, Del.	E. Brandt Boylan		100
WAFD	Detroit, Mich.	Albert B. Purfet Co.		100
WKBZ	Ludington, Mich.	K. L. Ashbacker		50
WMPC	Lapeer, Mich.	First Methodist Protestant Church.		30
WCBA	Allentown, Pa.	B. Bryan Musselman	WSAN	100
WSAN	do	Allentown Call Publishing Co. (Inc.)	WCBA	100
WALK	Willow Grove, Pa.	Albert A. Walker	WHBW-WOO-WPSW.	50

[1] WBMS, WNJ, WIBS, and WKBO divide time with each other.

Revised list of broadcasting stations, by frequencies, etc.—Continued

Call letters	Location	Owner	Divides time with	Power
	1,500 kilocycles—Contd.			*Watts*
WOO	Philadelphia, Pa	John Wanamaker	WHBW-WALK-WSPW.	100
WHBW	do	D. R. Kienzle	WALK-WOO-WPSW.	100
WPSW	do	Philadelphia School of Wireless Telegraphy.	WALK-WHBW-WOO.	50
WIBZ	Montgomery, Ala	Alexander D. Trum		15
KGHI	Little Rock, Ark	Berea Bible Class		100
WRBJ	Hattiesburg, Miss	Woodruff Furniture Co		10
WMBM	Memphis, Tenn	Seventh Day Adventist Church		10
KGKB	Goldthwaite, Tex	Eagle Publishing Co		100
KGDR	San Antonio, Tex	Joe B. McShane		100
KGHX	Richmond, Tex	Fort Bend County School Board		50
WKBV	Brookville, Ind	Knox Battery & Electric Co		100
KPJM	Prescott, Ariz	Frank Wilburn		100
KWBS	Portland, Oreg	Schaeffer Radio Co		15
KWTC	Santa Ana, Calif	Pacific Broadcasting Federation.	KFWO	100
KFWO	Avalon, Calif	Lawrence Mott	KWTC	100
KFCR	Santa Barbara, Calif	Santa Barbara Broadcasting Co		100
KUJ	Long View, Wash	Fred W. Lovejoy and R. W. Kerfoot.		10

APPENDIX G (3)

Statement of commission to accompany General Order No. 40, relative to new allocations announced August 30, as effective on October 1, 1928, but postponed under General Order No. 44, issued September 8, 1928, until November 11, 1928

SEPTEMBER 10, 1928.

General Order No. 40, issued yesterday by the Federal Radio Commission, supplies the official basis for an adjustment in the assignment of the country's broadcasting facilities, under a plan which it is believed will provide an improved standard of radio reception generally, and also distribute the broadcasting channels, powers, and periods of time on the air equally among the five radio zones as directed by the last Congress.

The plan provides for full-time assignments for 100-watt stations equaling in number the total of all other classes of broadcasters put together.

Of the 74 channels made available for high-grade reception, 34 will be assigned for regional service, permitting 125 full-time positions for this type of station, and 40 channels will be assigned to stations with minimum power of 5,000 watts and a maximum to be determined by the commission and announced with the allocation. On these 40 channels only one station will be permitted to operate at any time during night hours, thus insuring clear reception of the station's program, up to the extreme limit of its service range. These 40 channels will be assigned 8 to each of the 5 zones, thus insuring wide geographical distribution of the country's higher-power broadcasting facilities to all sections.

On the 34 channels shared by regional stations, ranging in power from 250 to 1,000 watts and assigned 2, 3, or 4 per channel, spacings generally of 1,000 to 1,500 miles have been observed.

Throughout the whole allocation wide geographical spacings have been observed between stations on adjoining channels in order to eliminate objectionable "cross talk."

Summarizing, for "local" stations of 50 to 100 watt ratings, 150 full-time positions have been provided, or 30 per zone; 125 regional positions have been provided for 250 to 1,000 watt stations; and 40 positions for stations of 5,000 watts and above. Each full-time assignment available for night use, in many instances, is shared by two or more stations or transmitters, depending upon the number of licensed stations to be accommodated in the zone or locality.

Recapitulating by zones, the equal division of the foregoing facilities among the 5 zones will provide each zone with 8 full-time assignments for stations

of 5,000 watts and above, 24 positions for 500-watt and 1,000-watt stations, and 30 positions for 50-watt and 100-watt stations.

In announcing this plan the commission does so realizing that it may have imperfections, but believes it an approach to an ideal situation which may be reached in the future.

APPENDIX G (4)

Analysis of new broadcasting station allocation by Dr. J. H. Dellinger, chief engineer, September 14, 1928

FEDERAL RADIO COMMISSION,
Washington, D. C., September 14, 1928.

The new allocation of broadcasting stations announced by the Federal Radio Commission on September 11, 1928, was prepared in accordance with the allocation plan set forth in the commission's General Order No. 40, of September 7, 1928. Both the plan and the allocation itself were drawn in compliance with the requirements of the 1928 amendment to the radio act as to equalization of broadcasting facilities between the zones and States. The allocation was, furthermore, made in compliance with the commission's decision that no existing stations should be abolished at the time of its inception. It is believed to provide the greatest aggregate of radio service to the country possible under the two conditions just mentioned. Its principal features are: (*a*) It provides a definite, invariant basis of station assignments for each zone and locality; (*b*) it can be improved wherever interference is found to exist in actual operation, through the reduction of power or the elimination of particular stations, without disturbing the station allocation as a whole; (*c*) it eliminates heterodyne interference on 80 per cent of the listener's dial; (*d*) it recognizes the essentially different requirements of local, regional, and distant service.

Proper provision for the differing requirements of the listeners in large rural areas, cities, and intermediate areas made the preparation of this allocation a difficult task. It would have been very easy to allocate all existing stations, and many more, if only local service or the effects a few miles from the station had been considered. As soon as consideration was given to service more than a few miles from a station, serious difficulty arose, since heterodyne interference extends to many times the distance from a station to which actual program service extends. Operation of two or more stations on a channel (i. e., on one frequency or wave length) results in an area of destructive interference very much greater than the area in which program service is provided unless the stations are of low power and widely spaced geographically. It is only when a station has exclusive use of its channel that program service free from interference can be furnished at great distances. But since there are only 90 channels available for broadcasting in the United States, there could not possibly be more than 90 simultaneously operating stations giving service at great distances.

The only reasonable solution of this dilemma is that which the commission has adopted, the setting aside of a certain number of channels (40) for distant or rural service, each with only one station assignment,[1] and the use of the remaining channels for service at more moderate distances with several station assignments on each channel, all with limited power and located systematically at proper distances apart to minimize interference.

The channels used for the latter type of station assignments are subdivided into "regional service" channels, which are kept substantially free from heterodyne interference by restricting power to 1,000 watts and keeping the stations on a given channel, in general 1,000 miles or more apart, and several other types of channels on which heterodyne interference is permitted but which give satisfactory local service.

Besides the channels designated as "local service" there are two classes of "limited-service" channels on which heterodyne interference is permitted. On five of these channels 1,000-watt stations are permitted and on four of them 5-kilowatt stations. These will not give distant service and are in that sense "limited," but will give better local service than the stations on the "local-

[1] The expression "station assignment," or "full-time assignment," indicates full-time operation 24 hours a day by a station, or a group of stations sharing time.

service" channels because of their higher power. In some discussions the 1,000-watt limited-service channels are lumped with the regional-service channels, because there is not a very sharp difference between them—a heavily loaded regional-service channel would be indistinguishable from a 1,000-watt limited-service channel.

There has been no specific designation of a name for the class of channels intended to give distant or rural service. They have been called variously "rural service," "distant service," "cleared," "high-power," "heterodyne-free," and "exclusive" channels. Stations on these channels may be authorized to use power up to 25 kilowatts and, experimentally, up to 50 kilowatts.

The allocation is in harmony with good engineering principles. In the separate provision for high-power exclusive channels and restricted-power local channels and in the geographical spacings of stations on the same and adjacent frequencies and in other vital respects the allocation is in accord with "A statement on engineering principles" presented to the commission on March 30, 1927, by the committee on radio broadcasting of the American Engineering Council. It is also in essential accord with the recommendations of the radio engineers in the April 6, 1928, conference, except that only 40 high-power exclusive channels are provided instead of 50.

SUMMARY OF ALLOCATION PLAN

The allocation plan is set forth in detail in General Order No. 40. Its principal features are indicated in the following table. The available numbers of station assignments have not in all cases been utilized in all the zones in the allocation which the commission has announced.

	High power, 5 kilowatts and up	Regional, 500–1,000 watts	Limited service		Local, 10–100 watts	Total
			5 kilowatts	1,000 watts		
Number of channels	40	35	4	5	6	90
Station assignments per channel	1	[1] 2½	2½	5	25	
Number station assignments in United States	40	90	10	25	150	315
Number station assignments in each zone	8	18	2	5	30	63

[1] Approximate average.

The allocation is based on nighttime transmission conditions. Besides the classes of stations shown in table there are a number of supplementary stations added on some channels. These include a number of "daytime-service" stations and "limited-time" stations. The latter are allowed to operate during the day and also during certain time (after late evening in the East by western stations) temporarily not used by the station entitled to the channel. The "daytime-service" stations are allowed to operate only during noninterfering hours. They are required to shut down at sunset. This shall be taken to be sunset at the daytime-service station unless it is the farthest east of the stations on the channel, in which case sunset at the next station west on the same channel. The time of sunset varies from about 4.30 in December to 7.30 in June, local sun time.

THE LISTENER'S DIAL

The choice of particular frequencies for the several classes of stations was influenced in considerable measure by the present frequencies of stations. Thus one reason that the high-power channels are begun at 640 kilocycles rather than at 550 kilocycles is because the public is accustomed to hearing some of the regional-service stations at this end of the spectrum. This principle has permitted reducing as much as possible the average shift of frequency which the stations must make.

The placing of several blocks of regional and local-service channels in different parts of the dial has the advantage that it permits the licensing of more stations in certain places (e. g., Boston and Los Angeles) than would be possible (because of interchannel interference) if the channels of each class of station were all bunched in a single group.

The high-power channels, however, are consolidated into a single block in the spectrum (except for Canadian exclusive and Canadian-shared channels and the group of regional channels from 880 to 950 kilocycles), so that the listeners on these heterodyne-free channels will be as free as possible from inter-channel interference from near-by stations of other classes.

The choice of channel locations is expected to have the effect of making programs as available at the high-frequency end of the listener's dial as at the low-frequency end. Thus the entire dial becomes useful for listeners everywhere in the United States.

In the following list the numbers in parentheses after certain frequencies indicate the zone to which that frequency is assigned:

550, 560, 570: Limited service, 1,000 watts.
580, 590, 600, 610, 620, 630: Regional service.
640 (5), 650 (3), 660 (1), 670 (4), 680 (5): Rural service (i. e., high power).
690: Canada.
700 (2), 710 (1), 720 (4): Rural service (i. e., high power).
730: Canada.
740 (3), 750 (2), 760 (1), 770 (4): Rural service (i. e., high power).
780: Regional service (shared with Canada).
790 (5), 800 (3), 810 (4), 820 (2), 830 (5): Rural service (i. e., high power).
840: Canada.
850 (3), 860 (1), 870 (4): Rural service (i. e., high power).
880, 890, 900: Regional service.
910: Canada.
920, 930, 940, 950: Regional service.
960: Canada.
970 (5), 980 (2), 990 (1), 1,000 (4): Rural service (i. e., high power).
1,010: Regional service (shared with Canada).
1,020 (2): Rural service (i. e., high power).
1,030: Canada.
1,040 (3), 1,050 (5), 1,060 (1), 1,070 (2), 1,080 (3), 1,090 (4), 1,100 (1), 1,110 (2): Rural service (i. e. high power).
1,120: Regional service (shared with Canada).
1,130 (5), 1,140 (3), 1,150 (1), 1,160 (4), 1,170 (2), 1,180 (4), 1,190 (3): Rural service (i. e., high power).
1,200, 1,210: Local service.
1,220, 1,230, 1,240, 1,250, 1,260, 1,270, 1,280, 1,290, 1,300: Regional service.
1,310: Local service.
1,320, 1,330, 1,340, 1,350, 1,360: Regional service.
1,370: Local service.
1,380, 1,390, 1,400, 1,410: Regional service.
1,420: Local service.
1,430: Regional service.
1,440, 1,450: Limited service, 1,000 watts.
1,460, 1,470, 1,480, 1,490: Limited service, 5 kilowatts.
1,500: Local service.

EQUALIZATION

The table given above under "Summary of allocation plan" shows how the frequencies are equalized between the zones. Each zone receives exactly one-fifth of the station assignments. In some zones there are a few vacancies in the station assignments, which will be available until future stations are constructed in the localities where those station assignments can be used. The allocation of frequencies and of station assignments to the individual States is closely proportional to population, as the law requires; this correspondence, of course, can not be exact, because the inequalities of State populations lead to many fractional quotas.

The aggregate power assigned to the stations is nearly equal for the five zones and is closely proportional to the populations of the States within each zone. For the future, moreover, the potential power of stations is exactly equalized between the zones, since by General Orders 40 and 42 the same upper limit of power is prescribed for all stations of each class.

The number of licenses is equalized only approximately, as follows: Zone No. 1, 108; zone No. 2, 106; zone No. 3, 115; zone No. 4, 155; zone No. 5, 132. The total number of licenses or stations is 616, an average per zone of 123. The principal disparity is an excess of 32 over the average in the fourth zone

(the Middle West). These departures from equality are inherent in the commission's fundamental decision that no existing stations should be abolished at the time of the inception of the new allocation.

The equalization of time "on the air" is indicated essentially by the distribution of "station assignments," which is equal as between the zones, and reasonably proportional to population as between the States. The equalization of time is somewhat altered, however, by the addition of "daytime service" stations on some of the channels.

CONCLUSION

The channels are carefully cleared of interchannel interference in every part of the dial. This clearing is particularly well effected in zones 3, 4, and 5. Zones 1 and 2 being smaller, the geographical spacings are somewhat less than in the other zones, and interference may in a few cases be perceptible on winter nights.

It is believed that heterodyne interference is eliminated except on the 9 limited-service channels and the 6 local-service channels. If such interference should develop on any of the 75 heterodyne-free channels, the commission may remove it by reducing a station's power or eliminating one or more stations.

The principal features of the allocation, such as the assignment of amounts of power and of particular frequencies to particular localities, can not in general be altered, because of the interdependence of the frequency and distance separations throughout the entire set-up. However, the selection of stations in a given locality to be put in a particular power class, the selection of stations in a locality to be assigned to the specific frequencies allotted to the locality, and the relative amounts of time divisions by groups of stations, are all features which can be changed at any time as the commission sees fit without affecting the soundness of the set-up in any way. Thus the commission will have a quick and definite way of determining what its action should be on all broadcast license applications.

APPENDIX G (5)

Radiobroadcast facilities due each State—An analysis of quotas of respective States on basis of population, with respect to the several classes of channels

[As required by the "equitable allocation" clause of the 1928 act of Congress]

The 1928 radio act, or Davis amendment, approved March 28, 1928, requires that the radio supervising authority "shall as nearly as possible make and maintain an equal allocation of broadcasting licenses, of bands of frequency or wave lengths, of periods of time for operation, and of station power, to each of (the five) zones, and shall make a fair and equitable allocation of licenses, wave lengths, time for operation, and station power to each of the States * * * within each zone, according to population."

The proportion of the total national radio facilities due each State is therefore fixed by law and is shown by the percentages in column B below, based upon official estimates of 1928 populations (column A) prepared by the United States Census Bureau.

The maximum of total broadcasting service which can be simultaneously carried on without interference, under the present status of the law and the radio art, has been determined by the Radio Commission and its engineers, after exhaustive study and experiment, as comprising the simultaneous operation of 40 stations of 5 kilowatts and upward, on cleared channels; 125 regional stations of 500 to 1,000 watts, and 150 local stations of 10 to 100 watts. By time divisions, a larger number of actual transmitters can, of course, be operated at different times on these "assignments," but the total stations running at any one moment during the night hours must not exceed the above limit, if good radio reception is to be preserved.

Dividing this national maximum into five equal parts for the zones, and also applying the State percentages of column B, we obtain the number of each class of station "assignments" due each State, as shown in the three right-hand columns.

Number of full-time "assignments" due States

[See notes following table]

	A Population of State (1928)	B Percentage of total national facilities due State	C Rural service, 5 kilowatts and above	D Regional service, chiefly 500–1,000 watts	E "Local"; chiefly 50 watts and 100 watts
FIRST ZONE					
(O. H. Caldwell, commissioner)					
		Per cent			
Maine	795,000	0.6		0.7	0.9
New Hampshire	456,000	.3		.4	.5
Vermont	352,428	.3		.3	.4
Massachusetts	4,290,000	3.1	1.2	3.9	4.7
Connecticut	1,667,000	1.2	.5	1.5	1.8
Rhode Island	716,000	.5		.7	.8
New York	11,550,000	8.4	3.5	10.6	12.7
New Jersey	3,821,000	2.8	1.1	3.5	4.2
Delaware	244,000	.2		.2	.3
Maryland	1,616,000	1.2	.5	1.5	1.8
District of Columbia	552,000	.4		.5	.6
Porto Rico	1,299,809	.9		1.2	1.4
Virgin Islands	26,051	.02			
Total	27,385,288	20	8	25	30
SECOND ZONE					
(Ira E. Robinson, commissioner)					
Pennsylvania	9,854,000	7.0	2.8	8.8	10.5
Virginia	2,575,000	1.8	.7	2.3	2.7
West Virginia	1,724,000	1.2	.5	1.5	1.8
Ohio	6,826,000	4.9	2.0	6.1	7.3
Michigan	4,591,000	3.3	1.3	4.1	4.9
Kentucky	2,553,000	1.8	.7	2.3	2.7
Total	28,123,000	20	8	25	30
THIRD ZONE					
(E. O. Skyes, commissioner)					
North Carolina	2,938,000	2.1	.8	2.6	3.1
South Carolina	1,864,000	1.3	.5	1.7	2.0
Georgia	3,203,000	2.3	.9	2.9	3.4
Florida	1,411,000	1.0		1.3	1.5
Alabama	2,573,000	1.8	.7	2.3	2.7
Tennessee	2,502,000	1.8	.7	2.2	2.7
Mississippi	1,790,618	1.3	.5	1.6	1.9
Arkansas	1,944,000	1.4	.5	1.7	2.1
Louisiana	1,950,000	1.4	.5	1.8	2.1
Texas	5,487,000	3.9	1.5	4.9	5.9
Oklahoma	2,426,000	1.7	.7	2.2	2.6
	28,088,618	20	8	25	30
FOURTH ZONE					
(Sam Pickard, commissioner)					
Indiana	3,176,000	2.4	1.0	3.0	3.6
Illinois	7,396,000	5.5	2.2	7.0	8.3
Wisconsin	2,953,000	2.2	1.0	2.8	3.3
North Dakota	641,192	.5		.6	.7
Minnesota	2,722,000	2.0	.8	2.5	3.0
South Dakota	704,000	.5		.7	.8
Iowa	2,428,000	1.8	.7	2.3	2.7
Nebraska	1,408,000	1.1		1.3	1.6
Kansas	1,835,000	1.4	.5	1.7	2.0
Missouri	3,523,000	2.6	1.1	3.3	4.0
Total	26,786,192	20	8	25	30

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THE RATIONALITY OF U.S. REGULATION OF THE BROADCAST SPECTRUM*

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> [An] option that was totally overlooked in the early radio debates was for spectrum to be allocated, like paper, ink, and printing presses, by market mechanisms rather than by licensing. The policy makers in the 1920s and 1930s, wrongly it now appears, did not believe spectrum was abundant enough to be handled in that way.[1]

In his classic 1983 *Technologies of Freedom,* Ithiel de Sola Pool so elucidated the prevailing wisdom concerning broadcast licensure in the United States. While the key legal questions surrounding this institution involve important First Amendment questions (hence, Pool's scarcity analogy to paper, ink, and presses), economists and other policy analysts have often remarked on the more general incongruity in federal licensing: while spectrum is regulated on the "physical scarcity" premise, it is awarded to private users on a no-fee basis, thus conferring significant economic rents on private parties at substantial opportunity cost to the fisc. Moreover, Federal Communications Commission (FCC)[2] policies have openly sought, virtually throughout the agency's entire life span, to restrict broadcast licenses and competition for broadcasters (particularly cable television) to far below the quantity technically available.[3] The

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[1] Ithiel de Sola Pool, Technologies of Freedom 138 (1983).

[2] The FCC licenses all radio and television broadcasters in the United States and regulates some aspects of cable television. It succeeded the Federal Radio Commission in 1934, in legislation virtually identical to that creating the FRC in 1927.

[3] The pointed restriction of TV broadcasting licenses is described in Roger M. Noll *et al.*, Economic Aspects of Television Regulation (1973); Robert W. Crandall, The Economic

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regulatory institutions appear to miss the point of scarcity entirely and have repeatedly been described as mistaken, accidental, and counterproductive: the historical product of policymakers who failed to understand the nature of property rights to airwaves.

This article seeks to revise such thinking about the "wrongheadedness" of U.S. regulatory policy toward the broadcast spectrum. Rather than stumbling into a legal structure under erroneous pretenses, a careful examination of the early radio broadcasting market and the legislative history of the Federal Radio Act of 1927 reveals that subsequent decision making under the "public interest, convenience, or necessity" licensing standard was a compromise designed to generate significant rents for each constituency influential in the process. Most fundamentally, the nature of rights in the "ether" was precisely understood; the regulatory approach adopted chose not to reject or ignore them but to maximize their rent values as dictated by rational self-interest.

This article is arranged as follows. First, the traditional interference rationale for licensing is outlined in Section I; this reasoning has served as the basis for important First Amendment law in the United States. Section II describes why this line of argument has been rejected by contemporary analysts of broadcast regulation, who have themselves set forth an "error theory" explaining the licensing and regulation of broadcasters. Sections III and IV explain the 1920s radio broadcasting market and the shock to that system in the 1926–27 "breakdown of the law" period. Section V details the 1926 *Oak Leaves* decision establishing private property rights to spectrum at common law. Sections VI, VII, and VIII discuss the legislative agendas of the major broadcasters, the regulators, and public interest advocates, respectively. Section IX interprets the Federal Radio Act of 1927 as an equilibrium solution for these competing interests, brought together by a rent-sharing arrangement created from the proceeds generated in the spectrum-assignment process. In concluding, Section X attempts to identify the source of analytical confusion as stemming from a focus on auctions, when vested rights in the ether were

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Case for a Fourth Commercial Network, 12 Public Policy 513–36 (1974); Bruce M. Owen, Economics and Freedom of Expression (1975); Harry J. Levin, Fact and Fancy in Television Regulation (1980). The protectionist policy (for incumbent broadcasters) against cable entry is detailed in Stanley M. Besen, The Economics of the Cable TV "Consensus," 17 J. Law & Econ. 39–51 (1974); Glenn O. Robinson, The Federal Communications Commission: An Essay on Regulatory Watchdogs, 64 U. Va. L. Rev. 169–262 (1978); Stanley M. Besen & Robert W. Crandall, The Deregulation of Cable Television, 44 L. & Contemp. Probs. 77–124 (1981); Thomas W. Hazlett, Cabling America: Economic Forces in a Political World, in Freedom in Broadcasting 208–23 (C. Veljanovski ed. 1989).

TABLE 1

ESTIMATED "LOST RENTS" FROM ZERO-PRICED TELEVISION SPECTRUM ALLOCATION (1975)

	No. of Stations	1975 License Rents (December 1985 $)	Capital Value of Rents (1985 $) at 5 Percent (Real Discount Rate + Risk Premium)
VHF	492	846,731,500	16,934,630,000
UHF	177	11,170,000	223,400,000

SOURCE.—Harry J. Levin, Fact and Fancy in Television Regulation (1980), at 114–15; and Economic Report of the President (1987), at 315.

quickly established de jure and de facto, thus biasing all future rent distribution schemes.

I. THE INTERFERENCE RATIONALE FOR LICENSING

The first U.S. spectrum policy was to seize the entire band for government use: the Navy took it for military communication.[4] But private users demanded access for purposes of radio telegraphy, and were successful in persuading Congress to direct the secretary of commerce to license private radio operators in the Radio Act of 1912. The federal government was asserting ownership of the electromagnetic resource, but in a rather peculiar way: the secretary took no payment and issued no exclusive frequency rights. "Licensing" was but a zero-priced club admission to unlimited use of the band.

The electromagnetic spectrum was, fortunately, an abundant resource; these initial transmissions occurred on point-to-point bases, and congestion was not an issue. That changed soon after radio broadcasting became viable in 1920–21 (see Table 1). Hundreds of commercial stations began emitting into "the ether," bringing the zero-cost band to an end. The prevailing "ownership" rule became increasingly bizarre, a fact which was only to become evident in a federal court case in 1926 and a subsequent opinion of the U.S. attorney general shortly thereafter. These revealed that the secretary of commerce was legally unable to enforce frequency exclusivity; many radio stations roamed the spectrum at will, crossing into desired areas and frequencies without constraint. The market degenerated into "chaos," as the Supreme Court would observe in

[4] This was not a unique political response. In China, the northern warlords monopolized all radio communications in the 1912–27 epoch as "[t]hey considered radio to be military equipment" (Zhenzhi Guo, A Chronicle of Private Radio in Shanghai, 30 J. of Broadcasting & Elec. Media 379–92 (1986)).

NBC[5] and *Red Lion*[6]—but a chaos mandated precisely by the fact that there was little private in this "private sector."[7]

With the creation of the Federal Radio Commission on February 23, 1927, the government began to behave more like an actual owner. The commission was empowered to allocate exclusive, enforceable broadcasting rights; in this straightforward manner the interference problem was solved. But in an interesting twist, the commission chose to assign rights only on a short-term lease basis, according to the broadcaster's furtherance of "the public interest, convenience or necessity" (the phrase appears in sections 4, 9, 11, and 21 of the Radio Act of 1927). The government would retain ownership of the spectrum on the premise that frequencies were inalienable public property. Despite remarkable economic and technological changes in the intervening six decades, the current regulatory regime in broadcasting is essentially that created in the Federal Radio Act of 1927.

To subsequent analysts, the most curious aspect of this contractual setting was the failure of the U.S. government to set a monetary price for the rental use of the airwaves. Broadcasters were to compete vigorously for radio (and later television) broadcast frequencies, yet the competitors have not been allowed to bid in cash at the "auction." (Instead, the Federal Communications Commission has historically elected to hold "comparative hearings" to select between competing license applicants based on various criteria deemed important to the "public interest.") While licensees are empowered to use a scarce "public" resource, much as buyers of public lands, drillers for federally owned oil, miners of government-held mineral deposits, or purchasers of Army surplus, the public treasury fails to reap the rents associated with spectrum allocations. The trading of radio and television stations in the United States has allowed economists to estimate that taxpayers are sacrificing nearly $1 billion annually by pricing band use at zero (see Table 1), without even counting nonbroadcast uses of the spectrum.

The ironic nature of this "nonmarket" policy regime was articulated by the late Ithiel de Sola Pool.

> In fact, however, there is a market in spectrum. It is a market in tangible things because what is bought and sold is broadcasting stations. The government initially

[5] National Broadcasting Co., Inc., v. United States, 319 U.S. 190 (1943).

[6] Red Lion Broadcasting Co., Inc. v. Federal Communications Commission, 395 U.S. 367 (1969).

[7] See Ronald Coase, The Federal Communications Commission, 2 J. Law & Econ. 1–40 (1959); Jora Minasian, The Political Economy of Broadcasting in the 1920s, 12 J. Law & Econ. 391–403 (1969).

gives away licenses for free; these are then sold in a second hand market. What is excluded from market allocation is only the initial grant of a frequency by the government to its first "owner." . . . Under existing practice the original licensees make a windfall profit by selling the license to someone else. . . . If the market mechanism created for broadcasting had been pushed one level further back and the government had offered spectrum rights for lease or sale at a price reflecting market value, any windfall would have gone to the public, not to politically favored individuals.[8]

The essential question, then, is: Why does the FCC not simply divvy up the electromagnetic spectrum into noninterfering "parcels" and auction them to highest dollar bidders? This has been advocated repeatedly since at least the early 1950s,[9] could be easily accomplished technically,[10] and has been suggested as a politically advantageous solution to spectrum scarcity in that it captures for the public treasury any available rents associated with band use. As Congressman Henry Reuss noted in 1958, in defense of his (unsuccessful) bill to require certain applicants to bid dollars for spectrum space: "The airwaves are public domain, and under such circumstances a decision should be made in favor of the taxpayers, just as it is when the government takes bids for the logging franchise on public timberland."[11]

II. The Existing Economic Interpretation

Economists,[12] political scientists,[13] and lawyers[14] generally agree that the interference rationale for licensure in "the public interest" is nonsens-

[8] Pool, *supra* note 1, at 139–140. Of course the right to transfer a license is a limited one; the FCC must approve sales and can deny license renewal. This implies that ownership rights are traded for prices lower than what would obtain under fee simple, all else equal.

[9] Leo Herzel, "Public Interest" and the Market in Color Television Regulation, 18 U. Chi. L. Rev. 802–16 (1951).

[10] De Vany *et al.* describe a market for defining spectrum rights such that market bids would allocate competing uses of the band. This would promote social efficiency by driving marginal values for each frequency toward equality. Without any innovation in the legal system, however, assignments now made in comparative hearings could be auctioned to initial assignees. While pure market allocation of this subset of the spectrum would not represent as large an efficiency savings as a full auctioning of rights (its primary cost savings would be to eliminate significant rent-seeking activities), it is very useful to consider as a policy alternative because it abstracts from any real or imagined difficulties in trading private frequency rights across uses. See Arthur S. DeVany, Ross D. Eckert, Charles J. Mayers, Donald J. O'Hara, and Richard C. Scott, A Property System for Market Allocation in the Electromagnetic System: A Legal-Economic Engineering Study, 21 Stan. L. Rev. 1499–1561 (1969).

[11] Cited in Coase, *supra* note 7.

[12] See Herzel, *supra* note 9; Coase, *supra* note 7; Minasian, *supra* note 7; Bruce M. Owen, Differing Media, Differing Treatment? in Free but Regulated: Conflicting Traditions in

ical.[15] The interference problem is widely recognized as one of defining separate frequency "properties"; it is logically unconnected to the issue of who is to harvest those frequencies. To confuse the *definition* of spectrum rights with the *assignment* of spectrum rights is to believe that, to keep intruders out of (private) backyards, the government must own (or allocate) all the houses. It is a public policy non sequitur, as has recently been noted in an important District of Columbia circuit opinion.[16]

Indeed, even when the government assumes legal ownership of property, a renegade broadcaster could still interrupt an assigned frequency. The interference problem is solved by allowing the assigned user (that is, the effective owner) the right to punish such interloping. And that comes by virtue of his title to the frequency right, which could be awarded by lottery or sold on the open market just as easily as it is assigned by federal comparative hearings to a particular broadcaster on the grounds of "public interest, convenience, or necessity."[17]

The standard economic interpretation, then, has been based on what I shall call the "error theory" of federal licensing. It holds that government

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Media Law 35–51 (Daniel L. Brenner & William L. Rivers eds. 1982) and Matthew Spitzer, Controlling the Content of Print and Broadcast, 58 S. Cal. L. Rev. 1349–1405 (1985).

[13] See Pool, *supra* note 1; and Edwin Diamond and Norman Sandler, The FCC and the Deregulation of Telecommunications Technology, in Telecommunications in Crisis 3–56 (1983).

[14] See Mark S. Fowler and Daniel L. Brenner, A Marketplace Approach to Broadcast Regulation, 60 Tex. L. Rev. 207–57 (1982); Lawrence H. Winer, The Signal Cable Sends, Part I: Why Can't Cable Be More Like Broadcasting? 46 Md. L. Rev. 212–83 (1987).

[15] The interference rationale for regulation is based on the common pool problem with spectrum since without rights definition the resource tends to be squandered. The act of rights definition is one of entry barriers, in the sense of excluding nonowners from the use of resources. This act of property enforcement to eliminate the interference problem has given birth (in *NBC* and *Red Lion*) to the notion of "physical scarcity" of the airwaves, thus placing government regulation in a unique light. It is the interference problem, then, that motivates the "physical scarcity" rationale for government licensing and regulation; hence, the two notions tend to be employed interchangeably. By whatever name, this doctrine has lost credibility in the contemporary legal literature. "The 'scarcity' rationale for treating broadcasting differently from other media of mass communications for purposes of substantive regulation has worn so thin that continuing to refute it would be gratuitous." Daniel L. Polsby, Candidate Access to the Air: The Uncertain Future of Broadcaster Discretion, 8 Sup. Ct. Rev. 223–62 (1981).

[16] Telecommunications Research Action Center and Media Access Project v. Federal Communications Commission, 801 F. 2d 517 (D.C. Cir. 1986).

[17] More easily, in fact. Comparative hearings consume large agency resources. Indeed, the FCC has, in recent years, pleaded for increased authority to assign frequency rights by lottery or auction primarily due to agency funding constraints. See Evan Kwerel & Alex D. Felker, Using Auctions to Select FCC Licensees (working paper, Office of Policy and Plans, FCC May 1985). The Congress has allowed the FCC to assign cellular phone spectrum rights by lottery in recent years but refuses to allow FCC auctions (or license fees).

frequency assignment, while logically uncompelling as a solution to the common property problem in spectrum allocation sans property rights, was a logical—if naive—response to a series of regulatory events that occurred in the early days of commercial radio broadcasting. This economic analysis was crafted largely in response to the "chaos theory" of the Supreme Court. "[B]efore 1927, the allocation [of radio broadcast] frequencies was left entirely to the private sector, and the result was chaos."[18] Ronald Coase, in his important 1959 article in this journal,[19] corrected this analysis by pointing out that chaos was not a product of the private sector, but the predictable consequence of ill-defined property rights.

At this stage, however, both sides of the debate accepted the two-stage (pre-1927, post-1927) analysis. The actual history of the marketplace turned out to be further truncated, though, as revealed by Jora Minasian.[20] Employing the basic property-rights approach developed by Coase, Minasian has established the current stylized history of the rights-assignment institution in broadcast spectrum, focusing on four distinct policy eras.

1920–23.—Radio broadcasting began in the United States in November 1920,[21] and developed very rapidly. By the end of 1922, there existed 576 broadcast stations (see Table 2). Each had received a federal license (zero priced) from the secretary of commerce, empowered to issue such by the Radio Act of 1912 (which, obviously, predated broadcasting and was designed for radio telegraphy). As excess demand for zero-priced broadcasting rights developed, Secretary Herbert Hoover (an engineer by training, and an enthusiastic booster of the emerging radio industry) pointedly withheld additional licenses on the grounds that interference would otherwise result. In a 1923 federal court case,[22] however, it was determined

[18] *Red Lion, supra* note 6, at 380. This reasoning piggybacked on Felix Frankfurter's 1943 *NBC* decision (*supra* note 5, at 212–13).

[19] So important analytically, in fact, that it led directly to the "discovery" of the Coase Theorem. George J. Stigler, Memoirs of an Unregulated Economist 75 (1988).

[20] Minasian *supra* note 7.

[21] Early voice broadcasting experiments ("radio telephony") had begun as early as 1908, and a San Jose, California, transmitter had broadcast phonograph music to receivers in San Francisco on an experimental basis in 1915 (Glenn A. Johnson, Secretary of Commerce Herbert C. Hoover: The First Regulator of American Broadcasting, 1921–28, 40–45 (unpublished Ph. D. dissertation, Univ. Iowa 1970)). But the first regularly scheduled and ongoing (to this day) broadcasts began on KDKA in Pittsburgh, November 2, 1920—announcing election returns in the Harding-Cox race (Gleason L. Archer, History of Radio to 1926, at 201–4 (1938). The station was owned by Westinghouse and began service in order to increase demand for radio receiving equipment.

[22] Hoover v. Intercity Radio Co., 286 Fed. 1003 (App. D.C. 1923).

TABLE 2

EARLY RADIO STATION DEVELOPMENT

Year	New Stations	Deletions	Increase	Decrease	Total
1921:					
September	3	...	3	...	3
October	1	...	1	...	4
November	1	...	1	...	5
December	23	...	23	...	28
1922:					
January	8	...	8	...	36
February	24	...	24	...	60
March	77	...	77	...	137
April	76	...	76	...	213
May	97	...	97	...	310
June	72	...	72	...	382
July	76	...	76	...	458
August	50	...	50	...	508
September	39	23	16	...	524
October	46	22	24	...	548
November	46	29	17	...	565
December	31	20	11	...	576
1923:					
January	28	34	...	6	570
February	24	13	11	...	581
March	30	29	1	...	582
April	21	14	7	...	589
May	27	25	2	...	591
June	32	50	...	18	573
July	19	25	...	6	567
August	7	11	...	4	563
September	15	16	...	1	562
October	22	14	8	...	570
November	12	33	...	21	549
December	12	34	...	22	527
1924:					
January	27	20	7	...	534
February	21	7	14	...	548
March	32	11	21	...	569
April	27	19	8	...	577
May	23	11	12	...	589
June	27	81	...	54	535
July	22	13	9	...	544
August	7	18	...	11	533

SOURCE.—Hiram L. Jome, Economics of the Radio Industry (1925), at 70.

that the secretary had no legal authority to withhold a license, on the grounds that Congress had not given him any standard on which to select among competing applicants. The Court, however, allowed the secretary to select times and wavelengths so as to minimize interference.

1923–26.—The secretary continued, in practice, to ration scarce broadcasting licenses by selecting frequency, location, and wavelength assignments, and even by refusing (in defiance of the *Intercity* verdict) to process a continuing stream of broadcast license applicants. This allowed property rights questions to be solved at low cost, and the industry progressed smoothly until another unfavorable court decision for the Commerce Department. In April 1926, in *United States v. Zenith Radio Corp.*,[23] the Hoover licensing method was again found without force of law, and this time the court explicitly denied the department discretion over time and wavelength assignment, as well as over license issuance generally. Rather than appeal, Hoover turned to William Donovan, acting attorney general of the United States, for an interpretation of the law. Donovan sided with the *Zenith* decision (and against *Intercity*) in his July 8 opinion and declared the federal government without authority to define rights to spectrum.

July 8, 1926–February 22, 1927.—Faced with open entry into a scarce resource pool, a classic "tragedy of the commons" ensued. Stations had to be licensed by the secretary of commerce; once licensed, they were free to roam the dial, select their own transmitting location, choose their desired amplification level, and set their own hours. A breakdown of the rights allocation scheme resulted in a predictable (in theoretical hindsight) chaos; the *Red Lion* opinion's "cacophony of competing voices."[24]

February 23, 1927–present.—Given the anarchy of the airwaves, Congress finally sought to establish a system of excludable property rights in the electromagnetic spectrum by passing the Federal Radio Act. Yet it made a fatal analytical mistake: it confused the "chaos of the ether" with a private enterprise policy regime and solved the interference externality problem with an overdose of federal intervention—licensing by a "public interest" standard as determined by the Federal Radio Commission (born in the act, signed into law February 23, 1927). While simply defining and not assigning rights would have dealt with the externality problem in broadcasting (or assigning rights without prejudice, as in an auction or a lottery), Congress mistakenly squeezed two distinct activities into one.

The entrusting to federal regulators of power over the life and death of

[23] United States v. Zenith Radio Corp., 12 F. 2d 614 (N.D. Ill. 1926).

[24] *Supra* note 6, at 380.

American broadcasters slipped through Congress and remains public policy today, due to a fundamental misunderstanding. "It is difficult to avoid the conclusion that the widespread opposition to the use of the pricing system for the allocation of frequencies can be explained only by the fact that the possibility of using it has never been seriously faced."[25] And, in some detail, Minasian outlines this historical episode when chaos erupted and was ended:

> Neither a regulatory agency existed that had control over the use of radio frequencies, nor was there a private property exchange system in operation. Indeed, the latter by definition cannot exist where there are no private rights to be exchanged. . . . Yet, the chaotic conditions have served as the basis for choosing a system of central control over the use of radio frequency spectrum. Aside from the incorrect assessment of the problem, the radio frequency use provides us an opportunity to evaluate the outcome of governmental action in terms of the original goals for which solution was sought—the desire to control interference.[26]

This view now dominates the received wisdom on broadcast licensing. That understanding has been stated thus:

> The drafters of the Radio Act [1927] and the Communications Act [1934] probably never considered creating a property rights mechanism; indeed, had they thought about it, they would have assumed its impossibility. As late as 1958, CBS President Frank Stanton, the acknowledged intellectual of the industry, stated that he had never considered an auction system for allocation of broadcast rights. Just a year later, Chicago's Ronald Coase demonstrated in a path-breaking article that just such a system not only would work but was also the typical way of allocating resources. In fact, despite the naive belief that allocation by government is the only sensible way of doing things, a private market in broadcast licenses now flourishes.[27]

[25] Coase, *supra* note 7, at 24.

[26] Minasian, *supra* note 7, at 403.

