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Testimony of Roslyn Layton, PhD on the State of U.S. Spectrum Policy

Thank you, Senator Thune, Ranking Member Schatz, and members of the committee. It is an honor and a privilege to testify on the State of U.S. Spectrum Policy. This issue which is arguably the most important in telecom policy. I hope to highlight some key findings from the academic field of spectrum management and policy and preliminary policy recommendations to improve the outcomes for the American people. I am an American and have enjoyed affiliation with Denmark's Aalborg University since 2012 where I earned my PhD and continue my research.¹ Our university hosts doctoral students from around the world who wish to make multidisciplinary and international comparisons of telecom policy. Our university is ranked by U.S. News and World Report as 4th in the world for its overall engineering program and 2nd for Electrical and Electronic Engineering.² In addition to my department of Communication, Media and Information Technologies, our research and educational domains include Antennas, Propagation and Millimeter-wave Systems; Automation and Control; Connectivity: Wireless Communication Networks; and Signal and Information Processing. We use "problem-based learning" to examine, teach, and learn about complex, real world problems. Spectrum management is a textbook example of a complex real-world problem for both for its engineering and political requirements. My comments reflect my own views.

Aalborg University has been strengthened with public-private partnerships for innovation and the frameworks of the country's industrial PhD program, soon celebrating its 50th year. My participation has been enabled by Strand Consult where I serve as Senior Vice President. Strand Consult is an independent company developing strategic research on critical topics in mobile telecommunications. Its most recent report details the percentage of Huawei and ZTE equipment in 103 European mobile operators' 4G networks.³ This report is used by European governments to identify problem areas for rip and replace efforts. Strand Consult founded China Tech Threat to bring attention the larger issue of technological threats from firms owned and affiliated with the Chinese government.⁴ While it is not the precise theme of this hearing, spectrum management has geopolitical implications. Not only does China influence global organizations where spectrum decisions are made such as the International Telecommunication Union and various technical standards organizations, it commands and controls its spectrum policy in a way to align military and industrial interests to promote its national champions in space/satellite technologies, network equipment, wireless devices, software platforms, and emerging technologies such as smart cities solutions, artificial intelligence, and quantum computing. Sometimes US policy appears to pit federal and commercial interests against each other, rather than adopt the market-based approach which will put the US on the best technological footing to challenge China both economically and militarily.

The gap between the US and China on mid-band spectrum has been noted. Mid-band frequencies, also called the Goldilocks band, are prized for their technological capabilities to send large amount of data over long distances. China and even Canada are on track to have some 500 MHz of mid-band spectrum deployed (and Japan with 1000 MHz), whereas the US has a scant 350 MHz. As such, *S. 1986, SPECTRUM NOW Act* sponsored by Chairman Wicker, Ranking Member Schatz, and Senators Moran and Udall has critical importance. Using the Spectrum Relocation Fund, this bill would support federal entities operating on mid-band spectrum to

¹ "Profile for Roslyn Mae Layton," Aalborg University's Research Portal, accessed July 17, 2020, <https://vbn.aau.dk/en/persons/roslyn-mae-layton>

² "Top Electrical and Electronic Engineering Schools in the World - US News Education," accessed July 17, 2020, <https://www.usnews.com/education/best-global-universities/electrical-electronic-engineering>.

³ "Understanding the Market for 4G RAN in Europe: Share of Chinese and Non-Chinese Vendors in 102 Mobile Networks." Strand Consult. July 2020 <http://www.strandreports.com/sw8772.asp>

⁴⁴ "Our Mission." <https://chinatechthreat.com/about-us/#Our-Mission> Accessed July 21, 2020



study the feasibility of increasing spectrum efficiency and relocating federally held spectrum or sharing it with commercial users to facilitate the deployment of 5G.⁵

To put the numbers into perspective, consider that the federal government sits on 70 percent of the so-called spectrum “beachfront”, some 2500 MHz, used primarily for radar and radio navigation. The government’s holdings amount to more than four times what America’s five major wireless carriers (T-Mobile, AT&T, Verizon, Dish, and US Cellular) have in mid-band frequencies for 5G. The US is in an existential battle with China for 5G, and it trying to do it on scraps of mid-band spectrum.

5G is the quickest way to equalize the digital divide between urban and rural America, providing the same, if not, superior connectivity than wireline networks. While there is a promise of some more mid-band spectrum in the future, the allocation process for these frequencies, which by rights should be have been a quick, speedy private transaction, was seized by political actors protecting incumbent firms.⁶

In any event, if there was a market-based process to allocate federal spectrum, there would be no need to quibble about the 3.7 to 4.2 MHz, as private actors would have the opportunity to buy, sell, lease, trade, or share the most valuable swath of the airwaves. Simply put, the federal spectrum holders are insulated to the pain caused by the spectrum imbalance. Policymakers have made a choice to prioritize certain federal (notably military) applications above civilian wants and needs. This is not to say military applications are unimportant, but it is a valid policy research question of whether all 2500 MHz is best deployed for radar and radio navigation when some measure of this spectrum could enable over 100 million school children to participate in distance learning during the pandemic.

While no country’s spectrum policy is perfect, the US has driven important successes over the last century. This Committee has been the driving force behind the FCC reforms to liberalize the allocation of commercial spectrum, which has become a model for countries around the world. Reforms include a liberalized allocation process for commercial spectrum, flexible use, competitive bidding to make rights assignments more efficient, and tools and processes to make spectrum use more efficient whether repacking spectrum (a result of the broadcast incentive auction, for example) or dynamic sharing such as in the 3.5 GHz Citizens Broadband Radio Service proceeding. As a result of these and other efforts, the FCC has improved the access, availability, and efficiency of commercial spectrum, without which our wireless economy would not be possible. Over 90 commercial spectrum auctions in the US have delivered over \$116 billion to the US Treasury.⁷ Wireless spectrum enables the trillion-dollar wireless economy. We now accept the premise that spectrum is a finite resource for which prices and markets can improve their allocation.

If such reforms have improved the outcomes for commercial spectrum, it stands to reason that similar improvements could be driven for federal spectrum. At the very least this would include improving access and availability for federal users, but more largely, better outcomes for the American people. Presently federal spectrum is managed the National Telecommunications and Information Administration (NTIA) and more specifically, the Interdepartment Radio Advisory Committee (IRAC), which was founded in 1922. While commercial spectrum allocation has been reformed, the management of federal spectrum is essentially unchanged for almost 100 years. It is timely and appropriate to review it.

Leading telecom economist and former FCC chief economist Thomas Hazlett observes, “The FCC had no idea that mobile would become a mass market (not a luxury niche), that handsets would become pocket (not car) phones, that texting and data (not just voice) would become standard, or that digital was superior to the analog

⁵ “Supplementing the Pipeline for Efficient Control of The Resources for Users Making New Opportunities for Wireless Act.” S. 1986, SPECTRUM NOW Act, 116th Congress. <https://www.congress.gov/bill/116th-congress/senate-bill/1968/text>

⁶ “A Government 5G Coup.” *Wall Street Journal*. Editorial Board. November 19, 2019. <https://www.wsj.com/articles/a-government-5g-coup-11574208133>

⁷ “REMARKS OF FCC CHAIRMAN AJIT PAI AT THE INFORMATION TECHNOLOGY AND INNOVATION FOUNDATION.” February 6, 2020 <https://docs.fcc.gov/public/attachments/DOC-362334A1.pdf>



standard it mandated. And that was after vast input from scientists, management consultants, broadcasters, Motorola, and AT&T.⁸ Spectrum markets had to be liberalized before innovation and adoption took hold.

To facilitate the buying, selling, and leasing of spectrum, the FCC operates a Universal Licensing System (ULS). The greatly increased use of the ULS by the public is indicative of the growth in the demand for spectrum. The FCC reports some remarkable statistics from the ULS platform, for example the thousands of licenses holders (including individuals), the many uses of spectrum, and the number of licenses issued annually (more than 150,000 per year for almost a decade).⁹ The FCC has responded to exploding demand for commercial spectrum by modernizing the ULS over a multi-year upgrade.

This Commerce Committee has already taken important steps to bring the IT system for America's federal users spectrum up to speed. While some have observed that having a single system for both federal and commercial spectrum, there are some important differences in the law and policy which creates some challenges to run an integrated system. For example, some federal uses may be classified for national security reasons and not suitable for commercial viewing. On the other hand, there are additional levels of data (e.g. precise location of infrastructure towers), which are collected for the federal system but are not collected for commercial spectrum (perhaps for competitive reasons).

In any event, there need not be a single system but make a systemic improvement in spectrum management. Indeed, there is much that federal users can learn from the FCC's ULS system. I applaud Chairman Wicker and Senators Cantwell, Inhofe, and Reed for introducing **S. 3717, the Spectrum IT Modernization Act** which requires NTIA and other federal agencies to outline a plan for modernizing the information technology infrastructure used for the management of federal spectrum, to define the parameters of interoperability, and for the Department of Defense to report on their challenges of management and utilization.¹⁰

Following the Federal Radio Act, it took US policymakers 67 years to try the market-based spectrum allocation for commercial spectrum which is now considered standard.¹¹ We should be rushing to bring these benefits of market based allocation to federal spectrum holdings.

Ronald Coase laid the theoretical foundations for market-based regimes and challenged the prevailing regulatory wisdom of administrative allocation of radio frequencies. His 1959 article *Federal Communications Commission*¹² exposed the fallacy of administrative allocation which justified restricting spectrum use to limit interference. Coase showed that the same function can be performed more efficiently through a "price system." In his day, Coase's proposals were mocked by policymakers. The first auction for spectrum rights was delayed until 1994.¹³

Today, however, spectrum auctions are practiced around the world and are considered *de rigueur* for telecom regulators and spectrum authorities. Coase is not alive today, but his Nobel prize and the legacy of his work (including the fact that he remains the most cited among Nobel prize winners, in law, and in economics¹⁴) attest

⁸ "Commentary: The Best Way for the FCC to Enable a 5G Future," *Reuters*, January 17, 2018, <https://www.reuters.com/article/us-hazlett-5g-commentary-idUSKBN1F6253>.