[27] Lucas A. Powe, Jr., American Broadcasting and the First Amendment 201 (1987). Further elucidations of the error theory may be found in De Vany *et al.*, *supra* note 10, at 1499–1500; Pool, *supra* note 1, as seen above; Owen, *supra* note 12, at 36–37, 43; Harry J. Levin, The Invisible Resource 111–12 (1971); John Fountain, The Economics of Radio Spectrum Management: A Survey of the Literature, New Zealand Dep't of Trade & Ind., at Executive Summary (1988); Bruce M. Owen *et al.*, Television Economics 139 (1974); David Bazelon, The First Amendment and the "New Media"—New Directions in Regulating Telecommunications, in Free but Regulated: Conflicting Traditions in Media Law 52 (Brenner & Rivers eds. 1982); Daniel L. Brenner, "Commentary," in Brenner & Rivers eds., 60–64, at 60; and Ida Walters, "Freedom for Communications," in Instead of Regulation 93–134, 97 (Poole ed. 1982). One must venture into the communications field to find assertions that a private rights-based answer could not solve the interference problem. Melody writes that "[r]ights to use the spectrum are not susceptible to legal enforcement as are private property rights" (William H. Melody, Radio Spectrum Allocation: Role of the Market, 70 Am. Econ. Rev. 393 (1980)). But this is analytically incorrect, as is demonstrated by the

Under this interpretation of the policy solution to chaos in the ether postulated as a good-faith error, great confusion surrounded the technical problems of establishing rights to the airwaves, and the path mistakenly chosen led to inefficiency and antisocial economic transfers.[28] In economic terms, the error theory posits the solution to the common resource allocation problem as the only argument in policymakers' objective functions, with distribution questions so misunderstood as to be unanswerable in any reasonable way. Yet in building an explanation of broadcast regulation on the "absence of any serious attempt to establish by legislation a system of transferable property rights in the spectrum,"[29] the modern interpretation identifies not the error of the political marketplace in regulating broadcasters but its own examination of the evidence. The historical record makes it abundantly clear that the allocation problem in avoiding a "tragedy of the commons" in spectrum confused neither radio's first regulators nor its regulatees. Quite the contrary, the property rights regime chosen was selected primarily due to its distributional consequences.

III. A Market for the Ether

> One of our troubles in getting legislation [in 1923–26] was the very success of the voluntary system we had created. Members of the Congressional committees kept saying, "it is working well, so why bother?" A long period of delay ensued.[30]

The pricing mechanism was more than considered an allocation device in the early days of radio—it was, in effect. There existed a very lively

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current (and hence easily observable) regulatory regime under which private rights to spectrum are today leased at a zero price to private broadcasters by the government. Such rights would not be fundamentally different in any technical sense if identical claims to spectrum were deeded over to private interests outright. A similar confusion is embodied in Dallas Smythe, Facing Facts about the Broadcasting Business, 20 U. Chi. L. Rev. 96–106 (1952). Both Professors Melody and Smythe are (were) in communications departments to which these faulty analyses appear to be confirmed. (Also note, however, that Hugh C. Donahue, of the Ohio State University journalism department, makes no such error. See Hugh C. Donahue, The Battle to Control Broadcast News (1989)).

[28] These transfers were ill advised on equity grounds (creating excess profits for the regulated industry) and led to dynamic inefficiencies, as the industry (reacting to the exogenous imposition of a regulatory scheme) then lobbied for protectionist barriers. Regulators were tempted to dictate wasteful cross-subsidies: Posner's "taxation by regulation" (Richard A. Posner, Taxation by Regulation, 2 Bell J. of Econ. & Mgt. Sci. 22–50 (1971)).

[29] Owen, *supra* note 12, at 36.

[30] Herbert C. Hoover, The Memoirs of Herbert Hoover: The Cabinet and the Presidency 1920–1933, at 142 (1952).

market in broadcast properties, sold with frequency rights attached, early in the development of the industry (that is, pre-1927). For instance, in Senate testimony taken February 26–27, 1926, Senator Burton Wheeler engaged Judge Stephen Davis, solicitor general of the Commerce Department and the preeminent government expert on radio policy, in the following exchange concerning trafficking in broadcast licenses, with Senator Howell interrupting:

SENATOR WHEELER: I want to get that clear. Supposing I have a wave length and sell it to you, I do not sell you my permit. They have got to come to the department and get their permit or else the permit is not any good to me.

SENATOR HOWELL: Yes; but the practice is to transfer that permit with the apparatus.

SENATOR WHEELER: Of course, they are not bound to do that.

SENATOR HOWELL: No; they are not bound to, but that is the practice. . . .

MR. DAVIS: The practical situation is as the Senator says—the wave lengths to-day are taken and used and occupied. . . . The Senator is correct in saying that we have, as I said before the committee the other day, recognized transfers of that sort. In other words, we recognize the purchaser as stepping into the shoes of the licensee.[31]

Station licenses were known to be scarce, were commonly taken to confer exclusive rights, and were traded freely, often at prices reflecting considerable rents. Indeed, as the spectrum policy problem of this era (1923–26) was that the secretary of commerce had been ordered to issue licenses to all comers, the secretary still relied on market transactions to minimize broadcasting disruptions, à la the Coase Theorem. On January 8, 1926, Judge Davis answered Senator Smith:

SENATOR SMITH: Now, in those licenses, do you give the total control of that wave length to the licensee? . . . For instance, if I had a license to use a certain wave length, could I sublet it to others to use it for such time as I, or whoever had the principle use of it, might not be using it?

MR. DAVIS: That situation is worked out somewhat similar to this, Senator. For instance, take the situation here in Washington. We have two stations, WRC and WCAP. Both operate on a single wave length. In other words, we assign one wave length to both of those stations. Then, Senator, they for themselves work out their time division.

SENATOR SMITH: Yes; that is what I meant.

MR. DAVIS: In other words, we do not say to one, "You go until 12 o'clock to-night. . . ." But they get together and work out the time on this

[31] Radio Control, Hearings before the Committee on Interstate Commerce, United States Senate, Sixty-Ninth Congress, First Session 118–19 (1926).

wave length, the fact being that they do not both go on the same wave length at the same time.

SENATOR WHEELER: Then suppose they do not agree, what do you do?

MR. DAVIS: We would have authority to enforce such a time division.

SENATOR WHEELER: How?

MR. DAVIS: Because, instead of giving—if it ever became necessary to do it, instead of giving full time to each of them, we would give them licenses which would allow them to operate only at certain limited times. That situation, however, has not arisen. In other words, the stations which are operating on one wave length have been able to get together and agree among themselves. And, obviously, that is what the department wanted them to do, rather than itself to attempt to dictate the times for operation. So that plan has worked out fairly.[32]

Not only do these passages indicate the philosophical disposition of the Commerce Department, more importantly, they illustrate that the price mechanism was the institutional tool used to allocate frequencies in the 1920s, it was understood by the regulators (who then explained it to the legislators) to be such, and it was accepted as socially efficient. Trades of spectrum rights were commonplace; the market was robust (indeed, the Washington radio band discussed above by Stephen Davis ended in Coasian optimality as WRC bought WCAP's air time).[33] It is clear that such chaos as potentially could exist was explicitly remedied by federal establishment of property rights, followed by market trading to assign such rights to their highest valued employments.

Property rights were no mystery in this market, nor, significantly, was the inherent conflict between market allocations and political discretion. Beginning in September 1921, when the Commerce Department first recognized radio broadcasting as a distinct license category, the department initially allowed just a single frequency (360 meters, or 833.3 kHz) to be used for broadcasting, necessitating complicated time-sharing arrangements. (What interference took place during this 1921–23 period was, in essence, an outcome of government control: over 500 broadcasters were "responsibly" bunching up all at the same point on the spectrum to which they had been directed by the Commerce Department, and operations were not always perfectly synchronized.) When this single channel became scarce, Hoover denied new licenses. The *Intercity* decision in February 1923, growing out of just such a denial, determined that the secretary had no authority to withhold a license but did have the legal right to set hours of operation and frequencies.

[32] *Id.* at 16.

[33] Erik Barnouw, A Tower in Babel 185–86 (1966).

The department quickly responded in the radio reallocation of 1923 by enlarging the band to accommodate about 70 channels (using ten kilocycles separation). These were assigned to existing stations, with larger broadcasting interests (such as AT&T and RCA) being granted clearer channels (and, hence, higher wattage assignments). The licenses of stations that failed to broadcast regularly were, conversely, revoked.[34] As these wavelengths became scarce, however, Hoover resorted first to time-sharing (that is, rights splitting) and then to a deliberately slow response time on new license applications. Secretary Hoover agreed to the request from broadcasters that "no further licenses could be issued," as Erik Barnouw writes, which "produced a new phenomenon. Though a channel could not now be obtained by applying, it apparently could by purchase. A traffic in licenses quickly developed. The Department of Commerce, far from discouraging it, furthered it by a policy it adopted."[35] That policy, of course, was to recognize the frequency allocation as a tradeable commodity. "Thus via the market place, channels were still available."[36]

This prompted a political backlash, as spectrum rents were being capitalized by private owners and, hence, being sacrificed by Congress. Whereas the *Chicago Tribune* would (in 1924) purchase one of forty local radio outlets (and its broadcast license) for $50,000, the Chicago Federation of Labor (CFL) chose to apply to the Commerce Department for a zero-priced license. In January 1926, the Department responded that all available frequencies were allocated, and "[t]he Secretary of Commerce has no right under existing law to select the individuals who should exercise the broadcasting privilege."[37] Morris Ernst of the American Civil Liberties Union testified in Congress in 1926 that the market price faced by the CFL was a healthy $250,000,[38] noting, "A brisk trade . . . had already developed in licenses, which were sold for exorbitant sums."[39]

[34] Philip T. Rosen, The Modern Stentors: Radio Broadcasting and the Federal Government 1920–1934, at 72–73 (1980). Both policies were efficient in the sense that the more commerically successful broadcasters would have bid the most for such rights (indeed, they were often doing just that) and awarding such rights to likely end users constituted a transactions cost minimizing allocation. See Harold Demsetz, When Does the Role of Liability Matter? 1 J. of Legal Stud. 13–28 (1972).

[35] Barnouw, *supra* note 33, at 174.

[36] *Id.*

[37] *Id.* at 175.

[38] Apparently the largest such sale was in September 1926, when the highly successful radio station WEAF in New York City was sold by AT&T to RCA for $1 million, of which $200,000 was allocated to physical capital and $800,000 for its favorable clear channel frequency right. Barnouw, *supra* note 33, at 185–86.

[39] As Ernst's testimony was summarized by Pool, *supra* note 1, at 122.

Political outrage quickly followed. "Senator James Couzens of Michigan expressed shock over the situation. . . . The Commerce Department policy seemed to Senator Couzens to invite a private auctioning of channels to the highest bidders. 'Anyone that buys the apparatus controls the situation.' "[40] Both Senator Couzens's understanding, and his "shock," are key pieces of evidence in evaluating the error theory. It was the distribution of rights, not their socially inefficient lack of definition, that was driving the demand for legislative action.

IV. The "Breakdown of the Law"

The extent to which the businessmen, lawyers, and policymakers of the era understood that establishment of property rights in spectrum constituted the necessary and sufficient condition for the efficient functioning of the pricing system[41] is revealed by the anticipation of, and reaction to, the seminal policy regime switch embodied in *Zenith*. Hoover had been assigning frequencies on a "first-come–first-served" (or "priority-in-use") basis, either withholding licenses to latecomers or issuing them only on a time-sharing arrangement, and he was openly enforcing license transfer via sales of stations. As this was the case, the great calm prevailing in broadcasting prior to the *Zenith* decision (and the confirming opinion of the attorney general) was abundant proof that no "public interest" licensing standard was necessary to eliminate the externality problem. That the sole solution to interference lay in enforceable, excludable rights was a commonplace; Hoover was commended enthusiastically (indeed, fawningly) by the broadcast industry for enabling a smoothly functioning market, despite imposing no more than a noninterference rule for license issuance. It was not until the Radio Act of 1927 that any public interest standard was adopted, yet the market was thought to have worked well until July 8, 1926.

In fact, the federal court's overruling of Secretary Hoover's rights-definition rule, not the "free market," was then universally credited with creating anarchy in radio broadcasting. A typical press report explained the property rights dilemma rather succinctly, if colorfully, in December 1926:

> Until last July, order was maintained on the broadcasting highways by the Department of Commerce, which assigned a channel to each station on which it could

[40] Barnouw, *supra* note 33, at 175.

[41] Further allocational efficiences could, of course, be gained from allowing market trades between uses (as in selling marine band for radio broadcasting, for example). The question of global spectrum efficiency, while interesting (see De Vany *et al.*, *supra* note 10; Levin, *supra* note 3; Owen, *supra* note 12) is not the primary focus of this article, which concerns itself largely with the assignment of rights *within* the broadcasting band.

operate without bumping its neighbors. After the wave lengths were all assigned, the Department refused to create confusion by licensing more stations. Then court decisions and Attorney General's opinions denied the right of the Department to regulate in any respect, and threw open the radio door to everyone who wished to enter. The air was declared free—that is, free to the broadcasters; but it is not free to the listening public, who now have no liberty of choice in radio reception. They may be able to get a desired station, but they receive its programs only to the tune of disturbing squeals, whistles, or jumbled words from some unwelcome intruder. For as soon as the bars went down, the expected occurred. Since July, some seventy-five new stations have pushed their way into the crowded lanes, and a like number have added to the jumble by shifting wave lengths, all jostling each other and treading on the toes of the first comers, who, from the height of their respectability, style the intruders "pirates" and "wave jumpers." The disturbed public uses still stronger appellations.[42]

So widespread was this understanding of the allocational importance of private property rights without a public interest award standard that a *Yale Law Journal* article of 1929 wrote plainly that, "in 1926, after a second adverse decision to the effect that the Secretary of Commerce had no power under the Act of 1912 to restrict the time of operation or frequency of any station, there came a period of unregulated confusion generally known as 'the breakdown of the law.' "[43] Similarly, Frank Rowley noted that "Until April, 1926, the situation was fairly well in hand. There was some interference, due to the surplus of stations over the number of available channels, but in almost every case, station owners showed a willingness to cooperate in making beneficial adjustments. In April, however, the comparative security of the broadcasting situation was disturbed by a decision in the Federal District Court for Northern Illinois in the case of *United States v. Zenith Radio Corporation*."[44]

V. An Innocent Solution Preempted

As interference plagued much of the broadcast spectrum during the "breakdown" period, an end to radio interference was being crafted not only in Washington but also in the courts. If the common resource problem was clearly identified by contemporary analysts, so was its solution: "establishing legally the priority to an established wave length," as *Radio Broadcast* magazine then put it.[45] In the fall of 1926, a simple and compelling state court decision did just that.

[42] The Survival of the Loudest, Independent 623 (December 11, 1926).

[43] Federal Control of Radio Broadcasting, 29 Yale L. J. 247, footnote omitted (1929).

[44] Frank S. Rowley, Problems on the Law of Radio Communication, 1 U. Cin. L. Rev. 5, footnote omitted (1927). This explanation became official doctrine in the Federal Radio Commission's first annual report. See Federal Radio Commission, Annual Report 10 (1927).

[45] The Courts Aid in the Radio Tangle, Radio Broadcast 358 (February 1927).

In *Tribune Co. v. Oak Leaves Broadcasting Station,*[46] the classic interference problem was encountered, litigated, and overcome, using no more than existing common-law precedent. In the matter, radio station WGN was owned by the *Chicago Daily Tribune* (hence, "World's Greatest Newspaper") and had broadcast popular shows for some time in order to sell its newspapers; the evening's programming was listed in each day's edition.

Radio station WGN built up a good following broadcasting at 990 kilocycles. In September of 1926, that is, during the "breakdown of the law," another Chicago broadcaster moved to an adjacent wavelength, causing WGN to file a complaint in state court alleging that it was necessary to maintain at least a fifty-kilocycle separation on stations located within 100 miles of each other. The "wave jumper" was thus accused of injuring the plaintiff's lawfully acquired business property, consisting of the capitalized "good will" associated with its established broadcasting frequency.

It is interesting that the defendant did not get far in contesting the premise of the suit—that willful interference with WGN's broadcasts would constitute a tort.[47] Instead, it argued that 40 kilocycles was sufficient band width separation to prevent most interference, and what static remained was the product of listeners' substandard receiving equipment. Most pointedly, they did not argue that licensing was necessary to prevent interference which, it appears, would have been a nakedly spurious argument given the straightforward manner in which excludable rights to spectrum space were then understood.

Chancellor Francis S. Wilson decided the case wholly within the spirit of a property rights solution to a common resource problem. His landmark decision, the first to deal with vested private rights in "the ether," noted that the facts "disclose a situation new and novel in a court of equity"[48] but was still able to uncover substantial precedent. The decision found that "unless some regulatory measures are provided for by Congress or rights recognized by State courts, the situation will result in chaos and a great detriment to the advancement of an industry which is only in its infancy."[49] It went on to analogize the right in broadcast frequencies to other long-protected propertied interests.

[46] This 1926 Cook County, Illinois, Circuit Court decision is reprinted in Cong. Rec.–Senate 215–19 (December 10, 1926).

[47] The defendants did, in typical fashion, object to the suit on jurisdictional grounds, claiming that the federal Radio Act of 1912 preempted any state court authority and "that a wave length can not be made the subject of private control" (*Oak Leaves, supra* note 45, at 217).

[48] *Id.*

[49] *Id.* at 219.

While it is true that the case in question is novel in its newness, the situation is not devoid, however, of legal equitable support. The same answer [that no rights in air space exist] might be made, as was made in the beginning, that there was no property right, or could be, in a name or sign, but there has developed a long line of cases, both in the Federal and State courts, which has recognized under the law known as the law of unfair competition, the right to obtain . . . a property right therein, provided that by reason of their use, he has succeeded in building up a business and creating a good will which has become known to the public and to the trade and which has served as a designation of some particular output so that it has become generally recognized as the property of such person.[50]

Using the further analogy of riparian rights, it concluded "that a court of equity is compelled to recognize rights which have been acquired by reason of the outlay and expenditure of money and the investment of time. . . . We are of the further opinion that, under the circumstances in this case, priority of time creates a superiority in right. . . ."[51] Judge Wilson then issued an admonition to the respondents, pending a final hearing, for the "pirate" broadcaster to keep a distance of at least fifty kilocycles from the established WGN frequency. Owing to his fundamental understanding of radio law and the crucial nature of *Oak Leaves* to the policy outcome, I quote the magistrate's findings at length.

[S]o far as broadcasting stations are concerned, there has almost grown up a custom which recognizes the rights of the various broadcasters, particularly in that certain broadcasters use certain hours of the day, while the other broadcasters remain silent during that particular period of time. Again, in this particular locality, a certain night is set aside as silent night, when all local broadcasters cease broadcasting in order that radio receivers may be able to tune in on outside distant stations.

Wave lengths have been bought and sold and broadcasting stations have changed hands for a consideration. Broadcasting stations have contracted with each other so as to broadcast without conflicting and in this manner be able to present their different programs to the waiting public. The public itself has become educated to the use of its receiving sets so as to be able to obtain certain particular items of news, speeches, or programs over its own particular sets.

The theory of the bill in this case is based upon the proposition that by usage of a particular wave length for a considerable length of time and by reason of the expenditure of a considerable amount of money in developing its broadcasting station and by usage of a particular wave length educating the public to know that that particular wave length is the wave length of the complainant and by furnishing programs which have been attractive and thereby cause a great number of people to listen in to their particular programs that the said complainant has created and carved out for itself a particular right or easement in and to the use of said wave length which should be recognized in a court of equity and that outsiders should

[50] *Id.*
[51] *Id.*

not be allowed thereafter, except for good cause shown, to deprive them of that right and to make use of a field which had been built up by the complainant at a considerable cost in money and a considerable time in pioneering.[52]

It was on this homesteading principle that the judge found a common-law remedy to the potential "tragedy of the commons." Relying on established law, without resort to any "public interest" or other political selection criterion, the opinion granted a priority-in-use property-rights rule the force of law in radio broadcasting.[53] Private rights in the ether under common law were immediately recognized as a solution to the interference problem. As an injunction had been issued to restrain the Chicago interloper on October 9, 1926, and the "Decision of Judge Wilson on Defendants' Motion to Dissolve Temporary Injunction" was issued November 17, the radio industry applauded instantly. *Radio Broadcast* noted in its February, 1927, issue that the case was key in "establishing legally the priority to an established wavelength," and concluded that "it establishes a most acceptable precedent."[54] Other stations beleaguered by spectrum trespassers quickly moved to file similar claims in state courts. And legal experts were soon to comment, citing *Oak Leaves*, "The claim to 'Property Rights' may be either in the use of the physical apparatus or in the right to freedom from interference by subsequently established stations. . . . Indeed, unless one adopts the suggestion of 'the government ownership of the ether,' an admission of property rights seems inevitable."[55] (A clue as to the motivation of the 1927 Radio Act to which I shall return, is contained herein.)

It was clear that a system of excludable, transferable property rights in spectrum (1) was widely understood as necessary and desirable so as to efficiently solve the radio allocation problem and (2) could well be expected to come by way of common law, via the priority-in-use principle. A single trial court decision would in no definitive way answer the national property rights question, but the analysis—and its political implications—were clear.[56] This ignited legislative activity in Washington where,

[52] *Id.* at 217.

[53] What is most remarkable, perhaps, is that this common law precedent arrived at precisely the interference-separation rule adopted the following year by the Federal Radio Commission. "To improve radio reception in New York, Chicago, and other large cities, the Commission decided that a separation of 50 kilocycles is necessary between local stations. All allocations were made on that basis" (Federal Radio Commission, *supra* note 43, at 8).

[54] Radio Broadcast, *supra* note 45.

[55] Yale L. J., *supra* note 43, at 252–53.

[56] Stephen B. Davis, solicitor general of the Commerce Department, "contended that a ruling following up this decision in a higher court would protect businessmen against wavelength piracy" (Rosen, *supra* note 34, at 103 footnote omitted).

since 1923, three separate bills to establish a politically discretionary licensing process had died after passage by one house (and dozens more had been introduced since 1921). In the interim, chaos had come to broadcasting—but the state courts were moving toward a solution at common law. The opportunity to construct a federal regulatory system would have to be seized quickly. In the winter of 1927, it was.

VI. The Agenda of the Radio Broadcasting Interests

Secretary of Commerce Herbert Hoover had been advocating broadcasting legislation since the early 1920s.[57] The legislation he advocated had always included a "public interest" standard in awarding franchises by federal authority. This was consistent with Hoover's belief that "we can surely agree that no one can raise a cry of deprivation of free speech if he is compelled to prove that there is something more than naked commercial selfishness in his purpose."[58]

Hoover sought radio legislation even as he conceded (boasted, actually) that the American broadcasting industry was progressing in dramatic fashion. In 1922, Hoover initiated a series of annual radio conferences, attended by major broadcasters and orchestrated by the Department of Commerce. By 1925, he was able to open the conference by remarking that they had "established principles upon which our country has led the world in the development of this service. . . . We have not only developed, in these conferences, traffic systems by which a vastly increasing number of messages are kept upon the air without destroying each other, but we have done much to establish the ethics of public service and the response of public confidence."[59]

Hoover was the political champion of major radio broadcasters.[60] In this 1925 conference, they outlined a policy agenda in which they advocated a "public interest" standard for licensing. Indeed, the newly formed National Association of Broadcasters presented their resolution (for the record, not for consideration) "that in any Congressional legisla-

[57] See, for example, Herbert C. Hoover, The Urgent need for Radio Legislation, 2 Radio Broadcast 211 (January 1923).

[58] Herbert C. Hoover, Opening Address, Fourth National Radio Conference Proceedings (1925), reprinted in Radio Control, *supra* note 31, at 50–68.

[59] *Id.* at 50.

[60] Hoover, however, was not entirely "captured" by industry interests, as will be seen below. He advanced both the incumbent broadcasters' agenda and a regulators' agenda—interests that most often intersected in Hoover's policy recommendations. He therefore played a large role in advancing either group's interests and will be discussed as multidimensional in the analysis herein.

tion . . . the test of the broadcasting privilege be based upon the needs of the public. . . . The basis should be convenience and necessity, combined with fitness and ability to serve, and due consideration should be given to existing stations and the services which they have established."[61]

Moreover, the industry plainly saw Hoover as their man in Washington. After the 1924 Radio Conference, it was noted that "Almost everyone feels that Secretary Hoover has done an excellent job. And few groups feel that more strongly than the radio folk."[62] In 1925, the broadcasters went so far as to pass a resolution endorsing a blank check backing Hoover's regulatory efforts: "[T]he members of this conference express to the Secretary their appreciation of this opportunity for offering their suggestions and pledge their best efforts to help carry out the various provisions thereof . . . [and] the members assure him of their hearty approval and cooperation in any individual deviations from these provisions if, in his judgment, greater service may be rendered to the public thereby."[63]

It is apparent why the major broadcasters, unified behind Hoover, were agitating for federal regulation. In November 1925 (the date of the Radio Conference discussed above), the radio broadcast market was developing well, radio-set sales were brisk, programming was expanding, and interference from rival broadcasters was not an issue. What was at issue was the ability of the secretary of commerce to exclude new requests for spectrum space (that is, broadcasting licenses), as the *Intercity* case had cast a shadow over Hoover's discretion without a standard issued by Congress explicitly granting him such. The industry was fearful that new licenses would, in fact, be issued—if not voluntarily by Hoover, then mandated by the courts (as did happen with the *Zenith* decision in April 1926)—and, moreover, that spectrum rents would be further dissipated either through forced time-sharing agreements or by expansion of the available broadcasting spectrum, which had been done in the spectrum reallocations of 1923 and 1924. Indeed, the 1925 Radio Conference voted down a proposal to extend the radio band to include wavelengths between 1500 and 2000 kHz, thereby effectively increasing available frequencies by one-half.[64]

By imposing a standard whereby the secretary could exclude new licensees on the grounds of "public interest, convenience, or necessity," the desired federal imposition of property rights could be achieved constitu-

[61] Radio Control, *supra* note 31, at 59.

[62] What the Hoover Conference Did, Radio Broadcast 251 (December 1924).

[63] Radio Control, *supra* note 31, at 61.

[64] Rosen, *supra* note 34, at 80.

tionally,[65] and this would allow possibilities for enhanced rents via restriction of band width as well. As a magazine summed up the conclusions of the 1925 Radio Conference, "Radio has done a wonderful job of regulating itself. But there should be a limit upon the total number of broadcasting stations, and this limit can be fixed and maintained only by Federal authority."[66] This legislative goal was doggedly pursued by the industry throughout the period, which is to say, both before, during, and after the "breakdown of the law."

That agenda focused on "the non-issuance of additional broadcasting licenses, the freedom from further division of time with other broadcasters, [and] the maintenance of the present distribution of frequency channels," as the 1925 Radio Conference's resolution cited above put it. In the months preceding the February 23, 1927, passage of the Radio Act, this strategy was quite clear, and its influence in shaping the Act was understood by informed observers both within and without the industry. As Morris Ernst wrote, "the proposed legislation contains phrases such as 'public utility,' 'public necessity,' and 'public interest,' but the operation of the bill is for private profit and for stabilization of investment."[67]

This agenda was artfully accomplished. When the Federal Radio Commission (FRC) was born out of the Federal Radio Act of 1927, it immediately grandfathered rights for major broadcasters, while eliminating marginal competitors and all new entry. Indeed, the FRC restored order out of chaos by ordering stations to "return to their [original Commerce Department] assignments,"[68] thus revealing much about the previous rights regime and the privatization of airwave properties achieved in "the public interest."

Still, the industry was most concerned about how the FRC would deal with "such dangerous propositions as the pressure to extend the broadcast band . . . ; the fatuous claims of the more recently licensed stations to a place in the ether; and the uneconomic proposals to split time on the air rather than eliminate excess stations wholesale . . . ," as one trade journal forthrightly summarized.[69] (The article went on to advocate the "principle of priority" in wavelength allocation, their self-interested conception of

[65] As explained in Louis G. Caldwell, The Standard of Public Interest, Convenience or Necessity as Used in the Radio Act of 1927, 1 Air Law Review 295–330 (1930). (Caldwell was formerly a general counsel of the Federal Radio Commission.)

[66] Ruling the Radio Waves, Outlook 463 (November 25, 1925).

[67] Morris Ernst, Who Shall Control the Air? 122 Nation 443, 444 (April 21, 1926). Notice, too, that Ernst's ACLU opposition to major broadcasters focused (correctly) on distributional issues, as the article's title makes plain.

[68] Rosen, *supra* note 34, at 125.

[69] Welcome to the Radio Commission, Radio Broadcast 555 (April 1927).

"public interest," and advocated reducing the number of broadcasting stations by "about four hundred"—or over *one-half*.)

Radio men were quickly assured that the newly appointed commission was politically sensitive to their needs and aspirations. Only two months after its inception they could be relieved that the commissioners had acted wisely. "Broadening of the band was disposed of with a finality which leaves little hope for the revival of that pernicious proposition; division of time was frowned upon as uneconomical . . . the commissioners were convinced that less stations was the only answer."[70]

Indeed, the second agenda item[71] dealt with by the Federal Radio Commission (on April 5, 1927) concerned possible enlargement of the "Broadcasting Frequency Band." The commission decided not to widen the band beyond 550–1500 kc, "[i]n view of the manifest inconvenience to the listening public which would result."[72]

The decision not to expand the broadcast spectrum serves as yet additional evidence for rejection of both the "chaos" and "error" theories of broadcast licensing. If regulators had made a good-faith, even if analytically unsophisticated, attempt to deal straightforwardly with overcrowding of the airwaves, their first step should have been to allow for an expansion of available broadcasting frequencies. Indeed, the European countries had devoted a larger portion of the electromagnetic band to radio despite a far smaller number of stations, a fact that was not missed by American commentators. Moreover, in 1927, radio broadcasters were allotted just one megahertz (MHz) of spectrum, when twenty-three MHz were in use, having been apportioned in an international radio conference that year,[73] and at least 60,000 kHz were known to be potentially available given then current technology.[74]

The radio industry's argument against broadening the band was that it was anticonsumer: it would "require" listeners to purchase new sets in order to receive new signals. The analysis is transparently false when

[70] Stabilizing the Broadcast Situation, Radio Broadcast 79 (June 1927).

[71] The first item, on March 29, 1927, was a perfunctory matter dealing with license extension for certain point-to-point radio operators. So band width broadening was the first substantive broadcasting issue taken up.

[72] Federal Radio Commission, *supra* note 44, at 13.

[73] Levin, *supra* note 27, at 20–21.

[74] That international conference specifically set aside several higher-frequency bands for radio broadcasting, including 6,000–6,150 kHz, 9,500–9,600 kHz, 15,100–15,350 kHz, and 21,450–21,550 kHz. Federal Radio Commission, Annual Report 233–34 (1928). Radio waves are now known to occupy at least 100,000 MHz of the electromagnetic spectrum. Christopher H. Sterling and John M. Kittross, Stay Tuned: A Concise History of American Broadcasting 506 (1978).

placed over the alternative: simple elimination of the marginal (interference-causing) broadcasters. Clearly, consumers would be better off having a choice between listening to an uncluttered one-MHz band on an existing radio and purchasing a broader-band receiver so as to enjoy enhanced program selection, than in being given only the first alternative. But that is precisely what was argued as a "proconsumer" response to "short-sighted would-be broadcasters and selfish set manufacturers."[75]

Similarly, time-sharing was viciously opposed by the industry for all the right (economically correct) reasons: it would dissipate rents of existing license holders. Their opposition had nothing whatever to do with any illusions concerning the relation between time-sharing and radio interference, or with poorer quality programming and productions. The Commerce Department had long assigned some licenses on a time-sharing basis, causing no great difficulty. As Rowley observed, stations commonly "by contract worked out a satisfactory and amicable schedule of hours."[76] (The one instance he cites in which a radio disagreement went to the courts concerned two nonprofit institutions, the Missouri State Marketing Commission and the Mormon Church.)[77] It was well known that efficient programmers would, if given a suboptimal level of air time, trade for the efficient allocation. A contemporary analyst noted that "the splitting of time on any one day being a disadvantage, the stations would tend to trade their time so as to minimize this difficulty."[78] This was alertly resisted by existing broadcasters, not missed due to ignorance.[79]

Given that the major radio stations wanted an end to time-sharing *and* a freezing of the spectrum at 550 kHz–1500 kHz, the question of expropriation arose: how could the band accommodate all those who had been broadcasting (many on shared frequencies)? The solution was to vest a trusted authority with discretionary authority, which could be legally upheld, in the licensing process. The "public interest, convenience or necessity" standard was chosen as the appropriate vehicle. It had been seen as such since 1922–23, when David Sarnoff, the young general manager of

[75] Radio Welcomes Government Control, Lit. Digest 21 (April 9, 1927).

[76] Rowley, *supra* note 44, at 22.

[77] Another dispute arose in the Cincinnati radio market in early 1925. Two stations were unable to reach agreement on a shared allocation and broadcast over one another's signal for weeks before Secretary Hoover settled the dispute. Barnouw, *supra* note 33, at 179.

[78] Carl Dreher, A New Plan to Regulate Radio Broadcasting, Radio Broadcast 59 (November 1926).

[79] As the above commentator, author of a column called "As the Broadcaster Sees it," saw it, "Half time on the air is worth much less than full-time." Carl Dreher, What Constitutes Fair Dealing in Radio Matters? Radio Broadcast 60 (May 1926).

the Radio Corporation of America,[80] argued (as over 550 radio broadcasters were sharing *one* frequency) that "the elimination of interference is most important and I believe that the well-organized station, charged with responsibility of disseminating information, instruction, and entertainment to the masses, should enjoy the greatest protection which it is possible for the government to provide."[81]

This plan to edge out competition from smaller broadcasters, on the grounds that the latter rendered poorer service to the public, worked perfectly; in Secretary Hoover's April 1923 reallocation plan, the major stations received favorable assignments, while numerous nonprofit stations emerged with severely truncated frequency rights. As Barnouw concluded, "The reallocation seemed to reflect a value judgment in which educational and religious interests were low on the scale."[82] And in the official rights allocation under the Federal Radio Commission in 1927–28, the agency chose to employ the market success standard of public interest—in essence, a simulated auction, with awardees keeping rents.

Since Congress had described the regulatory standard the bureaucrats should use in terms of public interest, convenience, and necessity, the FRC's first step toward establishing a national system involved defining these terms. Four radio conferences and seven years of control by the Department of Commerce had already begun the process. The commissioners agreed that the prevailing scarcity of channels required that those available be used economically, effectively, and as fully as possible. In practical terms, this meant that they favored the applicants with superior technical equipment, adequate financial resources, skilled personnel, and the ability to provide continuous service. According to this interpretation, established broadcasters with demonstrated ability best fulfilled the public interest standard. In most instances, priority and financial success guided the FRC in favoring one operator over another.[83]

When the dust had settled, the established broadcasters had gotten virtually all they could hope for from the new commission. As the *Harvard Business Review* was to comment in 1935, "[T]he point seems clear that the Federal Radio Commission has interpreted the concept of public

[80] Sarnoff was the quintessential advocate (and visionary) of broadcasting interests. He was the moving force behind RCA's radio sales, broadcasting interests, and creation of the National Broadcasting Company in 1926. He assumed the mantle of industry leadership very early in his, as well as in radio's, life. Eugene Lyons, David Sarnoff 117 (1966).

[81] David Sarnoff, Looking Ahead: The Papers of David Sarnoff 48 (1968). In a June 1922 letter he had posited the view that radio should "be distinctly regarded as a public service" (*id.* at 41).

[82] Barnouw, *supra* note 33, at 122.

[83] Rosen, *supra* note 34, at 133.

interest so as to favor in actual practice one particular group. While talking in terms of the public interest, convenience, and necessity the commission actually chose to further the ends of the commercial broadcasters. They form the substantive content of public interest as interpreted by the Commission."[84]

VII. The Agenda of the Regulators

Ironically, "chaos" was a necessary input to achieve this political result. It was clear that the "breakdown of the law" created the urgency Herbert Hoover had been unsuccessfully using as an argument for new legislation since at least 1922. He did not want to squander the moment (steadfastly forgoing the attempt at any enforcement of law) nor to promote some industry coordination post-*Zenith*; he appeared bent on using the confusing period as his contingency to obtain regulation. When Congress again failed in 1926 to enact any radio law, Hoover "refused to regulate radio transmission by common consent, although nearly all the broadcasters urged it. This, as one United States Senator observed, 'seemed almost like an invitation to the broadcasters to do their worst.' Certainly, it tended to fulfill the Secretary's gloomy prophecy about chaos."[85]

This inaction was not due to technical miscalculation: "Secretary Hoover understood the critical nature of the *Zenith* case. He, like McDonald [the Chicago broadcaster/defendant who had forced the case by broadcasting on an unassigned wavelength], utilized the ruling to pressure Congress for action."[86] Others, including Congressman Sol Bloom (D., N.Y.) and James C. Harboard, president of RCA, saw the situation in just the same light.[87] Chaos was strategically introduced into the political process, much in the spirit of the movement for municipal fire departments in the mid-nineteenth century, as described by Fred McChesney.[88]

By any nonstrategic standard, the regulatory reaction to market confusion was inexplicable. This lack of industry cooperation was grossly out of order for Hoover; state-corporate alliances were the hallmark of

[84] In Barnouw, *supra* note 33, at 219.

[85] Silas Bent, Radio Squatters, Independent 389 (October 2, 1926).

[86] Rosen, *supra* note 34, at 94.

[87] *Id.*

[88] Fred McChesney, Government Prohibitions on Volunteer Fire Fighting in Nineteenth Century America: A Property Rights Perspective, 15 J. of Legal Stud. 69–92 (1986). A general principle is that crisis tends to raise the demand for government controls, a hypothesis argued persuasively in Robert Higgs, Crisis and Leviathan (1987).

Hooverism,[89] and 1926 marked the first year since 1921 that a Radio Conference had *not* been called by the Secretary of Commerce (this when "chaos" haunted the airwaves). Such industry conferences had been a "ritual" for Hoover.[90] The *New York Times* specifically implored the Secretary likewise to arrange some stopgap industry arrangement during the "breakdown" period.[91]

But Hoover had stated that "he would welcome a test case"[92] and saw his *Zenith* "defeat" and the ensuing confusion, which he had predicted,[93] as a predicate to achieving his policy agenda. That he surprised the broadcasting industry by not appealing the verdict in *Zenith* is consistent with this,[94] despite the fact that *Intercity* had earlier determined that Hoover did have authority to enforce time and wavelength exclusivity.

It was at this point that a visible schism appears to have developed between Hoover and major radio broadcast interests. With the *Oak Leaves* verdict giving frequency users the hope of outright endowments, vesting the federal government with a public interest licensing standard was suddenly less important (although constricting band width remained a key policy goal). Hoover noted, of "radio men," that "many . . . were insisting on a right of permanent preemption of the channels through the air as private property."[95] Hoover challenged this view directly, arguing that the key legal aspects of radio were, first, its "immense importance," and second, "the urgency of placing the new channels of communication under public control."[96]

Finally, radio legislation really was urgent. Officials at the Department of Commerce's radio division were reported to "welcome the [*Zenith*] decision . . . for the reason that it will force Congress to give Mr. Hoover or somebody else the authority to prevent such interference."[97] Momentum for legislation gathered among the public, who were "being forcibly convinced of the undesirability of increasing the number of broadcasting

[89] See Ray L. Wilber and Arthur M. Hyde, The Hoover Policies (1937); Robert B. Horowitz, The Irony of Regulatory Reform: The Deregulation of American Telecommunications 116 (1989).

[90] Rosen, *supra* note 34, at 74.

[91] *Id.* at 102.

[92] Barnouw, *supra* note 33, at 1980.

[93] *Id.* at 95.

[94] *Id.* at 189.

[95] Hoover, *supra* note 30, at 139–40.

[96] *Id.* at 139.

[97] Air Piracy and Chaos, Lit. Digest 13 (May 1, 1926).

stations."[98] But vested rights were respected in *Oak Leaves,* and "wave jumpers" could, apparently, be enjoined in state courts. The solution to interference presented a challenge to policymakers: how could effective federal regulation take place once private rights to broadcasting spectrum were assigned at common law?

The Congress responded to *Oak Leaves* instantly. After years of debate and delay on a radio law, both houses jumped to pass a December 1926 resolution stating that no private rights to the ether would be recognized as valid, mandating that broadcasters immediately sign waivers relinquishing all rights, and disclaiming any vested interests. The power to require such was the interstate commerce clause, but the motive was that Congress was nervous that spectrum allocation would soon be a matter of private law. As a law review article published during the three months between *Oak Leaves* and the Radio Act commented, "The conclusion is unavoidable . . . that the license issued at present by the Department of Commerce amounts to nothing more than a perfunctory permission to broadcast. Therefore the issue of a second license to use a wave length already in use by a first licensee could have no effect on the permission of the first licensee to broadcast, the use or abuse of wave length being governed solely, at present, by common law principles."[99]

Should those common-law principles apportion the spectrum to private users, the "breakdown of the law" would be remedied, but the federal government's ability to control or even influence broadcasting would vanish. Compromise legislation was quickly hammered together; a bill creating an independent five-member regulatory commission was passed by both houses, endorsed by Hoover, and signed by President Coolidge.[100] The motive was apparent; having seen the creation of property rights in the first state court decision, "It is against such a conception that the

[98] The Wages of the "Wavelength" Pirate is Unpopularity, Radio Broadcast 474 (October 1926).

[99] Rowley, *supra* note 44, at 35.

[100] The nexus of licensing control was astutely seen to be a politically charged issue; hence, legislation had been held up for years in a contest between Congressman White, a House Republican from Maine wanting to vest the secretary of commerce with discretion in license awards, and Senator Dill, a Washington Democrat preferring to create an independent radio commission. (Both bills established a "public interest" standard for licensure, but no one was fooled as to the political leverage to be exercised therein.) Dill's legislation basically prevailed in the compromise, as the commission was established "temporarily," with the Department of Commerce regaining authority after one year (Rosen, *supra* note 34, at 84, 95–96, 104, 106). Due to annual extensions and the Communications Act of 1934, such authority has yet to revert to the Department of Commerce. As Senator Dill commented, however, this was not a surprise; he understood that any "temporary" commission would become permanent. Barnouw, *supra* note 33, at 199.

Radio Act is particularly directed."[101] A principal interest of the law, reinforced by the subsequent behavior of the FRC and FCC, has been to preempt such a solution to the interference problem. "[T]he proposed radio legislation in the nineteen twenties required a licensee to sign a waiver indicating that 'there shall be no vested property right in the license issued for such station or in the frequencies or wave lengths authorized to be used thereon.' . . . The Commission, fearful that licensees would assert property interests in their coverage to the listening public, has inserted elaborate provisions in application forms precluding the assertion of any such right."[102]

Whereas Hoover pushed for federal control primarily as an advocate of industry interests, Congress appeared more broadly based in its political concerns. Debate indicated that monopoly, the locus of licensing authority, and the geographical distribution of radio stations dominated the discussion. Regarding the latter, the first law amending the Radio Act (the Davis Amendment of 1928), ordered the FRC to allocate an "equitable" number of broadcast licenses to each of the nation's five zones (one commissioner was appointed from each zone, according to the 1927 act), on the claim that the South was being cheated out of its fair share of radio stations.[103] Congress was leery of the power of the radio broadcasters as "the press": they inserted an equal-time rule for all political candidates in the 1927 act. The new commission was also empowered to issue "special regulations applicable to radio stations involved in chain broadcasting" (sec. 4 [h]), to compel stations "to keep such records of programs . . . as it may deem desirable" (sec. 4[i]), and to prohibit "any alien or representative of alien" from owning a license to broadcast (sec. 12). The debate, the legislation, and subsequent legislative reaction to the commission all make it plain that lawmakers were primarily concerned about nonefficiency issues. "The 1927 Act was a quantum leap in regulation. Congress did not content itself with curbing interference among users of the spectrum, but instead included in the new Act provisions relating to programming, licensing and renewal, and many other aspects of broadcasting not related to electronic interference. Those provisions were incorporated seven years later into the Communications Act of 1934."[104]

[101] Carl Zollman, Radio Act of 1927, Marq. L. Rev. 121, 124 (1927).

[102] Paul M. Segal and Harry P. Warner, Ownership of Broadcasting Frequencies: A Review, 19 Rocky Mt. L. Rev. 111, 113, 121 (1947).

[103] This provoked a very bitter response in radio-dense New York; see Emmanuel Cellar, Will the Davis Amendment Bring Better Radio?: Con, 7 Cong. Digest 268–69 (October 1928).

[104] Anne P. Jones and Harry W. Quinlan, Broadcasting Regulation: A Very Brief History, 37 Fed. Comm. L. J. 107, footnotes omitted (1985).

The fact was that the policy debate was led by men who clearly understood—and articulated—that interference was not the problem, interference was the opportunity. The efficiency issues were demarcated from political-distributional questions both in their words and their actions. In 1925, Herbert Hoover explicitly separated the respective issues of rights-definition and political control over licensees thus:

> It seems to me we have in this development of governmental relations two distinct problems. First, is a question of traffic control. This must be a Federal responsibility. From an interference point of view every word broadcasted is an interstate word. Therefore radio is a 100 percent interstate question, and there is not an individual who has the most rudimentary knowledge of the art who does not realize that there must be a traffic policeman in the ether, or all service will be lost in complete chaos of interference. This is an administrative job, and for good administration must lie in a single responsibility.
>
> The second question is the determination of who shall use the traffic channels and under what conditions. This is a very large discretionary or a semijudicial function which should not devolve entirely upon any single official and is, I believe, a matter in which each local community should have a large voice—should in some fashion participate in a determination of who should use the channels available for broadcasting in that locality.[105]

Senator C. C. Dill authored the bill that finally gained passage in 1927. He was equally unconfused as to the purpose of federal licensing. "Of one thing I am absolutely certain," he declared. "Uncle Sam should not only police this 'new beat'; he should see to it that no one uses it who does not promise to be good and well-behaved."[106] In the event any misunderstanding had arisen that placed interference control as the primary aim of the federal legislation, Dill was pointedly direct. "There is much agitation and much resentment to-day over the chaos in the air, but that does not concern me so seriously as the problems of the future. Chaos in the air will be righted as a matter of business. The pressing need for legislation is found in the fact that the Government must provide for the protection of the public interest as the numerous and urgent demands for the use of the air develop. That is the crux of the situation."[107]

Dill's concerns were devoted to monopoly and political fairness over the airwaves, both derived from his belief that radio broadcasting would become an important, powerful medium of expression. Instead, therefore, of rushing to protect this sector from regulation under the shield of the First Amendment, Dill saw his alternative priority clearly. "The one

[105] Hoover, *supra* note 57, at 57.

[106] C. C. Dill, A Traffic Cop for the Air, 75 Rev. of Revs. 181 (February 1927).

[107] *Id.* at 183–84.

principle regarding radio that must be adhered to, as basic and fundamental, is that the Government must always retain complete and absolute control of the right to use the air."[108]

Senator Dill's only rival as a congressional authority on radio legislation was Representative W. H. White, Jr., who had been introducing pro-Hoover measures since 1921, and who authored the competing radio bill (but who endorsed Dill's compromise measure before its passage). Shortly after the Radio Act of 1927, the congressman explained the need for regulation as follows:

> [S]ome of us have . . . believed that in the absence of legislation by Congress it was inevitable that the courts of the country sooner or later would determine, as they have determined, that priority in point of time in the use of a wavelength established a priority of right.
>
> This is the situation that confronted us, and the necessity of dealing with this situation and of conferring an authority of regulation to minimize interference which now sadly impairs broadcasting has been the compulsion back of the effort to get legislation.
>
> This bill gives to the commission, and thereafter to the Secretary of Commerce, subject to appeal to the commission, the power to issue licenses if the public interest or the public convenience or public necessity will be served thereby.
>
> This is a rule asserted for the first time, and it is offered as an advance over the present right of the individual to demand a license whether he will render service to the public thereunder or not. It is one of the great advantages of the legislation. The bill gives to the Federal Government the power to determine the wavelength which every station shall use.[109]

This rich passage from the last of our trio of Radio Act prime movers demonstrates the salient points. It glides from the interference problem to the pressing need for legislation, despite implicitly revealing that such a goal had been sought for years, when the fear was not interference, but the assertion of private rights to spectrum. It focuses on the importance of the introduction of a public interest standard for broadcast licensing; it was well known that, while interference was but a recent phenomenon, the public trusteeship model of licensing had not been the old solution. But it would become the new solution, and therein lay "one of the great advantages of this legislation."

VIII. The Agenda of the "Public"

There existed nonbroadcaster, nongovernmental interests that shaped the debate creating the federal regulatory system in radio spectrum rights.

[108] *Id.* at 184.

[109] William H. White, Unscrambling the Ether, 42 Lit. Digest 7 (March 5, 1927).

While it is doubtful that these constituencies carried decisive political weight,[110] it is instructive to examine the manner in which they sought to make their respective cases.

The major interests can here be summarized as belonging to two loosely organized constituencies: nonprofit broadcasters and listeners' associations. The former consisted of such disparate groups as the American Civil Liberties Union (whose counsel, Morris Ernst, was a frequent contributor to the radio regulation discussion in congressional hearings and in the popular press), the Chicago Federation of Labor (which had been attempting to gain a broadcast license by assignment rather than purchase, as noted above), populist political movements (which voiced fear of the "radio trust" and monopolization of the airwaves through such spokesmen as Progressive Montana Senator Burton K. Wheeler), an impressive list of institutions of higher learning (which had entered radio broadcasting very early, with 151 colleges and universities being granted Department of Commerce radio licenses as of the end of 1924[111]), and certain municipalities (for example, New York, which had established WMCA as a city-run broadcast outlet largely to gain goodwill for incumbent officeholders[112]).

The theme uniting such groups was that the "public interest" standard adopted for licensure should be interpreted to give substantial weight to nonprofit criteria, creating a license auction in which their particular resources, or "currency," would go the furthest. Hence, the ACLU argued that nonprofit institutions should be given special consideration so as to promote cultural and political diversity.[113] Most compelling were the arguments of the universities, which, presumably, were equipped with a comparative advantage in the manufacture of "public interest" rationales for favorable treatment.[114] When the House and Senate were stalled over competing bills (the White bill favoring Commerce Department control and the Senate version establishing an independent commission), the Association of College and University Broadcasting Stations "tried to profit

[110] The best evidence is derived by following Federal Radio Commission decision making after 1927. Virtually none of the substantive outcomes ostensibly sought by such interests were realized, including (most significantly) licensing of nonprofit radio stations. "[T]he number of operating educational standard broadcast stations dropped steadily from 98 in 1927 (approximately 13 percent of all stations) to 43 in 1933 (about 7 percent)." Sterling and Kittross, *supra* note 73, at 111.

[111] Barnouw, *supra* note 33, at 173.

[112] *Id.* at 109.

[113] See Ernst, *supra* note 66, and Morris Ernst, Radio Censorship and the "Listening Millions," 122 *Nation*, April 28, 1926, at 473–75.

[114] Rosen, *supra* note 34, at 164, 170, 175.

from the deadlock . . . [by seeking] preferential treatment in the assignment of wavelengths and the division of time."[115] While Representative White rejected this on the grounds that it would open the door to similar demands from "labor organizations, amateurs, religious bodies and all manner of groups and interests,"[116] Senator Dill was more attentive. His Senate measure was amended to include special protection for educational broadcasters from commercial station rivalry. This was the legislation that eventually became the Radio Act of 1927, despite RCA and NAB support (representing major commercial broadcasters) for the White bill.

The listeners' groups generally supported Secretary Hoover's efforts at establishing de facto property rights and providing for orderly industry development. While the listeners and broadcasters could well have split over the issue of broadcast spectrum expansion (pro and con, respectively),[117] the fundamental concern during the "chaos" period was in reestablishing a traffic system. Rosen concludes that major radio broadcasters, Commerce Department officials, and listeners groups supported the White pro-Hoover legislation, while the nonprofits and anti-Hoover political interests backed the Dill proposal.[118] The only essential difference in the measures was distributional; the commission approach, with members chosen from each of five geographical regions and with specific nonprofit protectionist language, was seen as widening access to the regulatory process for those interests not well vested in the Administration. This latter group included Senate Democrats (a minority), and anti-Hoover Republicans, particularly Senator James E. Watson (R., Indiana), chairman of the Committee on Interstate Commerce.[119] This coalition won, and control of licensing was ostensibly wrestled away from Commerce Department control.[120]

[115] *Id.* at 99.

[116] *Id.* at 100.

[117] The Indiana Broadcast Listeners Association did, in sharp contrast to the major broadcasters, advocate an engineering study of the feasibility of expanding the broadcast "below 100 meters" (that is, above 3,000 kHz). As international agreements in 1927 set aside significant wavelengths in this region for broadcasting (see above), and as lower frequencies were reserved for mobile, amateur, and government use in the United States, this was a logical suggestion. Listeners Recommend New Bills be Drafted, N. Y. Times (January 9, 1927).

[118] Rosen, *supra* note 34, at 98.

[119] *Id.* at 96–97. Another "public" group consisted of small, independent broadcasters, who feared (correctly, it turned out) that they would receive poor time and wavelength assignments under the National Association of Broadcasters-backed legislation. They opposed both bills. *Id.* at 103.

[120] It is unclear which side actually determined policy actions following the Radio Act of 1927. While Dill's legislation clearly prevailed in law, establishing the Federal Radio Com-

IX. The 1927 Radio Act as an Equilibrium Political Solution

Although licensing control passed into the hands of an independent commission, economic allocation was not much affected vis-à-vis the rights established in the pre-"breakdown" period. By virtually all accounts, the commission made legal what Secretary Hoover had accomplished via extralegal authority: it recognized priority-in-use rights to spectrum space, with discretionary power and time assignments favorable to those broadcasters serving larger audiences. Marginal broadcasters with irregular transmissions were expropriated altogether; nonprofit institutions were relegated to crowded spectrum "ghettos" where time was scarce and listenership difficult to attract. Many such licenses were soon withdrawn by their owners due to unsustainable financial losses. In its third annual report, the Federal Radio Commission described its interpretation of the "public interest, convenience, or necessity" standard it had utilized in establishing order in the airwaves.

> The first important general principle in the validity of which the commission believes is that, as between two broadcasting stations with otherwise equal claims for privileges, the station which has the longest record of continuous service has the superior right. This is not a doctrine of vested rights or an extension of the property law to the use of the ether; it applies only as between private individuals or corporations operating stations and not as between either of them and the plenary power of the United States to regulate interstate commerce.
>
> Where two contesting broadcastings do not have otherwise equal claims, the principle of priority loses its significance, in proportion to the disparity between the claims. In a word, the principle does not mean that the situation in the broadcast band is "frozen" and that existing stations enjoying favorable assignments may not have to give way to others more recently established.
>
> * * *
>
> Broadcasting stations are licensed to serve the public and not for the purpose of furthering the private or selfish interests of individuals or groups of individuals. The standard of public interest, convenience or necessity means nothing if it does not mean this. The only exception that can be made to this rule has to do with advertising; the exception, however, is only apparent because advertising furnishes the economic support for the service and thus makes it possible.[121]

This passage is entirely in line with FRC and subsequent FCC policy pronouncements, in coupling de facto property rights with the potential

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mission by statute, Hoover moved quickly to exercise control over all presidential nominees for commissioner and even to use Commerce Department funds to pay for FRC expenses, strangely unprovided for in the initial legislation. Hence, Hoover's hand was decisive in all early FRC rule making.

[121] Federal Radio Commission, Annual Report 32 (1929).

for agency discretion in the "public interest." The market is neither purely private nor, in substance, one of government control, but is ruled by a hybrid policy in which spectrum rents are shared by private users and government regulators or their assignees. This distribution makes eminent sense for the two principal transactors, Congress and broadcast license holders, and gives both equity "owners" incentives to maximize rent values.

That the arrangement was legally fashioned to wear the clothing of "public interest" led quickly to logical curiosities. While condemning all forms of "selfishness," it asserts that advertising—quite controversial in the 1920s radio market and often condemned even by radio champions such as Herbert Hoover—would not be so defined, on the grounds that the selfish aspect of advertising makes enjoyable programs economically possible. Yet that view may as well be substituted into the argument for self-interest as a motive anywhere. The commission's purpose in condemning private self-interest and then endorsing advertising (the manner in which financial self-interest was pursued in radio) was to endorse an implicit marketplace standard, allowing licensees to maximize audiences and, hence, ad revenues, while carefully regulating "selfish" speech—that is, the airwaves would not be used for controversial communications interesting merely to a minority of listeners. This was the "selfishness" that the FRC believed it had a mandate to regulate. And, interestingly, it is the form of broadcasting of least interest to major broadcasters, particularly when one's competitors are similarly constrained.

The commission's "public interest" solution to the property right problem essentially accomplished the following:

1) it served to establish quickly and cheaply de facto property rights to spectrum based on the priority-in-use rule;

2) it thinned out the spectrum by failing to renew licenses of 83 broadcasters in July 1927 and gave reduced power and time assignments to nonprofit organizations;[122]

3) it awarded enhanced power assignments (as high as 50,000 watts—up from 5,000 watts) to some fortunate large broadcasters, generally network affiliated;[123]

4) it established a rights-enforcement mechanism, wherein license holders were to self-police the airwaves by filing complaints against interfering broadcasters;[124]

[122] Barnouw, *supra* note 33, at 216.

[123] *Id.* at 218.

[124] Federal Radio Commission, *supra* note 44, at 16.

5) it froze AM band width at essentially its 1924 size, using less than five percent of the then-utilizable capacity for broadcasting.

This solution represented an optimum politically because each of the influential parties was given a share of the rents created in proportion to their political influence, making each better off than they would fare in alternative nonlicensing arrangements. Such rents emanated from the allocation of spectrum rights to private users on a nonfee basis and from entry restrictions enhancing the values thereby created. In that vested rights were developing and lengthy, costly litigation would have followed had an expropriation of major broadcast license holders occurred, an outright nationalization of airwave property was not a desirable alternative for regulators. Such a course would also have carried the opportunity cost of an immediate loss of support by major broadcasters. It was far better for regulators to award broadcasters generous rents subject to "public interest" discretion in the licensing process that could be partially apportioned by incumbent officeholders.

Broadcast licensing became, hence, an inordinately political affair. FRC General Counsel Louis G. Caldwell noted the "political pressure constantly exercised . . . in all manner of cases," and the 1927 Act's creator, Senator Dill, pointedly rejected a later suggestion that congressional members treat the commission like a court of law and refrain from attempting to influence assignments.[125] The 1928 Davis Amendment was in the spirit of further politicization of wavelength assignments, and an authoritative Brookings Institution study soon reported that "probably no quasijudicial body was ever subject to so much Congressional pressure as the Federal Radio Commission."[126]

What was evident was that the issuance of zero-priced franchises could stimulate an effective rent-seeking competition from constituencies willing and able to pay for the broadcasting privilege, with the means of payment constrained by existing legal institutions. Hence, pecuniary transfers to the U.S. Treasury were not a viable option because they would have represented a de facto expropriation of not only private spectrum users, but also of political decision makers in both Congress and the regulatory bureaucracy. Instead, other margins in a quid pro quo arrangement were developed. For instance, Congress immediately acted to regulate content with such incumbent protectionist devices as the equal time rule (codified in the Radio Act), and the commission very quickly found it could exercise authority over broad forms of content, such as "fair-

[125] Barnouw, *supra* note 33, at 217.

[126] Laurence F. Schmeckebier, The Federal Radio Commission 55 (1932).

ness."[127] And, of course, pure influence peddling in the procurement of licenses could yield both legal and extralegal benefits for incumbent Congressmen.

It is interesting that "public interest" or "citizen" groups also acceded to the rent distribution form of regulation, even though their announced interests were soon liquidated by the regulatory apparatus selected. Educational broadcasters, for example, were treated very harshly by the Federal Radio Commission: "virtually all stations operated by educational institutions received part-time assignments," sharply increasing educational station fatalities in 1928 and 1929.[128] Yet their advocates had supported placing the question of license distribution into a political context where nonprofit spokesmen had access; this was preferred to a pure market allocation where all such leverage would have evaporated. The preliminary evidence suggests that a principal-agent problem dominated the interest group action of such nonprofit lobbyists, biasing their actions toward the establishment of institutions in which the agents' specific human capital—advocacy in the press, testimony in public hearings, and so forth—and not announced group objectives, was maximized.

The basic stability of the broadcast regulatory structure derives from the commission's ability to establish an off-budget auction, in which the rents associated with licensure are appropriated to competitive constitutencies as merited by the political pressure they effect. This can lead to a shifting equilibrium, as groups rise and fall in influence, but the agency's task is to find, at any moment, the optimum solution given the various claimants' strength. This is achieved via public hearings, where such demand intensities are gauged, ex parte contacts, congressional liaison and funding levels, and the market for postagency employment.[129] (Similarly, the legislative and executive branches calculate optimal oversight strategies based on such factors, as well as campaign contributions and [for Congress] speaking fees paid by trade associations.) Zero-priced broadcast licensing is not a "giveaway" of public resources in the strict sense; rather, it is the stimulus generating a rent-seeking competition in dimensions where gains may be internalized by regulatory authorities. Auction claimants are rewarded with rents in proportion to their economic and political strength, which is only to say that licenses go to highest bidders denominated in currency that can be converted by actual decision makers.

[127] By 1929, the commission was taking "fairness" into account in licensing decisions. See Federal Radio Commission, *supra* note 120, at 33.

[128] Barnouw, *supra* note 33, at 218.

[129] Robinson, *supra* note 3, offers a fascinating overview of this general process.

Hence this market exhibits Posner's classic "taxation by regulation," as has been noted (looking at regulatory decisions decades hence) by Bruce Owen.[130] What is noteworthy here is that the framework selected in 1927 was not the result of a series of "historical and technological accidents," nor did it reflect "simple ignorance on the part of courts, commissions, and Congressional committees of the economics and technology of broadcasting."[131] Private spectrum rights were not rejected in favor of government allocation out of "ignorance" but were actually established as part of a hybrid regulatory system that respected vested rights in broadcast spectrum and even enhanced them in value via supply restriction. Such private rights were "purchased" by broadcaster subsidies to "public interest" concerns, a tax which initially amounted to little more than nominal acquiescence to (and political support for) a federal licensing authority but would, over time, include significant payments to unprofitable local programming, "fairness doctrine" regulation, extensive proof of commitment to "community" in station renewals, and the avoidance of broadcasting content offensive to the political party in power.[132] That this means of payment is used to charge for the use of scarce spectrum, and not money bids to the fisc, is no more "mistaken" or "accidential" an arrangement than the sales price set by Oliver North on "bargain" missiles to the Ayatollah, allowing Colonel North to divert the excess demand not to the U.S. Treasury but to a *Contra* account in Switzerland.[133] Rents created by policy can be at least partially extracted by regulators exercising authority in the public interest, but property rights of the latter become severely diluted once such rents flow into the general budgetary pool.

The fact that spectrum fees and discretionary regulatory authority are substitutes has never been misunderstood in the U.S. regulation of the broadcast spectrum. While the Department of Commerce established a

[130] Owen, *supra* note 27, at 46–47.

[131] *Id.* at 43–44. Why the courts, specifically, have tended to endorse the constitutionality of the regulatory scheme chosen requires a different explanation than that given in this article for the behavior of regulators and politicians.

[132] See Robert Crandall, Regulation of Television Broadcasting, Regulation 31–39 (January/February 1978); Noll *et al.*, *supra* note 3; Owen *et al.*, *supra* note 27; Levin, *supra* note 3; Walters, *supra* note 27; and Powe, *supra* note 27.

[133] Whether regulators or legislators extract rent for "self-interest" or "ideological" purposes (assuming these to be distinct ends) is an interesting question beyond the scope of this article. While the North example prompts one to think of ideological preferences, the broadcast regulation experience suggests both motives to exist simultaneously (and, of course, as substitutes). The essential point is that rent may be extracted, whatever the ultimate purpose. See Fred McChesney, Rent Extraction and Rent Creation in the Economic Theory of Regulation, 16 J. of Legal Stud. 101–18 (1987).

separate designation for radio broadcasters only on September 15, 1921, by early 1922 Herbert Hoover and the radio interests were already considering the nature of the tradeoff involved. "Now the radio world was anxious for regulation to prevent interference with each other's wavelengths. A good many of them were insisting on the right of permanent pre-emption of the channels through the air as private property. And I concluded that would be a monopoly of enormous financial value and we had to do something about it."[134] What Secretary Hoover did was to call the first radio industry conference (February 1922) where he established the "public interest" rationale for regulation. The regulatory strategy selected reflected a keen sense of the fundamental value and importance of the budding marketplace. "It is inconceivable that we should allow so great a possibility for service, for news, for entertainment, for education, and for vital commercial purposes, to be drowned in advertising chatter, or for commerical purposes that can be well served by other means of communication. . . . There is involved . . . in all of this regulation, the necessity to so establish public right over the ether roads that there may be no national regret that we have parted with a great national asset into uncontrolled hands."[135]

X. Auctions, Property Rights, and Coase: A Conclusion

Ronald Coase has theorized that policymakers of the twenties were largely unaware of the efficient solution to the common resource problem in spectrum, when "[T]he simplest way of doing this would undoubtedly be to dispose of the use of a frequency to the highest bidder, thus leaving the subdivision of the use of the frequency to subsequent market transactions."[136] Yet the early history of broadcasting shows why this was not the simplest assignment rule. Airwaves were not resources that had been carried in inventory by any public agency. In essence, the spectrum for broadcasting was discovered by radio pioneers and exploited by entrepreneurs who risked capital in the creation of valued rights. Early discoveries were rapidly communicated; the number of broadcast stations populating this new frontier jumped to several hundred virtually overnight. And by then the public auction idea was moot; resource owners were established, and auctioning their spectrum was far from the simplest allocation rule.

Homesteading was. Indeed, the legislation that established federal control of the airwaves owes its success in great measure to the methodical

[134] In Johnson, *supra* note 21, at 81.

[135] *Id.* at 83.

[136] Coase, *supra* note 7, at 30.

manner in which the FRC and, subsequently, the FCC, have observed the homesteading principle in practice.[137] But, of course, this allocation mechanism is not identical to a priority-in-use rule enforced at common law. Market transfers are screened by federal authorities; license renewals are less than costless or riskless; new spectrum use for broadcasting is prohibited by law. The system has transferred net resources to incumbent broadcasters, broadcast regulators (including oversight congressional committees), and advocates of the "public interest."

One of the most interesting findings available in observing the actual establishment of these private rights is the manner in which political "rights" were quickly vested as well. The partnership of airwave holders (private) and airwave rights grantors (public) created a natural community of interest for those agents intimately involved in creating the rights structure itself. In essence, Secretary Hoover, Senator Dill, and Congressman White "homesteaded" broadcasting policy nearly as quickly as broadcasters staked out the spectrum. Reverting to a money auction would have expropriated the political agents' de facto rights as well.

Of course, new spectrum allocations were made as early as 1923, 1924, and 1927. They would be granted without dollar payment, as would later allocations of VHF and UHF television (1940s and 1950s), microwave and satellite broadcasting rights (1970s), and cellular telephone frequencies (1980s). It is interesting to note that the early assignments were made in a sort of prospective homesteading basis—awarded to comparatively advanced broadcasters who were likely to exploit the resources most quickly and fully. Yet the system of assignment which later developed to replace the pioneering rule (when government awarded de novo rights) came after an established legal structure demonstrating a political optimum was firmly in place in the radio market. This would guide policymakers in the creation and assignment of new rights. The institution then established was the comparative hearing, where political interests could be weighed in a formal procedure in order to achieve a social maximum—as determined by the assignment authority. Bringing themselves to the nexus of decision making in a brisk competitive rivalry for zero-priced frequency rights has given regulators and lawmakers a very well understood discretion over the life and death of lucrative and influential broadcasters.[138]

[137] It is also revealing that, even decades later, international divisions of spectrum rights were achieved via national homesteading. Levin, *supra* note 27, at 106–7.

[138] Comparative hearings were not a radical departure from the homesteading solution of the 1920s but an institutional adaptation to a new market where the vested rights of broadcasters to "ether" were somewhat weaker. But the principal result of the de jure outcome

Once the initial homesteading had occurred, diverse constituencies came to demand their share of lucrative spectrum rights. These demands brought the prevailing industry attitude vis-à-vis property rights to the fore well before the Radio Commission was born. The May 1926 issue of *Radio Broadcast* featured a provocative essay dealing with the moral dilemma involved in deciding who—including the antivivisectionists—should be allowed to broadcast.

> [S]uppose that the anti-vivisectionist brethren want to broadcast, and have the money, but can't get a license because there are no wavelengths left? Isn't that a hardship, in a world where publicity is everything and the inarticulate go under? Already flour mills, vaudeville theaters, public service corporations, colleges, cabarets, Christian Scientists, Zionists, and the Y.M.C.A. have stations on the air, and why should not the anti-vivisectionists, who consider their cause vastly important, be given a wavelength? They would have got one, if they had come a little earlier. Let them divide time with an existing station, it is proposed. But the existing stations are filling their time. If a man or a firm has invested $100,000 in a broadcasting station, taking away some of its time may cut the value of the investment 50 percent, or more. That is confiscation, and not ethics.[139]

That the soon-to-be established Radio Commission would endow large commercial broadcasters not only with de facto private rights to airwaves but would also protect them with monopolistic restrictions (by freezing broadcast band width) was testimony to the broadcasters' perfect understanding of economics and politics, the eagerness of legislators and regulators to channel competitive forces to the political arena in their self-interest, and the willingness of "public interest" agents (antivivisectionist and otherwise) likewise to push the auction process toward the political sphere no matter what its ultimate economic effect on the constituencies they purported to represent. There was little confusion over the role of property rights; the political conflict was in constructing a prevailing "distributional coalition."

The public interest licensing arrangement has not come about due to "simple misunderstandings which are rife in discussion of government policy toward the radio industry."[140] Nor was "The main reason for government regulation of the radio industry . . . to prevent interference."[141] Indeed, as early as 1924, the *American Economic Review* very

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was the de facto result of Hoover's "priority-in-use," *Oak Leaves*' "pioneering," and the FRC's "public interest" standards: the best television assignments were won by the major radio networks (which had, in essence, established a vested right in FCC influence).

[139] Dreher, *supra* note 77.

[140] Coase, *supra* note 7, at 32.

[141] *Id.* at 24.

nicely framed the property rights problem in these words: "Are we not simply dealing with space in a fourth dimension? Having reduced space to private ownership in three dimensions, should we not also leave the wave lengths open to private exploitation, vesting title to the waves according to priority of discovery and occupation?"[142]

The policy pursued by the Commerce Department was then seen for what it was. In the most complete volume dealing with the economics of broadcasting to that time, Hiram Jome's 1925 analysis[143] saw that any spectrum confusion would be ameliorated by either effectively expanding the band width so as to eliminate scarcity, or by rights definition and rational market behavior. "Unless technical advances remedy the situation, the tendency will be for certain broadcasting stations to establish property rights to wave lengths as a protection against interference. In effect, this is what happens when wave lengths are assigned by the licensing authorities."[144]

The interference problem was not a puzzlement to the policymakers of the time. But later analysts would miss the obvious, apparent solution in favor of the theoretically appealing auction model of allocation. "Define and sell" is an analytically satisfying approach to resource allocation problems. It achieves appealing results in terms of both allocation and equity (that is, rents go to the public treasury). Yet it has led even the best economists astray in interpreting the intent and, hence, the actual origins of broadcast regulation in the United States.

In focusing on the idea of auctions, it was not recognized that the first claimants on broadcast spectrum resources were private prospectors whose rights became vested in fact, if not in law, before the government was generally aware of its "inventory." These rights seriously complicated any future auctioning of spectrum as it would upset the quasi-legal arrangements already established. Wave owners did not want the government charging for spectrum that they de facto owned. Significantly, "fiat allocation"[145] was not the initial assignment rule, "priority-in-use" was. Hence, private rights were vested in law and in fact from the earliest days of radio.

Conversely, regulators and legislators did not desire to part with their ownership rights, exercised in the license assignment process, which auc-

[142] William Wallace Childs, Problems in the Radio Industry, 14 Am. Econ. Rev. 520, 522 (1924).

[143] Dr. Jome was professor of economics at Denison University and dedicated his lengthy volume on radio economics to his teacher, Richard T. Ely.

[144] Hiram L. Jome, Economics of the Radio Industry 173 (1925), footnote omitted.

[145] Owen, *supra* note 27, at 36.

tioning would do both legally (claimants could argue that they had established greater rights via their payment for such) and practically (as any pecuniary payment to the treasury for broadcast rights would necessarily lower the intensity of competition for new licenses or renewals). It is only the "public interest" discretion that legislators or regulators may realistically employ to internalize benefits, once we see license fees as common resources owned jointly by government policymakers. Moreover, in proportion to their political strength, agents for organized nonindustry, nongovernmental interests concerned with broadcasting tend to favor the licensing regime as transfers of wealth in terms of political currency. By being endowed with human capital specific to the public regulation process, they acquire rents not available to them in a common law-based regulatory structure for spectrum rights.

The behavior of regulators in this market is far less mysterious, or analytically error prone, than has been previously asserted. When viewed in the context of utility maximization, these actors have pieced together a regulatory apparatus that is entirely consistent. Although the modern interpretation of broadcast regulation has been built upon the view that federal licensing was a faulty allocational policy with unforeseen—and unfortunate—consequences, the construction of public interest licensing distributed property rights to spectrum in a manner in which the important regulatory players were compensated as anticipated. Most compellingly, a common-law solution to the "tragedy of the commons" problem was seen by the creators of the regulatory system as an unsatisfactory alternative, due specifically to its distributional effects. That the political marketplace pointedly vetoed a property rights solution that would bypass regulators and legislators while holding entry open into broadcasting was not a reflection of technical incompetence but of self-interested rationality.

Allocating the Spectrum: The Origins of Radio Regulation

HUGH G. J. AITKEN

Knowledge of the electromagnetic spectrum is just over one hundred years old, if we take Heinrich Hertz's experiments at Karlsruhe in 1887–88 as our point of departure.[1] In the years since then, we have accumulated much information about the spectrum, and in the process the spectrum has become an economic resource. Rights of access to the spectrum, or at least to certain segments of it, are now valuable economic assets.

Introduction: Spectrum Scarcity

One segment of the spectrum has acquired a particular economic significance: this is the radio spectrum, ranging from frequencies of about 20 kHz (kilohertz) at one end to perhaps 300 GHz (gigahertz) at the other.[2] The economic significance arises from the fact that we have learned how to use this particular spectral domain for communication. It is only with reference to this segment of the spectrum that concerns about spectrum scarcity have so far been voiced. As a consequence, it is only with reference to this segment that the question of regulation of access by government has become problematic.

Scarcity is an elusive concept when applied to the radio spectrum. On the one hand, there are ultimate limits set by the laws of physics. Below

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[1]Heinrich Hertz, *Electric Waves, being Researches on the Propagation of Electric Action with Finite Velocity Through Space*, authorized English translation by D. E. Jones (London, 1893); John H. Bryant, *Heinrich Hertz: The Beginning of Microwaves: Discovery of Electromagnetic Waves and Opening of the Electromagnetic Spectrum in the Years 1886–1892* (New York, 1988); and Hugh G. J. Aitken, *Syntony and Spark: The Origins of Radio* (Princeton, N.J., 1985), pp. 48–79.

[2]One hertz equals one cycle per second. One kilohertz (kHz) equals 10^3 cycles per second, one megahertz (MHz) equals 10^6 cycles per second, and one gigahertz (GHz) equals 10^9 cycles per second.

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a certain frequency electromagnetic fields radiate poorly if at all. Above a certain frequency we communicate by infrared or visible light. Within these ultimate limits there are contingent limits set by the state of radio technology at any given time. Technological change, largely in response to the pressure of demand on supply, has typically taken the form of opening up higher and higher frequencies—first the "shortwaves" above 28 MHz, then the VHF and UHF segments, and now microwaves. Spectrum scarcity in that sense has been a recurrent feature of radio history—more urgent at some times than at others, but always present.

There is, on the other hand, another sense in which spectrum scarcity results from human institutions. Here property rights and what Adam Smith called "the disposition to truck, barter, and exchange," rather than the laws of physics or the state of technology, become relevant.[3] Spectrum is scarce in the sense that there is not enough of it to give all potential users all they want at a zero price. There is, therefore, a problem of distribution. Spectrum has to be rationed. Rationing can be accomplished either through markets, with prices serving to indicate which demands are most intense and which resources are most scarce, or through some form of governmental or community-based system of allocation. Most contemporary economists appear to prefer the market solution, believing it to be the more efficient way to allocate scarce resources. Given a functioning market, the argument goes, all those wishing to purchase the resource at the market price, and able to do so, will find their demands satisfied. There will be no excess demand at the prevailing price. There will be no queuing. There will be neither a shortage nor a surplus of the scarce resource.

Where markets are not used and no price is established, other criteria of allocation have to be used, and there will be persons (or firms or government agencies) wishing to acquire units of the resource but not permitted to do so. That is a special kind of scarcity, one that results from the absence of markets, or in other words from human institutions. It must be distinguished from the kind of scarcity discussed earlier, which results from physical or technological limits. Much confusion has resulted from failure to make this distinction. It has been argued, for example, that the Radio Act of 1927, my concern in this article, was passed because an economic problem was mistakenly diagnosed as a technical one.[4] There was, in short, no physical scarcity but only the kind of scarcity that results from the absence of markets. If true, this is a

[3]Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (Oxford, 1904), 1, chap. 2:18.

[4]William H. Meckling, foreword to *A Property System Approach to the Electromagnetic Spectrum*, by Arthur S. De Vany, Ross D. Eckert, Charles J. Myers, Donald J. O'Hara, and Richard C. Scott (San Francisco, 1980), p. xiii.

serious charge, for the Act of 1927 laid the foundations for the system of radio regulation under which we function today. It is disquieting to be told that the regulatory system that governs electronic communications in America had its origins in an error.

Ithiel de Sola Pool argued several years ago that spectrum scarcity, as economists would define the term, arises only because the spectrum is not priced.[5] It has been formally excluded from the market economy, unlike other natural resources. Permission to use the spectrum can be obtained from government authorities in various ways, depending on the regulatory regime in force, and those rights of access—traded in secondary markets—can become very valuable properties. But the spectrum itself has never up to the present time been treated as a commodity, to be bought and sold at a market price.

How did this come about? In most countries, when the value of the radio spectrum became apparent to civil and military authorities, the immediate reaction was to declare that the spectrum was exclusively state property. Access to the spectrum came to be restricted to organizations that were either departments of government or crown corporations. Private parties, whether commercial users or amateurs, obtained rights of access to the spectrum only by permission of these arms of the state.

In the United States the reaction was different. The radio spectrum was considered part of the public domain and therefore the property of all the people. Access to the spectrum was the right of every citizen, as for many years access to the public lands had been. Radio licensing as it existed in the United States up to 1927 was merely a matter of registration. No bureau of government had the authority to deny a license, or in other words to deny a citizen's right of access to the spectrum. Government ownership of the spectrum—"nationalization" of the resource on the British model—was never seriously proposed in the United States except by the Navy Department, and then only on condition that the navy should hold the monopoly.[6]

Some have seen in this contrast between the United States and Europe a reflection of long-standing differences in attitudes toward hunting rights. Gary Libecap, for example, points out that in the United States since colonial times law courts have held that the right to hunt

[5]Ithiel de Sola Pool, *Technologies without Boundaries: On Telecommunications in a Global Age* (Cambridge, Mass., 1990). The point had been made earlier by R. H. Coase in his "The Federal Communications Commission," *Journal of Law and Economics* 2 (October 1959): 1–40.

[6]Compare Ithiel de Sola Pool, *Technologies of Freedom* (Cambridge, Mass., 1983), pp. 108–12; Asa Briggs, *The History of Broadcasting in the United Kingdom*, vol. 1, *The Birth of Broadcasting* (London, 1961). On the position of Josephus Daniels as Secretary of the Navy in the Wilson administration, see Hugh G. J. Aitken, *The Continuous Wave* (Princeton, N.J., 1985), pp. 254, 281–88.

wild animals belongs to all citizens.[7] In Great Britain and elsewhere that right belonged to the crown and the aristocracy. When crude oil was discovered in the United States, the courts transferred to that migratory resource the same common law of capture that had been applied to hunting and fishing. Game and fish were nobody's property until they were caught. When in 1921 the Court of Appeals for the District of Columbia upheld the principle that the Secretary of Commerce had no authority to deny a broadcast license, the court was upholding a law of capture for the radio spectrum.[8] The government could require that broadcast stations be licensed, as hunters were licensed. But it could not, without new legislation, deny a license to any citizen.

The right to deny access to the spectrum first appeared in the Radio Act of 1927—a statute whose importance grows the more it recedes into history. Pool, for example, saw in its passage a major threat to the First Amendment and freedom of speech. On the grounds that spectrum was a scarce resource (an assumption Pool questioned), it imposed a licensing system on the transmission of ideas that had long been abandoned for the print media, "thereby breaching a tradition that went back to John Milton."[9] That raises a host of questions, questions of immense importance in our new "information age." The concern of this article is different, however. The Act of 1927 was passed by Congress in the hope that it would solve what was regarded as a serious problem of interference—of "chaos" on the airwaves, as it was commonly called. I ask to what extent that perceived problem reflected the limitations of radio technology at that time and to what extent it reflected institutional constraints. By "institutional constraints" I mean specifically the absence of formally recognized markets in which rights to spectrum could legally be traded.

A word about terminology is in order here. The Federal Communications Commission (FCC) uses the term "allocation" to refer to the initial partition of the spectrum into large blocks, such as for AM broadcasting, police communications, and so on. The term "assignment" refers to authorization given to a specific station licensee to use specific frequencies or channels within those blocks. In this article, I use "allocation" in the most general sense to refer to the way in which a scarce resource is distributed among alternative uses.

[7]Gary D. Libecap, *Contracting for Property Rights* (Cambridge, Mass., 1989), pp. 19, 76. See also T. A. Lund, *American Wildlife Law* (Berkeley, Calif., 1980); and J. A. Tober, *Who Owns the Wildlife?* (Westport, Conn., 1981).

[8]Philip T. Rosen, *The Modern Stentors: Radio Broadcasters and the Federal Government, 1920–1934* (Westport, Conn., 1980), pp. 53–54; and Jora R. Minasian, "The Political Economy of Broadcasting in the 1920's," *Journal of Law and Economics* 12 (October 1969): 391–403.

[9]Pool, *Technologies of Freedom*, pp. 2–3.

The Spectrum as a Common-Property Resource

Our starting point is the conception of the broadcast spectrum as a common-property resource and therefore as a resource inherently subject to the dangers of overexploitation, overinvestment, and falling yields that have been thoroughly documented with reference to (for example) fisheries, oil reservoirs, and groundwater basins.[10] Such resources have always presented problems of public policy, essentially because users of the resource do not take account of the full social costs of their actions, and consumers do not pay the full price for what they consume. The pursuit of individual self-interest in such circumstances does not lead to a social optimum.[11]

From the earliest days of radio, few doubted that regulation of some kind was called for. The reason was not interference but the safety of ships at sea. Regulation was required in order that standard wavelengths could be designated as calling frequencies or distress frequencies, to ensure that radio stations using different equipment would communicate with each other, and to mandate that all vessels over a certain capacity carried radio equipment and operators. This is the context in which the Berlin Conference of 1906 and the London Conference of 1912 were held. The problem at that time was not congestion or overoccupancy but rather protocols by which radio operators could locate and communicate with each other in what was virtually empty terrain. The spectrum could be a lonely place in those days.[12]

In this context congestion and its major symptom, interference, did not present major issues for public policy. To be sure, there were

[10]The relevant literature is now extensive. For a sample, see Garrett H. Hardin, "The Tragedy of the Commons," *Science* 162 (1968): 1243–48; J. M. Acheson, *The Lobster Gangs of Maine* (Hanover, N.H., 1988); Arthur McEvoy, *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850–1980* (Cambridge, Mass., 1986); D. W. Bromley, ed., *Essays on the Commons* (Madison, Wisc., 1990); S. V. Ciriacy-Wantrup and R. C. Bishop, " 'Common Property' as a Concept in Natural Resource Policy," *Natural Resources Journal* 15 (1975): 713–27; Gary Libecap and S. N. Wiggins, "Contractual Responses to the Common Pool: Prorationing of Crude Oil Production," *American Economic Review* 74 (1984): 87–98; Yoram Barzel, *Economic Analysis of Property Rights* (Cambridge, Mass., 1989); and H. Scott Gordon, "The Economic Theory of a Common-Property Resource: The Fishery," *Journal of Political Economy* 62 (February 1954): 124–42. For a fine discussion of the spectrum as a resource, see Harvey J. Levin, *The Invisible Resource: Use and Regulation of the Radio Spectrum* (Baltimore, 1971).