⁹ "FCC Licenses at a Glance." Accessed July 21, 2020. <http://reboot.fcc.gov/license-view/>

¹⁰ S. 3717, the Spectrum IT Modernization Act. 116th Congress. <https://www.congress.gov/bill/116th-congress/senate-bill/3717/text>

¹¹ Coase, R. H. "Comment on Thomas W. Hazlett: Assigning Property Rights to Radio Spectrum Users: Why Did Fcc License Auctions Take 67 Years?" *The Journal of Law & Economics*, vol. 41, no. S2, 1998, pp. 577–580. *JSTOR*, www.jstor.org/stable/10.1086/467403. Accessed 16 July 2020.

¹² Coase, R. H. "The Federal Communications Commission." *The Journal of Law & Economics*, vol. 2, 1959, pp. 1–40. *JSTOR*, www.jstor.org/stable/724927. Accessed 9 July 2020.

¹³ Coase, R. H. "Comment on Thomas W. Hazlett: Assigning Property Rights to Radio Spectrum Users: Why Did Fcc License Auctions Take 67 Years?" *The Journal of Law & Economics*, vol. 41, no. S2, 1998, pp. 577–580. *JSTOR*, www.jstor.org/stable/10.1086/467403. Accessed 16 July 2020.

¹⁴ Landes, William M., and Sonia Lahr-Pastor. "Measuring Coase's Influence." *The Journal of Law & Economics*, vol. 54, no. 4, 2011, pp. S383–S401. *JSTOR*, www.jstor.org/stable/10.1086/666478. Accessed 21 July 2020.



that he was correct on pricing and radio spectrum. Hazlett, Porter and Smith argue that Coase's work on radio spectrum is on par of that of Adam Smith's *Wealth of Nations* for its bringing "disruptive clarities to system dynamics."¹⁵ They note that Coase dispensed with then-prevailing notions from economist Arthur Pigou on externality and spillover, showing that central planning was not costless. Moreover, Coase demonstrated the destructive fallacy of assigning rights by government fiat, noting that how the airwaves were used and who used them were not one in the same.¹⁶ The existence of secondary markets proves that the creation of rights and its assignment are separable.¹⁷ An additional irony and inequality is that the federal government is primary holder of spectrum rights, but is not the primary user. This suggests that additional optimization is possible.

Coase discussed the IRAC at length in his 1962 article.¹⁸ This testimony highlights some of his observations which are still highly relevant.

The "First Best" realization of Coase's recommendation is to liberalize the underlying resource—privatizing the spectrum itself—not just the use and licensing regime. This would entail sunseting administrative allocation, also called command and control. A 1996 policy proposal suggested that the sale of federal spectrum holdings could generate as much as \$300 billion (almost half a trillion in today's dollars) to pay down the national debt and transition the administrative allocation regime to privatization within a decade.¹⁹

Indeed, a common law property rights regime for spectrum had already emerged before the Federal Radio Act of 1927. I review this briefly, but as it is outside today's scope, I will describe "Second Best" options, notably spectrum fees. I provide additional suggestions for transparency, accountability, and IRAC reforms.

In recent years Congress has had success to reform Executive Branch agencies, most recently with the Foreign Investment Risk Review Modernization Act of 2018 (FIRRMA) for the Committee on Foreign Investment in the US. (CFIUS). This reform was achieved within a single session of Congress and was overwhelmingly bipartisan. It represents one of the most significant Congressional efforts to improve national security by requiring that CFIUS screen foreign investment for cybersecurity and privacy implications. Already it resulted in the halting, if not reversal, of foreign acquisitions of MoneyGram, PatientsLikeMe, Grindr, and StayNTouch because of concerns that that Americans' personal data would fall into the hands of the Chinese government. Importantly, FIRRMA requires greater accountability of CFIUS to Congress, as it was observed that Congress' concerns about security threats had been discounted by the Executive Branch in the past in an effort to effect quick transactions.²⁰ It is entirely appropriate that Congress and the Commerce Committee assert greater authority over federal spectrum, which after all, is what the Constitution prescribes.

Common law property rights for spectrum

Spectrum markets were already working before the creation of the 1927 Federal Radio Act. The government created a solution that the market didn't need, but it did serve to cement federal power over the radio spectrum and protect politically favored incumbents. Up to that time, hundreds of radio stations flourished under free market, common law tenets, and a secondary market emerged with transferring rights with equipment. Parties met annually under the auspices of the Department of Commerce to make trades.

¹⁵ Thomas Hazlett, David Porter, and Vernon Smith, "Radio Spectrum and the Disruptive Clarity of Ronald Coase," *Journal of Law and Economics* 54 (November 1, 2011), <https://doi.org/10.1086/662992>.

¹⁶ Ibid

¹⁷ Ibid

¹⁸ Coase, R. H. "The Interdepartment Radio Advisory Committee." *The Journal of Law & Economics*, vol. 5, 1962, pp. 17–47. *JSTOR*, www.jstor.org/stable/725004. Accessed 16 July 2020.

¹⁹ David Colton. "Spectrum Privatization: Removing the Barriers to Telecommunications Competition." Reason Foundation, July 1, 1996. <https://reason.org/policy-study/spectrum-privatization/>

²⁰ Roslyn Layton and Robert Pittenger, "CFIUS' Growing Power to Protect American Security from China Tech Threats: Examining TikTok and Lenovo" (China Tech Threat, June 26, 2020), https://chinatechthreat.com/wp-content/uploads/2020/06/CFIUS-Paper-062420_.pdf.



Hazlett details this little-known spectrum history in a recent article, showing that a common law property rights regime was well-established before the implementation of the Act.²¹ Hazlett challenges the conventional view that policymakers of the day didn't have information of how a spectrum rights market could work and therefore opted for administrative allocation. Hazlett shows that Senator Clarence Dill (D-WA) and the bill's supporters knew exactly what they were doing. Moreover, Hazlett uses market data from the 1920s to demonstrate how the National Association of Broadcasters (NAB) and Radio Corporation of America (RCA) benefitted from the new regime, which limited competitive entry into the market, secured licenses to existing broadcasters, and ensured a stream of revenue for established manufacturers of radio receivers. Indeed, Hazlett observes how the term "public interest" was coined by private actors to protect their market position.

The U.S. Department of Commerce had powers granted under the 1912 Radio Act to "minimize interference." It used a common law method to recognize first-in-time emission rights and to protect against encroachment. Stations that strayed from their registered frequencies were disciplined with the Department of Commerce's police powers. Commerce convened an annual conference where emergent players organized. Hazlett describes,

Commerce had designated an AM radio band, collaborating with radio manufacturers and broadcast stations in annual Radio Conferences that were convened by the Commerce Department from 1922 through 1925 (Benjamin 1998). Entrants that requested new rights were assigned vacant AM channels. Where none were available, applicants were told to strike a time-sharing agreement with an existing licensee or to buy a station, in which case the transmission rights would be transferred (with the broadcasting facility) to the new owner. The chief sponsor of the 1927 Radio Act, Sen. Clarence C. Dill (D-WA), explained that the legal institution employed by Commerce was well known as "property by right of user," "squatter sovereignty," or "adverse possession" (Dill 1938, p. 78). Under this regime, over 500 radio stations were broadcasting—which created a new mass media market—with substantial investments of private capital. In early 1926, a trade union in Chicago, intent on launching radio station WCFL, had the option to buy the broadcasting rights of three different local stations, including that of WHT, which was asking \$285 000 (Godfried 1997, p. 33). In September 1926, AT&T sold its New York City radio station, WEAJ, for \$1 million to the Radio Corporation of America (RCA), of which \$800,000 was for the value of spectrum rights (Barnouw 1966, pp. 185–186).²²

Data from the period shows that the common law regime worked such that consumers purchased radios (which amounted to \$1000 in today's money) at a brisk pace. However, to create the needed "chaos" in the airwaves which would support the bill, then Commerce Secretary Herbert Hoover cancelled the annual conference and stopped enforcing rights. The subsequent interference "chaos" that ensued was seized by the press and policymakers as justification for the new law.

Hazlett notes that 1927 Act was decidedly against property rights. The statute states that while it will consider the "use" of spectrum, its purpose is to "pre-empt the assertion of private property rights in radio spectrum." The law further prescribes that "No station or license shall be granted... until the applicant therefore 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

²¹ Thomas W. Hazlett, 2020. "The 1927 Radio Act as Pre-emption of Common Law Property Rights," *Review of Industrial Organization*, Springer; *The Industrial Organization Society*, vol. 56(1), pages 17-35, February. <https://ideas.repec.org/s/kap/revind.html>

²²"Two major interests sought a new regime that would grant regulators greater discretion: On the one hand, successful commercial stations sought to limit competitive entry. In the 1925 formation of the National Association of Broadcasters—a trade group that represented incumbent broadcasting stations—the industry created a novel standard for rights assignment. "An interesting fact," wrote Senator Dill, is that the broadcasters themselves suggested the inclusion of the words "public interest" in the law as a basis for granting licenses" (Dill 1938, p. 89). On the other hand, policy makers—such as Hoover, Dill, and other members of Congress—desired to assert political authority over what they recognized as an influential new medium of public opinion. License awards were said to be mandated as a consequence of nature, and licensing authority was then leveraged to include administrative oversight of speech and the press; this skirted constitutional limits that were binding elsewhere (Hazlett 1998)."



otherwise.” The 1927 Radio Act did not “stumble” into administrative allocation of frequencies but sought a regime change. The prospect of property rights in frequencies was not a foreign concept. Indeed, a system of priority-in-use rights for radio broadcasts was in play since the first radio station, KDKA, in Pittsburgh in 1920.

The Act launched the regime of administrative licensing or command and control spectrum management. The government served as the clearing house for spectrum, its proffered benefit being the control of interference by exclusivity to protect the licensee’s signals. To get a license, the applicant would participate in a “beauty contest” to show why its service did a better job to realize the “public interest” than another. There was no fee based on an estimated value of the spectrum. Such a model emphasizes the political rewards of spectrum assignment which accrue to the licensing body and the licensee. Moreover, it incentivizes the application to over-promise to win the application but underdeliver once received.

Naturally, command and control offers some marginal economic benefits (some use of the spectrum is better than none at all), but it is not optimal. Some countries have attempted to rectify perceived political bias through spectrum lottery, but this also fails to reflect the economic contest by competing actors for a scarce resource. The command and control regime was further legitimized by the 1943 Supreme Court decision *NBC v. FCC* asserting that there is not enough spectrum for everyone and that there is a finite natural limit of radio stations that can operate without interference.