[11]The classic reference is R. H. Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (October 1960): 1–44. H. Scott Gordon had expressed the central problem succinctly in 1954: "Wealth that is free for all is valued by none because he who is foolhardy enough to wait for its proper time of use will find that it has been taken by another. . . . Common-property natural resources are free goods for the individual and scarce goods for society" (n. 10 above).

[12]James M. Herring and Gerald C. Gross, *Telecommunications: Economics and Regulation* (New York and London, 1936), pp. 359–61.

occasional systemic failures, as during the *Titanic* disaster of April 1912, when scores of stations competed for occupancy of a few frequencies, rendering effective communication very difficult.[13] But, such tragedies aside, it could hardly be said that up to 1912 spectrum congestion presented a major problem. Certainly, the U.S. Congress did not think so. The Radio Act of 1912 was passed only in the aftermath of the *Titanic* disaster and because a statute was required to implement the provisions of the London Wireless Conference of that year.[14] The only users of the spectrum who were disadvantaged by the statute were the amateurs.[15] To other users—the navy and other government agencies, marine operators, and shore stations—this first regulatory statute did not disturb existing rights of access to the spectrum.[16] It moved the amateurs to their private pasture but left other users undisturbed. And it did not grant to the Secretary of Commerce the authority to deny a license to any citizen. The Radio Act of 1912, in short, did not limit access to the spectrum. That was neither its purpose nor its effect.

Nevertheless, this was the only statute governing radio when the broadcast boom began in 1920–21. The Department of Commerce, when Herbert Hoover joined the Harding cabinet, had no powers to regulate radio other than those specified in this act. Nor did anyone believe, before the advent of popular broadcasting, that additional powers were necessary. With the amateurs out of the way, the major source of interference to commercial and government stations had been removed. International conventions, backed up by treaty and implemented by statute law, provided whatever additional coordination was required.

It is true, nevertheless, that even in those days there were signs of difficulties ahead. The number of stations competing for access to the spectrum was increasing. Indeed, one of the effects of the Act of 1912 was to mandate such an increase. And the technical boundaries of the

[13]See Susan Douglas, *Inventing American Broadcasting, 1891–1922* (Baltimore, 1987), pp. 226–39.

[14]The bill (37 Stat. 302), "An Act to Regulate Radio Communication," was actually reported out of committee before the sinking of the *Titanic*, but the disaster undoubtedly helped mobilize the votes necessary for passage. See Marvin R. Bensman, "The Regulation of Radio Broadcasting by the Department of Commerce, 1921–1927" (Ph.D. diss., University of Wisconsin, 1969), pp. 27–28.

[15]Clinton B. DeSoto, *Two Hundred Meters and Down: The Story of Amateur Radio* (West Hartford, Conn., 1936), pp. 30–31.

[16]Technically, the Act of 1912 was a revision of the Wireless Ship Act of 1910 (P.L. 262), which required that after July 1, 1911, all oceangoing vessels carrying fifty or more passengers should be fitted with efficient radio apparatus and be staffed by one skilled operator. See L. S. Howeth, *History of Communications-Electronics in the United States Navy* (Washington, D.C., 1963), pp. 158–60.

spectrum were constraining. The range of frequencies on which a ship station could transmit was effectively set by the physical size of the antenna that could be erected. This meant that ships were limited to frequencies between 667 and 500 kHz (450 and 600 meters, in the parlance of the time).[17] Shore stations did not suffer from that limitation but rather from a limitation of knowledge—in this case knowledge of radio propagation. The conventional wisdom of the age held that only long waves could cover long distances: wavelengths shorter than 250 meters were thought to be essentially useless for commercial work, which is why they were given to the amateurs.[18] The effect was to confine commercial and government use of the spectrum to a narrow segment. This meant a higher probability of interference as stations multiplied.

Compounding the problem was the state of radio technology. Spark transmitters were intrinsically "dirty"; they spread their signals over an unnecessarily wide band of frequencies. The fact that the key tuning patents were claimed by the Marconi Company meant that other transmitters occupied more spectrum than they needed to, and receivers found it difficult to discriminate among them. Amateurs could build their own tuners, ignoring patent rights. Navy and commercial stations could not allow themselves that liberty. Their transmitters were usually coupled directly to the antenna (the major frequency-determining element in the system); their receivers could usually discriminate among stations received only by the tone of their spark. Broadly tuned spark transmitters and unselective receivers were a prescription for interference.

These were, however, diminishing problems, and for this advances in technology were responsible. First, by the end of World War I, radio technology had been revolutionized by the introduction and diffusion of the vacuum tube. Invented by John Ambrose Fleming and Lee De Forest before the war, converted into a truly usable device by Irving Langmuir at General Electric and H. D. Arnold and H. J. van der Bijl at AT&T, and manufactured in large quantities during the war, the vacuum tube made amplification of radio signals possible for the first time and also (in a feedback circuit) the generation of true continuous waves instead of sparks.[19] Second, in the United States, the structure of the industry had been transformed by the formation of the Radio Corporation of America. RCA controlled the key patents on vacuum-tube technology, plus the tuning patents formerly controlled by the Marconi Company. As the chosen instrument of American telecommunications policy, formed with the blessing of the U.S. Navy, RCA brought to the

[17]A useful approximation: to convert kHz into meters, divide into 300,000.

[18]DeSoto, p. 31.

[19]Leonard S. Reich, *The Making of American Industrial Research: Science and Business at GE and Bell, 1876–1926* (Cambridge, Mass., 1985), esp. pp. 163, 208–10.

radio industry a consolidation of interests such as had never existed before.[20]

In this context, prospects for managing the underlying resource without government regulation seemed immeasurably improved. What need for government regulation could there be? Standard frequencies on the marine radio band were now universally accepted. The gradual phasing out of spark sets and their replacement by continuous-wave vacuum-tube transmitters meant that many more stations could now communicate without interference. The availability of more selective and sensitive receivers worked in the same direction. The Act of 1912, providing for registration and licensing of transmitters by the Department of Commerce, provided all the government supervision that appeared necessary. On the very low frequencies—the only ones, according to the wisdom of the day, that could be used for intercontinental transmission—RCA's engineers were already concerned about congestion and warned that there would never be room for more than a score of high-powered stations.[21] But, that did not necessarily require a government agency to assign frequencies or restrict the number of transmitters. RCA and its corporate allies in the United States and abroad were perfectly capable of working out that problem themselves. None of them elected to invite legal complications and political animosity by asserting property rights in the spectrum; none of them felt any need to do so. Secure rights of access were all that was necessary; RCA, backed by corporations that controlled the technology, the research laboratories, and the manufacturing capacity, already had those.

Broadcasting, Congestion, and Interference

What upset these arrangements was the coming of popular broadcasting and with it an explosively increasing number of new users whose appetite for spectrum seemed insatiable.[22] The idea of using radio to

[20]Standard sources on the formation of RCA are Gleason Archer, *History of Radio to 1926* (New York, 1938), and *Big Business and Radio* (New York, 1939); Josephine Case and Everett Case, *Owen D. Young and American Enterprise: A Biography* (Boston, 1982); and Aitken, *Continuous Wave* (n. 6 above).

[21]Ernst F. W. Alexanderson, Alexander E. Reoch, and Charles Taylor, "The Electrical Plant of Transoceanic Radio Telegraphy," *Transactions of the American Institute of Electrical Engineers* 42 (1923): 707–17.

[22]The first broadcast license was issued in September 1921. By March 1922 there were sixty licensed broadcast stations, and by December of that year 576. By February 1927 the total had grown to 733. These figures tell us nothing about increases in average power levels. Hoover estimated that the total power of broadcast stations using 500 watts or more increased by 250 percent between November 1924 and November 1925. See Laurence F. Schmeckebier, *The Federal Radio Commission: Its History, Activities, and Organization* (Washington, D.C., 1932), p. 9. The best recent account of the rise of broadcasting is Douglas (n.

send programs "broadcast" to the general public, rather than from point to point, had played no role at all in the negotiations that led to the consolidation of the post–World War I radio industry. RCA had been formed to serve only two functions: first, to be a radio-operating company for ship and intercontinental traffic; and second, to be a sales agent for radio equipment manufactured by GE, Westinghouse, and Western Electric, the manufacturing arm of AT&T. Similarly, the division of manufacturing rights among the constituent companies had at first seemed simple enough: the "radio group" (GE and Westinghouse) would manufacture receivers and radiotelegraph equipment, Western Electric would be responsible for making radiotelephone transmitters, and AT&T would have a monopoly of radiotelephone service.[23]

Broadcasting made nonsense of these distinctions. Was broadcasting "public telephony for toll"? If so, it was the exclusive province of AT&T, and none of the other companies could use the group's patents in that field. Could Western Electric manufacture receiving sets for use in the home, or was that rich market the exclusive domain of GE and Westinghouse?

We do not need to follow here the complex maneuverings and arbitrations to which these ambiguities led. That story has been told elsewhere.[24] Nor do we need to argue over who was the first true broadcaster—whether De Forest, Reginald Fessenden, Frank Conrad, "Doc" Herrold, or some other. The matter is irrelevant for my purposes. What is of central importance is to recognize that what shattered the carefully built structure of the radio industry in the years immediately after World War I was technological change, specifically, the ability of the vacuum tube to transmit speech and music—plus the ready availability of war-surplus tubes and the knowledge of how to use them that was now widely diffused among radio engineers and amateur radio operators. Once the technical feasibility had been demonstrated, the idea of broadcasting a signal to a multitude of listeners, rather than merely passing traffic from one station to another, was bound to follow.[25]

The advent of the broadcast boom was not accompanied by expansion of the available spectrum. The Department of Commerce at first assigned to broadcast stations only a single frequency—360 meters

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13 above). But see also Erik Barnouw, *A History of Broadcasting in the United States*, vol. 1, *A Tower in Babel* (New York, 1966); and Rosen (n. 8 above).

[23]For the arrangements, see Aitken, *Continuous Wave*, pp. 432–513; and Barnouw, 1:59–61, 72–74, 81–83.

[24]See Aitken, *Continuous Wave*, pp. 432–513; and Archer, *Big Business and Radio*, passim.

[25]This is not to minimize the importance of broadcasting as a *social* innovation. On the social construction of American broadcasting, see Douglas (n. 13 above).

(833.3 kHz)—far enough from the amateur band and from customary ship frequencies to avoid interference with those services.[26] But, restriction to a single frequency, when the demand for spectrum was increasing exponentially, was a guarantee of conflict. Other frequencies were made available as time passed, culminating in 1923 in the release for broadcast use of the entire 500–1,500 kHz band, over the strenuous objections of the U.S. Navy.[27] But the number of broadcast stations multiplied faster than the number of available channels, and the potential for interference grew apace.[28]

Statistics of the total number of broadcast stations do not fully disclose the growing potential for interference, since average power levels were rising. Of the fifty-five licensed stations existing in March 1922, few if any exceeded 250 watts of output.[29] When the so-called Class B stations were authorized in August 1922 and given preferred frequencies, they were required to operate at no less than 500 watts of power and no more than 1,000.[30] By the time of the Third Radio Conference in 1924, however, Hoover could report that at least two stations were contemplating using up to 5,000 watts; and David Sarnoff confidently stated that RCA's new "superpower" station would transmit at up to 50,000 watts, "if no regulatory proposals are adopted that would limit

[26]A second frequency was made available for the broadcasting of government bulletins, weather and crop reports, etc.

[27]See Howeth (n. 16 above), pp. 383, 398, and 406. The navy had previously used this band for fleet tactical communications. These frequencies are still the core of the American AM broadcast band today.

[28]Department of Commerce policies during this period have been analyzed in two doctoral dissertations on which I have drawn heavily for references: Glenn A. Johnson, "Secretary of Commerce Herbert C. Hoover: The First Regulator of American Broadcasting, 1921–1928" (Ph. D. diss., University of Iowa, 1970); and Bensman, "Regulation" (n. 14 above). See also Donald G. Godfrey, "The 1927 Radio Act: People and Politics," *Journalism History* 4, no. 3 (Autumn 1977): 74–78; Marvin R. Bensman, "The Zenith-WJAZ Case and the Chaos of 1926–27," *Journal of Broadcasting* 14, no. 4 (Fall 1970): 423–40; George H. Gibson, *Public Broadcasting: The Role of the Federal Government, 1912–76* (New York, 1977); Daniel E. Garvey, "Secretary Hoover and the Quest for Broadcast Regulation," *Journalism History* 3, no. 3 (Autumn 1976): 66–85; Robert W. McChesney, *Telecommunications, Mass Media, and Democracy: The Battle for the Control of U.S. Broadcasting, 1928–1935* (New York, 1993); and Thomas W. Hazlett, "The Rationality of U.S. Regulation of the Broadcast Spectrum," *Journal of Law and Economics* 33, no. 1 (April 1990): 133–75.

[29]Statistics for the number of licensed broadcast stations vary widely. The figure in the text is from D. B. Carson to Herbert Hoover, March 2, 1922, cited in Johnson, p. 88; but compare the totals in Hiram L. Jome, *Economics of the Radio Industry* (Chicago, 1925), p. 70, reprinted in Hazlett, p. 138.

[30]Johnson, p. 101. It is often unclear whether the figure quoted refers to the power input to the transmitter or to the transmitter's power output to the antenna. The relationship between the two figures varied, depending on the efficiency of the tubes and associated circuitry.

the art."[31] This was no idle boast: General Electric's Schenectady station, WGY, had already boosted its power to 50,000 watts, on an experimental basis, in August 1924. In December 1925, RCA's new station, WJZ, at Bound Brook, New Jersey, was authorized to transmit on a regular basis with 50,000 watts.

Not all stations, of course, tried to attain such power levels or could afford to do so. Some stations were and remained little more than amateur transmitters, using low power, relying on phonograph records for program material, and transmitting on "ghetto frequencies." But others were highly sophisticated in a technical sense; well-funded by the radio manufacturers, newspapers, or department stores with which they were associated; and transmitting on clear channels allocated to them by the Department of Commerce. As sponsored advertising grew in importance, there was no argument about which type of station could most effectively deliver listeners to advertisers. The result was increasing differentiation of firms within the industry: those with preferred channels and sophisticated station equipment had a clear interest in restricting the entry of new stations and, indeed, in opposing any expansion of the broadcast band.

Increases in output power of this magnitude had several consequences. First, they extended the range and therefore the market coverage of the more powerful stations. At lower power levels the Department of Commerce could safely allocate the same frequency to stations that were geographically distant from each other. Now that strategy became more difficult, and as a result the competition for clear channels became more intense. Second, higher power levels increased the stratification in the industry. Corporate leaders like Sarnoff were clear about their intention to build stations whose transmissions would blanket, not just a metropolitan area or a section of a state, but whole regions of the country.[32] This put intense pressure on the smaller stations, which had previously survived by serving a limited area. Sponsors preferred stations with wider geographic coverage; and listeners preferred the more expensive program material that superstations

[31]Ibid., p. 164, citing the minutes of sub-committee no. 3 of the third National Radio Conference, October 6–10, 1924.

[32]Readers should bear in mind that in this period network or chain broadcasting was in its infancy. AT&T experimentally linked several stations together in the summer of 1923, using WEAF as the station of origin; and in December of that year six stations were interconnected to carry President Coolidge's first message to Congress. But the National Broadcasting Company, the first company formed solely to conduct chain broadcasting, was not chartered until 1927. The delay may have been partly due to uncertainty over whether the telephone wires that would be used to interconnect stations had the bandwidth to carry music without distortion. On network broadcasting, see Rosen (n. 8 above), esp. chaps. 7, 8, and 9.

could afford to buy. Third, and most obviously, higher power meant more interference.

Broadcast stations differed not only in their output power but also in their frequency stability. It was all very well for the Commerce Department to assign a station to a certain frequency, but not all stations had the technical capability to maintain that frequency, and not all cared much whether they did or not. In his *Memoirs*, Hoover cites the case of a Los Angeles station owned by the evangelist Aimée Semple McPherson which was notorious for wandering from one end of the broadcast band to the other. After repeated warnings, an inspector from the Commerce Department sealed the station and put it off the air. McPherson's reaction was indignant: she fired off a telegram to Hoover which referred to the department's agents as "minions of Satan" and continued, "You cannot expect the Almighty to abide by your wavelength nonsense. When I offer my prayers to Him I must fit into his wave reception. Open this station at once."[33]

The case was perhaps extreme, but the problem was not unusual. Frequency stability depended on the tuned circuits of the transmitter; even if at first adjusted to the correct parameters, these changed with changes in temperature and humidity. Not all stations possessed calibrated wavemeters, nor engineers skilled in their use. In May 1923, for example, the Ford Motor Company station in Dearborn, Michigan, was found to be without any means of checking its own frequency.[34] The fact of the matter was that, in the absence of close monitoring and vigorous enforcement by the Department of Commerce, the matter was not of great significance to many station owners. No station had its license suspended or revoked for departing from its assigned frequency.[35]

The problem of frequency stability was eased, in principle if not often in practice, by the introduction of crystal control. Developed by Bell Laboratories and Westinghouse, working in cooperation with the Commerce Department's Bureau of Standards, this innovation depended on the properties of piezoelectric quartz crystals which, when inserted into an oscillating circuit, made possible control of frequency with a precision never possible before.[36] But, crystal control of transmitter frequency

[33]Herbert Hoover, *Memoirs*, vol. 2, *The Cabinet and the Presidency, 1920–1933* (New York, 1951–52), pp. 142–43; see also Johnson, p. 222.

[34]Bensman, "Regulation" (n. 14 above), p. 166.

[35]Ibid.

[36]Crystals are still used for this purpose in many items of consumer electronics, though most users are unaware of their existence. Every personal computer and color TV set, for example, depends on a crystal oscillator to control its internal clock. For information on the origins of the innovation, see M. D. Fagen, ed., *A History of Engineering and Science in the Bell System: The Early Years (1875–1925)* (Murray Hill, N.J., 1975), pp. 318, 988; Johnson (n. 28 above), p. 60. The Bureau of Standards began transmitting standard frequency signals

was not without problems of its own—crystals sometimes jumped in frequency for reasons inexplicable at the time—and their use was the exception rather than the rule through the 1920s.[37] Most stations seem to have relied on simple tuned circuits—coils and capacitors—to set their frequencies, and the radio inspectors of the Department of Commerce had no authority to impose sanctions on those who drifted off frequency.

It would be a mistake, however, to blame interference solely on the increasing numbers of broadcast stations and their technical deficiencies. Some of the worst interference came from the navy's high-powered arc transmitters—notorious for generating harmonics—and on navy and coast guard spark sets, particularly on the East Coast and around the Great Lakes. Amateur stations got much of the blame, and probably contributed to the problem, but government stations were prime offenders. Nor was it solely a question of the design and operation of transmitters. Receivers also added to the problem. The typical receiver in the early years of the broadcast boom was the crystal set, broadly tuned and lacking selectivity. When vacuum tubes came into wider use, the single-tube regenerative receiver became popular. These relied on a feedback circuit to build up the strength of the received signal and when properly tuned were remarkably effective. The trouble was that maximum amplification was achieved when the set was just on the verge of oscillation, and it was very easy to turn the regeneration control just a bit too far. When that happened, the regenerative receiver became a miniature transmitter and could wipe out reception over a sizable area.[38] Edwin Armstrong's superheterodyne receiver, developed in 1918–19, became available commercially in 1924 and offered the prospect of vastly improved sensitivity and selectivity.[39] But superhets were expensive, the early models were tricky to operate, and the vast majority of the

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in 1923. See Rexmond C. Cochrane, *Measures for Progress: A History of the National Bureau of Standards* (New York, 1951).

[37]Bensman, "Regulation," p. 257.

[38]As an example, the first tests of amateur transatlantic radio communications were a dismal failure, largely because the 250 or so British stations listening for prearranged signals from the United States jammed each other so badly with their regenerative receivers that they could hear nothing from North America. A second series of tests in December 1921, using a superheterodyne receiver, was successful.

[39]On the invention of the superheterodyne receiver, see the articles in *Proceedings of the Radio Club of America*, vol. 64, no. 3 (November 1990), "The Legacies of Edwin Howard Armstrong." Plans and kits for building superhets were available from 1922 on, but only RCA could legally build them. Its Radiola superheterodyne receiver was first marketed in 1924. See Alan Douglas, *Radio Manufacturers of the 1920s* (New York, 1988), 1:xiii. On the problems raised by multiple-tuned circuits, see Arthur P. Harrison, Jr., "Single-Circuit Tuning: An Analysis of an Innovation," *Technology and Culture* 20 (April 1979): 296–321.

listening public continued to make do with simpler apparatuses. The majority of receivers in use as late as 1925 were probably "home brew" rather than commercial models. Informed observers at the time were well aware that much of the responsibility for interference could be ascribed to the large consumer inventory of primitive receivers; but until superhets fell in price, there was not much that either leaders of the industry or government bureaucrats could do about that aspect of the problem.

One could argue, therefore, that increases in transmitter power and weaknesses in transmitter and receiver design were primarily responsible for the interference problem throughout the 1920s. If so, the problem would be properly characterized as a technological one, rather than a political or institutional one. Unfortunately, this argument is incomplete. Technological deficiencies in transmitters and receivers undoubtedly aggravated the problem, but technological advance alone would not have solved it. Equally important was the fact that access to a common-property resource was not institutionally constrained. There were too many beasts foraging in the pasture.

Licensing and Control of Access

That there were too many stations competing for access to the "ether" was obvious to everyone at the time. Why then did the responsible agency, the Department of Commerce, not limit access to the broadcast spectrum? The answer is twofold. In the first place, although Hoover very early in his term as Secretary of Commerce recognized in principle the need to limit the number of broadcast licenses, in practice he had scruples about doing so. To grant access to some but deny it to others was in his opinion the same thing as creating monopoly rights in a national resource. "You will recognize," he told the *New York World* in 1924, "that if anybody should be able to have the exclusive use of a certain wavelength, he would have a monopoly on that part of the ether. That cannot be permitted."[40] Even more explicitly, he informed the *Cleveland Plain Dealer* in 1925 that "if we limit the number [of broadcast stations], the possession of a license becomes commercially valuable, and in a sense, a monopoly."[41] These, of course, were statements for public consumption, echoing standard populist and progressive leitmotivs. Within the Department of Commerce, Hoover's legal and technical advisers knew very well that limitations on the number of stations and strict enforcement of frequency assignments were the only feasible

[40] "The Government's Duty to Keep the Ether Open and Free for All," interview with the *New York World* (March 16, 1924), cited by Bensman, "Regulation," p. 234.

[41] "Hoover Battles to Block Special Privilege in Radio," interview with the *Cleveland Plain Dealer* (May 28, 1925), cited by Bensman, "Regulation," p. 236.

answers to broadcast interference. But, here the second reason for inaction became relevant: the department's legal authority to deny anyone a broadcast license was highly questionable. Only slightly less questionable was its authority to set and enforce frequency assignments.

Hoover had been warned by his staff that his discretionary authority over radio was minimal. In March 1921, for example, his Commissioner of Navigation told the new Secretary of Commerce that his powers with regard to radio were "scarcely more than ministerial."[42] As Stephen B. Davis, chief legal adviser to the Department of Commerce after 1923 later noted, the matter had basically been settled when the Act of 1912 was passed. The Committee on Merchant Marine and Fisheries, responsible for radio matters at that time, had assured the full House that the bill "does not give the head of that Department [of Commerce and Labor] discretionary power over the issue of the license."[43] And the Senate Committee on Commerce had made it explicit that the failure of the bill to grant discretionary authority to the secretary was no oversight. Former bills, the committee noted, had delegated to the President and to the Secretary of Commerce the power to make regulations governing radio which would have the force of law. "That amounted practically, at least in the judgment of some members of this committee, to the surrender by Congress of its powers and the bestowal of legislative power to all intents and purposes upon administrative officers."[44] The statute of 1912 was framed so as to avoid that grievous error: it embodied nineteen regulations and made no provision for the promulgation of more without the explicit consent of Congress.

If any doubts remained as to the secretary's inability to regulate radio beyond the explicit provisions of the Act of 1912, they were dissipated by two legal decisions: the *Intercity* case of 1921–23 and the *Zenith* case of 1926. These have been so thoroughly analyzed by legal scholars and radio historians that they now resemble a thrice-squeezed orange. But perhaps they can still yield some drops of information.

The *Intercity* case had, at first, little to do with broadcasting. The Intercity Radio Company, founded and run by Emil Simon, had a contract with the Hearst newspapers to provide a direct news feed from Telefunken in Germany—one that would be independent of the Reuters-Marconi-RCA system. With that in mind, Intercity Radio in December 1920 built a high-powered radiotelegraph station and sited it in lower Manhattan. From there it communicated in Morse code with

[42]E. T. Chamberlin to Hoover, memorandum, March 17, 1921, cited in Johnson (n. 28 above), p. 63.

[43]Stephen B. Davis, *The Law of Radio Communication* (New York, 1927), p. 36.

[44]Ibid., p. 35, citing Report on Bill 698 to accompany S. 6412, 62d Cong., 2d sess., pp. 7–8.

Telefunken stations in Germany and, overland, with other Intercity stations in Detroit, Cleveland, and Chicago.[45]

A more unsuitable location for a high-powered radiotelegraph transmitter would be hard to imagine. When the Intercity station was on the air it completely wiped out radio reception in most of the New York metropolitan area—including, by an unhappy coincidence, a receiving station operated by the *New York Times* only 400 yards away, a U.S. Navy marine communications facility, and, of course, a large number of privately owned broadcast receivers. But was Intercity doing anything illegal? Construction permits were not required in those days. The company had a valid license. Intercity had as much right to use the radio spectrum as anyone else. And Simon, backed by Hearst with his well-known antipathy to eastern capital and Washington bureaucrats, was not one to back down meekly.

Despite numerous complaints, the Commerce Department moved cautiously. In May 1921 it revoked Intercity's license on the grounds that it was interfering with ship-to-shore traffic. Intercity went to court, and after sundry legal maneuvers the case ended up in the Court of Appeals for the District of Columbia Circuit.[46] There, on November 17, 1921, the department was ordered to issue a license to Intercity on the grounds that the Act of 1912 gave the Secretary of Commerce no discretionary power to refuse a license. At Hoover's request the Justice Department moved to appeal the decision, and a writ of error to the Supreme Court was allowed. In the meantime, however, Intercity went into bankruptcy, and in September 1924 the case became moot and was dismissed.[47]

There was never any doubt about what the central issue was. Could the Secretary of Commerce read implied powers into the Act of 1912, or was he restricted to the nineteen regulations explicitly spelled out in that statute? The fact that the case was finally declared moot clouded the issue somewhat and enabled the department to continue a semblance of control over licensing. But after *Intercity,* no one concerned with broadcasting could have been unaware that the legal underpinnings for Department of Commerce policy were decidedly shaky.

The *Intercity* decision called into serious question whether the Commerce Department had the power to deny a radio license. It did not question, however, the department's power to assign a wavelength or to define the hours during which a transmitter might be on the air. Indeed, a layman's reading of the statute might suggest that these powers were

[45]Research has not disclosed what type of transmitter Intercity used, but one suspects either an arc or a quenched spark.

[46]Court of Appeals, District of Columbia Circuit, November 23, 1921 (not reported), and *Hoover v. Intercity Radio Company,* 286 Fed. 1003.

[47]266 U.S. 636.

expressly provided. Did not Section 2 declare that the Secretary of Commerce "shall state the wave length or wave lengths authorized for use by the station for the prevention of interference and the hours for which the station is licensed to work"? Relying on these powers, which *Intercity* left intact, the department from 1921 to 1926 did assign a wavelength when it issued a broadcast license, and it did limit hours of operation. Without this exercise of authority, the problems of spectrum congestion and interference would have been much worse than they were. The department might not legally be able to limit the number of beasts grazing in the pasture, but it could assign them specific locations, and it could limit their appetites.

The *Zenith* decision eliminated even these powers.[48] The case began quietly enough. The Zenith Radio Corporation, headed by Eugene F. McDonald, owned and operated station WJAZ, located at the Edgewater Beach Hotel outside Chicago. In May 1924 the station was sold to WGN, owned by the *Chicago Tribune*, but McDonald asked for and received permission to retain the WJAZ call letters for a new station that he planned to build. He was warned, however, that all the available frequencies were already assigned and that he would have to make arrangements to share time with other stations. McDonald raised no objection and asked for a wavelength of 322.4 meters. Notified by the department that this would bring him too close in frequency to WSAI in Cincinnati and KOA in Denver, he gave assurances that this would cause no problem, as the Zenith station intended to operate only between 10:00 P.M. and midnight on selected nights. "Our station," he wrote, "is constructed with the sole purpose of giving to the public the highest form of entertainment in but a limited time. We have felt that to do this, sufficient high class talent could not be secured throughout the year for more than two hours per week."[49]

McDonald was at this time president of the National Association of Broadcasters and had already made known his views on broadcast policy. While professing unbounded admiration for Hoover personally, McDonald's preference was for the establishment of a regulatory commission that would have the authority to limit entry into the industry.[50] Like most established broadcasters, he saw little to be gained by unrestricted licensing of new stations. This was also the position endorsed in November 1925 by the Fourth Radio Conference which, for the same reasons, opposed any expansion of the broadcast band.

[48] *United States v. Zenith Radio Corporation*, 12 Fed. 2d ser. 614.

[49] Eugene F. McDonald to Stephen B. Davis, June 26, 1925, cited in Bensman, "Regulation" (n. 14 above), p. 310.

[50] Eugene F. McDonald, "The March of Radio: Hoover's Suggestions for New Radio Legislation," *Radio Broadcast* 7 (March 1925): 890–92, cited in Bensman, "Regulation," p. 230, and Johnson (n. 28 above), p. 171.

The legal staff at the Commerce Department may well have wondered whether McDonald's aspirations were as modest as they at first appeared. If so, they did not have to wonder for long. McDonald's request for limited hours was cleared with the General Electric Company, owner of KOA, and with the U.S. Playing Card Company, owner of WSAI. Neither raised any objections, provided that the new station caused no interference and was on the air for only the two hours that had been requested. Accordingly, on July 22, 1925, McDonald received the license he had asked for, authorizing the station to broadcast on a wavelength of 322.4 meters (930 kHz) for the two hours each week that he had specified.

Up to this point McDonald had received all that he had asked for. Shortly before or after the issuance of the license, however, part ownership in station WJAZ was sold to the *Chicago Herald Examiner.* The tone of exchanges with the Department of Commerce now altered remarkably. There was no more talk of giving the public "the highest form of entertainment" for only two hours a week. Now it was a question of being treated on a par with other powerful stations and other important newspapers. As McDonald wrote to Davis, solicitor to the department, "We divide [our] wavelength with the Denver station, K.O.A., and consider the division of time inequitable, as we have only two hours per week for our share. In other words, Denver has one hundred and sixty-four hours of the week and we are allowed only two hours. The Chicago Daily News, the Chicago Evening Post, and the Chicago Tribune, each receive on their respective wavelengths eighty-four hours per week, and in addition to this the Chicago Tribune, through its subsidiary, the Liberty Magazine, also enjoys two additional wavelengths. It is obvious that we cannot adequately serve the public in two hours per week."[51]

It is tempting to speculate that the entry of a major newspaper as an important stakeholder had changed the rules of the game and, in the process, McDonald's idea of public service. "Serving the public" was now defined, not as delivering high-quality programming to listeners, but as delivering the largest possible number of listeners to advertisers. This may indeed be true; but it is not inconsistent to suggest that McDonald had his own agenda, which was to challenge the department's authority to assign wavelengths, undercut the quasi-legal structure of regulation that Hoover had created, and thereby strengthen the drive for legislation.[52] McDonald's next move was certainly one that the department could not ignore.

[51]Eugene F. McDonald to Stephen Davis, November 12, 1925, cited in Bensman, "The Zenith-WJAZ Case" (n. 28 above), pp. 423–40.

[52]Rosen (n. 8 above) appears to regard this as self-evident and compares McDonald to Swift, Armour, Insull, and other Chicago-based firms that "rebelled in order to bring about government regulation for their corporations" (pp. 93–94).

Radio waves show no respect for international boundaries. Much of southern Canada, then as now, was within easy range of U.S. broadcast stations. To save the bulk of the Canadian population from being swamped by American broadcasts, nine of the available frequencies in the broadcast band had been set aside for the exclusive use of Canadian stations, leaving some eighty-nine for the United States. No treaty, convention, or other formal agreement mandated this arrangement; it was no more than an understanding, observed up to this point by both countries. As such, it provided an ideal opportunity for McDonald to test the Commerce Department's position.

In early January 1926 WJAZ shifted its frequency to 329.5 meters (910 kHz), a frequency then in use by seven stations in Canada. This move could not be overlooked, since diplomatic sensitivities were involved, and on January 14, 1926, the U.S. Attorney in Chicago was instructed to begin a vigorous prosecution. The decision in the case was rendered on April 16. It went far beyond *Intercity* in circumscribing the powers of the Department of Commerce.

The decision turned not on the facts of the case, which were undisputed, but on interpretation of the Act of 1912, and particularly on differences in the language in Section 2 and that in Section 4 of the statute. Section 2 described the licensing authority granted to the Secretary of Commerce in rather general terms, although it did specify that each license granted should state "the wave length or wave lengths authorized for use by the station to prevent interference." Section 4, however, enumerated nineteen specific regulations to be enforced by the Secretary of Commerce. These included limits on the frequencies to be used and restrictions on hours of operation if commercial stations caused interference to naval or military installations. But it did not specifically empower the secretary to assign a particular frequency to a particular station, nor to designate its permitted hours of operation. And, most significantly, neither in Section 4 nor anywhere else in the statute was the secretary empowered to issue additional regulations.

The question, as posed by the presiding judge, was whether the specific regulations of Section 4 supervened the general regulatory authority implied in Section 2. And he decided that they did. The logic was simple. If Congress had intended to delegate general regulatory power to the Secretary of Commerce, then the statute was unconstitutional, since Congress could not delegate lawmaking authority to an officer of the executive branch without defining the test or standard intended to control the discretion of that officer. This the Act of 1912 had not done. The governing rubric was that, in considering an act of Congress, a construction that might render it unconstitutional, or even raise grave doubts as to its constitutionality, was to be avoided. There-

fore, the Act of 1912 should be read as stating that the Secretary of Commerce had the powers enumerated in Section 4, and only those powers.

A formalist interpretation such as this may strike us today as somewhat antique. It was less so in 1926. There was no hint in the court's ruling that the Department of Commerce might properly act under powers implied by the act, though not explicitly stated in it. There was no exercise of creative jurisprudence to interpret the law in such a way as to make it relevant to circumstances quite different from those in which it had been passed. There was, indeed, no attempt to get at the original intent of the legislators, which (one might plausibly argue) had been to give to the Secretary of Commerce the licensing powers necessary for orderly use of the spectrum. Other courts might have ruled differently; but to speculate along those lines would be to exceed acceptable limits for hypothetical history.

Hoover did not appeal the verdict. In fact, for two-and-a-half months after the Zenith decision he did very little about broadcasting, beyond warning that, if stations were free to select their own frequencies, the outcome would be "utter chaos." When in July 1926 he did move, it was to secure from the acting Attorney General an opinion that in all essentials confirmed the ruling of the Chicago court.[53] True, the Commerce Department did appeal to broadcasters not to move from their assigned frequencies. Statistics were collected which sometimes suggested that only a few stations were "jumping frequency," sometimes that many were. And Hoover did encourage station owners to test their common-law rights in court, if other stations encroached on their normal frequencies. But there were no new initiatives, no attempt to elicit some form of self-regulation from the industry. Every year since the broadcast boom began, Hoover had convened a Washington Radio Conference to debate the problems facing the industry and suggest remedial action; but not this year.

The most plausible explanation for Hoover's inactivity is that he intended to put pressure on Congress. Two bills to regulate radio broadcasting were before Congress at this time, one in the House, the other in the Senate. This was no new thing: some thirty radio bills had been introduced in Congress since the end of World War I, and none had become law. Radio interference, it had become evident, was something congressmen might deplore but not something on which they were in any hurry to legislate. And as long as Hoover's quasi-legal assignment of frequencies seemed to be working, as long as station

[53]Opinions of the Attorney General, vol. 35, no. 126 (1926), as cited in Coase, "Federal Communications Commission" (n. 5 above), p. 5, n. 10.

owners could and would negotiate time-sharing agreements among themselves, legislation had not seemed urgent.

Hoover's intention now was to convey that sense of urgency, and the *Zenith* decision gave him the ideal opportunity. He had his preferences about the kind of legislation he wanted. Unlike McDonald and the National Association of Broadcasters, who sought an independent commission, Hoover preferred to retain authority within the Department of Commerce with an appointed commission serving as a form of appeals court. In this he had the support of President Coolidge, who had no liking for independent commissions, and of Representative Wallace White of Maine, who with remarkable pertinacity had been introducing radio bills in the House regularly since 1921.[54] But Senator Clarence Dill from the state of Washington, who was the key figure in the upper House on radio matters, preferred an independent commission. Congressional compromise eventually produced the Radio Act of 1927 and the Federal Radio Commission. Most people regarded the statute as progressive legislation: it brought order to the airwaves; it preserved the ether as, in principle, a public domain; and it promised to prevent a "monopoly in the air" by RCA and the other major radio corporations.[55] It can hardly be said, however, that Congress showed much enthusiasm for the new enterprise or viewed it as a permanent solution. The commission was originally established for one year only, and no funds were appropriated for its support.

The Act of 1927: Alternative Interpretations

The term "chaos" is frequently used to describe conditions in American radio broadcasting between the *Zenith* decision and passage of the Act of 1927. Hoover used the word, and it has become part of the classic rationale for government regulation. It may not be entirely appropriate. Certainly, it is true that, within this brief period, many stations changed frequencies. Others increased their power. And more than two hundred new stations began broadcasting.[56] But it is not self-evident that these trends would have continued. Removal of bureaucratic controls over entry was certain to cause transitional difficulties. The question is whether firms in the industry could have settled down to a reasonably stable accommodation, without the imposition of government control.

[54]For Coolidge's attitude toward independent commissions, see Johnson (n. 28 above), p. 205.

[55]McChesney (n. 28 above), p. 17.

[56]Stephen B. Davis, "The Law of the Air," chap. 5 in *The Radio Industry: The Story of Its Development*, by the Harvard Business School (Chicago, 1928), p. 169.

The answer to this question depends on the interpretation of the events leading up to the Act of 1927. There are three main lines of interpretation. The first is the traditional view and has been referred to as the "chaos theory"; it rests essentially on a scarcity argument, in the sense of physical scarcity. There were not enough wavelengths in the broadcast band to accommodate all the stations that wished to broadcast, without a level of interference which was intolerable and which created, in effect, chaos on the airwaves.[57] Interference was caused by the unrestricted entry of new firms into the industry, together with increases in power by established firms, and could be eliminated only by government intervention. This view, reflected in Supreme Court decisions, finds support in the recent literature on common-property resources.[58] Interference was a symptom of the overexploitation that results from open access; overexploitation sharply reduces the value of the resource and dissipates the rents of those using it. Absent some form of self-regulation, the remedy is to be found in the imposition of superior authority—Hobbes's Leviathan, if you will—with power to control access.

The second interpretation is commonly associated with the name of Pool, but its analytic foundations are to be found in earlier work by Ronald Coase and before him Leo Hertzel.[59] This view holds that scarcity by no means implies government control over access. If the broadcast spectrum was an overexploited resource, the reason was that the resource was not priced. Instead, it was made available without cost to all applicants. In those circumstances, the semblance of scarcity was inevitable. There was not enough to satisfy all potential users when the price was zero. The fundamental problem, then, was not scarcity in any absolute sense but an institutional defect: the absence of defined property rights and of a market in which those rights could be freely traded. The Act of 1927, in short, was passed as a result of error: an institutional limitation was mistaken for a physical one.[60]

This second line of interpretation, though attractive to many economists, has not gone unchallenged. Its basic assumptions are that no market in spectrum rights existed in the 1920s, that spectrum rights

[57]Compare *National Broadcasting Company Inc. v. United States,* 319 U.S. 190 (1949), pp. 212–13, and *Red Lion Broadcasting Company Inc. v. Federal Communications Commission,* 395 U.S. 367 (1969), p. 380.

[58]See the works cited in n. 10 above.

[59]See the references cited in n. 5 above, and Leo Hertzel, " 'Public Interest' and the Market in Color Television Regulation," *University of Chicago Law Review* 18 (1951): 802–9.

[60]Compare Meckling (n. 4 above), p. xiii. Meckling, like Pool, raises the fundamental question "why political democracy has created and perpetuated a system of rights that is not only grossly inefficient but also presents a real threat to freedom of speech."

were not priced, and that passage of the Act of 1927 was irrational, in the sense that participants would have been better off under some alternative arrangement, such as a spectrum auction.