Hazlett offers further history and analysis *The Political Spectrum: The Tumultuous Liberation of Wireless Technology, from Herbert Hoover to the Smartphone*.²³ He documents systematic deterrence of new technology by bureaucracy. He blames not the regulators themselves, individuals who want new technologies, but the “administrative apparatus” and “regulatory gridlock” to access unused spectrum, requiring potential licensee to file an application, detail the business plan, and demonstrate the technology before it is ever tried. Moreover, the applicant must prove that the technology will serve the “public interest, convenience, and necessity.” Incumbents can nix technologies they believe to be threatening. It can take a decade or more to bring a new technology to market. Most innovators fail, and many pass away unrecognized, bankrupted, and demoralized.

Problems with Administrative Allocation

Coase critiqued IRAC for what he termed “governmental administrative machinery”, the “complex process of bargaining and accommodation,” and the “widespread feeling of dissatisfaction with the way the present arrangements are working.”²⁴ He noted that IRAC allocates too much spectrum to government departments and too little to private users. Coase took issue with IRAC’s policy of “first come, first served,” calling it a system in which “those who are first granted the use of a radio frequency are not easily displaced by a newcomer” (p. 37). Coase noted that IRAC’s assignments are rarely disturbed. “What this implies is that radio frequencies are used by Government departments for purposes which have a relatively low value as compared with what are the same frequencies would be worth if they could be made available to a private user,” says Coase. By contrast,

²³ Thomas W. Hazlett, 2020. “The 1927 Radio Act as Pre-emption of Common Law Property Rights,” *Review of Industrial Organization*, Springer; <https://ideas.repec.org/s/kap/revind.html>. The Industrial Organization Society, vol. 56(1), pages 17-35, February.

²⁴ Coase quotes Dr. Irvin Stewart of served in leadership functions for the FCC and IRAC: “It is a body composed of users. The situation is one in which naturally there is a desire to accommodate the wishes of the users who participate. There is nobody sitting in the position of arbiter. There is nobody who can ask too many hard questions. There is nobody who has an overriding task of requiring that the necessity for a particular new assignment be established in light of all the assignments that have been made in the past. . . . It is natural for each Government department to emphasize the importance of its role; and there isn’t inherent in the situation any necessary motivation to conserve frequencies in order that they might be available for only-Government use. In many cases in the assignment of frequencies, security considerations must be taken into account, and that means that justifications for the assignments cannot be made a matter of record. And then when you have no public record, you have another fertile ground for suspicion” (Hearings on Spectrum Allocation p. 33-34).



we can see that since the FCC adopted market-based reforms, assignments are frequently changing as license holders trade up for better uses.

Coase ascribed the challenge for IRAC in part to the downsides of central planning, observing,

The experience in the United States with the administrative structure which has been devised to handle the allocation of radio frequencies illustrates very vividly one of the dilemmas of planning. The attempt to control everything from the center is liable to lead to paralysis. The delegation of control leads to inconsistency of action. If central control is instituted, the necessity of referring all questions to the center involves expense in compiling and transmitting information and delay before decisions can be made. Nor are the decisions necessarily better when they are made. The remoteness of the center from the areas affected by the decision may lead to a failure to understand the significance of the issues under consideration. . . . The division of control of the allocation of radio frequencies between the FCC and IRAC has no doubt led to misuse of radio frequencies. It may well have resulted in too great an allocation of radio frequencies in total for the use of Government departments. But there is every reason to suppose that an attempt to avoid such misallocation by extending the powers of the FCC to cover Government stations or by establishing a new Board to supervise the allocation of frequencies to Government departments (using procedures similar to those of the FCC) or by setting up a single super Board to control the allocation of all frequencies in the United States, would impose additional expense and delay and would bring about new misallocation. It is no doubt desirable to realize the inefficiencies inherent in the present system. (p. 39)

It is interesting to note that there have been multiple attempts to improve allocation of government spectrum, even an idea from the 1930s that the FCC would allocate the government frequencies. "But this move was resisted by the Government departments, particularly the military departments, and the final result of success reorganization was to place the FCC, if anything, in a subordinate rather than dominant position," notes Coase (p. 38). Moreover, in the realpolitik of spectrum among federal agencies, there are political payoffs which never appear on the balance sheet. Spectrum can be a valuable token when budgets and other assets are limited. As such keeping some spectrum issues unresolved allows them to be used for later trades.