These assumptions have been sharply questioned by Thomas W. Hazlett.[61] Passage of the 1927 act, he argues, was not the result of error; on the contrary, the statute yielded an equilibrium political solution, in the sense that each of the influential parties received a share of the rents created in proportion to their political influence. All major players ended up better off than they would have been under alternative nonlicensing arrangements.[62]

If the major participants were the regulating agency, members of the House of Representatives and the Senate, and the established firms in the broadcast industry, the logic of the argument is clear. The broadcast industry got what its leading members had long desired: free access to a public resource, plus restrictions on the entry of new firms, enforced by an agency with undisputed legal authority. For the more heavily capitalized and technically sophisticated broadcasters, regulation was a blessing, confirming their de facto property rights in the spectrum and establishing a mechanism by which those rights could be protected.[63]

Political decision makers received their rents in a different currency: the ability to influence the allocation and renewal of licenses and, indirectly, the programming decisions of broadcasters. Hazlett cites with approval the authoritative history of the Federal Radio Commission to the effect that "probably no quasijudicial body was ever subject to so much Congressional pressure as the Federal Radio Commission."[64]

The third major participant was the regulatory authority. Hoover suffered a minor setback with passage of the Senate version of the bill, but this was of territorial significance only. A regulatory body was created which rapidly acquired its own vested interest in survival and expansion—in the protection and enhancement of its budget and in the enlargement of the powers of its staff. So in this sphere too rents were created, in the appropriate currency, that would never have come into existence had rights of access to the spectrum been bought and sold in a market.

[61]Hazlett (n. 28 above).

[62]Ibid., p. 168.

[63]Compare the argument in George Stigler, "The Theory of Economic Regulation," *Bell Journal of Economics and Management Science* 2, no. 1 (Spring 1971): 3–21. Stigler argues that regulation is typically not forced on an industry but is actively sought by it. Regulation is a service that industries demand and the political process supplies. See also Harvey Levin, "Federal Control of Entry in the Broadcast Industry," *Journal of Law and Economics* 5 (October 1962): 49–67.

[64]Schmeckebier (n. 22 above), p. 55. Compare Barnouw, *Tower in Babel* (n. 22 above), pp. 211–19.

Such an interpretation must please those who like to identify the rational component in human behavior. But does it tell us much about the thinking of those involved? Was regulation imposed in order to prevent the emergence of a market in spectrum rights? Was such a market a realistic alternative to regulation? The rhetoric of the time suggests otherwise. Members of the Senate were not the only ones to state eloquently that the airwaves were a national resource and that the ether belonged to all the people. Broadcast licenses issued by the Department of Commerce were for terms of only three months, specifically in order that no vested rights in the ether might be created. Hoover compared radio channels to channels of navigation, which should be open to all and not the property of a few. The standard view, espoused both by the regulating agency and by political representatives, was that, as a matter of law, no ownership rights in the spectrum could exist. And where no property rights exist there can be no market.

And yet broadcast stations were bought and sold, at prices that reflected the market value not just of their buildings and equipment but also of their frequency assignments, power levels, and authorized hours of operation. And this has continued to the present day. Pool faulted policy makers in the 1920s and 1930s for overlooking the market option. But he also recognized that the absence of a market is an illusion: "In fact . . . there is a market in spectrum. . . . The government initially gives away licenses for free; these are then sold in a second hand market. What is excluded from market allocation is only the initial grant of a frequency by the government to its first owner."[65] Today, as in the 1920s, the regulatory authority must approve license renewals and license transfers, and this introduces some small uncertainty into the transaction. But in the overwhelming majority of cases, renewals and transfers are routine. As the solicitor general of the Commerce Department told Congress in 1926, "We recognize the purchaser as stepping into the shoes of the licensee."[66] The clearest example was the purchase by RCA of AT&T's New York station, WEAF, in September 1926. The purchase price was $1 million, of which only $200,000 was for physical facilities; the larger portion was for the clear channel frequency assignment.[67] Smaller-scale transactions of the same nature were common, as were cash purchases of broadcast time from other stations sharing the same frequency.

[65]Pool, *Technologies of Freedom* (n. 6 above), pp. 133, 137.

[66]*Radio Control: Hearings before the Committee on Interstate Commerce*, U.S. Senate, 69th Cong., 1st sess. (1926), pp. 118–19, cited by Hazlett, p. 144. More formally, the position of the Department of Commerce was that "the license ran to the apparatus" and that it would recognize a sale, and license the new owner, if there was no good reason to do otherwise.

[67]Barnouw, *Tower in Babel* (n. 22 above), p. 185.

This shared confidence that licenses and their spectrum assignments would be transferred when stations changed hands makes it possible for Hazlett to state flatly that "the price mechanism was the institutional tool used to allocate frequencies in the 1920s . . . such chaos as potentially could exist was explicitly remedied by federal establishment of property rights, followed by market trading to assign such rights to their highest valued employments."[68] If we accept this view, we have to dismiss the "error theory" that underlies standard critiques of the Radio Act of 1927. The act emerges, on this interpretation, as a preemptive strike; a regulatory apparatus had to be established promptly, since otherwise property rights in the spectrum would become a reality.

What kind of property rights would these have been? Would they have had status in law, or were they no more than a set of expectations about what the Commerce Department would very probably do?

The critical evidence is provided by the *Oak Leaves* case, decided in November 1926.[69] Station WGN in Chicago was owned by the *Chicago Tribune* and broadcast on a frequency of 990 kHz. Its program listings were published in the newspaper, and it had built up a loyal following of listeners. Station WGES was owned partly by the Oak Leaves Broadcasting Company, partly by the Coyne Electrical School, and partly by one Louis Guyon, who ran the Paradise Ball Room, a dancehall in downtown Chicago. WGES was originally located in Oak Park, a suburb of Chicago. In September 1926, it moved to the Paradise Ball Room. At the same time it changed its frequency, moving to 950 kHz, a location on the spectrum distant only 40 kHz from that of WGN. The Tribune Company entered a complaint, alleging interference with its radio broadcasts and—interestingly—damage to the circulation of its newspaper.

The Department of Commerce at that time required that stations geographically close to each other maintain a channel separation of 50 kHz. The Tribune Company clearly believed that the Oak Leaves station was deliberately "crowding" its frequency in the hope that listeners, tuning their radios to a familiar spot on the dial, would end up listening, not to WGN, but to WGES instead—and, perhaps, patronizing the Paradise Ball Room.

The defendants claimed, first, that a wavelength could not be made "the subject of private control," and second, that they had not in fact interfered with WGN, since a 40-kHz channel separation was quite sufficient, if listeners' receivers were of proper design and properly

[68] Hazlett, p. 145.

[69] *The Tribune Company v. Oak Leaves Broadcasting Station Inc., Coyne Electrical School Inc., and J. Louis Guyon*, Circuit Court of Cook County, Illinois. The decision of Judge Francis Wilson may be found reprinted in the *Congressional Record* (Senate), December 10, 1926, pp. 215–19.

tuned. The judge, accordingly, had to decide two major questions: whether WGN had any rights that the court should protect, and whether, if such rights existed, WGES had infringed on them.

The first question was a matter of the jurisdiction of the court and, if jurisdiction could be established, of common law and principles of equity; the second, however, required a judgment on a matter of technology. Equity considerations arose because the federal government, in the Act of 1912, had not specifically preempted the field of radio regulation. Citing the opinion of the acting Attorney General that the act gave to the Commerce Department no powers to regulate radio other than those specifically enumerated, Judge Wilson concluded that, since Congress had made no other provision for regulating the use of wavelengths and since the act made no provision for the protection of private rights in wavelengths, "the question becomes one as to whether or not under such circumstances the fundamental or common law of the States will undertake . . . to protect the rights and interests of citizens." And, while admitting that the present case was "novel in its newness," he had no great difficulty in finding precedents in western water rights cases and in the protection given by the common law to property rights in trade names. On that basis he ruled that WGN did indeed have rights to its frequency—rights that would justify a court of equity in assuming jurisdiction. And he stated the general principle, which must have been music to the ears of all established broadcasters, that, under the circumstances of this case, "priority of time creates a superiority in right."

The second question—whether WGES had actually caused interference with WGN—might seem to involve only a question of fact. But matters were not so simple. Attorneys for WGES claimed that, if the WGN transmitter were properly adjusted, and if radio receivers in the listening area were properly constructed and operated, no interference would take place even though the channel separation was only 40 kHz. Implicit in this claim is the argument we have made earlier: that interference in the 1920s was as much the result of the large consumer inventory of nonselective receivers as it was of the proliferation of transmitters. It so happens that 40 kHz is the channel separation normally maintained by the FCC today for stations in the broadcast band transmitting in the same general area.[70] The defendants' argument, in other words, was not in itself unreasonable; but it did make an unreasonable assumption, namely, that households in the listening area either had or would acquire modern receivers, such as the superheterodynes then being marketed by RCA. The judge trod carefully. He noted

[70]James M. Moore, *Radio Spectrum Handbook* (Indianapolis, Ind., 1970), p. 56.

that the technology of broadcasting was changing from day to day and that within a short time a channel separation of 40 kHz might be enough. But in November 1926, he decided, it was not. He declined to prohibit the defendants from using any particular wavelength, but he enjoined them from broadcasting over any wavelength that caused material interference to WGN. And he made clear the feeling of the court that a separation of 50 kHz would do the job.

The concern here is not whether the court's decision was correct or not, but with the considerations that it took into account and with what it might have meant for spectrum allocation, if the Radio Act of 1927 had not supervened. The decision clearly required taking into account both institutional and technical factors: on the one hand, the failure of federal legislation to define and protect the rights of spectrum users; on the other, the limitations of radio technology, particularly as they affected receiver selectivity. The court correctly identified the key variables. Any system of spectrum allocation, whether regulatory or market-based, would have had to face the same set of issues.

What did *Oak Leaves* mean for the future? Hazlett strongly suggests, if he does not explicitly assert, that *Oak Leaves* would have been accepted as setting a precedent, and that a market system, based on property rights defined and protected by common-law principles of equity, would have emerged and flourished—if federal legislation had not intervened. This is a heavy burden to place on a single decision in a single state court. *Oak Leaves*, however, was no ordinary decision. It was widely noted and widely discussed. It had the potential, if accepted as a precedent, to determine the future of the broadcast industry. Senator Dill knew what he was about when he had the court's ruling inserted into the *Congressional Record*. Congress had shown itself singularly reluctant to pass any type of regulatory statute for broadcasting. Legislation of that sort was politically hazardous to vote against in view of the public clamor that something be done about the interference problem. Creation of a new agency, however, nominally independent of both the legislative and executive branches, was not something most congressmen wanted to vote for. *Oak Leaves* made it very difficult to procrastinate further. Whether that decision would have been accepted as a precedent, in other courts and other states, is impossible to say; that it served to accelerate legislative action is highly probable.

The Spectrum as Public Domain

Institutional defects had much to do with the impasse that led to this attempt to claim property rights in the spectrum and, shortly thereafter, to the assertion of federal authority. But one additional factor influenced both the reluctance of the Department of Commerce to restrict

the issuing of broadcast licenses and the refusal of Congress to accept a property rights regime. This was the conception of the radio spectrum as part of the public domain.

Throughout the 19th century there had been a political consensus that federal land, grazing, and mineral rights should be distributed quickly and at zero or minimal cost to individuals on an egalitarian basis. Federal land policy established a general expectation that citizens had the right to access the public domain, claim sections of it as their own, and convert what had been public property into private. In the case of the radio spectrum, this expectation collided directly with public and political insistence that the broadcast spectrum should under no circumstances become private property. It belonged to all the people, not just to those who could afford to build and operate a broadcast station. Broadcasters could use the spectrum, but they should not own it. Two sectors of the public domain were, in short, defined differently in a cultural sense and treated differently as matters of public policy.

Why the difference? The question admits of no easy answer. This is partly because of the force of conservationist ideologies, most strongly voiced by legislators from the western states who had inherited the populist tradition. Partly it is because of public recognition of the abuses to which federal land policy had been subject. Partly it is because, as more than one senator expressed it, the spectrum was the last remaining public domain, and it was scarce in a sense in which public land never had been.[71] And partly too it is because there was a sense that the radio spectrum was a special kind of resource, conveying as it did information and ideas, shaping the thoughts and feelings of listeners.

There is a conflict here—a contradiction in American ideologies. Political sentiment in the 1920s regarded private ownership of the broadcast spectrum as unacceptable. That is, it refused to treat the spectrum as a commodity, to be allocated through markets and a price system. Expressed in other terms, it rejected commercialization of the spectrum. Yet, commercialization of the spectrum was exactly what was happening, and what has continued to happen from that time to our own. Few public resources can ever have been commercially exploited as rapidly and thoroughly as the broadcast spectrum between 1920 and today. And yet, in ideological terms, what other natural resource available to the American people has ever been as thoroughly insulated from the marketplace as the radio spectrum has?

[71] A bill (S. 2813) introduced by Senator Howell of Nebraska and passed by the Senate on April 7, 1925, affirmed "the use of the ether for radio communication or other-wise to be the inalienable possession of the nation." See Davis, "The Law of the Air" (n. 56 above), pp. 156–88. I have found no evidence that anyone at this time thought of the oceans as a scarce resource.

Logicians might call this an antinomy, a contradiction in principles. In this case one set of principles governed the treatment of the physical public domain—lands, minerals, forest resources; another set governed the electromagnetic spectrum. One of the functions of politics is to bridge such antinomies, to make contradiction seem like consistency. How was it done in this case? The answer is the licensing system, as established by the Radio Act of 1927 and reinforced by the Communications Act of 1934. One function of these statutes was precisely to make possible vigorous commercial exploitation of the radio spectrum while simultaneously stipulating that the spectrum could never become private property. Every radio license issued by the federal government requires the licensee to abjure all claims to *ownership* of the spectrum. And, at least in theory, the licenses themselves are for limited terms and are revocable. None of this has in any way impeded the development of a vigorous market in broadcast stations and the creation of very valuable rights of access to the spectrum.

The conviction that the radio spectrum was a physically scarce resource was one constraint on communications policy in the 1920s. The belief that in this case traditional commercial methods for allocating a scarce resource—property rights, prices, and markets—were inappropriate was another. These two constraints produced the Radio Act of 1927 and have served as the ideological infrastructure for American communications policy from that day to the present. In our own time, however, each of these contraints has been relaxed, partly by technological change, partly by shifting beliefs as to the efficacy of the price system as compared with regulation. And, as a result, communications policy has begun to change too, moving away from the regulatory procedures and assumptions that have been normal for more than six decades.

Innovations in procedures for allocating "new" spectrum have been particularly instructive. To cope with the explosive growth in the demand for cellular telephones, pagers, and other wireless communication services, and to avoid the lengthy, expensive, complicated, and uncertain process of comparative hearings, the Federal Communications Commission has until recently conducted lotteries to allocate channels in the spectrum above 800 MHz. These lotteries have attracted much criticism, since—as with any lottery—they invite the filing of multiple applications and the winner, selected by chance, reaps very large unearned capital gains (an estimated $50 million in one case). While lotteries (or "random selection") will still be permissible, the FCC now intends to distribute frequency assignments by auction. Winners of these auctions will become, if not in the literal sense owners of the radio channels, at least holders of exclusive rights to their use—rights which,

one presumes, they will be free to sell at a market price.[72] At the moment these auctions will apply only to spectrum above 800 MHz and perhaps to spectrum that may later be released by the Department of Defense and other government agencies. There is no suggestion so far that spectrum already allocated for broadcast use—the radio and TV channels with which we are all familiar—should be auctioned.

This innovation reflects not merely a change in bureaucratic procedures but also a change in political ideology. In the 1920s, claiming that the spectrum was a public resource owned by all the people, legislators set their face against its alienation to private interests. Today, a significant segment of public opinion is willing to believe that the public domain is likely to be managed at least as efficiently by private firms as it is by government agencies and furthermore that the public treasury should reap some return from disposing of rights to the public domain that have up to now been given away free or at nominal cost.[73]

A property-rights approach to spectrum management is, in consequence, now no longer a matter of abstract theorizing but rather one of current policy formation. The nuts-and-bolts aspects were spelled out more than a decade ago by Arthur De Vany and his associates, members of a Presidential Task Force on Communications Policy.[74] Congress authorized the FCC to conduct spectrum auctions in August 1993 as part of the Budget Reconciliation Act.[75] The issue, in short, has gone beyond theoretical speculation and has entered the realm of politics and public finance. In that arena fiscal considerations will play an important role.[76] The fundamental intellectual rationale, however, as spelled out by theorists more than three decades ago, rests not on budgetary savings but on efficiency in resource allocation.

[72]An auction that conferred exclusive rights of occupancy without also conferring marketability would be merely a fiscal change in the system, raising money for the public treasury but offering little prospect for increased efficiency in resource allocation. A market approach, strictly interpreted, requires that spectrum owners be able to use their spectrum for any purpose they choose (subject to the usual laws governing libel, treason, etc.) and to sell their spectrum to anyone they wish. One can, however, imagine "zoning ordinances" for the spectrum coexisting with an active market in property rights.

[73]In this sense spectrum auctions reflect the same policy initiative as recent increases in fees for the use of federal minerals and grazing land.

[74]De Vany et al. (n. 4 above).

[75]See Title VI section 6002 of the Omnibus Budget Reconciliation Act (P.L. 103-66) of August 1993.

[76]See Executive Office of the President, Office of Management and Budget, *A Vision of Change for America* (Washington, D.C., 1993), p. 83 and app., p. 127. This document estimates the revenue to be raised from spectrum auctions from 1994 through 1998 at $4.2 billion. The Budget Reconciliation Act sets the five-year total at $10.2 billion. See the *New York Times*, Sunday, August 8, 1993, national sec., p. 22.

If this market approach to spectrum allocation becomes generalized, it can eliminate spectrum scarcity in the economists' specialized sense of the term. At the same time technological change has, at least for the time being, banished the ghost of spectrum scarcity in the physical sense. It has become commonplace to suggest that in the near future we will have more communications channels available for our use than we know what to do with. Microwave technology has vastly expanded the bounds of the usable spectrum. The advent of digitized communications and new techniques for compressing data flows have expanded the capacity of existing networks such as the telephone system. Fiber optics and coaxial cable provide multiple-channel communications without requiring any allocation of spectrum at all.[77] And communications satellites make point-to-point communications possible without an intervening ground-based network. If technological advance does indeed eliminate physical spectrum scarcity, and if a market-based system for making new spectrum assignments ensures that there will be neither a shortage nor a surplus of spectrum at the market price, the assumptions that have underlain communications policy in the past are no longer valid. A rewriting of the Communications Act of 1934, which, despite six decades of ad hoc tinkering, is still fundamentally based on the scarcity rationale, becomes highly probable.

But are matters really so simple? Spectrum auctions have up to this time been presented as convenient for the FCC, beneficial to the Treasury, and acceptable to the industry. No counterarguments, on those grounds, have been offered. There may, however, be less tangible issues involved: perhaps the past does not give up its hold over us so easily. What were, at the root, the fears and anxieties that shaped communications policy in the past? They were concerns about concentrated economic power, about control over the creation and movement of information, and about equal access to the means of communication by all members of society. Those concerns are still with us, however transformed by new technology. There may, in other words, yet persist some residue of the sentiment that the electromagnetic spectrum is a special kind of natural resource, affecting the public interest in a distinctive way, and not to be treated as just another kind of real property.

[77]Signals carried in a coaxial cable are at radio frequencies, but in perfectly shielded cable the electromagnetic fields are completely confined within the outer conductor. Many commercially installed coaxial cables, however, are "leaky"; they can pick up interference, and they can cause interference to on-the-air stations.

Vernon A. Spring

ANNUAL REPORT OF THE FEDERAL RADIO COMMISSION

TO THE

CONGRESS OF THE UNITED STATES

FOR THE FISCAL YEAR ENDED JUNE 30, 1927

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Radio Services Bureau

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ANNUAL REPORT OF THE FEDERAL RADIO COMMISSION FOR THE FISCAL YEAR 1927

FEDERAL RADIO COMMISSION,
Washington, July 1, 1927.

To the CONGRESS OF THE UNITED STATES:

The Federal Radio Commission submits herewith its report for the fiscal year ended June 30, 1927.

The passage of the radio act of 1927 presented a situation without parallel in the history of American executive departments. A wholly new Federal body was called into being to deal with a condition which had become almost hopelessly involved during the months following July 3, 1926, when it had become clear that the Department of Commerce had no authority under the 1912 radio law to allocate frequencies, withhold radio licenses, or regulate power or hours of transmission. The new law itself was, of course, totally untested, and the Federal Radio Commission was called upon to administer it with no clear knowledge as to the limitations which might be created by subsequent court action.

The act embraces the whole field of radio communication, but public interest was concentrated almost wholly on the single section of it devoted to radio broadcasting. The problems of point-to-point radio communication, of radiotelegraphy, of marine wireless, of power transmission, etc., though of vast importance, did not present such an urgent need for immediate action as the utter confusion within the broadcasting band. Public opinion assumed that the prime purpose of the law in creating the Federal Radio Commission was the immediate establishment of a sound basis, in the interest of the radio broadcast listener, for the orderly development of American broadcasting.

For this reason the work of the Federal Radio Commission from its first meeting, on March 15, 1927, up to June 30, was devoted almost exclusively to clearing up the broadcasting situation. With the physical capacity of the available channels, or wave lengths, already far exceeded by the number of stations actually in operation, and with no provision in the law for the Federal acquisition or condemnation of broadcasting stations in order to reduce the total number, the commission found it necessary to evolve some plan whereby, without any unconstitutional exercise of arbitrary authority, the listening public could receive more dependable broadcasting service, and whereby a gradual and orderly development could be counted on to bring about a progressive reduction in radio interference.

The following record, taken largely from the orders and bulletins of the commission, outlines the steps whereby this plan was evolved and put into execution. These steps were, in brief, four: First, the determination of the best scientific opinion through a series of public

hearings; second, the internal organization of the commission, handicapped as it was by lack of funds, to handle the enormous amount of documentary material which was required; third, the protection of the broadcasters against liability for unlicensed broadcasting until a suitable basis for the new licenses could be worked out; and, fourth, a complete new allocation of frequencies, power, and hours of operation for all of the existing 732 broadcasting stations to provide adequate local separation and a basis for the gradual elimination of distant interference.

Under the radio act of 1927 the Federal Radio Commission was formally organized on March 15, 1927, as follows:

Rear Admiral W. H. G. Bullard, of Media, Pa., commissioner from the second zone, chairman; Judge Eugene O. Sykes, of Jackson, Miss., commissioner from the third zone, vice chairman; O. H. Caldwell, of New York, N. Y., commissioner from the first zone; Henry A. Bellows, of Minneapolis, Minn., commissioner from the fourth zone; Col. John F. Dillon, of San Francisco, Calif., commissioner from the fifth zone.

Sam Pickard, chief of the radio division, Department of Agriculture, was engaged as acting secretary when the commission was organized. Mr. Pickard was made permanent secretary on April 20. 1927.

ASSIGNMENT OF COMMISSIONERS

Chairman Bullard took direct charge of the radio stations in the second zone, embracing Pennsylvania, Virginia, West Virginia, Ohio, Michigan, and Kentucky.

Commissioner Sykes took charge of the third zone, embracing North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Mississippi, Arkansas, Louisiana, Texas, and Oklahoma.

Commissioner Caldwell took charge of the first zone, embracing Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Delaware, Maryland, District of Columbia, Porto Rico, and the Virgin Islands.

Commissioner Bellows took charge of the fourth zone, embracing Indiana, Illinois, Wisconsin, Minnesota, North Dakota, South Dakota, Iowa, Nebraska, Kansas, and Missouri.

Commissioner Dillon took charge of the fifth zone, embracing Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Hawaii, and Alaska.

Due to the lack of funds, the commission was forced to open its offices at the Department of Commerce, where Secretary Hoover provided a suite of rooms formerly occupied by the Bureau of Navigation. It was possible to engage only a small office force, and it has been necessary to economize in every possible way.

When the Federal Radio Commission was inaugurated it found a chaotic condition prevailing in the radio field, for after Government control broke down in 1926 many broadcasters jumped their waves, seeking more desirable channels, regardless of their existing occupants. Even the channels reserved for Canada were appropriated, and split frequencies were used, with only a slight separation of from 1 to 5 kilocycles in many instances.

The problem confronting the commission was to try and bring order out of chaos by placing the 732 broadcasting stations on 89

wave lengths, so as not to create serious interference. The first act of the commission was to continue in force all radio amateur and ship licenses issued by the Department of Commerce and all coastal, point to point, technical, training, and experimental radio licenses, in order that attention might be concentrated on the pressing problems within the broadcasting band.

PUBLIC HEARINGS HELPFUL

For the purpose of providing opportunity for the presentation of general suggestions by the public and by qualified experts as to the methods for reducing interference within the broadcasting law, at its first meeting the commission arranged for a series of public hearings for March 29 to April 1, inclusive.

The subjects assigned for discussion were: Broadening the broadcasting band, limitation of power, reducing frequency separation, simultaneous broadcasting with the same frequency, chain broadcasting, division of time, consolidation of broadcasting service, limiting the members of broadcasting stations, and general discussion.

United opposition to widening the broadcasting band in order to accommodate more stations was expressed at the hearings by representatives of the radio art, science, and industry. Diverse views were presented regarding limitation of the power output, with the general opinion prevailing that this should be determined on the basis of area to be served by the respective stations. Stout opposition was registered also against reducing the frequency separation between channels from 10 to 7 kilocycles, while chain broadcasting in the main was indorsed. It was agreed that a division of time by stations is absolutely necessary to relieve to some extent the congestion on the ether channels.

PROMINENT PERSONS OFFER SUGGESTIONS

Among those who took part in the public hearings and made suggestions for the guidance of the commission were:

Paul B. Klugh, representing the National Association of Broadcasters.
Frank D. Scott, general counsel of the National Association of Broadcasters and the Radio Manufacturers' Association.
Jack Binns, treasurer of the Hazeltine Corporation.
R. H. Langley, treasurer of the Crosley Radio Corporation.
Dr. F. A. Kolster, Federal Telegraph Co. of California.
Dr. Alfred N. Goldsmith, chairman of the board of consulting engineers of the National Broadcasting Co.
C. Francis Jenkins, a noted inventor, of Washington, D. C.
Alfred P. Thom, jr., counsel for the American Railway Association.
George T. Stanton, chairman of committee No. 12, radio and wire carrier system, American Railway Association.
Lamden Kay, Atlanta, Ga., director of station operated by the Atlanta Journal.
L. P. F. Raycroft, vice president of National Electrical Manufacturers' Association.
Ray H. Manson, chief engineer, Stromberg-Carlson Telephone Manufacturing Co.
Robert H. Marriott, consulting engineer of New York, representing the Independent Wireless Telegraph Co.
L. W. Wallace, secretary of the American Engineering Council.
Paul Godley, radio engineer of Newark, N. J.
Samuel A. Waite, Worcester Telegram Publishing Co., Worcester, Mass.
L. C. F. Horle, Federal Radio Corporation, Buffalo, N. Y.
H. B. Hough, Fort Worth, Tex., radio announcer.

On April 24, 1927, the commission granted temporary permits to all broadcasters who held a license, or an extension thereof, issued by the Secretary of Commerce under the act of 1912. That was done mainly to allow stations to operate without rendering their owners liable to the penalties provided by the radio act of 1927.

AIM AND PURPOSE OF TEMPORARY PERMITS

Explaining the aim and purpose of the temporary permits, the commission issued this statement:

Although the temporary permits to broadcasting stations now being issued by the Federal Radio Commission are designed chiefly to protect broadcasters who were licensed under the 1912 law from incurring the penalties provided by the 1927 act for operating without a license, they will also provide an immediate measure of real relief to the radio listeners. When the new law went into effect there were 129 broadcasting stations operating on frequencies outside of the regularly authorized scale.

Originally licenses were issued by the Department of Commerce to use frequencies on a decimal basis, thereby maintaining the necessary separation of 10 kilocycles between frequencies. After July 1, 1926, however, a considerable number of stations selected intermediate frequencies, realizing that the Department of Commerce had no power to prevent such action. Each station thus operating has created interference on three different wave lengths—on the one on which it is actually operated and on the nearest regular wave lengths above and below.

As no temporary permits are being issued for these intermediate frequencies, and as the Federal supervisors are being instructed to watch carefully for any violation of the terms of these permits, all of the 129 stations which have been creating interference on two wave lengths besides their own will within the next week or 10 days be operating on frequencies where they will create interference only with other stations on the same wave length. In many cases it has not been found practicable, on account of interference, to move the stations to the nearest authorized frequency, and accordingly many of them have been assigned to frequencies in less congested parts of the broadcasting band.

Furthermore, the temporary permits state the maximum permissible power, and in a number of cases, particularly where stations are located in congested residential districts, this maximum power is being materially cut down in the interests of the listening public. Thus, although the temporary permits do not represent any complete attempt to solve the broadcasting problem, which will begin with the issuing of short-time licenses as soon as possible after April 24, the commission believes that these temporary permits will in themselves bring about a certain amount of immediate and very desirable relief to the radio listeners of the entire country.

AN OPEN-DOOR POLICY ADOPTED

An "open-door" policy was agreed upon by the commission. Commissioner Bellows was named director of publicity, and twice a week he held conferences with the Washington correspondents. On these occasions Commissioner Bellows outlined as far as practical the plans of the commission and explained action already taken. The keen interest in the problems before the commission was evidenced by the large attendance at the press conferences. Chairman Bullard in explaining the views of the commission with relation to its contact with the public said on one occasion:

The commission has no desire to arrive at any conclusions without taking the public into its fullest confidence, and while its membership is limited by law to five members yet the commission would like to consider that really every listener and every broadcaster, whether owner or operator, is a potential member for submitting constructive ideas to keep the other channels clear that just

as many stations may operate as possible. To use the words of a former President, the commission believes in "open covenants openly arrived at." The only motto we have is the doormat welcome, and there are no czars, as some newspapers like to suggest; we are all equals—the commission and the public—striving to solve many difficult problems and propitiate the ire of perhaps some disgruntled ones.

AN APPALLING RESPONSIBILITY

The spirit with which the commission approached its task was expressed by Commissioner Bellows in an address before the League of Women Voters at a dinner in Washington on April 29, 1927. At that time he said:

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 the 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. That, in just four words, is what Congress has told us to do. We are to determine who shall and who shall not broadcast and how such broadcasting shall be carried on, simply in accordance with our conception of public interest, convenience, or necessity.

It is a rather appalling responsibility. The law tells us that we shall have no right of censorship over radio programs, but the physical facts of radio transmission compel what is, in effect, a censorship of the most extraordinary kind. A broadcasting station is in many ways akin to a newspaper, but with this fundamental difference there is no arbitrary limit to the number of different newspapers which may be published, whereas there is a definite limit, and a very low one, to the number of broadcasting stations which can operate simultaneously within the entire length and breadth of our country. This limit has not only been reached, it has been far overpassed; the demand from every section of the country is to cut down the number of broadcasting stations in the interests of the listening public.

What does this mean? It means that the Federal Radio Commission must say to this person, "You may broadcast," and to that person, "You may not broadcast; there is no room for you." It means, in actual practice, that we can not find suitable frequencies, or wave lengths, even for all of the stations already built and in operation, and that to several hundred applicants for new construction permits we can say only, "We are sorry, but we can see no present hope for you." We must say to John Doe, "You are rendering a service of great value in the interest, convenience, or necessity of the public, and you shall have a good wave length, plenty of time, and ample power," while we say to Richard Roe, "We find your service of less value to the public; so you shall have a poorer wave length, less time, and less power, or perhaps no wave length, time, or power at all."

HARD TO MEASURE CONFLICTING CLAIMS

We can not evade this responsibility, for it is the thing which Congress has told us we must do, and it is the thing which the people of America rightly demand shall be done. The variety of broadcasting service has become infinite; how shall we measure the conflicting claims of grand opera and religious services, of market reports and direct advertising, of jazz orchestras and lectures on the diseases of hogs?

It is for help in making such decisions, wisely and justly, that the Federal Radio Commission turns to you and to those who, like you, have the larger and truer vision of what radio can mean in our national life. Congress has said that we shall administer the radio law in the public interest; we in turn ask you to help us define public interest in such a way that this marvelous agency shall be free to play the great part it ought to play in building up and strengthening the understanding of our people.

Every broadcasting station exists for one sole purpose—the creation of public good will for its owners or for the sponsors of its programs. It will broadcast

whatever it believes will best create and maintain that good will. Very rightly, Congress has held that the broadcaster shall not be subject to governmental dictation as to the character of the material he sends out; the Federal Radio Commission, under the present law, can not and will not interfere with any broadcaster's right to control and censor his own programs. In that matter his relations are not with the Government, not with the commission, but with you. It is for you, the listeners, not for us, to censor his programs. It is for you to tell him when he is rendering, or failing to render, real service to the public, and you may be sure that he will listen to your voices.

PUBLIC MUST GUARD FREEDOM OF AIR

Above all, it is for you, not for us of the commission, to safeguard the so-called freedom of the air. Here is a problem which, because you are primarily interested in radio as a means of political education, touches you very closely. You would be quick to see the danger if there could be only a fixed and rather small number of newspapers and magazines published in the United States; you would rightly fear that the newcomer, the nonconformist, the representative of the minority, would have small chance to present his ideas to the public. This is just the situation which exists in broadcasting and which inevitably must continue to exist unless some fundamental change in the science of radio transmission comes about as the result of new discovery, to make possible a totally unforeseen increase in the number of stations which can broadcast simultaneously.

The radio law tells us that we shall not fix any condition "which shall interfere with the right of free speech by means of radio communication," and yet, if radio communication of any kind is to be possible at all we must sharply limit the number of broadcasting stations. The safeguarding of that right of free speech which is essential to intellectual growth lies in the hands of the broadcasters themselves, and, ultimately, in yours, for it is your good will that the broadcasters are seeking. If they and you do not so safeguard it—if you do not make it clear that your understanding of public interest, convenience, and necessity involves a very broad conception of the obligations of the broadcaster to his listeners—then it may be that Congress will feel that there is need for some amendment to the present radio law, an amendment calling for such Government regulation of radio programs as would manifestly be deplorable if it can possibly be avoided.

LISTENERS TO DECIDE FUTURE COURSE OF RADIO

The future of radio broadcasting is in your hands. The broadcasters exist solely to serve you as listeners; they charge you nothing and they ask only your good will. Congress, recognizing the full significance of the problem, has created this new Federal body, of which I have the honor to be a member, solely to administer the law in your interests. The vast scope of this new medium of transmitting ideas passes all comprehension. Your imaginations can not conceive, even though guesswork may boldly state numbers, of the audience which may listen to a single voice. And it is for you to say whether this potent agency shall be used rightly or wrongly. It is for you to say whether it shall degenerate into a mere plaything or develop into one of the greatest forces in the molding of our entire civilization. It is for you to establish close relations with the broadcasters who serve your communities and to show them that it is to their advantage to use their stations for the highest type of public service.

It is as such a mighty power for linking together all parts of our national life, for making better and wiser citizens of our great country, that the Federal Commission conceives of broadcasting. But we can do only what you tell us you want done. Our present problem is to clear the channels of radio communication; yours is to say what commodities of human thought, of reason, and of art shall be borne on those channels to millions of listeners. Our task is not an easy one; yours is, I believe, in the long run, even harder. But I know the broadcasters, many of them, well, and I know that they are eager for your help and cooperation. It is the glory of democracy that the will of the people rules, and to-day the Federal Radio Commission, created to serve the people of the United States, asks of you that you will do your utmost to create a demand for that kind of radio service which will make our country a better and happier and finer place in which to live.

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POWER REDUCED IN RESIDENTIAL DISTRICTS

Owing to constant complaints of interference caused by broadcasting stations using too much power within residential sections, the commission issued an order on May 4, 1927, reducing the power of many stations in the large cities. To improve radio reception in New York, Chicago, and other large cities the commission decided that a separation of 50 kilocycles is necessary between local stations. All allocations were made on that basis.

From the beginning of its existence the commission has been literally swamped, almost daily, with letters and telegrams from listeners and broadcasters. At first the listeners confined themselves to suggestions as to ways and means to improve radio reception. Later many of them were enlisted by certain broadcasters in their fight for special consideration in the allotment of waves and power.

"FANS" TELL HOW TO SOLVE PROBLEMS

Some of the proposals of the "fans" were very helpful to the commission, while others were fantastical and impractical. For the guidance of the commission, Ira L. Grimshaw, of the Department of Commerce, spent several weeks reading 3,000 letters and telegrams. His digest was very illuminating. In brief, it follows:

The following suggestions seem to have been made with considerable regularity and unanimity:

1. Whatever plan is followed, every station must remain exactly on its assigned wave length. A crystal or other control should be required to accomplish this purpose.
2. Stations logically should be classified into the big and the little, or the high power and the low power—the local and the national—the general and the special. The higher-grade stations should have greater range and signal strength and more desirable frequencies upon which to operate. They should be subjected to the minimum of regulation by the Government. The other class should take what is left. They should be purely secondary in everything but regulation.
3. Pirates should be given no consideration. Fundamentally they are persona non grata with the rank and file of radio listeners. They simply interfere with good programs.
4. Directly advertising wares must be either entirely prohibited or greatly restricted. It has been suggested daylight hours only be used for advertising directly.
5. All transmitters should be located outside of cities and congested areas, particularly outside of residential districts.
6. Telegraphic interference is either ruining or seriously jeopardizing broadcast reception in many specific localities. Foreign ships and wandering amateurs are charged with this high misdemeanor.
7. Chain broadcasting is either the greatest blessing or curse of broadcasting. The conclusion is dependent entirely upon either the location of the listener or his particular taste. It is noteworthy that but few suggest the elimination of chain broadcasting. Hours of operations and power limitations and specific frequencies come in for appropriate attention when discussing this subject.

NEW ALLOCATION OF FREQUENCIES REDUCES INTERFERENCE

After spending considerable time and thought on formulating important policies and basic principles the members of the commission mapped out a new allocation of frequencies and power which was announced on May 24 to become effective June 15, 1927.

The members of the commission found it possible to reassign the stations to frequencies which would, in their judgment, serve as a

sound basis for the development of good broadcasting to all sections of the country with comparatively little interference and heterodyning.

In working out the new national traffic system for broadcasting the commission's first consideration was to devise ways and means to improve radio reception throughout the United States. While large groups of stations—more than 100—were operating in two centers, New York and Chicago, they were given secondary consideration and were not allowed to dominate the situation.

Practically all stations were given new assignments, and listeners were obliged to scrap their old logs. It was found necessary to place several stations on the same wave and to provide for a division of time, in many instances, in order to give all qualified broadcasters a place on the air. For the most part the broadcasters accepted the new assignments with good grace and showed a fine spirit of cooperation. A few of them demurred and instituted court proceedings. But after a more careful study two of them announced that their suits had been withdrawn.

SHORT-TERM LICENSES ISSUED

In announcing the issuance of the new licenses the commission made the following statement:

The new licenses are all for 60 days, during which period the new allocations can be tested by actual practice. The law provides that any broadcaster who is dissatisfied with his allocation may have a public hearing before the commission, and at such a hearing his claim for a specific frequency or power will be considered in all its relations.

The commission recognizes that no scheme of reallocation which does not at the very outset eliminate at least 400 broadcasting stations can possibly put an end to interference. Accordingly, it regards the new allocations, not as creating in any sense an ideal broadcasting situation, but as providing for the first time a sound basis for radio service to the listener. With the cooperation of the public and the broadcasters, the commission believes that it will be possible to improve conditions progressively by an orderly process of actual experience.

Until such experience has been gained, both the listeners and the broadcasters are urged to exercise patience. The listener will, of necessity, have to relog his receiving set and may find considerable difficulty in locating all the stations he desires to hear. The broadcasters will doubtless find that many of their listeners are at first somewhat bewildered by the changes in frequencies. It is the belief of the commission, however, that within a very few weeks the material reduction of local or regional interference, the redistribution of frequencies so as to clear most of the broadcasting channels, and the decrease of power for stations in residential districts will combine to render radio reception in general very much better than it has been in a long time.

Special attention is called to the fact that the commission has no unused frequencies to allocate. Every broadcasting channel is filled to its apparent capacity and in some cases possibly overcrowded. Accordingly, any listener who wants a different allocation of frequency or power for his favorite station, or any broadcaster who seeks increased facilities for service, must be prepared to show specifically what other station should be required to give up its frequency or have its power reduced in order to make possible the desired reallocation.

CONSOLIDATION OF STATIONS

In an address before the National Press Club, on April 30, 1927, which was widely broadcast, Chairman Bullard said:

One of the plans whereby the commission hopes and expects to help the public to get better broadcasting service, and at the same time to bring about

far greater economy and efficiency in broadcasting service, is that of encouraging the consolidation of radio stations through the use of two or more sets of call letters for a single transmitter. This plan has actually been put into operation in a number of places, with admirable results, and the commission is definitely encouraging it as one way to provide better service for the listening public.

In reviewing the work of the commission up to that time, Chairman Bullard said:

When the commission began its work less than six weeks ago, it was apparent that the first requisite was complete and accurate information as to the actual broadcasting situation. The license applications on file with the Department of Commerce merely showed what the applicants asked for; they did not give any adequate information as to just what power and time each station was actually using, and in some cases they did not even indicate whether the station was actually in operation. The sworn statements made by the broadcasters in their new applications for license, together with the applications for construction permits and the detailed reports of the Federal radio supervisors, have given the commission a complete and accurate picture of the broadcasting situation as it really is to-day, and it is on the basis of this picture that the commission is going ahead with the task of reassigning frequencies, power, and time. Remember, that all this assembling of information had to be done by an entirely new body, with no previously existing staff and with very limited funds. Considering the difficulties which had to be overcome, the commission feels that these six weeks have shown a very satisfactory amount of progress and give the listeners just reason to hope and believe that within the next month or two the commission will have gone far toward solving the problem of untangling the traffic on the channels of radio communication.

Although the temporary permits now in force were issued primarily to save the broadcasters themselves from liabilities under the law, they have resulted in a most gratifying improvement in broadcasting conditions. The six waves reserved for Canada have been entirely cleared, and thus an international radio problem has been very largely solved. One hundred and twenty-nine stations which were operating on "split kilocycle frequencies"—that is to say, on wave lengths where each station caused heterodyning both above and below itself—have been reallocated. Maximum power allowances have been materially cut down for stations located within congested residential districts and in cases where acute interference was reported. Although the definite nation-wide reallocation has yet to be carried out, the progress thus far made is most encouraging and helpful.

PRELIMINARY WORK OF THE COMMISSION

Reviewing the preliminary work of the commission while discussing "The big job yet to be done in radio," Commissioner Caldwell, in an address in Chicago June 11, 1927, said in part:

We have had about six years of radio broadcasting. It was in 1921 that the first station (KDKA) started operating, and soon other stations followed. From 1922 to the middle of 1926 radio grew and grew in popularity, sales mounted, and a great new industry was in the making. Then something happened.

In July, 1926, just 10 months ago, the Attorney General of the United States rendered his famous opinion that the Secretary of Commerce, under the radio law of 1912, was without power to control the broadcasting situation or to assign wave lengths. Thus, after five years of orderly development, control was off. Beginning with August, 1926, anarchy reigned in the ether.

As the result many stations jumped without restraint to new wave lengths which suited them better, regardless of the interference which they might thus be causing to other stations. Proper separation between established stations was destroyed by other stations coming in and camping in the middle of any open spaces they could find, each interloper thus impairing reception of three stations—his own and two others.

Instead of the necessary 50-kilocycle separation between stations in the same community, the condition soon developed where separations of 20 and 10 kilocycles, and even 8, 5, and 2 kilocycles, existed. Under such separations, of

course, stations were soon wildly blanketing each other while distracted listeners were assailed with scrambled programs.

Wave lengths assigned to Canada were violated, in spite of repeated warnings from the Government and even personal appeals from members of the President's Cabinet that national good faith and international good will were at stake. Meanwhile 250 new stations had injected themselves into the already overcrowded situation and undertook to find perches on which to light, without respect to the existing stations.

Some of the older stations also jumped their power, increasing 5 to 10 times their output, and as a result delivering terrific heterodyne interference to distant stations that had been previously undisturbed under the orderly radio pattern developed by the former supervising authorities and heterodyne interference between broadcasters on the same wave length became so bad at many points on the dial that the listener might suppose instead of a receiving set he had a peanut roaster with assorted whistles. Indeed, every human ingenuity and selfish impulse seemed to have been exerted to complicate the tangle in the ether.

NEW LAW BROUGHT RELIEF

On February 23 of this year Congress passed the new radio law of 1927, putting great powers of radio control in the hands of a commission appointed by the President to serve full time for one year in clearing up the radio confusion. For the first 60 days of the law, or until April 23, no penalties were enforceable; but on April 24, when fines up to $5,000 and penitentiary sentences up to five years became effective, the commission actively put into effect its plans and operations to clear out the interference.

The first steps were (*a*) to transfer all stations to authorized channels on "even tens" of kilocycles, (*b*) to clear the Canadian waves, and (*c*) to combine interfering stations and tuck them in wherever possible in the spectrum, in order to keep them in operation without interfering with those stations who had remained faithfully on their assigned channels. This was accomplished for the period of the temporary permits, beginning April 24.

REALLOCATION OF ALL STATIONS

During the meantime, with the public given partial relief, it was possible for the commission to make a careful study of the situation, and by painstaking planning arrange for the second big step—a reallocation of all stations in the best interests of the listening public. When this reallocation took effect listeners found that (*a*) for each locality local stations were well distributed along the dial, with minimum separations of 50 kilocycles; (*b*) stations were recognized in terms of position and time on the basis of their demonstrated capacity to serve the public; and (*c*) heterodyne interference between distant stations, in general, diminished. These improvements have been accomplished by repacking the channels accord'ng to an orderly plan, actually increasing the capacity of the 89 channels available, in much the same way that a lumber bin which appeared full when lumber had been carelessly thrown into it from all directions can hold considerably more when the lumber is packed in an orderly fashion and the former wasted open spaces avoided.

Sixty-day licenses issued for June 15 to August 15, and the operation of the new allocation will be carefully watched in the light of actual experience during this period, so that necessary changes can be made where interference is experienced. Such actual experience is necessary in view of the irregular and unpredictable transmission in different directions which almost every station sends out. If the ordinary station's radiation went out equally in all directions, making the station's interference area a big circle, the task of fitting stations together without interference at minimum distances would be simple; but as every listener knows, some stations are unaccountably heard for many miles in one or more directions while being shut off by natural "barriers" in other directions. Advantage must be taken of all these curious unpredictable phenomena and adjustments made before the new station set-up will be really working at its best. Here only actual experience, and not engineering theory, can be the guide. The commission is therefore likely to continue issuing only short-term licenses of 60 to 90 day duration on through the winter months, in order to test out the transmission conditions during the cold-weather period of greatest radio effectiveness, before any long-term licenses are granted.

PUBLIC HEARING DOCKET

Under General Order No. 12, the commission held 16 hearings before June 30, 1927—the period covered by this report—of broadcasters who were dissatisfied with the allocation as to frequency, power, or time division granted them under the 60-day licenses, effective June 15. Because of his legal training and experience, Commissioner Sykes presided at the hearings at the request of Chairman Bullard. The first hearing was held on May 27, 1927, upon application of Station WJAZ, Mount Prospect, Ill., which sought a change in frequency from 1,140 kilocycles to 770 kilocycles. That application was denied. The other hearings, with decisions of the commission, follow:

May 31.—Station WGS, New York, asked for a change in frequency from 1,170 kilocycles to 710 kilocycles. Denied. Station WGL, New York, assigned 1,170 kilocycles, sought 1,070 kilocycles. Denied.

June 1.—Station WDWM, Newark, N. J., licensed to operate on 1,270 kilocycles, sought 1,070 kilocycles. Application denied.

June 2.—Station WGES, Chicago, assigned 1,240 kilocycles, sought 920 kilocycles. Denied.

June 8.—Station WGCP, Newark, N. J., assigned 1,070 kilocycles, sought 810 kilocycles. Denied. Station WLWL, New York, assigned 1,020 kilocycles, sought 810 kilocycles. Approved.

June 10.—Station WBT, Charlotte, N. C., assigned 500 watts power, sought 1,000 watts. Application approved for period 7 a. m. to 7 p. m. Station WGBI, Scranton, Pa., assigned 100 watts, sought 500 watts. Granted 250 watts.

June 14.—Station WBBR, Brooklyn, Assigned 1,170 kilocycles, sought 660 kilocycles. Denied.

June 21.—Station WCGU, Sea Gate, New York Harbor, assigned 1,420 kilocycles, sought 970 kilocycles. Denied. Station WBRS, Brooklyn, N. Y., assigned 1,420 kilocycles, sought 760 kilocycles. Denied.

June 22.—Station WBNY, New York, assigned 1,270 kilocycles, sought 1,070 kilocycles. Denied. Station NHAP, New York, assigned 1,270 kilocycles, sought 1,070 kilocycles. Denied. Station WGBB, Freeport, N. Y., applied for permission to remain at assigned frequency of 1,220 kilocycles. Granted.

GENERAL ORDERS ADOPTED

General orders adopted by the commission outline succinctly the policies agreed upon as the most effective way to put into effect the radio act of 1927. Those approved up to July 1, 1927, follow:

EXTENSION OF AMATEUR AND SHIP LICENSES

[General Order No. 1, March 15, 1927]

The Federal Radio Commission, under authority of the act of February 23, 1927, hereby extends the force and effect of all radio amateur and ship licenses issued by the Department of Commerce from and after this date until further orders from this commission, this extension to be of the same force and effect as though new licenses had been issued by this commission, subject to such general regulations as this commission may from time to time issue.

PUBLIC HEARINGS

[General Order No. 2, March 15, 1927]

For the purpose of providing opportunity for the presentation to the Federal Radio Commission of general suggestions as to methods for reducing interference within the broadcasting band, but not for hearing individual claims or complaints, the Federal Radio Commission hereby sets the dates of Tuesday,

March 29, Wednesday, March 30, Thursday, March 31, and Friday, April 1, for public hearings, to be held in the offices of the Federal Radio Commission, Commerce Building, Washington, beginning each morning at 10 o'clock.

EXTENSION OF LICENSES

[General Order No. 3, March 29, 1927]

All coastal, point-to-point, technical and training, and experimental radio-station licenses in force on the 22d day of February, 1927, are hereby extended until the further order of the commission.

BROADCASTING FREQUENCY BAND

[General Order No. 4, April 5, 1927]

In view of the manifest inconvenience to the listening public which would result from any immediate widening of the frequency band devoted to radio broadcasting, the Federal Radio Commission will not at this time allocate to broadcasting stations frequencies other than those between 550 and 1,500 kilocycles (545.1 to 199.9 meters), except on specific request of such stations. It believes, however, that the band between 1,500 and 2,000 kilocycles (199.9 to 149.9 meters) should, so far as may be practicable, be held open for experimental work in broadcasting and allied forms of radio service, to the end that, with the further development of the art, this band may be eventually made available for broadcasting, whether for the ear or the eye, if it shall prove particularly well adapted to such type of service to the public.

EXTENSION OF BROADCAST LICENSES

[General Order No. 5, April 5, 1927]

On Sunday, April 24, at 11.59 p. m., terminates the period of 60 days during which, under section 40 of the radio act of 1927, no holder of a license or an extension thereof issued by the Secretary of Commerce under the act of August 13, 1912, is subject to the penalties provided in the radio act of 1927 for operating a station without a license.

The Federal Radio Commission will issue a temporary permit to operate a radio broadcasting station, good only until final action is taken by the commission on the application for license, to each holder of a license or an extension thereof from the Secretary of Commerce under the act of August 13, 1912, whose application for a license under the radio act of 1927 has been received by the Federal Radio Commission on or before April 24, 1927, and such temporary permit shall, until withdrawn, be considered as having the force and effect of a license in so far as the penalties provided in the radio act of 1927 are concerned.

After April 24, 1927, any person operating a radio broadcasting station otherwise than under the authority of such a temporary permit or a license issued by the Federal Radio Commission will be deemed by the commission to be operating a broadcasting station without a license.

LICENSES FOR PORTABLE STATIONS

[General Order No. 6, April 26, 1927]

Since the exact location of any radio broadcasting transmitter is an essential feature of the license, the Federal Radio Commission, as already announced, will not consider any application for a broadcasting license, except for a very limited period of time, in which the permanent location of the transmitter is not specified. However, for the purpose of enabling so-called portable stations which were duly licensed under the law of 1912 to render service to the public during the spring and summer months, the Federal Radio Commission will issue to such stations licenses for not more than 120 days, to operate with not more than 100 watts power output, and with frequencies of 1,470 and 1,490 kilocycles only. Any such permit may be revoked by the commission at any time if it be shown that the operation of the station thus licensed is causing interference prejudicial to the public interest.

ONLY HALF KILOCYCLE DEVIATION ALLOWED

[General Order No. 7, April 28, 1927]

The Federal Radio Commission hereby fixes a maximum of one-half kilocycle as the extreme deviation from authorized frequency which will be permitted to any broadcasting station operating under permit or license issued under the terms of the radio act of 1927. The Department of Commerce is hereby requested to notify its proper agents immediately of this order and to direct them to report promptly any apparent violations thereof. Maintenance of the assigned frequency within the limits herein prescribed is the duty of each radio broadcasting station, and violation of this order will be deemed by the Federal Radio Commission cause for revocation of license under section 14 of the radio act of 1927.

To facilitate the execution of this order, each radio broadcasting station is hereby directed, effective 12.01 a. m., local time, Monday, May 9, to announce twice each day, at the beginning and end of its program, that it is broadcasting on a frequency of —— kilocycles by authority of the Federal Radio Commission.

PLAN TO CHECK FREQUENCIES

[General Order No. 8, May 5, 1927]

For the purpose of facilitating a more accurate check on station frequencies both by the Federal radio supervisors of the Department of Commerce and by the public, each radio broadcasting station, licensed under the radio act of 1927, is hereby directed to announce its call letters and location as frequently as may be practicable while it is broadcasting, and in any event not less than once during each 15 minutes of transmission.

It is understood, however, that this requirement is waived when such announcement would interrupt a single consecutive speech or musical number, and in such cases the announcement of the call letters and location shall be made at the beginning and end of such number.

This order becomes effective at 12.01 a. m. Wednesday, May 11, 1927, and will remain in force until further notice.

TO PREVENT SPECULATION IN RADIO STATIONS

[General Order No. 9, May 13, 1927]

Section 12 of the Federal radio act provides that no station license shall be transferred or assigned, either voluntarily or involuntarily, without the consent in writing of the licensing authorities.

It is hereby ordered that any person desiring to purchase a broadcasting station shall make application for a new license to the commission on the application blank forms. In addition thereto, the proposed seller or assignor of the station must also write a letter to the commission to the effect that he desires to sell or transfer this station to the applicant for the above-named license and wishes a license issued to this applicant in place and instead of himself.

The commission may either grant or refuse the license or grant with modification as to frequency and power.

DAYTIME POWER INCREASED IN SPECIAL CASES

[General Order No. 10, May 18, 1927]

For the purpose of facilitating wider and better reception of daytime service programs, such as those of educational and religious institutions, civic organizations, and distributors of market and other news, the Federal Radio Commission will consider applications from holders of broadcasting station licenses for the use, between the hours of 6 a. m. and 6 p. m. local time only, of a larger power output than is authorized by such licenses. Applications for this daytime privilege must be made to the commission in writing and shall specify the maximum daytime power to be used, the approximate daytime broadcasting schedule, and the reasons why, in the applicant's estimation, the granting of such privilege would be in the interest, convenience, or necessity of the public.

In each case where such privilege is granted the Federal Radio Commission will notify the radio division of the Department of Commerce, requesting this division, through the Federal radio supervisors, to check carefully the use of power by such station, both day and night. Any failure to revert to the power specified in the license between 6 p. m. and 6 a. m. will be held cause not only for immediate withdrawal of the daytime power privilege but for reduction of the maximum power authorized for use at night.

TERMINATES TEMPORARY PERMITS

[General Order No. 11, May 21, 1927]

The Federal Radio Commission hereby orders that all temporary permits to operate radiobroadcasting stations under the terms of the radio act of 1927 shall terminate at 3 o'clock, local standard time, on the morning of Wednesday, June 1, 1927, and that thereafter all radiobroadcasting stations subject to the provisions of the radio act of 1927 shall be operated solely in accordance with the provisions of the licenses issued as of June 1, 1927, by the Federal Radio Commission.

RULES FOR HEARINGS BEFORE COMMISSION

[General Order No. 12, May 26, 1927]

In all cases in which the 60-day license, effective June 1, offered the licensee is not in accord with the application, the applicant is hereby notified that the commission has not determined that public interest, convenience, or necessity would be served by the granting of such application.

Any applicant for license who is dissatisfied with the allocation as to frequency, power, or time division granted him in the 60-day license issued by the commission which is effective June 1, and who desires a hearing upon his application, may notify the commission in writing of such desire by June 15, 1927.

The commission will thereupon fix a time and place for such hearing. Pending the hearing and the decision thereon by the commission, the applicant will be permitted to broadcast only under the terms and conditions and in accordance with his 60-day license issued by the commission.

The applicant for license may introduce at the hearing before the Federal Radio Commission any witnesses he may desire. In addition thereto, he may introduce any affidavits relating to relevant facts.

The fact in issue is whether or not public interest, convenience, or necessity will be served by granting to the applicant a license upon the wave length or frequency requested in the application, or in the application as amended in the request for hearing, and with the power therein requested and the place for said station therein designated.

All persons interested in the granting or refusal of the application and the frequency therein applied for, including other licensees authorized to use the frequency requested, licensees upon frequencies where interference is claimed, other applicants for the same frequency, and representatives of the public in general, may appear and will be heard upon any relevant matters. The commission may likewise introduce witnesses or affidavits.

All applications for licenses or copies thereof on file with the commission may be introduced in evidence at the hearing. All temporary permits, temporary licenses or copies thereof, and other records on file with either the Federal Radio Commission or the Department of Commerce may be introduced in evidence at the hearing without any further verification.

The witnesses introduced at the hearing, before testifying will be sworn by a member of the commission. The commission will pass upon the relevancy and competency of the testimony offered to be introduced before it. After the conclusion of the hearing and within a reasonable time the commission will render its decision in writing.

The testimony and proceedings at these hearings will be taken down by shorthand reporters designated by the commission, so that the entire record of the proceedings and hearings may be preserved in case of appeal, as provided by section 16 of the radio act of 1927. All hearings provided for by this order will be public and will be held at the offices of the Federal Radio Commission in Washington.

NEW LICENSES MADE EFFECTIVE JUNE 15, 1927

[General Order No. 13, May 28, 1927]

In consideration of the fact that a certain amount of time is required in many cases for making the changes of equipment required by changes of station frequency and for securing suitable control equipment to maintain frequency without serious variation, the Federal Radio Commission hereby amends General Order No. 11, dated May 21, 1927, to read as follows: "The Federal Radio Commission hereby orders that all temporary permits to operate radio broadcasting stations under the terms of the radio act of 1927 shall terminate at 3 o'clock, local standard time, on the morning of Wednesday, June 15, 1927, and that thereafter all radio broadcasting stations subject to the provisions of the radio act of 1927 shall be operated solely in accordance with the provisions of the licenses issued as of June 1, 1927, by the Federal Radio Commission."

The Federal Radio Commission hereby orders that all licenses for the period of 60 days, issued as of June 1, 1927, shall not become effective until 3 o'clock, local standard time, on the morning of Wednesday, June 15, 1927, and shall continue in effect unless previously revoked or modified by order of the commission, for a period of 60 days after June 15, 1927.

TESTIMONY AS GUIDE TO COMMISSION

[General Order No. 14, June 3, 1927]

Testimony introduced at any hearing relative to any particular station or any particular frequency will, when relevant, be considered as testimony by the commission at any of its subsequent hearings. Applicants may examine these records.

INTERFERENCE HEARINGS

[General Order No. 15, June 7, 1927]

For the purpose of providing an orderly method for the reduction and eventual elimination of interference between radio broadcasting stations operating on the same or on closely adjacent frequencies, the Federal Radio Commission announces the following procedure: "At any time after July 15, 1927, any radio broadcasting station operating under license from the Federal Radio Commission may file with the commission an affidavit certifying that unreasonable and injurious interference with its signals is being caused by the simultaneous operation of another radio broadcasting station, the name or call letters of which must be specified in the affidavit. The affidavit must likewise specify not less than two occasions on which such interference was observed, with the name and address of the person making each of such observations, the type of receiving set used, and the date and hour thereof. On receipt of such affidavit, and if in the judgment of the Federal Radio Commission the interference complained of is actually unreasonable and injurious to the affiant, the commission will appoint a date for a hearing, at its convenience, will notify thereof the parties interested, and on the basis of the testimony presented at such hearing will order such changes of frequency, power, or hours of operation as may appear best to serve public interest, convenience, or necessity."

Respectfully,

W. H. G. BULLARD,
Chairman Federal Radio Commission.

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Approved, February 23, 1927.

February 23, 1927.
[H. R. 9971.]
[Public, No. 632.]

CHAP. 169.—An Act For the regulation of radio communications, and for other purposes.

Radio Act of 1927.
Regulation and control of all radio transmission intended hereby.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act is intended to regulate all forms of interstate and foreign radio transmissions and communications within the United States, its Territories and possessions; to maintain the control of the United States over all the channels of interstate and foreign radio transmission; and to provide for the use of such channels, but not the ownership thereof, by individuals, firms, or corporations, for limited periods of time, under licenses granted by Federal authority, and no such license shall be construed to create any right, beyond the terms, conditions, and periods of the license. That no person, firm, company, or corporation shall use or operate any apparatus for the transmission of energy or communications or signals by radio (a) from one place in any Territory or possession of the United States or in the District of Columbia to another place in the same Territory, possession, or District; or (b) from any State, Territory, or possession of the United States, or from the District of Columbia to any other State, Territory, or possession of the United States; or (c) from any place in any State, Territory, or possession of the United States, or in the District of Columbia, to any place in any foreign country or to any vessel; or (d) within any State when the effects of such use extend beyond the borders of said State, or when interference is caused by such use or operation with the transmission of such energy, communications, or signals from within said State to any place beyond its borders, or from any place beyond its borders to any place within said State, or with the transmission or reception of such energy, communications, or signals from and/or to places beyond the borders of said State; or (e) upon any vessel of the United States; or (f) upon any aircraft or other mobile stations within the United States, except under and in accordance with this Act and with a license in that behalf granted under the provisions of this Act.

Licenses required for use of radio apparatus.

Interstate and foreign transmission.

Within a State if use extends beyond its borders.

American vessels, aircraft, etc.

Zones designated.

SEC. 2. For the purposes of this Act, the United States is divided into five zones, as follows: The first zone shall embrace the States of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Delaware, Maryland, the District of Columbia, Porto Rico, and the Virgin Islands; the second zone shall embrace the States of Pennsylvania, Virginia, West Virginia, Ohio, Michigan, and Kentucky; the third zone shall embrace the States of North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Mississippi, Arkansas, Louisiana, Texas, and Oklahoma; the fourth zone shall embrace the States of Indiana, Illinois, Wisconsin, Minnesota, North Dakota, South Dakota, Iowa, Nebraska, Kansas, and Missouri; and the fifth zone shall embrace the States of Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, the Territory of Hawaii, and Alaska.

Federal Radio Commission.
Creation, composition, and appointment.

SEC. 3. That a commission is hereby created and established to be known as the Federal Radio Commission, hereinafter referred to as the commission, which shall be composed of five commissioners appointed by the President, by and with the advice and consent of

the Senate, and one of whom the President shall designate as chairman: *Provided*, That chairmen thereafter elected shall be chosen by the commission itself. Chairman.

Each member of the commission shall be a citizen of the United States and an actual resident citizen of a State within the zone from which appointed at the time of said appointment. Not more than one commissioner shall be appointed from any zone. No member of the commission shall be financially interested in the manufacture or sale of radio apparatus or in the transmission or operation of radiotelegraphy, radiotelephony, or radio broadcasting. Not more than three commissioners shall be members of the same political party. Citizenship and residence qualifications. Financial interests prohibited. Political party selection.

The first commissioners shall be appointed for the terms of two, three, four, five, and six years, respectively, from the date of the taking effect of this Act, the term of each to be designated by the President, but their successors shall be appointed for terms of six years, except that any person chosen to fill a vacancy shall be appointed only for the unexpired term of the commissioner whom he shall succeed. Tenure of first appointees. Successors.

The first meeting of the commission shall be held in the city of Washington at such time and place as the chairman of the commission may fix. The commission shall convene thereafter at such times and places as a majority of the commission may determine, or upon call of the chairman thereof. Meetings.

The commission may appoint a secretary, and such clerks, special counsel, experts, examiners, and other employees as it may from time to time find necessary for the proper performance of its duties and as from time to time may be appropriated for by Congress. Secretary and personnel.

The commission shall have an official seal and shall annually make a full report of its operations to the Congress. Seal, and reports.

The members of the commission shall receive a compensation of $10,000 for the first year of their service, said year to date from the first meeting of said commission, and thereafter a compensation of $30 per day for each day's attendance upon sessions of the commission or while engaged upon work of the commission and while traveling to and from such sessions, and also their necessary traveling expenses. Compensation for first year. Thereafter.

SEC. 4. Except as otherwise provided in this Act, the commission, from time to time, as public convenience, interest, or necessity requires, shall— Duties specified.

(a) Classify radio stations; Classify stations.

(b) Prescribe the nature of the service to be rendered by each class of licensed stations and each station within any class; Service to be rendered.

(c) Assign bands of frequencies or wave lengths to the various classes of stations, and assign frequencies or wave lengths for each individual station and determine the power which each station shall use and the time during which it may operate; Assign wave lengths, etc.

(d) Determine the location of classes of stations or individual stations; Locate stations.

(e) Regulate the kind of apparatus to be used with respect to its external effects and the purity and sharpness of the emissions from each station and from the apparatus therein; Regulate apparatus, etc.

(f) Make such regulations not inconsistent with law as it may deem necessary to prevent interference between stations and to carry out the provisions of this Act: *Provided, however*, That changes in the wave lengths, authorized power, in the character of emitted signals, or in the times of operation of any station, shall not be made without the consent of the station licensee unless, in the judgment of the commission, such changes will promote public convenience or Regulations to prevent interference. *Proviso.* Restriction on changes.

interest or will serve public necessity or the provisions of this Act will be more fully complied with;

Areas to be served.

(g) Have authority to establish areas or zones to be served by any station;

Chain broadcasting.

(h) Have authority to make special regulations applicable to radio stations engaged in chain broadcasting;

Require station records,

(i) Have authority to make general rules and regulations requiring stations to keep such records of programs, transmissions of energy, communications, or signals as it may deem desirable;

Exclude railroad rolling stock, etc.

(j) Have authority to exclude from the requirements of any regulations in whole or in part any radio station upon railroad rolling stock, or to modify such regulations in its discretion;

General authority.

(k) Have authority to hold hearings, summon witnesses, administer oaths, compel the production of books, documents, and papers and to make such investigations as may be necessary in the performance of its duties. The commission may make such expenditures (including expenditures for rent and personal services at the seat of government and elsewhere, for law books, periodicals, and books of reference, and for printing and binding) as may be necessary for the execution of the functions vested in the commission and, as from time to time may be appropriated for by Congress. All expenditures of the commission shall be allowed and paid upon the presentation of itemized vouchers therefor approved by the chairman.

Expenditures allowed.

Powers to be vested in Secretary of Commerce after first year.

SEC. 5. From and after one year after the first meeting of the commission created by this Act, all the powers and authority vested in the commission under the terms of this Act, except as to the revocation of licenses, shall be vested in and exercised by the Secretary of Commerce; except that thereafter the commission shall have power and jurisdiction to act upon and determine any and all matters brought before it under the terms of this section.

Jurisdiction of Commission thereafter.

Duties of Secretary.

It shall also be the duty of the Secretary of Commerce—

During first year.

(A) For and during a period of one year from the first meeting of the commission created by this Act, to immediately refer to the commission all applications for station licenses or for the renewal or modification of existing station licenses.

Thereafter to refer to Commission disputes as to granting station licenses.

(B) From and after one year from the first meeting of the commission created by this Act, to refer to the commission for its action any application for a station license or for the renewal or modification of any existing station license as to the granting of which dispute, controversy, or conflict arises or against the granting of which protest is filed within ten days after the date of filing said application by any party in interest and any application as to which such reference is requested by the applicant at the time of filing said application.

Issue station operators' licenses.

(C) To prescribe the qualifications of station operators, to classify them according to the duties to be performed, to fix the forms of such licenses, and to issue them to such persons as he finds qualified.

Suspend operators' licenses.
Grounds for specified.

(D) To suspend the license of any operator for a period not exceeding two years upon proof sufficient to satisfy him that the licensee (a) has violated any provision of any Act or treaty binding on the United States which the Secretary of Commerce or the commission is authorized by this Act to administer or by any regulation made by the commission or the Secretary of Commerce under any such Act or treaty; or (b) has failed to carry out the lawful orders of the master of the vessel on which he is employed; or (c) has willfully damaged or permitted radio apparatus to be damaged; or (d) has transmitted superfluous radio communications or signals or radio communications containing profane or obscene words or language; or (e) has willfully or maliciously interfered with any other radio communications or signals.

(E) To inspect all transmitting apparatus to ascertain whether in construction and operation it conforms to the requirements of this Act, the rules and regulations of the licensing authority, and the license under which it is constructed or operated. Inspect transmitting apparatus.

(F) To report to the commission from time to time any violations of this Act, the rules, regulations, or orders of the commission, or of the terms or conditions of any license. Report to Commission, violations, etc.

(G) To designate call letters of all stations. Designate call letters.

(H) To cause to be published such call letters and such other announcements and data as in his judgment may be required for the efficient operation of radio stations subject to the jurisdiction of the United States and for the proper enforcement of this Act. Publish call letters, announcements, etc.

The Secretary may refer to the commission at any time any matter the determination of which is vested in him by the terms of this Act. Refer any matter to Commission.

Any person, firm, company, or corporation, any State or political division thereof aggrieved or whose interests are adversely affected by any decision, determination, or regulation of the Secretary of Commerce may appeal therefrom to the commission by filing with the Secretary of Commerce notice of such appeal within thirty days after such decision or determination or promulgation of such regulation. All papers, documents, and other records pertaining to such application on file with the Secretary shall thereupon be transferred by him to the commission. The commission shall hear such appeal de novo under such rules and regulations as it may determine. Appeals allowed to Commission from decisions of Secretary. Hearings on, by Commission.

Decisions by the commission as to matters so appealed and as to all other matters over which it has jurisdiction shall be final, subject to the right of appeal herein given. Effect of Commission's decision.

No station license shall be granted by the commission or the Secretary of Commerce until the applicant therefor shall have signed a waiver of any claim to the use of any particular frequency or wave length or of the ether as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise. Waiver of claims required of applicants for station licenses.

SEC. 6. Radio stations belonging to and operated by the United States shall not be subject to the provisions of sections 1, 4, and 5 of this Act. All such Government stations shall use such frequencies or wave lengths as shall be assigned to each or to each class by the President. All such stations, except stations on board naval and other Government vessels while at sea or beyond the limits of the continental United States, when transmitting any radio communication or signal other than a communication or signal relating to Government business shall conform to such rules and regulations designed to prevent interference with other radio stations and the rights of others as the licensing authority may prescribe. Upon proclamation by the President that there exists war or a threat of war or a state of public peril or disaster or other national emergency, or in order to preserve the neutrality of the United States, the President may suspend or amend, for such time as he may see fit, the rules and regulations applicable to any or all stations within the jurisdiction of the United States as prescribed by the licensing authority, and may cause the closing of any station for radio communication and the removal therefrom of its apparatus and equipment, or he may authorize the use or control of any such station and/or its apparatus and equipment by any department of the Government under such regulations as he may prescribe, upon just compensation to the owners. Radio stations on board vessels of the United States Shipping Board or the United States Shipping Board Emergency Fleet Corporation or the Inland and Coastwise Waterways Service shall be subject to the provisions of this Act. Government stations. Provisions governing. President may suspend regulations, etc., in time of war or other emergency. Authorize use of stations by departments, etc. Shipping Board, etc., vessels subject to this Act.

SEC. 7. The President shall ascertain the just compensation for such use or control and certify the amount ascertained to Congress Compensation for Government use.

Appeal if amount unsatisfactory.

for appropriation and payment to the person entitled thereto. If the amount so certified is unsatisfactory to the person entitled thereto, such person shall be paid only 75 per centum of the amount and shall be entitled to sue the United States to recover such further sum as added to such payment of 75 per centum which will make such amount as will be just compensation for the use and control. Such suit shall be brought in the manner provided by paragraph 20 of section 24, or by section 145 of the Judicial Code, as amended.

Procedure.
Vol. 30, pp. 1093, 1131.

Special letters for Government stations.

SEC. 8. All stations owned and operated by the United States, except mobile stations of the Army of the United States, and all other stations on land and sea, shall have special call letters designated by the Secretary of Commerce.

Licenses not applicable to foreign ships in American jurisdiction. Regulations for.

Section 1 of this Act shall not apply to any person, firm, company, or corporation sending radio communications or signals on a foreign ship while the same is within the jurisdiction of the United States, but such communications or signals shall be transmitted only in accordance with such regulations designed to prevent interference as may be promulgated under the authority of this Act.

Granting of station licenses.

SEC. 9. The licensing authority, if public convenience, interest, or necessity will be served thereby, subject to the limitations of this Act, shall grant to any applicant therefor a station license provided for by this Act.

Consideration of applications.

In considering applications for licenses and renewals of licenses, when and in so far as there is a demand for the same, the licensing authority shall make such a distribution of licenses, bands of frequency of wave lengths, periods of time for operation, and of power among the different States and communities as to give fair, efficient, and equitable radio service to each of the same.

Terms allowed for operating stations.

No license granted for the operation of a broadcasting station shall be for a longer term than three years and no license so granted for any other class of station shall be for a longer term than five years, and any license granted may be revoked as hereinafter provided. Upon the expiration of any license, upon application therefor, a renewal of such license may be granted from time to time for a term of not to exceed three years in the case of broadcasting licenses and not to exceed five years in the case of other licenses.

Renewals.

Time for granting renewals.

No renewal of an existing station license shall be granted more than thirty days prior to the expiration of the original license.

Application requirements.
Facts to be stated in.

SEC. 10. The licensing authority may grant station licenses only upon written application therefor addressed to it. All applications shall be filed with the Secretary of Commerce. All such applications shall set forth such facts as the licensing authority by regulation may prescribe as to the citizenship, character, and financial, technical, and other qualifications of the applicant to operate the station; the ownership and location of the proposed station and of the stations, if any, with which it is proposed to communicate; the frequencies or wave lengths and the power desired to be used; the hours of the day or other periods of time during which it is proposed to operate the station; the purposes for which the station is to be used; and such other information as it may require. The licensing authority at any time after the filing of such original application and during the term of any such license may require from an applicant or licensee further written statements of fact to enable it to determine whether such original application should be granted or denied or such license revoked. Such application and/or such statement of fact shall be signed by the applicant and/or licensee under oath or affirmation.

Additional statements may be required.

Oath to application.

Conditions, etc., if use in intercourse with foreign countries intended.

The licensing authority in granting any license for a station intended or used for commercial communication between the United

States or any Territory or possession, continental or insular, subject to the jurisdiction of the United States, and any foreign country, may impose any terms, conditions, or restrictions authorized to be imposed with respect to submarine-cable licenses by section 2 of an Act entitled "An Act relating to the landing and the operation of submarine cables in the United States," approved May 24, 1921.

Vol. 42, p. 8.

Issue authorized if public interest would be served thereby.

SEC. 11. If upon examination of any application for a station license or for the renewal or modification of a station license the licensing authority shall determine that public interest, convenience, or necessity would be served by the granting thereof, it shall authorize the issuance, renewal, or modification thereof in accordance with said finding. In the event the licensing authority upon examination of any such application does not reach such decision with respect thereto, it shall notify the applicant thereof, shall fix and give notice of a time and place for hearing thereon, and shall afford such applicant an opportunity to be heard under such rules and regulations as it may prescribe.

Hearings, etc., if no decision reached.

Additional statement on licenses.

Such station licenses as the licensing authority may grant shall be in such general form as it may prescribe, but each license shall contain, in addition to other provisions, a statement of the following conditions to which such license shall be subject:

Operation only as designated.

(A) The station license shall not vest in the licensee any right to operate the station nor any right in the use of the frequencies or wave length designated in the license beyond the term thereof nor in any other manner than authorized therein.

Limiting assignments.

(B) Neither the license nor the right granted thereunder shall be assigned or otherwise transferred in violation of this Act.

Subject to Government control.
Ante, p. 1165.

(C) Every license issued under this Act shall be subject in terms to the right of use or control conferred by section 6 hereof.

Temporary emergency, authority of Secretary during first year.

In cases of emergency arising during the period of one year from and after the first meeting of the commission created hereby, or on applications filed during said time for temporary changes in terms of licenses when the commission is not in session and prompt action is deemed necessary, the Secretary of Commerce shall have authority to exercise the powers and duties of the commission, except as to revocation of licenses, but all such exercise of powers shall be promptly reported to the members of the commission, and any action by the Secretary authorized under this paragraph shall continue in force and have effect only until such time as the commission shall act thereon.

Limitations.

Prohibition of granting or transfers to aliens, etc.
Classification of.

SEC. 12. The station license required hereby shall not be granted to, or after the granting thereof such license shall not be transferred in any manner, either voluntarily or involuntarily, to (a) any alien or the representative of any alien; (b) to any foreign government, or the representative thereof; (c) to any company, corporation, or association organized under the laws of any foreign government; (d) to any company, corporation, or association of which any officer or director is an alien, or of which more than one-fifth of the capital stock may be voted by aliens or their representatives or by a foreign government or representative thereof, or by any company, corporation, or association organized under the laws of a foreign country.

No transfers without consent of licensing authority.

The station license required hereby, the frequencies or wave length or lengths authorized to be used by the licensee, and the rights therein granted shall not be transferred, assigned, or in any manner, either voluntarily or involuntarily, disposed of to any person, firm, company, or corporation without the consent in writing of the licensing authority.

Licenses refused to any party guilty of monopoly, unfair competition, etc.

SEC. 13. The licensing authority is hereby directed to refuse a station license and/or the permit hereinafter required for the construction of a station to any person, firm, company, or corporation,

or any subsidiary thereof, which has been finally adjudged guilty by a Federal court of unlawfully monopolizing or attempting unlawfully to monopolize, after this Act takes effect, radio communication, directly or indirectly, through the control of the manufacture or sale of radio apparatus, through exclusive traffic arrangements, or by any other means or to have been using unfair methods of competition. The granting of a license shall not estop the United States or any person aggrieved from proceeding against such person, firm, company, or corporation for violating the law against unfair methods of competition or for a violation of the law against unlawful restraints and monopolies and/or combinations, contracts, or agreements in restraint of trade, or from instituting proceedings for the dissolution of such firm, company, or corporation.

Granting a license no estoppal of proceedings against violators of antitrust laws, etc.

Revocation of license.
Grounds for, specified.

SEC. 14. Any station license shall be revocable by the commission for false statements either in the application or in the statement of fact which may be required by section 10 hereof, or because of conditions revealed by such statements of fact as may be required from time to time which would warrant the licensing authority in refusing to grant a license on an original application, or for failure to operate substantially as set forth in the license, for violation of or failure to observe any of the restrictions and conditions of this Act, or of any regulation of the licensing authority authorized by this Act or by a treaty ratified by the United States, or whenever the Interstate Commerce Commission, or any other Federal body in the exercise of authority conferred upon it by law, shall find and shall certify to the commission that any licensee bound so to do, has failed to provide reasonable facilities for the transmission of radio communications, or that any licensee has made any unjust and unreasonable charge, or has been guilty of any discrimination, either as to charge or as to service or has made or prescribed any unjust and unreasonable classification, regulation, or practice with respect to the transmission of radio communications or service: *Provided*, That no such order of revocation shall take effect until thirty days' notice in writing thereof, stating the cause for the proposed revocation, has been given to the parties known by the commission to be interested in such license. Any person in interest aggrieved by said order may make written application to the commission at any time within said thirty days for a hearing upon such order, and upon the filing of such written application said order of revocation shall stand suspended until the conclusion of the hearing herein directed. Notice in writing of said hearing shall be given by the commission to all the parties known to it to be interested in such license twenty days prior to the time of said hearing. Said hearing shall be conducted under such rules and in such manner as the commission may prescribe. Upon the conclusion hereof the commission may affirm, modify, or revoke said orders of revocation.

Proviso.
Notice to interested parties.

Application for hearing.

Notice of hearing, and procedure

Authority of Commission.

Antitrust laws applicable to dealers in radio apparatus, etc.

SEC. 15. All laws of the United States relating to unlawful restraints and monopolies and to combinations, contracts, or agreements in restraint of trade are hereby declared to be applicable to the manufacture and sale of and to trade in radio apparatus and devices entering into or affecting interstate or foreign commerce and to interstate or foreign radio communications. Whenever in any suit, action, or proceeding, civil or criminal, brought under the provisions of any of said laws or in any proceedings brought to enforce or to review findings and orders of the Federal Trade Commission or other governmental agency in respect of any matters as to which said commission or other governmental agency is by law authorized to act, any licensee shall be found guilty of the violation of the provisions of such laws or any of them, the court, in addition to the penalties imposed by said laws, may adjudge,

Revocation of license, etc., in addition to other penalties, if licensee guilty of violating.

order, and/or decree that the license of such licensee shall, as of the date the decree or judgment becomes finally effective or as of such other date as the said decree shall fix, be revoked and that all rights under such license shall thereupon cease: *Provided, however*, That such licensee shall have the same right of appeal or review as is provided by law in respect of other decrees and judgments of said court.

Proviso. Right of appeal.

Applicants for construction permits, licenses, etc., refused by licensing authority, may appeal to Court of Appeals, D. C.

SEC. 16. Any applicant for a construction permit, for a station license, or for the renewal or modification of an existing station license whose application is refused by the licensing authority shall have the right to appeal from said decision to the Court of Appeals of the District of Columbia; and any licensee whose license is revoked by the commission shall have the right to appeal from such decision of revocation to said Court of Appeals of the District of Columbia or to the district court of the United States in which the apparatus licensed is operated, by filing with said court, within twenty days after the decision complained of is effective, notice in writing of said appeal and of the reasons therefor.

Appeal if license revoked.

Action on appeals.

The licensing authority from whose decision an appeal is taken shall be notified of said appeal by service upon it, prior to the filing thereof, of a certified copy of said appeal and of the reasons therefor. Within twenty days after the filing of said appeal the licensing authority shall file with the court the originals or certified copies of all papers and evidence presented to it upon the original application for a permit or license or in the hearing upon said order of revocation, and also a like copy of its decision thereon and a full statement in writing of the facts and the grounds for its decision as found and given by it. Within twenty days after the filing of said statement by the licensing authority either party may give notice to the court of his desire to adduce additional evidence. Said notice shall be in the form of a verified petition stating the nature and character of said additional evidence, and the court may thereupon order such evidence to be taken in such manner and upon such terms and conditions as it may deem proper.

Papers to be filed in court.

Additional evidence may be adduced.

Early action of court.

At the earliest convenient time the court shall hear, review, and determine the appeal upon said record and evidence, and may alter or revise the decision appealed from and enter such judgment as to it may seem just. The revision by the court shall be confined to the points set forth in the reasons of appeal.

Limits of revision.