The Case for Spectrum Fees

Coase thought that private and government users should pay for spectrum. He described the simplicity and superiority of a pricing system over administrative allocation, how it eliminates waste and misuse, and how it would deliver better outcomes in the national interest. He described, quite plainly in 1962, that the demand for the scarce resource of spectrum exceeds supply:

In the case of radio frequencies, as the price that is charged at the present time is, of course, zero, it is hardly surprising that we find a situation in which there is an excess of demand over supply and there is need for some governmental administrative machinery to decide who among the many claimants shall be granted this valuable resource. Those in positions of authority who deal with the problems of allocating the radio spectrum act as if they were unaware that the rest of the American economic system largely works on different principles. (p. 42)

Coase then described why a pricing system is superior to administrative allocation, noting that,

. . . resources are obtained by those who will pay the most for them. Since the amount which a user will pay for a resource reflects the value of that resource in whatever employment he is contemplating using it, the pricing system tends to result in that allocation of a resource between its various uses which maximizes the value of production. If a price had to be paid for radio frequencies, government departments would not use them unless they felt that, by spending their money in this way, it would serve the purposes of the department better than by spending that money in any other way. And if the price was made sufficiently high so as to bring the demand for radio frequencies into equality with the supply, this would both eliminate the need for an administrative allocation and ensure radio frequencies were used for those governmental purposes which justified the greatest monetary sacrifice (p. 41).



Coase understood the economics of information and observed that government users

would be naturally reluctant to disclose information which might result in their having to relinquish any radio frequencies. It is one of the advantages of the pricing system that, for its efficient working, the only person who needs to know about how any given user would use radio frequencies is the user himself. He has to decide how much it is worth his while to offer for a certain radio frequency: whether he obtains it depends on what others are willing to offer. (p. 43) . . . The absence of a market price (which measure the value of a frequency to another user in another use) means that a user has little idea of when he is using a frequency “wastefully” and no financial inducement to find out. Obviously, a frequency should not be used for a particular purpose if it prevents the accomplishment of some other purpose of greater value or if the same purpose could be achieved by the use of another resource which would mean a smaller fall in the value of production than the use of the frequency. It is clear that such wasteful use must be very common with the existing system. Any user with the existing system will not willingly surrender frequencies that he has been allocated so long as their use (or potential use) has a value greater than zero and this even though there may be others to whom the frequency has higher value (p 45).

Coase described that a pricing system for spectrum would benefit the military and the nation. “The introduction of a market would tend to bring the interest of the military departments and the national interest into a closer conformity,” he wrote (p.44) Coase noted that spectrum usage fees could be made available for short or long terms and that this did not preclude the addition of other regulation.

Assessing fees on government agencies is logical and rational. Just as agencies procure resources from the market (labor, building rental, electricity), they should also pay for spectrum. A fee regime can be implemented without requiring the government to divest its spectrum ownership. Though it still requires some administration, it is an improvement because it brings pricing discipline. Spectrum regulator Ofcom in the United Kingdom implemented a fee regime in 2007.²⁵ The goal was to nudge agencies to return their lightly used spectrum. While the agencies ended up requesting the funds to purchase the frequencies outright, the regime brings greater attention and accountability to resource management and forces the agencies to acknowledge the value of spectrum.

Some might resist a fee regime for spectrum on the ground that the US military has been rendered less effective by the bureaucratic “accountability police”.²⁶ However it is not logical nor rational that the military (or any federal agency) acquire all of its inputs (land, labor, weapons etc.) through a market process, but not a problem. The bureaucratization of the military is a separate problem, but it is no excuse to a continue the command and control regime that diminishes the effectiveness of spectrum policy and discourages the military from being a responsible spectrum user.

IRAC and Reform

Conflict within and between NTIA/IRAC and FCC is not new. Over the decades there have been a series of political struggles. This will likely continue as long as spectrum is allocated by administrators, not the market. Policymakers should not invest hope that there is some magical institutional design that can resolve the conflicts. It is natural and predictable that incumbent industrial and government interests will use institutions to maintain the status quo and protect their position, which appears to be the case with the proposals under development by

²⁵Ofcom. “Modifications to Spectrum Pricing.” January 10, 2007. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/287994/UK_Spectrum_Strategy_FINAL.pdf

²⁶ Christian Browse. *The Kill Chain: Defending America in the Future of High-Tech Warfare*. Hachette Books, 2020.



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Commerce Spectrum Management Advisory Committee (CSMAC) for “new” versions of NTIA, FCC, or a unified spectrum authority.²⁷

Indeed, leaders have been aware of the consequences of the IRAC policy choice. Reflecting on his role leading the organization, E.M. Webster described IRAC in 1945 noting,

The IRAC is unique among government agencies in that it came into being, not as the result of action by either the executive or legislative branches of the government, but spontaneously through a demand of the interested government agencies. . . These people represent their respective agencies whenever frequencies are involved, but it should be emphasized that, while each is acting to some extent as an individual, he is primarily the medium of policy expression for his organization.²⁸

This statement dispels the view that IRAC acts collectively on behalf of the American people. Rather it is designed to further the interest of vested federal agencies. Today’s members include the Air Force, Army, Navy, Coast Guard, Broadcasting Board of Governors, Federal Aviation Administration; the Postal Service, the National Science Foundation, the National Aeronautics and Space Administration, and the Departments of Commerce, Energy, Homeland Security, Interior, Justice, State, Transportation, Treasury, and Veterans Affairs. The FCC is only a liaison. Observers include the Department of Defense, the Food and Drug Administration, and the National Security Agency.

Webster recounts the debate on the need for trials on vacuum tubes versus arc transmitters and how the government would dispose of obsolete radio equipment from World War II (lest it continued to be used and cause interference.) He observed how the agency spent significant time regulating small pieces of spectrum, which in retrospect was a waste of time as new technology from the private sector made government choices obsolete. He recognized that federal spectrum holders needed to be more tolerant of interference and that receivers needed to be improved.