Radio licenses forbidden to acquire, etc., telegraph or telephone systems between United States and foreign countries affecting monopoly, etc.

SEC. 17. After the passage of this Act no person, firm, company, or corporation now or hereafter directly or indirectly through any subsidiary, associated, or affiliated person, firm, company, corporation, or agent, or otherwise, in the business of transmitting and/or receiving for hire energy, communications, or signals by radio in accordance with the terms of the license issued under this Act, shall by purchase, lease, construction, or otherwise, directly or indirectly, acquire, own, control, or operate any cable or wire telegraph or telephone line or system between any place in any State, Territory, or possession of the United States or in the District of Columbia, and any place in any foreign country, or shall acquire, own, or control any part of the stock or other capital share of any interest in the physical property and/or other assets of any such cable, wire, telegraph, or telephone line or system, if in either case the purpose is and/or the effect thereof may be to substantially lessen competition or to restrain commerce between any place in any State, Territory, or possession of the United States or in the District of Columbia and any place in any foreign country, or unlawfully to create monopoly in any line of commerce; nor shall any person, firm, company, or corporation now or hereafter engaged directly or indirectly through any subsidiary, associated, or affiliated person,

Telegraph and telephone systems, forbidden to acquire, etc., radio stations if thereby creating a monopoly in commerce, etc.

company, corporation, or agent, or otherwise, in the business of transmitting and/or receiving for hire messages by any cable, wire, telegraph, or telephone line or system (a) between any place in any State, Territory, or possession of the United States or in the District of Columbia, and any place in any other State, Territory, or possession of the United States; or (b) between any place in any State, Territory, or possession of the United States, or the District of Columbia, and any place in any foreign country, by purchase, lease, construction, or otherwise, directly or indirectly acquire, own, control, or operate any station or the apparatus therein, or any system for transmitting and/or receiving radio communications or signals between any place in any State, Territory, or possession of the United States or in the District of Columbia, and any place in any foreign country, or shall acquire, own, or control any part of the stock or other capital share or any interest in the physical property and/or other assets of any such radio station, apparatus, or system, if in either case the purpose is and/or the effect thereof may be to substantially lessen competition or to restrain commerce between any place in any State, Territory, or possession of the United States or in the District of Columbia, and any place in any foreign country, or unlawfully to create monopoly in any line of commerce.

Candidates for office to be accorded equal opportunity, for using broadcasting stations.

SEC. 18. If any licensee shall permit any person who is a legally qualified candidate for any public office to use a broadcasting station, he shall afford equal opportunities to all other such candidates for that office in the use of such broadcasting station, and the licensing authority shall make rules and regulations to carry this provision into effect: *Provided*, That such licensee shall have no power of censorship over the material broadcast under the provisions of this paragraph. No obligation is hereby imposed upon any licensee to allow the use of its station by any such candidate.

Proviso. No censorship allowed, etc.

Paid broadcast matter to be so announced.

SEC. 19. All matter broadcast by any radio station for which service, money, or any other valuable consideration is directly or indirectly paid, or promised to or charged or accepted by, the station so broadcasting, from any person, firm, company, or corporation, shall, at the time the same is so broadcast, be announced as paid for or furnished, as the case may be, by such person, firm, company, or corporation.

Transmissions only by licensed operators.

SEC. 20. The actual operation of all transmitting apparatus in any radio station for which a station license is required by this Act shall be carried on only by a person holding an operator's license issued hereunder. No person shall operate any such apparatus in such station except under and in accordance with an operator's license issued to him by the Secretary of Commerce.

Construction permits required.

SEC. 21. No license shall be issued under the authority of this Act for the operation of any station the construction of which is begun or is continued after this Act takes effect, unless a permit for its construction has been granted by the licensing authority upon written application therefor. The licensing authority may grant such permit if public convenience, interest, or necessity will be served by the construction of the station. This application shall set forth such facts as the licensing authority by regulation may prescribe as to the citizenship, character, and the financial, technical, and other ability of the applicant to construct and operate the station, the ownership and location of the proposed station and of the station or stations with which it is proposed to communicate, the frequencies and wave length or wave lengths desired to be used, the hours of the day or other periods of time during which it is proposed to operate the station, the purpose for which the station is to be used, the type of transmitting apparatus to be used, the power to be used, the date upon which the station is expected to be

Facts to be set forth in applications.

completed and in operation, and such other information as the licensing authority may require. Such application shall be signed by the applicant under oath or affirmation.

Permits to show dates of operation, etc.

Such permit for construction shall show specifically the earliest and latest dates between which the actual operation of such station is expected to begin, and shall provide that said permit will be automatically forfeited if the station is not ready for operation within the time specified or within such further time as the licensing authority may allow, unless prevented by causes not under the control of the grantee. The rights under any such permit shall not be assigned or otherwise transferred to any person, firm, company, or corporation without the approval of the licensing authority. A permit for construction shall not be required for Government stations, amateur stations, or stations upon mobile vessels, railroad rolling stock, or aircraft. Upon the completion of any station for the construction or continued construction for which a permit has been granted, and upon it being made to appear to the licensing authority that all the terms, conditions, and obligations set forth in the application and permit have been fully met, and that no cause or circumstance arising or first coming to the knowledge of the licensing authority since the granting of the permit would, in the judgment of the licensing authority, make the operation of such station against the public interest, the licensing authority shall issue a license to the lawful holder of said permit for the operation of said station. Said license shall conform generally to the terms of said permit.

Assignment of rights restricted.

License for operation granted if conditions complied with.

Stations liable to interfere with distress calls, to be designated.

Requirements for.

SEC. 22. The licensing authority is authorized to designate from time to time radio stations the communications or signals of which, in its opinion, are liable to interfere with the transmission or reception of distress signals of ships. Such stations are required to keep a licensed radio operator listening in on the wave lengths designated for signals of distress and radio communications relating thereto during the entire period the transmitter of such station is in operation.

Distress signals. Requirements for, on shipboard stations.

SEC. 23. Every radio station on shipboard shall be equipped to transmit radio communications or signals of distress on the frequency or wave length specified by the licensing authority, with apparatus capable of transmitting and receiving messages over a distance of at least one hundred miles by day or night. When sending radio communications or signals of distress and radio communications relating thereto the transmitting set may be adjusted in such a manner as to produce a maximum of radiation irrespective of the amount of interference which may thus be caused.

Priority to distress signals to be given by all stations.

All radio stations, including Government stations and stations on board foreign vessels when within the territorial waters of the United States, shall give absolute priority to radio communications or signals relating to ships in distress; shall cease all sending on frequencies or wave lengths which will interfere with hearing a radio communication or signal of distress, and, except when engaged in answering or aiding the ship in distress, shall refrain from sending any radio communications or signals until there is assurance that no interference will be caused with the radio communications or signals relating thereto, and shall assist the vessel in distress, so far as possible, by complying with its instructions.

Public shore stations to exchange communications with shipboard, and shipboard with each other.

SEC. 24. Every shore station open to general public service between the coast and vessels at sea shall be bound to exchange radio communications or signals with any ship station without distinction as to radio systems or instruments adopted by such stations, respectively, and each station on shipboard shall be bound to exchange radio communications or signals with any other station on shipboard

without distinction as to radio systems or instruments adopted by each station.

Time arrangement for land stations to prevent interference with Government ones in proximity.

SEC. 25. At all places where Government and private or commercial radio stations on land operate in such close proximity that interference with the work of Government stations can not be avoided when they are operating simultaneously such private or commercial stations as do interfere with the transmission or reception of radio communications or signals by the Government stations concerned shall not use their transmitters during the first fifteen minutes of each hour, local standard time.

Government stations to have first 15 minutes in each hour.

The Government stations for which the above-mentioned division of time is established shall transmit radio communications or signals only during the first fifteen minutes of each hour, local standard time, except in case of signals or radio communications relating to vessels in distress and vessel requests for information as to course, location, or compass direction.

Minimum power to be used.

SEC. 26. In all circumstances, except in case of radio communications or signals relating to vessels in distress, all radio stations, including those owned and operated by the United States, shall use the minimum amount of power necessary to carry out the communication desired.

Unauthorized divulgence of radio communication by receiver, forbidden.

SEC. 27. No person receiving or assisting in receiving any radio communication shall divulge or publish the contents, substance, purport, effect, or meaning thereof except through authorized channels of transmission or reception to any person other than the addressee, his agent, or attorney, or to a telephone, telegraph, cable, or radio station employed or authorized to forward such radio communication to its destination, or to proper accounting or distributing officers of the various communicating centers over which the radio communication may be passed, or to the master of a ship under whom he is serving, or in response to a subpœna issued by a court of competent jurisdiction, or on demand of other lawful authority; and no person not being authorized by the sender shall

Unauthorized intercepting any message.

intercept any message and divulge or publish the contents, substance, purport, effect, or meaning of such intercepted message to any person; and no person not being entitled thereto shall receive or assist in receiving any radio communication and use the same or any information therein contained for his own benefit or for the benefit of another not entitled thereto; and no person having received such

Divulging contents, etc., of intercepted message.

intercepted radio communication or having become acquainted with the contents, substance, purport, effect, or meaning of the same or any part thereof, knowing that such information was so obtained, shall divulge or publish the contents, substance, purport, effect, or meaning of the same or any part thereof, or use the same or any information therein contained for his own benefit or for the benefit of another not entitled thereto: *Provided*, That this section shall not

Proviso.
Not applicable to broadcasting or distress signals.

apply to the receiving, divulging, publishing, or utilizing the contents of any radio communication broadcasted or transmitted by amateurs or others for the use of the general public or relating to ships in distress.

Uttering false distress signals, forbidden.

SEC. 28. No person, firm, company, or corporation within the jurisdiction of the United States shall knowingly utter or transmit, or cause to be uttered or transmitted, any false or fraudulent signal of distress, or communication relating thereto, nor shall any broadcasting station rebroadcast the program or any part thereof of another broadcasting station without the express authority of the originating station.

Rebroadcasting prohibitions.

No censorship, etc., allowed.

SEC. 29. Nothing in this Act shall be understood or construed to give the licensing authority the power of censorship over the radio communications or signals transmitted by any radio station, and no

regulation or condition shall be promulgated or fixed by the licensing authority which shall interfere with the right of free speech by means of radio communications. No person within the jurisdiction of the United States shall utter any obscene, indecent, or profane language by means of radio communication.

Communication of obscene, etc., language by radio, prohibited.

SEC. 30. The Secretary of the Navy is hereby authorized unless restrained by international agreement, under the terms and conditions and at rates prescribed by him, which rates shall be just and reasonable, and which, upon complaint, shall be subject to review and revision by the Interstate Commerce Commission, to use all radio stations and apparatus, wherever located, owned by the United States and under the control of the Navy Department (a) for the reception and transmission of press messages offered by any newspaper published in the United States, its Territories or possessions, or published by citizens of the United States in foreign countries, or by any press association of the United States, and (b) for the reception and transmission of private commercial messages between ships, between ship and shore, between localities in Alaska and between Alaska and the continental United States: *Provided*, That the rates fixed for the reception and transmission of all such messages, other than press messages between the Pacific coast of the United States, Hawaii, Alaska, the Philippine Islands, and the Orient, and between the United States and the Virgin Islands, shall not be less than the rates charged by privately owned and operated stations for like messages and service: *Provided further*, That the right to use such stations for any of the purposes named in this section shall terminate and cease as between any countries or localities or between any locality and privately operated ships whenever privately owned and operated stations are capable of meeting the normal communication requirements between such countries or localities or between any locality and privately operated ships, and the licensing authority shall have notified the Secretary of the Navy thereof.

Naval stations. Use of, authorized.

Press messages.

Private commercial messages with ships, and Alaska.

Proviso. Rates, other than Pacific coast press messages.

Termination of use when private stations able to meet requirements.

Notification to Secretary of the Navy.

SEC. 31. The expression "radio communication" or "radio communications" wherever used in this Act means any intelligence, message, signal, power, pictures, or communication of any nature transferred by electrical energy from one point to another without the aid of any wire connecting the points from and at which the electrical energy is sent or received and any system by means of which such transfer of energy is effected.

Meaning of "radio communication."

SEC. 32. Any person, firm, company, or corporation failing or refusing to observe or violating any rule, regulation, restriction, or condition made or imposed by the licensing authority under the authority of this Act or of any international radio convention or treaty ratified or adhered to by the United States, in addition to any other penalties provided by law, upon conviction thereof by a court of competent jurisdiction, shall be punished by a fine of not more than $500 for each and every offense.

Penalty for violating regulations, etc.

SEC. 33. Any person, firm, company, or corporation who shall violate any provision of this Act, or shall knowingly make any false oath or affirmation in any affidavit required or authorized by this Act, or shall knowingly swear falsely to a material matter in any hearing authorized by this Act, upon conviction thereof in any court of competent jurisdiction shall be punished by a fine of not more than $5,000 or by imprisonment for a term of not more than five years or both for each and every such offense.

Punishment for violating provisions, false swearing, etc.

SEC. 34. The trial of any offense under this Act shall be in the district in which it is committed; or if the offense is committed upon the high seas, or out of the jurisdiction of any particular State or district, the trial shall be in the district where the offender may be found or into which he shall be first brought.

Venue of trials.

Not applicable to Philippines or Canal Zone.
Authority of Secretary of State.

SEC. 35. This Act shall not apply to the Philippine Islands or to the Canal Zone. In international radio matters the Philippine Islands and the Canal Zone shall be represented by the Secretary of State.

Administrative officers in Territories and possessions.

SEC. 36. The licensing authority is authorized to designate any officer or employee of any other department of the Government on duty in any Territory or possession of the United States other than the Philippine Islands and the Canal Zone, to render therein such services in connection with the administration of the radio laws of the United States as such authority may prescribe: *Provided*, That such designation shall be approved by the head of the department in which such person is employed.

Proviso.
Approval of.

Wireless communication.
Unexpended balances for, made available.
Ante, p. 858.

SEC. 37. The unexpended balance of the moneys appropriated in the item for "wireless communication laws," under the caption "Bureau of Navigation" in Title III of the Act entitled "An Act making appropriations for the Departments of State and Justice and for the judiciary, and for the Departments of Commerce and Labor, for the fiscal year ending June 30, 1927, and for other purposes," approved April 29, 1926, and the appropriation for the same purposes for the fiscal year ending June 30, 1928, shall be available both for expenditures incurred in the administration of this Act and for expenditures for the purposes specified in such items. There is hereby authorized to be appropriated for each fiscal year such sums as may be necessary for the administration of this Act and for the purposes specified in such item.

In appropriations for 1928.
Post, p. 1206.

Future authorization.

Invalidity of any provision not to affect remainder of Act.

SEC. 38. If any provision of this Act or the application thereof to any person, firm, company, or corporation, or to any circumstances, is held invalid, the remainder of the Act and the application of such provision to other persons, firms, companies, or corporations, or to other circumstances, shall not be affected thereby.

Laws repealed.
Vol. 37, p. 302; Vol. 41, p. 1061; Vol. 42, p. 1495; Vol. 43, p. 1001.

SEC. 39. The Act entitled "An Act to regulate radio communication," approved August 13, 1912, the joint resolution to authorize the operation of Government-owned radio stations for the general public, and for other purposes, approved June 5, 1920, as amended, and the joint resolution entitled "Joint resolution limiting the time for which licenses for radio transmission may be granted, and for other purposes," approved December 8, 1926, are hereby repealed.

Ante, p. 917.

Pending suits, etc., not affected by repeal.

Such repeal, however, shall not affect any act done or any right accrued or any suit or proceeding had or commenced in any civil cause prior to said repeal, but all liabilities under said laws shall continue and may be enforced in the same manner as if committed; and all penalties, forfeitures, or liabilities incurred prior to taking effect hereof, under any law embraced in, changed, modified, or repealed by this Act, may be prosecuted and punished in the same manner and with the same effect as if this Act had not been passed.

Use of radio apparatus except as hereby provided forbidden.

Nothing in this section shall be construed as authorizing any person now using or operating any apparatus for the transmission of radio energy or radio communications or signals to continue such use except under and in accordance with this Act and with a license granted in accordance with the authority hereinbefore conferred.

In force on approval.
Penalties not enforced for 60 days.

SEC. 40. This Act shall take effect and be in force upon its passage and approval, except that for and during a period of sixty days after such approval no holder of a license or an extension thereof issued by the Secretary of Commerce under said Act of August 13, 1912, shall be subject to the penalties provided herein for operating a station without the license herein required.

Title of Act.

SEC. 41. This Act may be referred to and cited as the Radio Act of 1927.

Approved, February 23, 1927.

PART II

BROADCAST BAND

EXTENT OF BROADCAST BAND AND FREQUENCY SEPARATION BETWEEN CHANNELS

The extent of the broadcast band remains as it has been at all times since the creation of the commission; it extends from 550 to 1,500 kilocycles (corresponding to wave lengths from 545 to 200 meters), both inclusive. The commission adopted the policy of reserving this band for broadcasting, and of not extending it to include either higher or lower frequencies, after a series of public hearings held immediately after its organization. The experience of the commission since that time has confirmed it in the wisdom of its policy. The congestion in both the low and the high frequencies is already such as to forbid any extension.

The commission has also maintained its original policy of preserving a 10-kilocycle separation between channels used for broadcasting. Even a 10-kilocycle separation is a compromise with the ideal of good radio reception and any decrease in the separation would lead to disastrous results by way of interference.

Both the policy of the commission with respect to the extent of the broadcast band and its policy with respect to frequency separation were crystallized into definite form in the commission's General Order No. 40, issued and promulgated on August 30, 1928.[1] Under the International Radio Telegraph Convention of 1927 the entire band of 550 to 1,500 kilocycles is assigned to broadcasting, except the frequency of 1,365 kilocycles, on which the licensing of maritime mobile service is permitted. The practice in Europe (which is the only other continent in which broadcasting is sufficiently advanced to serve as a basis for study) is to maintain a frequency separation of 10 kilocycles and, in addition, only one station is permitted to operate on a channel at any one time.

There are thus a total of 96 channels in the broadcast band. Six of these are exclusively reserved for Canadian stations and 11 are shared with Canadian stations, as is shown in the next paragraph.

CHANNELS RESERVED FOR EXCLUSIVE AND SHARED USE BY CANADIAN STATIONS

One of the first acts of the commission on assuming office was to clear six channels which, under an informal understanding arrived at between the Department of Commerce and Canadian representatives, had been reserved for exclusive use by Canada. Prior to that time there were 41 American stations on those channels or so close thereto as to cause serious interference with the Canadian stations.

[1] See Appendix A, Supplement.

Since that time the commission has maintained the policy of keeping these channels clear and, furthermore, of regulating the use of 11 other channels shared by Canadian and American stations. This policy had also been recognized by the Department of Commerce prior to the enactment of the radio act of 1927. The proper regulation of the shared channels necessitates a limitation on the power of stations assigned to these channels on either side of the boundary line. Obviously stations located relatively closely to the boundary line can be assigned only a very small amount of power, while stations located at greater distances, such as in the south of the United States, can safely be authorized to use as much as 500 watts.

The policy of the commission with reference to the exclusive and shared Canadian channels was crystallized in definite form in its General Order No. 40 on August 30, 1928. The frequencies assigned exclusively to Canada are the following: 690, 730, 840, 910, 960, and 1,030 kilocycles. The frequencies assigned for shared use with Canadian stations are the following: 580, 600, 630, 780, 880, 890, 930, 1,010, 1,120, 1,200, and 1,210 kilocycles.

The question of the allocation of broadcasting channels between the United States and Canada can not as yet be regarded as definitely determined. During the past year representatives of Canada have strongly protested against the present basis as being unfair to Canada, and there seems to be a disposition on the part of that country to press a demand for an increased assignment. This was rather forcibly suggested in the course of the North American conference held in Washington, D. C., on August 20 to 25, 1928. The present allocation, however, is based on the respective populations of the two countries. Furthermore, the programs of American stations give extensive service in Canada. The commission believes, therefore, that the allocation as it now stands is fair to Canada and should not be changed. A more scientific choice of frequencies could be made than that now in force. So far there has been no serious problem of interference between broadcasting stations of this and other countries, including Canada, Mexico, and Cuba.

GENERAL ORDERS

During the period from July 1, 1927, to June 30. 1928, the commission issued its General Orders, Nos. 16 to 34, inclusive, and during the period from July 1, 1928, to October 26, 1928, it issued its General Orders, Nos. 35 to 49, inclusive. These orders cover a variety of subjects, some of them being in the nature of rules and regulations and others covering such matters as extension of existing licenses. For convenient reference these orders have been reprinted in chronological order in Appendix A of the Supplement. A few of the orders having to do with other forms of radio service than broadcasting will be referred to under the proper headings.

RENEWALS OF LICENSES

The broadcasting licenses which were in effect on July 1, 1927, had been issued under General Order No. 11 as amended by General Order No. 13. They were effective beginning with June 15, 1927, for a period of 60 days. Applications were required of all stations during that period, the applications consisting of reaffirmations of the truth of the data submitted in the original applications made to

the commission where no change in facts had occurred. Renewal licenses were issued, effective beginning with August 15, 1927, for a period of 60 days, to October 14, 1927, and by General Order No. 18 these licenses were all extended to October 31, 1927. On November 1, 1927, renewal licenses were issued, effective until December 31, 1927. By General Orders, Nos. 21, 22, 23, 25, 27, 33, 35, 36, 38, and 44, these licenses were extended to January 31, March 1, April 1, May 1, June 1, August 1, September 1, October 1, and November 11, 1928, respectively. All stations were required by General Order No. 21 to file, prior to January 15, 1928, renewal applications on forms provided by the commission. These forms were more detailed than those which had previously been used and required additional information on the subject of chain connection, advertising, and nature of program which had not previously been required. It was on the basis of these renewal applications that the proceedings under General Order No. 32, hereinbelow described, were held.

The renewals and extensions issued from time to time have, of course, been subject to many changes in frequency, power, and hours of operation of particular stations. Furthermore, certain stations have gone out of existence and new ones have been licensed.

CHANGES IN ASSIGNMENTS OF FREQUENCY, POWER, HOURS OF OPERATION, ETC., OF BROADCASTING STATIONS PRIOR TO MARCH 28, 1928

On the 90 channels available for broadcasting stations (including the 11 channels shared with Canada) there were, on July 1, 1927, a total of 698 stations in licensed operation, including 16 portables. A portion of them were dividing time, so that the total does not represent the number in simultaneous operation. Appendix B contains a complete list of these stations, arranged alphabetically by call letters, showing the authorized frequency and power of each station and noting cases of division of time. Appendix C (1) shows a comparison of the situation on July 1, 1927, and June 30, 1928.

Extensive changes were made in these assignments between July 1, 1927, and March 28, 1928 (the date on which the Davis amendment became law). These changes were accomplished both by action affecting individual stations (as the result of applications and hearings) and by general reassignments affecting a large number of stations simultaneously. Radio-reception conditions were far from satisfactory as the result of the commission's reallocation of June 15, 1927. The reallocation had succeeded to a marked extent in reducing interference arising from congestion in the larger metropolitan centers, where the stations had been crowded together without adequate frequency separation; it had not, however, succeeded in remedying the heterodyne interference (resulting from two or more stations operating simultaneously on the same channel), which was ruining reception in rural areas, and indeed in all parts of the country. The complaints which deluged the commission immediately made it apparent that changes would have to be effected.

HEARINGS ON APPLICATIONS FOR MODIFICATIONS OF LICENSES

In addition, a large number of stations which were complaining of their particular assignments applied for modifications of their

licenses and participated in hearings. These hearings resulted in a limited number of changes hereinafter briefly summarized.

(*a*) *Hearing on applications for modification of licenses.*—Between July 1, 1927, and March 28, 1928, the commission held a total of 51 hearings on applications of particular broadcasting stations for better assignments with respect to frequency, power, and/or hours of operation. In all cases where a station applied for a particular frequency all stations assigned to that frequency (and in some cases to adjacent frequencies where the stations on these frequencies would be affected) were notified and were accorded the privilege of appearing at and participating in the hearing. In all cases where a station applied for an increase of power without asking a change in frequency all stations assigned to the frequency affected were notified and accorded a similar privilege. In the great majority of cases one or more of the stations so notified availed themselves of the privilege and opposed the applications. The commission guided itself by the test of public interest, convenience, or necessity in determining whether any particular application should be granted, and required the contending stations to make complete showings of their past record of service, their program resources, etc. In a very substantial number of cases the contention was made, with success, that the applicant (or one of the respondents) represented a station located in a State which did not have its fair or equitable share of radio service, and the commission gave full weight to the contention whenever it was made. A summary of the hearings and of the commission's decisions is contained in Appendix C (2).

(*b*) *Changes made in fifth zone as result of inspection trip by Commissioner Bellows.*—By its General Order No. 17, issued on August 16, 1927, the commission authorized each of its members to visit the zone from which he was appointed, at some time between August 20 and October 4, for the purpose of observing the actual conditions of radio reception resulting from the new allocation. The commissioners were authorized to take testimony relating to the stations at any place within the zone.

Commissioner Bellows held hearings in Indianapolis, Ind., and then, because of Commissioner Dillon's illness, proceeded to Denver, Colo., where he held a series of public hearings from September 26 to September 30, 1927. As a result of these hearings the commission ordered extensive changes in the assignments of stations in that vicinity, effective November 1, 1927. These changes are summarized in Appendix C (3).

(*c*) *Clearing of 25 channels.*—With the approach of winter conditions in the fall of 1927 the widespread development of heterodyne interference, in rural areas particularly, made immediate action imperative. On November 14, 1927, the commission, in an effort to ameliorate the situation, issued its General Order No. 19. This order designated the band of channels from 600 to 1,000 kilocycles, inclusive, as a band to be cleared of and maintained free from heterodyne or other interference. Stations then operating on such of those channels as would not be free of interference on November 1 were directed to clear the channels during the pending license period (which terminated on December 31, 1927) by sharing time, controlling power,

controlling frequency, or any other methods. The commission indicated that if cooperation between the stations would not effect the desired result, then the commission would hold hearings, to determine which stations should be relicensed to continue on any particular channel. General Order No. 19 was accompanied by a statement issued by the commission, which is set forth in Appendix C (4). The commission simultaneously ordered a large number of changes to be made in the assignments of stations, effective December 1, 1927. The changes thus ordered are set forth in Appendix C (5). The consequent effect of the order and of the changes made under it was shown by a list of stations published by the commission setting forth the stations assigned to each frequency from 600 to 1,000 kilocycles, inclusive. This statement was entitled "Channels Cleared of Heterodyne Interference and Channels yet Uncleared." It is set forth in Appendix C (6).

(*d*) *Changes made in the fifth zone, effective March 1, 1928.*—By its General Order No. 20, issued November 29, 1927, the commission again authorized each of its members to visit the zone from which he was appointed. This was to be done between November 29, 1927, and February 1, 1928, for the purpose of further observing the actual conditions of radio reception resulting from the new allocation and the character of programs broadcast.

Commissioner Lafount, who had just been appointed, made an intensive and personal survey and study of radio problems in his zone, which includes the Rocky Mountain and Pacific Coast States. Upon his return on January 16, 1928, he made a report, which is set forth in Appendix C (7). In the course of his 8,206-mile trip he interviewed 769 persons representing 102 broadcasting stations out of 122 in the fifth zone; he interviewed 96 persons who desired broadcasting licenses; he interviewed 141 listeners and 74 persons interested in radio privileges in the short-wave band, etc. He made an analysis of the programs of 100 stations in the fifth zone, which is set forth in Appendix C (8). On January 19, 1928, he sent to the stations in his zone a digest of requests which had been made to him by the 102 broadcasters he had interviewed. This digest is set forth in Appendix C (9).

As a result of Commissioner Lafount's studies the commission on February 18, 1928, ordered a large number of changes in station assignments in the fifth zone, effective March 1, 1928. These changes are set forth in Appendix C (10). The reports which followed the putting into effect of these changes indicated that a vast improvement in radio reception had been achieved in that zone.

(*e*) *The third zone.*—Under General Orders, Nos. 16 and 20, Commissioner Sykes had made extensive studies of broadcasting problems in the third zone. The charge had been made that the commission had discriminated against the South. This charge was emphatically denied by the commission, and set forth its attitude on the subject in a letter signed by Admiral Bullard, chairman, made public August 24, 1927. (Appendix C (11).) The underrepresentation of the South was due to purely historical reasons, for which the commission was not responsible. The South did not have its proportionate share of broadcasting stations when the commission came into existence and applications from the South were not as numerous as from the other zones.

CHANGES IN TOTAL NUMBER OF STATIONS

We are discussing separately below the changes in number of stations due to the commission's General Order No. 32 and to the elimination of portable stations and to the new allocation of September 10, 1928. Independently of these actions of the commission 47 broadcasting stations voluntarily surrendered their licenses during the period between March 15, 1927, and June 30, 1928. A list of these stations is contained in Appendix D (1). During the same period a total of 32 construction permits were granted by the commission for new stations, largely in the third zone, and later licenses were granted. A list of applications for construction permits showing those granted, pending, and disapproved, arranged by zones, appears as Appendix D (2). In a number of cases applications were styled as being for construction permits when in reality they were simply for increases of power or changes of location without new apparatus. The above-mentioned lists did not, of course, include the new stations that were licensed or to which construction permits were granted in connection with or shortly after the allocation of September 10, 1928. A complete list of licensed broadcasting stations alphabetically arranged by call letters as of June 30, 1928, is contained in Appendix D (3); and a list of licensed broadcasting stations numerically arranged by frequencies, as of June 30, 1928, is contained in Appendix D (4).

THE DAVIS AMENDMENT

The problems of the commission in endeavoring to achieve better radio reception and at the same time to work toward the "fair, efficient, and equitable radio service" as between the different States and communities, as required by section 9 of the radio act of 1927 before the amendment, were somewhat changed in character by the amendment which became law on March 28, 1928. (Appendix E (1).) It has become popularly known as the Davis amendment. It has as its declared purpose:

> That the people of all the zones * * * are entitled to equality of radio-broadcasting service, both of transmission and reception.

It then proceeds to prescribe the methods for attaining the desired equality. These methods are as follows:

> 1. The licensing authority shall, as nearly as possible, make and maintain an equal allocation of broadcasting licenses, of bands of frequency or wave lengths, of periods of time for operation, and of station power to each of said zones when and in so far as there are applications therefor; and
>
> 2. Shall make a fair and equitable allocation of licenses, wave lengths, time for operation, and station power to each of the States, the District of Columbia, the Territories, and possessions of the United States within each zone, according to population.

Congress directed that the equality should be carried into effect whenever necessary or proper—

> By granting or refusing licenses or renewals of licenses, by changing periods of time for operation, and by increasing or decreasing station power when applications are made for licenses or renewals of licenses.

The amendment contains a proviso permitting a zone which is over its quota under any of the four headings of prescribed equality to borrow from a zone which is under its quota, the borrowing to be shown in temporary licenses.

Radiobroadcasting service depends in the first instance upon geographical considerations, principally distance and area, and not upon population. Approximately correct figures with regard to population and area of each zone, and of the radius of the largest circle that can be drawn in each zone, are as follows:

	Population	Area	Radius of largest circle
		Square miles	*Miles*
First zone	27,385,288	129,110	250
Second zone	28,123,000	247,517	131
Third zone	28,088,618	761,895	427
Fourth zone	26,786,192	658,148	380
Fifth zone	11,266,244	1,774,437	725

A given number of broadcasting stations of given power will give much better service to a zone which is small in area than to a zone which is large in area. The commission in working out the proper application of the amendment, desired to take advantage so far as possible of the difference in time between the Atlantic and Pacific coasts, of the daytime operation of stations, of the greater use of Canadian-shared channels which is possible in the South, and other considerations which could not easily be accommodated to mathematical equality. The "borrowing" clause proved to be of practically no assistance in solving the problem, because there were very few cases where a facility due any particular area could be spared from the service of that area.

There was in the commission a difference of opinion as to the intention of Congress with regard to the method of putting the amendment into force. A majority of the commission has construed the amendment as requiring an immediate reallocation of broadcasting facilities so as to attain the prescribed equality. Commissioner Robinson has construed the amendment as indicating a policy to be followed in the future by the commission in gradual steps without calling for any general rearrangement of stations immediately, and that the equalization was to be accomplished "when and in so far as there are applications." There has also been a difference of opinion as to whether the amendment, properly construed, requires an equality in number of licensed broadcasting stations by zone without regard to division of time or whether two or more stations dividing time in one zone may be balanced as against one station occupying full time in another zone.

On June 30, 1928, the broadcasting facilities of the United States were distributed among the five zones approximately as follows:

	Total number of stations	Total frequencies in use	Total power
			Watts
First zone	128	64	228,135
Second zone	112	53	109,990
Third zone	116	54	59,535
Fourth zone	206	73	162,805
Fifth zone	134	74	67,145

These figures are of only approximate accuracy but will serve the purpose. They include 13 portable stations which were forced to cease operation beginning with July 1, 1928. They also include under the heading of "Total power" a certain amount due to increases granted to new stations under construction permits or to old stations, particularly in the third zone. Appendix E (2) shows an allocation of radio facilities to the various States and Territories as of June 30, 1928.

VARIOUS PLANS SUBMITTED TO COMMISSION

(*a*) *Various plans presented to the commission for compliance with the Davis amendment.*—The problem of applying the Davis amendment to the approximately 700 existing broadcasting stations was submitted by the commission to a group of experts consisting largely of well-known radio engineers. This group submitted a memorandum to the commission on March 30, 1928, setting forth a plan classifying the 90 broadcasting channels into three groups—"exclusive," "regional," and "local"—apportioning these channels equally to the five zones and in each zone to the States so far as possible, in accordance with the population. The memorandum was accompanied by two sample allocations which differed only in the number of channels assigned to exclusive and regional service, respectively. In one of these it was proposed to allocate 50 channels for rural as well as urban service, each channel to be exclusive, and 36 for regional service with an average of 2½ stations on each channel. In the second the exclusive and regional channels were 30 and 56, respectively. In both cases 4 channels were to be devoted to local stations. The average power contemplated on the local channels was to be 100 watts, on the regional 500 watts, and on the exclusive 20 kilowatts. The memorandum, together with the sample allocations, is set forth in Appendix E (3).

The commission held a conference with a number of radio engineers on April 6, 1928. Dr. J. H. Dellinger, of the Bureau of Standards, acted as chairman of the conference. The broadcasting committee of the Institute of Radio Engineers submitted a report, which is contained in Appendix E (4), likewise favoring the plan of allocation just mentioned and covering other matters of importance for the prevention of interference. The engineers present adopted a resolution favoring the plan calling for 50 exclusive channels and 36 regional channels. This resolution is set forth in Appendix E (5). Doctor Dellinger prepared a summary of the discussion and conclusions of the conference, which is set forth in Appendix E (6).

On April 23, 1928, the commission held a further hearing to permit the radio industry to express its views on the proper method of applying the Davis amendment. The meeting was held largely at the request of the National Association of Broadcasters, the Federated Radio Trades Association, and the Radio Manufacturers' Association. It was attended, however, by a number of persons representing practically all interests concerned directly or indirectly in broadcasting and including a number of the radio engineers who had participated in the previous discussion. A partial list of those present is contained in Appendix M (4). Congressman Davis, the author of the amendment, was unable to be present, but submitted to the commission a letter outlining his views as to its proper application, which

letter is set forth in Appendix E (7). A series of recommendations was made to the commission in a memorandum submitted by the National Association of Broadcasters, the Federated Radio Trades Association, and the Radio Manufacturers' Association, which memorandum is set forth in Appendix E (8). The memorandum, while expressing sympathy with the ideals sought to be attained by the engineers' recommendations, suggested a method of procedure which was calculated to bring about as small a change in existing allocations as was possible, consistent with the requirements of the law, at the same time leaving the way open to a gradual improvement of conditions. Suggestions were also made in a memorandum presented by Louis B. F. Raycroft, vice president of the National Electric Manufacturers' Association (Appendix E (9)), and Louis G. Caldwell, representing several individual broadcasting stations (later general counsel of the commission), the latter suggestions being incorporated in a printed pamphlet which is too long for reprinting in the report. Doctor Dellinger prepared a memorandum discussing the proposals made at the hearing, which is set forth in Appendix E (10). Experts employed by the commission made a tabulation showing the percentages of radio facilities assignable to each State in proportion to population, based upon estimates in the 1928 population prepared by the United States Census Bureau, which gives the total population of the United States as 121,649,342. This is contained in Appendix E (11).

(*b*) *Discontinuance of portable stations.*—Prior to July 1, 1928, there were 13 portable broadcasting stations in licensed operation. Four were in the first zone, 1 in the second zone, none in the third zone, 6 in the fourth zone, and 2 in the fifth zone. They have been a constant source of interference both because of lack of proper equipment and because their changing geographical locations made it impossible to avoid interference arising out of too small a frequency separation as they moved into the vicinity of broadcasting stations assigned to adjacent frequencies. On May 10, 1928, the commission issued its General Order No. 30 to the effect that no licenses or renewals of licenses or extension of existing licenses would be issued to portable broadcasting stations after July 1, 1928, and that on that date such stations would cease operation. By its General Order No. 34 the commission extended the licenses of the portable stations to July 1, 1928, at which date they were to expire. Provision was made for giving these stations a hearing, but at their request the hearing has been continued from time to time and has not yet been held. Since the issuance of General Order No. 30 two of the portable stations have become "anchored" and have been licensed as fixed stations with small amounts of power. A list of portable stations affected by General Orders, Nos. 30 and 34, is contained in Appendix F (1).

(*c*) *General Order No. 32.*—The Davis amendment provided that the required equality of broadcasting service should be carried into effect whenever necessary or proper—

> By granting or refusing licenses or renewals of licenses, by changing periods of time for operation, and by increasing or decreasing station power when applications are made for licenses or renewals of licenses.

The commission had before it requests of approximately 700 broadcasting stations for renewals of their licenses prior to January 15, 1928.

Obviously, before it could intelligently fix upon the quota of each zone the commission had to ascertain approximately how many stations were to remain in operation. A list of 164 stations (Appendix F (2)) was made up and required to make a showing that their continued operation would serve public interest, convenience, or necessity. The commission had in its files reports of supervisors and other records of information indicating that it was very doubtful whether any of these broadcasting stations was performing any service entitling it to a renewed license. The procedure followed was that prescribed by section 11 of the radio act of 1927. A hearing was set for Monday, July 9, 1928, at 10 o'clock a. m., at the office of the commission in Washington, D. C. A copy of the letter sent to each station and a list of the stations included in General Order No. 32 is contained in Appendix F (2). An analysis showing the total number of licensed stations in each State and zone as of June 30, 1928, and the number thereof that were included in General Order No. 32 is contained in Appendix F (3). Reference to the last-mentioned appendix will show that in making up the list the commission had under consideration the necessity for reducing the number of stations in the overcrowded zones, particularly the fourth, where 91 of the 164 were located.

During the period between the issuance of General Order No. 32 and the date set for hearings the members of the commission devoted themselves to a study of conditions in the zones most affected. Commissioners Robinson and Caldwell spent June 5 and 6, 1928, in New York City studying the congested New York area.

Commissioners Sykes and Pickard visited various points in the fourth zone and held meetings with broadcasters in Chicago, Ill., on Monday, June 4; in Des Moines, Iowa, on Wednesday, June 6; in Lincoln, Nebr., on Thursday, June 7; and in Kansas City, Mo., on Friday, June 8. Broadcasters from the territory surrounding each of the cities, including the adjacent States, were invited to these conferences. Commissioners Sykes and Pickard discussed with the broadcasters various proposals of consolidations of stations, further division of time, the removal of particular stations to less congested districts, and other plans which would materially reduce the number of channels occupied in the overcongested areas.

(*d*) *Hearings pursuant to General Order No. 32.*—Approximately 110 of the 164 stations appeared before the commission on July 9, 1928, to take advantage of the hearing which had been provided, and about 14 additional stations submitted their cases on affidavits. Thirty-six stations defaulted, but of these four later made a showing before the commission on which their cases were reinstated and considered. Four stations voluntarily surrendered their licenses.

Hearings were held daily throughout the two weeks between July 9 and 21, 1928. After the first day the commission divided into two sections, one presided over by Commissioner Robinson and one by Commissioner Sykes. Hearings were held until late in the evening on nearly every day, with the result that by Friday, July 20, every station desiring a hearing had been accorded full opportunity to present any material evidence. On July 23 evidence was heard by the commission on facts and principles of radio engineering limiting the total number of broadcasting stations that can broadcast

simultaneously in the United States consistently with good radio reception. This testimony was made applicable to each of the cases heard. The witnesses heard by the commission consisted of Dr. J. H. Dellinger, of the Bureau of Standards; John V. L. Hogan, consulting radio engineer of New York; and Prof. C. M. Jansky, jr., of the University of Minnesota. C. W. Horn, radio engineer for the Westinghouse Electric & Manufacturing Co. at Pittsburgh, was called to make a statement as to the present status of synchronization.

(*e*) *Decisions in cases heard pursuant to General Order No. 32.*—The commission devoted the weeks following the hearings to a consideration of the evidence (as well as to work on the reallocation which was then in progress). Some time was necessary for the consideration of the evidence because of the fact that each of the two divisions had to examine the evidence heard by the other division. The decisions were all entered during the week commencing August 20. An analysis of the decisions shows that out of the 164 stations cited 81 escaped adverse action by the commission, 12 were substantially reduced in power, 4 were placed on probation, and 5 were left on as the result of consolidations with other stations (2 of these consolidations also involving reductions in power). All told, 62 stations were deleted—4 as the result of surrender of license, 26 as the result of action by the commission, and 32 as the result of default. A list of all cases of adverse actions against the stations is contained in Appendix F (4).

In connection with the announcement of the decisions the commission issued several statements setting forth principles which had guided it in making the decisions. The most important of these statements will be found in Appendix F (5). A statement by the commission relating to public interest, convenience, or necessity is shown as Appendix F (6).