Webster observed that the conduct of war is not for the military alone. Many actors which need to use the spectrum when the nation is at war, especially domestic and international broadcasters. He noted that the government’s use of spectrum must by necessity be constrained. If the use of spectrum is limited for government during war, it must certainly be limited during times of peace, and it must be shared for communications, aviation, navigation, public safety, forestry, channels for allies, and so on. He noted how during wartime that government users had to shuffle and relinquish rights and accept higher levels of interference. Given limited frequencies, priority use was established. This is an important lesson for today’s pandemic. Households and business are economizing during a financial crisis. There is no reason why the Department of Defense should not examine how to make better use of its \$800 billion budget. Indeed, pricing could help NTIA and IRAC make better decisions and reduce internal conflict among competing agencies.

Webster described IRAC’s decision guidelines as the protocols of priority use, freedom from harmful interference, and precedence. He described detailed decision making at the agency which requires it to assess many factors when making spectrum allocation including

- a. Rule of law as defined by agreements and records, Executive Orders, IRAC minutes and records, international and interagency agreements;

²⁷ “Report on the Presidential Memorandum on Developing a Sustainable Spectrum Strategy for America’s Future: Governance” (CSMAC Working Group 1, April 22, 2020), https://www.ntia.gov/files/ntia/publications/csmac_sc1_presentation_april_22_2020.pdf.

²⁸ E. M. Webster, “The Interdepartment Radio Advisory Committee,” in *Proceedings of the IRE*, vol. 33, no. 8, pp. 495-499, Aug. 1945, doi: 10.1109/JRPROC.1945.230506.



- b. National interest, where in consideration is given to relative need for the frequency in question and to the degree of utilization by the agencies involved;
- c. Necessity for using radio, taking into consideration the availability of other means of communication;
- d. Expansion. Here, in the interest of planned and orderly utilization of the radio spectrum, the Committee recognizes the desirability of providing for normal expansion of a service where it is shown by the applicant that expansion will occur, and where its trend and magnitude can be estimated;
- e. Geographical priority, which, as applied to mobile stations, is construed to extend only to the geographical area specified at the time the frequency was assigned; as applied to a fixed station, it extends only to the geographic allocation of the points of communication designated in the authorization;
- f. Dates of assignment and first use, where other considerations are substantially equal, establish the priority as between stations unless by the terms of an agreement it is specifically provided otherwise. To the end that there be most efficient utilization of the radio spectrum, acceptance of a radio-frequency assignment imposes definite obligations on the assignee with respect both to equipment and to use. Some of these are specified in treaties and laws.

Additionally, the organization was obligated to

- a. To use the best and most selective radio apparatus the state of the art and service operating requirements permit;
- b. To use frequencies economically by avoiding unnecessary emissions and conducting operations on a minimum number of frequencies;
- c. To share frequencies between agencies as a recognized and necessary expedient for the fullest utilization of the radio spectrum.

These requirements are interesting in light of today's interagency conflicts. For one, the pricing mechanism would eliminate much of the "administrative machinery" Coase described, but also, it is not evident that federal agencies even follow IRAC's rules. For example, the former Under Secretary of Defense for Research and Engineering Michael D. Griffin in the Department of Defense noted that the military's GPS receivers will not fulfil military grade expectations until 2035.²⁹ Government agencies have made technological choices which are not emissions-efficient, and rather than using a "minimum" number of frequencies, they claim to need more than they have, even challenging private rights' holders. Moreover, the notion that agencies need to share the scarce spectrum resources is belied by government behavior which challenges new uses.

While Congress has vested authority in NTIA and IRAC, there could be an issue in the violation of the nondelegation doctrine in that Congress has devolved too much power and function to the Executive Branch on an issue which it is constitutionally bound to exercise itself.³⁰ Spectrum is at the heart of interstate commerce, which is clearly an Article I responsibility, and one of critical importance to the people of the United States.

Aside from public choice and rule of law questions about IRAC, its governance today consists of some 20 federal agencies whereas the "public" (purportedly consumers) is represented only by the FCC, which does not enjoy the same standing or power as the other agencies. IRAC's proceedings are not fully public, and it appears to be subject only to limited Congressional oversight and judicial review. As such, most spectrum remains under legacy rules and is unavailable to satisfy the highest-valued demands of consumers.

²⁹ "Department of Defense Spectrum Policy and the Impact of the Federal Communications Commission's Ligado Decision on National Security," Armed Services, May 6, 2020, <https://www.armed-services.senate.gov/hearings/20-05-06-department-of-defense-spectrum-policy-and-the-impact-of-the-federal-communications-commissions-ligado-decision-on-national-security>.

³⁰ Kelley, William K. "Justice Scalia, the nondelegation doctrine, and constitutional argument." *Notre Dame L. Rev.* 92 (2016): 2107.