(*f*) *Legal proceedings arising out of decisions under General Order No. 32.*—In only one case has an appeal been taken to the Court of Appeals of the District of Columbia as provided in section 10 of the radio act of 1927. The case is that of Station WTRL, of Midland Park, N. J. Two other stations—WCRW, Clinton R. White, of Chicago and WEDC, Emil Denemark, of Chicago—have had recourse to the courts without appeal. Both stations were reduced in power from 500 to 100 watts. Each has filed a bill in the Federal Court for the Northern District of Illinois, Eastern Division, naming the United States attorney and the local radio supervisor and members of the Federal Radio Commission as defendants. The bills seek to restrain enforcement of the commission's orders by any of the defendants and attack the radio act of 1927 as amended as unconstitutional. Motions on the part of plaintiff for temporary injunction in each case and motions to dismiss on the part of the defendants have been argued and have resulted in (1) the dismissal of the bills as against the commission, (2) denial of the plaintiffs' motion for a temporary injunction, and (3) denial of the United States attorney's motion to dismiss on the face of the bill (for the purpose of requiring him to file an answer and thus completing the record). The court held the radio act of 1927 to be constitutional and valid. Station WCRW has appealed from this decision to the Court of Appeals for the Seventh Circuit.

NEW ALLOCATION

During the months of July and August, 1928, the commission, with the assistance of its engineering division, was endeavoring to work out an allocation of broadcasting stations with respect to frequency, power, and hours of operation that would conform as nearly as possible to the requirements of the Davis amendment. Commissioners Caldwell and Pickard constituted a committee for the purpose, and Commissioner Lafount participated in their work. The best engineering advice in the country was sought and received. Several different plans were crystallized complete in every detail only to fail to meet the approval of the requisite majority of the commission. Finally, however, an allocation was achieved which met with the approval of four members of the commission. Commissioner Robinson voted against it, adhering to his belief that the Davis amendment was not intended to require a reallocation of the entire broadcasting spectrum to be made at one time, and that the equalization was to be a gradual process of changes which were, in the language of the amendment, to be accomplished only "when and in so far as there are applications therefor." He opposed the plan also because it included what, in his opinion, were excessive power assignments to certain stations.

The first step toward putting the new allocation into effect was the issuance of General Order No. 40 (Appendix A), the terms of which were agreed upon only after a majority of the commission had found themselves in agreement on the application of its terms to the existing stations. This order was issued on August 30, 1928. It represented a combination of the plans which had been suggested to the commission from time to time, together with certain concessions which had to be made to the practical necessities of the situation because of the existing number and character of the broadcasting stations. Forty channels were set apart for stations of sufficient power on cleared channels to give good service to rural and remote listeners. These channels were allocated equally, eight to each zone. This type of service corresponds to the type which was called "national" in the plans submitted to the commission by expert engineers in April. Thirty-five channels were set aside for stations of power not to exceed 1,000 watts, to be allocated equally among the zones, each channel to be used—with certain exceptions—by not less than two nor more than three stations. Six channels were set aside for use in all five zones by stations of 100 watts or more; five channels were set aside for use in all five zones by stations having not to exceed 1,000 watts; four channels were set aside for use by stations of 5 kilowatts in two or more zones. By a supplementary General Order No. 42 the power of stations on the 40 cleared channels was limited to 25 kilowatts, with provision for the use of 50 kilowatts during the next license period in order to determine what interference, if any, would result. Commissioner Robinson urged a limitation to 10 kilowatts.

A majority of the commission believes that this plan is the best which could be devised with due regard to existing conditions. It provides, or at least makes possible, excellent radio reception on 80 per cent of the channels. The few other channels will suffer from heterodyne interference except in a small area close to each station.

The general orders were followed by an announcement of the specific assignments of stations with respect to frequency, power, and hours of operation. This new allocation arranged by States was announced on September 10, 1928, to go into effect on November 11 (Appendix G (1)), and was revised on October 16 and 19 (Appendix G (1 *a* and *b*)). The intervening period was considered necessary in order to give the stations affected ample time to make such changes in apparatus and such tests as may be necessary to meet the new requirements. Provision was made by General Order No. 45, issued on September 24, for tests on the new frequencies by all stations during the hours between shortly after midnight and morning. The original allocation (revised) is set forth in Appendixes G (1) and G (1 *a* and *b*), the former being a list of stations arranged by States showing their new and old assignments. The latest revised list setting forth the allocation by channels forms Appendix G (2). The announcement was accompanied by a statement explaining its effect and advising stations not satisfied with their assignments of the method for bringing their claims to the attention of the commission. This statement is set forth in Appendix G (3).

The new allocation was analyzed by Dr. J. H. Dellinger, chief engineer of the commission, in a statement which is set forth in Appendix G (4).

As was to have been expected, there have been a number of complaints against the allocation on the part of particular stations and their adherents. On the whole, however, the complaints have been to date very much less in number than the commission expected. The commission intends to commence hearings on these complaints immediately after October 12, and, if possible, to conclude them prior to November 11. New licenses will be issued corresponding to the allocation and to any changes that may be made as the result of hearings. These licenses are to be effective as of November 11, to terminate on January 31, 1929.

An analysis of the quotas to which the respective States are entitled as to each of the classes of channels, if the Davis amendment is to be applied with mathematical precision, is set forth in Appendix G (5). A certain number of stations were accommodated in the new allocation on the basis of daytime and limited time assignments. General Order No. 41 was issued on September 4, 1928, defining daytime stations.

CONSTRUCTION PERMITS AND NEW LICENSES

Immediately after the new allocation the commission proceeded to act upon the large number of applications for construction permits and for increases in power which it had from existing or prospective broadcasting stations. These were granted only in cases and to the extent to which they could be accommodated under the allocation and the principles thereof which had been adopted by the commission.

RULES AND REGULATIONS

A variety of subjects have been covered by rules and regulations of the commission, promulgated in the form of general orders.[1]

[1] See Appendix A, Supplement.

By its General Order No. 16, issued on August 9, 1927, the commission, while not condemning the practice of using mechanical reproductions such as phonograph records or perforated rolls, required that all broadcasting of this nature be clearly described in the announcement of each number. The commission has felt, and still feels, that to permit such broadcasting without appropriate announcement is, in effect, a fraud upon the public. It is true that in the smaller communities which do not have adequate original program resources the use of phonograph records may fill a need; it is true also that there may be developments in specially produced phonograph records which can be made use of to advantage by radio. On the whole, however, the commission is inclined to believe that the use of ordinary commercial records in a city with ample original program resources is an unnecessary duplication of service otherwise available to the public, and the crowded channels should not be wasted in this manner. General Order No. 49, issued on October 26, 1928, makes more rigid requirements as to announcements of mechanical reproductions.

Section 18 of the radio act of 1927 prohibits any discrimination by broadcasting stations as between regularly qualified candidates for a public office. By its General Order No. 31, issued on May 11, 1928, the commission called particular attention of all stations to this section. It has not yet proved possible, however, to issue definite regulations on the subject. There has been practically no cause for complaint in the conduct of the stations.

A problem with which the commission is faced from time to time is the extent and character of advertising which will be permitted by broadcasting stations. There is a tendency to make a distinction between "direct" and "indirect" advertising, but, obviously, there is no sharp line of demarcation between them. By "direct" advertising is usually meant the mention of specific commodities, the quoting of prices, and soliciting of orders to be sent directly to the advertiser or the radio station. By "indirect" advertising is usually meant advertising calculated simply to create or maintain good will toward the advertiser. In some localities, such as Iowa, direct advertising has assumed very substantial proportions. Soon after the commission was established many objections to such advertising were received by the commission from listeners, and in the first allocation certain of these stations were given only limited facilities. Hearings were held at the request of these stations, and the mass of documentary evidence submitted seemed to show overwhelmingly that a majority of the public in certain areas favored direct advertising by radio of certain products for farm consumption, having the idea that there were economic advantages in this method. One such station submitted evidence showing that it had received over one-half million commendatory letters in one year.

On the other hand, there has been some measure of complaint by competing merchants who do not have broadcasting facilities to the effect that they were placed under an unfair disadvantage by such use of a Government franchise.

The problem is far from being solved. It is manifest that broadcasters must resort to some form of advertising to obtain the revenue

for the operation of their stations. On the other hand, it is equally manifest that the advertising must not be of a nature such as to destroy or harm the benefit to which the public is entitled from the proper use of broadcasting channels. The commission has, of course, no power to censor programs and must proceed cautiously in its regulations on this subject.

As yet no extensive regulations have been established governing the technical operation of broadcasting stations. With the going into effect of the new allocation the commission will be able to devise and put into effect much-needed regulations intended to require broadcasters to keep reasonably abreast of the state of the art. The most important occasion for regulation is frequency stability, namely, the adherence of a station, as nearly as possible, to the exact frequency to which it has been assigned. By its General Order No. 7, issued April 28, 1927, the commission fixed a maximum of one-half kilocycle as the extreme deviation from authorized frequency.

Some experiments have been made on synchronization of broadcasting stations; that is to say, the operation of two or more stations on exactly the same frequency or so closely thereto that the separation is such as not to produce an audible whistle. The nature of the problem, as well as the methods which have been attempted, are outlined in an address by Commissioner O. H. Caldwell before the American Institute of Electrical Engineers in New York on October 14, 1927. (Appendix H.) The information received and investigation made by the commission to date indicate that synchronization on a wide scale is not yet practicable. If and when it is successful the commission's problem of allocation will be immeasurably reduced, because of the increased capacity of each channel with two or more stations broadcasting simultaneously. The commission has adopted the policy of encouraging synchronization, but does not feel that the time is ripe for making any assignment based on it. Experiments have been conducted under authority of the commission by stations WAIU, of Columbus, Ohio, and KMOX, of St. Louis, Mo.; by stations WDRC, of New Haven, Conn., and WAIU; and by stations WTMJ, of Milwaukee, Wis.; WODA, of Paterson, N. J.; WGL, of New York City; KPRC, of Houston, Tex.; WBZ, of East Springfield, Mass., and WBZA of Boston, Mass.; and WSYR, of Syracuse, N. Y., WTMJ being the key station.

POPULARIZING OF HIGHER FREQUENCIES

During the year the commission endeavored to popularize the frequencies just below 1,500 kilocycles by a policy of granting more power to stations on these channels. With the development in the frequency range covered by receiving sets during the last two years there is decreasing basis for complaint against the use of these channels and there is no inherent engineering reason against the use of such channels for broadcasting. Pursuant to this policy, the commission licensed several stations to use substantial power on these channels such as WTFF, at Mount Vernon Hills, Va.; WCSH, at Portland, Me.; WHBN, at Gainesville, Fla.; and WKBW, at Buffalo, N. Y.

CHAIN BROADCASTING

With a comparatively few exceptions the chain stations are independently owned and have no connection with companies owning or interested in the chain broadcasting company other than their arrangements for taking a certain amount of such programs. The commission has never favored chain stations in its assignments because of any affiliations with the chain. It has uniformly selected for the preferred positions such stations as are entitled thereto because of their individual history and standing, their popularity with their audiences, the quality of their apparatus, and their faithful observance of radio rules of the air. It is interesting to note, however, that in many cases stations which were not affiliated with chains at the time they received favorable assignments from the commission thereafter entered upon such affiliations. An example of this is station WEBC, of Superior, Wis. In order to make it certain that President Coolidge would have good radio reception at his summer home, the commission on June 4, 1928, temporarily increased this station's power from 250 to 1,000 watts for evening broadcasting during the summer. Soon after obtaining this increase the station on its own volition affiliated itself with one of the large chains.

By its General Order No. 43, issued on September 8, 1928, the commission sought to limit the use of cleared channels for chain programs by requiring a geographical separation of 300 miles between stations using such programs, except for one hour each evening. The order sought to encourage synchronization by making an exception in case two stations operated on the same frequency. It also made provisions for exceptions in cases of programs of extraordinary national interest. Nevertheless the very drastic effect of the order soon became apparent from the storm of protest from the listening public, and the commission deemed it wise to postpone the effective date of the order from November 11, 1928, to February 1, 1929, in order to give it an opportunity to make further investigation to avoid injustice to listeners.

The commission will observe with particular care the effect of its new allocation of broadcasting stations upon chain broadcasting.

TELEVISION

The recent advances in radio television threaten to create serious problems. The commission has allowed a few broadcasting stations to experiment with television in the broadcast band on their assigned channels on condition that this form of communication be limited to a small amount of time per day and be so conducted as not to cause interference on adjacent channels. There is also a distinct development of television in the high-frequency band. It has been urged upon the commission that it should permit regular television service in the broadcast band as well, because of the fact that a large potential audience is already at hand and in some cases the ordinary receiver can be adapted to receive television by the addition of certain apparatus. Television signals, however, will subject the broadcast listener to objectionable noises. The International Radio Convention limits the broadcasting band to telephonic signals. The

commission has not yet determined its final policy with reference to this subject.

RECEIVING SETS IN THE UNITED STATES

For convenient reference there is appended a table showing the approximate number of receiving sets in use in the United States. (Appendix I.) This table is the result of a nation-wide survey completed in May, 1928, and conducted by Radio Retailing in compliance with the request of the commission. The survey shows a total of nearly 12,000,000 receiving sets in use, serving an audience of more than 40,000,000 people. Appeals for all available statistics were addressed to trade bodies, trade publications, and others in close touch with the industry. The figures show that 7,500,000 standard receiving sets with loud-speaker volume are now in use; they do not include crystal or ear-phone receivers of obsolete type. The survey indicates that the total would approach 12,000,000.

Radio Manufacturing

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*287 OVERCOMING AGORAPHOBIA:BUILDING THE COMMONS OF THE DIGITALLY NETWORKED ENVIRONMENT

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*290 I. INTRODUCTION

We are in the process today of making a fundamental choice about how we will communicate with each other in the next century. We are making this choice without debating it. In fact, we are talking about the wrong thing, at the wrong time, and making this choice (which may be right) for the wrong reasons or for no reason at all. The decision to be made is deceptively "technical":how to regulate that part of the digitally networked environment that utilizes wireless or radio-communications technology. The current legal framework for radio transmission relies on administrative licensing of broadcasters. The emerging regulatory alternative replaces licensing with an exhaustive system of property rights in the radio frequency spectrum. This article analyzes a third alternative:regulating wireless transmissions as a public commons, as we today regulate our highway system and our computer networks. The choice we make among these alternatives will determine the path of development of our wireless communications infrastructure. Its social, political, and cultural implications are likely to be profound.

Most contemporary debates about how to regulate communications using the radio frequency spectrum revolve around whether to regulate through administrative licensing or by auctioning property rights "in the spectrum." For a long time, that was the right question to argue about. But it is no longer so. Technological developments in digital information processing and wireless communications have made possible an alternative regulatory approach. It is now possible to regulate wireless communications as we do the Internet-- with minimal standard protocols--or the highway system--with limited governmentally-imposed rules of the road. A Federal Communications Commission ("FCC") order that became effective in April 1997 has indicated how this regulatory framework might look. But it also suggests how our present commitments to centralized control of wireless communications by licensees or owners of radio frequency bands could stunt the development of the communicative equivalent of "the open road" in the digitally networked environment.

Our capacity to think about the truly central questions concerning regulation of wireless communications is obscured by the language we use to discuss the problem. When we speak of regulating wireless communications, we speak of managing "a resource," namely, "the spectrum." Generally, we use market-based solutions for resource management, and therefore when posed with such a problem look for some*thing* to which we can affix property rights to be traded in the market. But there is no such "thing" as "spectrum." There is no ether out there, no finite physical "resource" that needs to be allocated. There *291 are simply people communicating with each other, transmitting and receiving messages with equipment that uses electromagnetic waves to encode meaningful communications and send them over varying distances without using a wire. "Spectrum management" means regulating how these people use their equipment. "Spectrum allocation," whether it be done by licensing or

auctioning, is the practice whereby government solves this coordination problem by prohibiting most people in society from operating radio transmitters, and threatening that it will tear down their antennas and confiscate their transmitters if they try to communicate with each other using wireless communications equipment without permission. This is done so that other people--broadcast licensees or spectrum "owners"--can successfully communicate.

The rhetorical effects of treating spectrum as "a resource" obscure the more important choice to be made with respect to radio communications:whether to regulate them by centralizing control of wireless communications or, alternatively, by establishing a means of allowing users to coordinate their wireless transmissions multilaterally. Once we understand that the question is how to regulate the use of *equipment,* rather than "a resource," we will be able to recognize that we have alternative regulatory models in our society. In the case of automobiles or networked computers, which involve similar coordination problems, our social choice has not been to give a small number of users an exclusive license or property right to control an input essential to effective use of the equipment. Instead, in the case of automobiles, we have chosen to allow anyone to buy and use the equipment, subject to certain "rules of the road" that allow equipment users to coordinate their use and avoid interference. In the case of networked computers, we have relied primarily on a public domain standard, TCP/IP, supplemented by industry and professional standard-setting procedures, and on competition in the equipment and service markets that rely on access to this standard.

Using traditional broadcast technology, it was simplest to coordinate transmission by defining discrete narrow channels and giving one person the right to transmit over that channel to the exclusion of all others. In that technological context, the primary critique of the institutional organization of broadcast was that rights to dominion over a channel were assigned by licensing instead of through a private property regime. [FN1] In recent years, this critique has gained significant support, and privatization of spectrum-use rights, initially allocated through auction, ***292** is becoming the new orthodoxy concerning how best to regulate radio communications. [FN2]

Privatization was the most important alternative to licensing in the 65 years following passage of the Radio Act of 1927. However, the case for privatization is no longer as clear. [FN3] Contemporary wireless communications technologies, developed primarily for mobile communications, show that sharing of broad swaths of frequencies by many users may be a better model for wireless communications than control by one party of a narrow frequency band. This new reality removes the technological imperatives and assumptions underlying both licensing and privatization. The licensing/privatization dichotomy no longer marks the most important institutional choice to be made. It is merely a sub-debate within a broader conceptual choice.

The central institutional choice regarding wireless communications is whether to rely on centralized control by identifiable organizations, or on multilateral coordination among numerous users. On the one hand, it is possible to treat spectrum as a resource whose use must be centrally determined by an entity with the power to decide how wireless communications equipment will be used in a given spectrum unit. That entity can either be "the owner" of the defined spectrum unit, if privatization is chosen, or the licensee operating within parameters set by the regulator, if licensing continues to be the rule. On the other hand, it is now technically feasible to rely on standards and protocols that enable multilateral coordination of transmissions among equipment owners, without identifying any person whose choices trump those of all other potential users. The central question then, is no longer *how to allocate spectrum channels*--how to decide who makes unilateral decisions about who may communicate using a frequency band and for what types of communications--but *whether to coordinate by defining channel allocations.* While the answer may be that we should permit a commons to develop alongside proprietary allocations, we will fail to ***293** permit that development if we continue to misperceive the choice at hand as one between licensing and exhaustive privatization.

The choice is very real and very immediate. The Heritage Foundation [FN4] and the Progress and Freedom Foundation [FN5] are advocating exhaustive privatization of the right to control wireless communications capabilities. In the last Congress, then-Senator Pressler introduced a draft bill seeking exhaustive auctioning of perpetual property rights in spectrum. [FN6] More recently, extensive privatization has been advocated within

the FCC. [FN7] Exhaustive privatization, as its name indicates, would privatize the entire usable spectrum, thereby effectively eliminating the possibility that a spectrum commons will develop.

The alternative is also at hand. Prompted by Apple Computer and WINForum (an industry group), and supported by such radical institutions as Microsoft, Compaq, Motorola, AT&T (in part), and the Consumer Electronics Manufacturer's Association, as well as the American Educational Research Association and the American Library Association, the FCC issued an order in 1997 providing for the operation of "Unlicensed National Information Infrastructure" devices (the "U-NII Order"). [FN8] The Order permits devices meeting certain specifications to operate without a license in a 300 MHz range (as compared to the allocation of between 270 and 300 MHz for all High Definition TV licenses) [FN9] in the 5 GHz band. [FN10] This represents a significant frequency allocation. These devices will not be legally protected from interference, will share the spectrum with licensed devices, and will be required to operate so as not to interfere with these licensed devices. [FN11] Even under these constraints, equipment manufacturers got what they lobbied for:permission*294 to manufacture and sell equipment that will allow users to set up high-speed, broadband data networks for local and wide area networks. These networks could potentially supplant some of the services currently offered by local telephone companies, cable companies, and cellular/PCS [FN12] providers.

Within the resource management metaphor, this swath of spectrum, called the Unlicensed-National Information Infrastructure band ("U-NII band"), would be considered a commons. Indeed, in the Notice of Proposed Rulemaking, [FN13] the FCC raised the concern that the U-NII proposal would suffer from "tragedy of the commons" effects. [FN14] But one of the most important implications of the U-NII Order is that it opens the possibility of stepping outside the "resource management" box as a way of thinking about radio communications regulation. The U-NII Order does not "reserve" spectrum for unlicensed use. It gives users of U-NII devices no "rights." It simply removes the prohibition to transmit that underlies the present system. It is this prohibition that necessitates an FCC license, or permission from a licensee, before one can transmit. Within this alternative institutional framework, anyone who possesses equipment capable of transmitting at the frequencies for which no license is required will be able to send anything to anyone else without obtaining a license from the FCC, without purchasing spectrum rights, and without paying use fees or deferring to the unilateral transmission control choices of anyone else. [FN15] The U-NII band opens a legal space for multilateral coordination of communications to develop as a mechanism for avoiding interference. It also raises the possibility that unlicensed wireless devices will provide a component of the information infrastructure that is not owned by anyone. No other communications facility currently offers that promise.

Other small allocations that were provided by the FCC for unlicensed use a few years ago [FN16] have already been exploited and tested as the basis for both wireless Internet access and mobile communications services, providing potential sources of insight into the workability of a *295 variety of organizational models that could replace the prevalent centralized model. [FN17] These models suggest that allowing extensive deployment of unlicensed wireless devices could provide an infrastructure of first and last resort for digitally networked communications. In a communicative environment increasingly dominated by digital communications applications, such an infrastructure would serve the same role in our communicative environment as streets, sidewalks, highways, and parks play in our physical environment.

There is, however, an ecological conflict between an approach based on centralization through licensing or privatization, on the one hand, and an approach based on coordinated unlicensed use, on the other hand. Most centralized solutions operate on the assumption that interference may only be suppressed by allowing one person to transmit very "loudly" over a given channel. This strategy for avoiding interference makes use of that channel by anyone else difficult. A review of the U-NII Order provides ample insight into this conflict. Many of the constraints placed by the Order on the operation of U-NII devices derive not from the need to protect these devices from each other, but from the need to protect incumbent licensed operations using the same, or adjacent, frequency bands. If too much of the radio frequency spectrum is placed off limits for unlicensed devices that can operate in a multilaterally coordinated environment, or if too many constraints are placed on the operation of unlicensed devices to prevent them from interfering with licensed devices, then the regulatory choice to "allocate" spectrum to other uses shall have choked off development of this alternative. Once investments have been made in

technology that relies on exclusive control of frequency bands, as opposed to sharing of those bands, and once companies have purchased control rights at auctions and created organizational structures to exploit these rights, we will be unable to revisit this regulatory choice.

The first four parts of this article lay the foundation for analyzing the choice between licensing/privatization and unlicensed operations. Part II describes a business history of the radio industry that suggests that our conceptualization of radio regulation is the contingent product of the 1920s. The state of technology and the actions of business and government actors during this period focused on the market in crude radio receivers as the only way to make money from radio. To serve this market, they created the system of transmission rights that has dominated thinking about radio regulation ever since. Part III outlines the ***296** intellectual critique of licensing offered by economists over the past forty five years and the recent increasing acceptance of that critique as a basis for policy. Part IV explains the technological obsolescence of the licensing/privatization dichotomy and analyzes how both licensing and privatization rely on the outdated assumption that to achieve an acceptable signal-to-noise ratio, one entity must be permitted to transmit at a high power over a narrow frequency band, while interference and noise are reduced by prohibiting the emissions of others in the same frequency/space/time dimension. It then describes three current organizational approaches to creating communications networks based on unlicensed devices operating in the relatively limited frequency bands in which the FCC has permitted unlicensed operation. Part V describes the U-NII Order and how it opens up the possibility of multilateral coordination among unlicensed devices. The order is also a prime example, however, of how regulatory solicitude to the needs of incumbent licensees can constrain the development of unlicensed operations. In effect, the U-NII Order opens up the possibility that alongside telephone local loop, cable, and owned wireless local loop, there will develop a local infrastructure capable of carrying high bandwidth transmissions in an Internet-like model that will rely solely on unowned infrastructure.

Parts VI, VII, and VIII analyze the choice between licensed and unlicensed use. Part VI suggests some parameters for a microeconomic analysis of the regulatory choice. It suggests that under an unlicensed spectrum regime, the equipment market will provide the benefits sought of the spectrum market by advocates of spectrum privatization. Part VI concludes that it is at least indeterminate whether an equipment market based on unlicensed spectrum or a spectrum market based on privatization will be a more efficient means of assuring development and deployment of wireless communications technology. It offers some indications that a market in equipment for individual use--like the personal computer or automobile markets--will be better than a market in infrastructure.

Part VII offers an institutional economic analysis of the choice between unlicensed operations and spectrum licensing/privatization. It suggests that our choice between a private spectrum based system and an unlicensed/commons system is likely to affect the information that flows over the infrastructure deployed in each institutional framework. This occurs primarily because in a system based on unowned infrastructure, end-users have strong incentives to invest in developing and articulating first-best preferences as to what should be communicated, whereas in an owned infrastructure system, they seek to shift those costs to infrastructure owners and to invest only in choosing ***297** from a menu of choices determined by the owners. Part VII also suggests that under certain conditions the information flow patterns implied by a distributed model of communications may provide a better basis for economic productivity. The analysis concludes with an explanation of why, despite its potential advantages, a distributed model may not emerge through market-based allocation, due to the resistance of incumbent institutional frameworks to change.

If it is at least indeterminate whether a distributed or centralized model will be more efficient in micro-economic terms, and if the institutional economic analysis suggests that the regulatory choice will affect the patterns of distribution of control over information and knowledge production in society, how are we to think of the choice in terms of our social and political values? Part VIII suggests that for a society concerned with individual autonomy and robust public debate, an institutional choice that affects the social distribution of power to control what a choosing individual knows of the world, how perceptions of the choice set open to each individual are produced, and whether and how an individual can communicate with others has significant social-political implications. Understood in these terms, there are good reasons in terms of democratic values to support the development of a significant component of our information infrastructure that is free of centralized control by

any body, governmental or commercial.

Part IX recapitulates the analysis and identifies three specific institutional measures that should be taken in light of the discussion. It suggests that at the very least there is an important role to be played by permitting a significant portion of the broadcast spectrum to be used in a commons-like model, and that such a commons will not develop if we adopt the program of exhaustive auctioning of spectrum use rights. The purpose of the measures proposed in Part IX is to reserve judgment about the institutional framework for wireless communications until after a market in unlicensed devices has had an opportunity to develop. They are intended to negate the potential institutional and technological lock-in effects of the present auctioning policy and the parsimonious introduction of unlicensed operations. The conclusion suggests (a) that the FCC revisit its decision concerning unlicensed operations, and analyze the constraints placed on unlicensed devices solely in terms of the potential interference among devices operating in an unlicensed environment, so as to avoid warping the development of the capabilities of unlicensed operations around the needs of incumbent licensees using the same frequencies; (b) that the FCC constrain its auctioning policy, rather than expand it towards exhaustive privatization, to the extent necessary to reflect the possible opportunity costs involved in devoting spectrum to privatized use that might better be employed to expand the ***298** commons; and (c) that licenses auctioned include explicit provisos tempering renewal expectations.

II. THE CREATION OF ADMINISTRATIVE CONTROL OVER WIRELESS COMMUNICATIONS:THREE BRIEF HISTORIES OF RADIO REGULATION

A. Three Histories

The core elements of the present radio regulation system were formally set forth in the Radio Act of 1927, [FN18] and have not changed since. [FN19] A large segment of the available spectrum is reserved for government use. Other parts of the spectrum are regulated by a federal commission. This Commission regulates radio communications by (a) dividing the spectrum into distinct channels, each defined over a range of frequencies; (b) assigning specific communications uses to stated sets of channels; (c) determining which private party will control transmissions over each channel; and (d) determining at what power that party can radiate on that channel for the use defined by the commission.

One might, in gross terms, identify three types of histories of the development of this system. The first is the "official" history. [FN20] It focuses on the period from July 1926 to February 1927, called "the breakdown of the law," [FN21] as proof that the market cannot work, and that broadcast by its nature requires administrative control. Following two decisions that held he had no power to refuse a license [FN22] or to impose restrictions as to frequency, power, and hours of operation of a licensee, [FN23] Secretary of Commerce Herbert Hoover declared that he ***299** would no longer regulate radio. [FN24] What followed was "confusion and chaos." [FN25] More than 200 new stations began operations between July 1926, when the Secretary ceased regulation, and February 1927, when the Radio Act of 1927 came into force. [FN26] Older stations wandered the spectrum in search of better broadcast slots. [FN27] "With everybody on the air, nobody could be heard." [FN28] Justice Frankfurter concluded this description with the following analysis of its causes:

The plight into which radio fell prior to 1927 was attributable to certain basic facts about radio as a means of communication-- its facilities are limited; they are not available to all who may wish to use them; the radio spectrum simply is not large enough to accommodate everybody. *There is a fixed natural limitation upon the number of stations that can operate without interfering with one another.* Regulation of radio was therefore as vital to its development as traffic control was to the development of the automobile. In enacting the Radio Act of 1927, the first comprehensive scheme of control over radio communication, Congress acted upon the knowledge that if the potentialities of radio were not to be wasted, regulation was essential. [FN29] The first economist to tell an alternative history of radio regulation as a prelude to economic critique was Ronald Coase. [FN30] Coase started his story with the early attempts by the Navy to appropriate all the spectrum, beginning in 1910 and continuing through 1920. [FN31] In the 1920s, Hoover, as Secretary of Commerce in charge of implementing the Radio Act of 1912, gathered representatives of government departments and the radio industry for radio

conferences. [FN32] These conferences sought greater regulation of the radio frequency spectrum. [FN33] Bills introduced to that *300 effect, however, did not pass. [FN34] The Secretary nonetheless used his licensing authority to implement the recommendations of the conferences, until he was prevented by adverse court decisions. [FN35] In response, legislative action quickly followed, creating the current regulatory regime. [FN36]

The most important difference between this history and the "official" history is how small a role Coase assigns to the period from July 1926 to February 1927, the "breakdown of the law" or "chaos" period. For Coase, the Radio Act of 1927 was part of a long-standing drive by the federal government to regulate spectrum use--beginning with the Navy's demands before WWI, continuing with numerous bills during the 1920s, and culminating in quick action following the *Zenith* decision in 1926. [FN37] Coase's story, unlike the official story, is therefore not about the self-defeating excesses of unmanaged private transmissions, given the technical constraints of radio, but about the progression of choices intended to organize the use of wireless transmissions in an administrative regulation model. This theme--that cumulative institutional choices *caused* spectrum scarcity, rather than responded to it-- remains the mainstay of the economists' history of radio regulation. [FN38]

The third type of history, not commonly told in discussions of how radio ought to be regulated, is the business history of the radio industry. This third set of stories identifies the interaction among multiple forces, and suggests that we live under a historically-contingent regulatory system, amenable to no simple conclusions about the necessity of administrative regulation or its folly. It also suggests that we take seriously the possibility that the present institutional and organizational framework is in large measure a product of the structure of the radio equipment market in the early 1920s. If one accepts this proposition, then one may have to reevaluate how the technological parameters of *301 present communications equipment might change the conceptual assumptions underlying the regulatory framework and its primary alternative, privatization.

B. A Brief Business History of Radio Regulation

The world in which the Radio Act of 1912 was passed saw radio as a means of wireless telegraphy, as a means of ship-to-shore and ship-to-ship communications, with the potential of one day challenging transoceanic cable communications. Guglielmo Marconi's sales panache had sealed this perception. [FN39] Almost all radio communications regulated by the Radio Act of 1912 [FN40] were wireless Morse code transmissions; there were no broadcast stations in any contemporary sense, although some amateurs tried to be somewhat consistent in offering a voice program once in a while; [FN41] equipment was primitive and incapable of focusing on relatively narrow frequencies; [FN42] time (scheduling transmissions) and space (placing transmitters far enough from each other) were the primary units to be manipulated in avoiding interference, although crude channelization of frequencies was used in the 1912 Act *302 as well. [FN43] Broadcast radio as a mode of entertainment, as opposed to wireless as a mode of telegraph or telephone, was not understood as a function that radio could fulfill, except by a few visionaries. [FN44]

The first decade of radio saw rapid innovation and the emergence of competition. Despite his early success, Marconi lost ground in the United States when his business plan shifted from equipment sales to sales of ship-to-shore communications as a service, modeled on telephone service. In the new model, Marconi owned the equipment and charged per-message fees. [FN45] In 1899, Marconi offered similar terms to the U.S. Navy, for a lump sum of $10,000 and an annual royalty of $10,000. The Navy balked, opening the way to American wireless telegraphy competitors. [FN46] The Navy built its own shore stations, [FN47] and Navy contracts provided an important anchor for companies founded by competing inventors, like Lee de Forest, who invented the Audion (the three element vacuum tube) and Reginald Fessenden, the first to modulate voice over a continuous wave. [FN48]

The second decade of radio did little to change its role but was marked by consolidation through patent prosecutions, the wartime efforts of the U.S. Navy, and finally by the creation of the patent alliance, whose actions in the 1920s determined the organizational structure of broadcast to this day. In 1912, two of the innovators of voice radio dropped out of the picture. Fessenden's National Electric Signaling Company declared bankruptcy. [FN49] The patent for the alternator that Fessenden had ordered from General Electric ("GE") to

generate voice transmission remained with GE, where it was developed by Ernst F. W. Alexanderson. [FN50] Lee de Forest's companies were in trouble that same year. [FN51] His United Wireless Company collapsed under indictment *303 for stock manipulation schemes. [FN52] Its assets were bought by American Marconi. [FN53] American Marconi now had a virtual monopoly over point-to-point wireless telegraphy. De Forest's patents to the Audion were also attacked by Marconi, who owned the patents to the vacuum tube without the third element de Forest had added. [FN54] Under this pressure, de Forest sold his Audion patents to AT&T. [FN55]

In 1916, a federal district court held in *Marconi Wireless Telegraph Co. of America v. De Forest Radio Telephone & Telegraph Co.* [FN56] that de Forest's Audion, as a radio-transmission detector, infringed the original Fleming glass-bulb detector patent owned by Marconi. [FN57] The third element, or "grid," of the Audion was, however, protected by de Forest's patent. Neither Marconi nor AT&T could produce a radio receiver using the Audion without the other's consent. [FN58] In the meantime, GE had been perfecting the Alexanderson alternator, [FN59] while a Columbia University undergraduate, Edwin H. Armstrong, had developed a "feedback circuit" that reinforced the Audion. He received a patent in 1914. [FN60] The perfect piece of radio equipment, which would combine the Audion, the Alexanderson alternator, and the Armstrong feedback circuit, now needed the consent of Marconi, AT&T, GE, and Armstrong. No such agreement developed.

With the entry of the United States into World War I in April 1917, the government took over radio and broke the patent stalemate. In April, the Navy took over the operations of all wireless stations not under Army control. [FN61] The Navy issued indemnities to the manufacturers of radio equipment against patent suits arising from war production contracts. [FN62] War production brought GE and Westinghouse, the great light-bulb manufacturers, into the manufacture of radios around vacuum *304 tubes. [FN63] General Electric also produced the most powerful Alexanderson alternators and installed them at the New Brunswick Marconi shore station, then held by the Navy. The New Brunswick station became the most powerful station in the world in 1918, enabling, among other things, President Wilson to transmit a plea to the German people to oust the Kaiser. [FN64]

The two years following the war saw a scramble to gain control over radio. The Navy attempted to leverage its control of shore stations and its role in technological development into a government monopoly over wireless communications. [FN65] The Post Office tried to create a government monopoly as part of its Air Mail Service. [FN66] Neither department succeeded, and in the period of 1921-22, Herbert Hoover succeeded in positioning the Commerce Department as the ally of commercial operators and amateurs, and the honest broker among the government departments. [FN67] The model he used relied on industry and amateur-based development, with government regulation conceived as an aid to this development. [FN68]

At the same time, the wireless industry was adjusting to the post-war era. American Marconi had entered the war with a near monopoly on shore stations. To sustain its position, Marconi suggested to GE that it would buy exclusive worldwide use of the Alexanderson alternator. Under the proposed agreement, Marconi would retain exclusive use of the alternator, while GE would continue to be the exclusive manufacturer. [FN69] An exclusive contract would deny Marconi's competitors access to transmitters powerful enough to allow them to compete, while promising GE a stable stream of orders for its wartime production facilities. The exclusivity deal raised concerns in the Navy over loss of control of wireless communications to a British company. One of Britain's early acts in the war was to cut off Germany's cable communications, which it could do because of its control over submarine cables. [FN70] To keep radio technology from being similarly controlled by the British-owned Marconi, the Navy acted to thwart the deal and proposed an alternative. Possibly maneuvered by then GE general *305 counsel Owen D. Young and perhaps even urged by President Wilson, the two top Navy radio officers, Commander S.C. Hooper and Rear Admiral W.H.G. Bullard, approached GE. [FN71]

To replace the Marconi deal, a new company was created in October 1919, the Radio Corporation of America ("RCA"). RCA would not be a subsidiary of GE. It would instead be a successor to American Marconi, with the British Marconi interests bought out by GE. The U.S. stockholders of American Marconi would receive shares in the new company, in return for American Marconi's conveyance of all its property, including its installed base of shore stations, patents, and goodwill, to RCA. [FN72] A central feature of the RCA deal was a cross-licensing agreement in which GE and RCA cross-licensed each other to use all radio technology they owned then or would

develop in the next 25 years. This agreement became the template for the cross-licensing agreements around which the patent alliance would coalesce a year later. [FN73]

Like GE, Westinghouse found itself at the end of the war with idled production capacity. Unlike GE, which had focused on the expensive Alexanderson alternator as the central component of high-powered transmission equipment, Westinghouse had developed and manufactured smaller receivers and transmitters. [FN74] In response to GE's alliance with American Marconi through RCA, Westinghouse allied itself with Fessenden's almost-defunct International Radio Telegraph Company, in the hope of setting itself up as a competitor in transatlantic telegraphy. [FN75] RCA had, however, secured exclusive rights to communicate with British Marconi stations and with most other stations in Europe. [FN76] Westinghouse was America-bound. [FN77] To make matters worse, RCA completed a cross-licensing agreement with AT&T that would allow each to manufacture transmitting and receiving equipment using the de Forest Audion, to which each group held a partial patent. Western Electric and GE would continue to manufacture equipment, but RCA would sell it under its brand name. [FN78] Outflanked in international communications and blocked from competing in the production of Audion-based equipment, Westinghouse made two moves to save its ***306** ability to compete in the radio equipment manufacturing business. The first was to acquire the Armstrong patents for the feedback circuit. [FN79] The second was to invent broadcast radio as a mass medium. The purchase of the Armstrong patents would lead to the inclusion of Westinghouse in the patent alliance--sealed through joint ownership of RCA by GE (30.1%), Westinghouse (20.6%), AT&T (10.3%), and United Fruit Company (4.1%)--which brought in patents for the loop antenna and crystal detectors. [FN80]

But in late 1920, eight months before Westinghouse was included in the patent alliance, the company had launched a different solution to its problem. Developing an idea that its chief wireless technology investigator, Frank Conrad, had pursued since 1912, Westinghouse concluded that, without Audion patents and transoceanic communications facilities, the market it should target was that of simple home receivers. In that market, it could compete using licenses it had for patents not held by the RCA-GE-AT&T alliance. [FN81] But to sell such equipment, there must be something for receiver owners to listen to. [FN82] Thus was launched KDKA Pittsburgh, whose first broadcast covered election returns from the 1920 presidential elections. [FN83] That same night, the *Detroit News* amateur station, 8MK (later WWJ), also broadcast the returns. But the *Detroit News* broadcast was presented as a technical fraternity event. Westinghouse advertised its coverage in terms of a social delight open to all, at their homes or clubs. Westinghouse was out ***307** to sell receivers, not glorify the new technology and its operators. And it worked. [FN84]

RCA now controlled all equipment manufacture, except for manufacture by amateurs. Under the RCA-GE-AT&T-Westinghouse agreements ("the RCA alliance"), GE and Westinghouse would manufacture all receiving equipment (GE manufacturing sixty percent and Westinghouse forty percent of the total). [FN85] RCA would sell the receivers under RCA trademarks. Transmitters would be manufactured by Western Electric, and sold by AT&T. Telephony, wired or wireless, belonged to AT&T. RCA had the chief role in international communications. [FN86] Throughout the 1920s, equipment sales would be big business. [FN87]

Radio stations, however, were not generally run as profit centers. Many were run by educational and religious institutions. [FN88] Even stations considered "commercial" or "professional" were limited primarily to using unpaid programming. [FN89] Stations operated by retail businesses and newspapers hoped to increase sales through broadcast exposure. [FN90] The manufacturers built powerful stations like KDKA Pittsburgh, WJZ Newark, KYW Chicago (all owned by Westinghouse) and WGY Schenectady (GE), but made their money from equipment sales. [FN91]

Even as late as September 1926, when RCA publicly announced the creation of the National Broadcasting Company ("NBC"), which revolutionized the business of broadcasting, the business purpose of the move was explained in terms of equipment sales:

The market for receiving sets in the future will be determined largely by the quantity and quality of the programs broadcast. We say quantity because they must be diversified enough so that some of them will appeal to all