It is not even clear that NTIA and IRAC are fulfilling their duty to inform the White House of their activities. The requirement to develop a Sustainable Spectrum Strategy is one of many requests from the President which has not been delivered, or at least not made public.³¹

Congress should consider the introduction of a pricing system for federal users which reflects the market value of the spectrum. Failing this, Congress should consider reforms so that the American people are duly represented in IRAC, or at least to bring more accountability to its decisions. The recommendations in the subsequent section begin to address these issues. Simply put, having more spectrum in use by private actors makes our country richer, increases gross domestic product, and provides valuable services to consumers and producers.

Second Best Options

Transparency of spectrum use

Senator Mike Lee's (R-UT) proposed the Government Spectrum Valuation Act which would task NTIA, the Office of Management and Budget, and the FCC to estimate the value of relative spectrum for licensed or unlicensed and report what is assigned and allocated to each agency.³² Coase explained why government users will resist such an effort, and unsurprisingly, this common-sense bill has not moved forward. However, such a study need not be stymied by lack of legislative support. The National Science Foundation (NSF), for example, could conduct the study, though without access to NTIA's underlying information, NSF would only be able to provide estimates.

Market actors could help bring transparency to opaque government spectrum usage. The FCC has approved seven Spectrum Access System (SAS) administrators for the 3.5 GHz band.³³ One or more of these administrators could create a public dashboard of frequencies to show how little federal spectrum is used. This promises to show the opportunity cost of leaving spectrum fallow when so many actors are willing to use it more efficiently and pay for the right to do so. Some 350 firms have signed up to participate in the forthcoming 3.5 GHz auction in which the FCC offers three payment tiers to access 70 MHz of valuable but little used federal spectrum.³⁴ Given the plethora of firms willing to pay significantly for spectrum access, the FCC should consider implementing a similar tiered framework for the 6 GHz band, which otherwise is a giveaway to America's richest software companies during a time of national financial crisis.

Report Cards

The Congressional Budget Office could play a role not only to estimate the opportunity cost of little used federal spectrum but could issue report cards on agencies for their efficiency of spectrum use. Spectrum stewardship could be included as part of the review criteria for appropriations and authorizations. Reports cards need not be developed by government actors. Private and academic actors could contribute on this instrument.

Examination of interference studies

Recent spectrum conflicts offer a valuable policy research opportunity to test the purported claims of interference. Many agencies have portended Y2K-like disaster scenarios from FCC decisions on commercial spectrum.³⁵ As some time has elapsed since these proceedings and services have been deployed, it is valuable to

³¹ "Presidential Memorandum on Developing a Sustainable Spectrum Strategy for America's Future," The White House, October 25, 2018, <https://www.whitehouse.gov/presidential-actions/presidential-memorandum-developing-sustainable-spectrum-strategy-america's-future/>.

³² "Sen. Lee Introduces Government Spectrum Valuation Act," Mike Lee, May 23, 2019, <https://www.lee.senate.gov/public/index.cfm/2019/5/sen-lee-introduces-government-spectrum-valuation-act>.

³³ "3.5 GHz SAS Conditional Approval Public Notice," Federal Communications Commission, December 21, 2016, <https://www.fcc.gov/document/35-ghz-sas-conditional-approval-public-notice>.

³⁴ Mike Dano, "The Full List: Here Are the Actual Bidders in the CBRS Auction," Light Reading, June 19, 2020, <https://www.lightreading.com/5g/the-full-list-here-are-the-actual-bidders-in-the-cbrs-auction/d/d-id/761602>.

³⁵ Roslyn Layton, "GPS Interference Fears Are Today's Y2K, Says Former UK Spectrum Director," Forbes, May 8, 2020, <https://www.forbes.com/sites/roslynlayton/2020/05/08/gps-interference-fears-are-todays-y2k-says-former-uk-spectrum-director/>.



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see whether the predictions proved true, were mitigated as the FCC described, or never occurred. This is also a legitimate area of study for the FCC's Office of Economics and Analytics and NTIA's Institute for Telecommunications Sciences.

Spectrum policy choices have economic and national security consequences. While market reforms have helped correct misguided historical choices for spectrum decisions, many features of command and control administrative allocation remain. Today, many stakeholders are unsatisfied. Nearly every industry and federal agency would like more spectrum but can't get it. Inefficient use is encouraged; new technologies are deterred; and Americans are denied new jobs and services in the wireless domain.

The most cited academic literature and experience shows the value of market-based allocations of spectrum. The first best policy choice for consumers is to privatize the spectrum itself and sunset administrative allocation. However, the second-best policy choice, the introduction of a market-based pricing system, has been introduced within a framework in which regulators still make the categorical allocations, albeit with more flexible uses.

The template for federal spectrum allocation is essentially unchanged for a century. Bringing pricing discipline to federal users would be a quantum leap from the status quo and would improve outcomes for federal users and Americans in general. It could be implemented without having to dismantle existing agencies.

With the SPECTRUM Now Act and the Spectrum IT Modernization Act, this Committee is taking important steps to bring federal spectrum allocation into the 21st century and building on proven success of improved management and efficiency of commercial spectrum. A feasibility study of increasing federal spectrum efficiency and relocating federally held spectrum and/or sharing it with commercial users to facilitate the deployment of 5G is much needed. Similarly, modernizing the IT infrastructure for federal spectrum can also help to bring transparency and improved decision-making.

Thank you for the opportunity to testify today. I look forward to your questions.

Sincerely,

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