Insight

Spectrum Auctions and the Reallocation Bottleneck

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Executive Summary

- Radio spectrum enables wireless communications, but these communications can be disrupted by harmful interference; this interference can be mitigated either through assigning exclusive licenses, unlicensed spectrum commons with general rules of use, or sharing regimes with a mix of restricted licensed and unlicensed access.
- The Federal Communications Commission (FCC) uses auctions to assign licensed spectrum to the highest bidder, a more efficient method that enables faster assignment and deployment of licensed spectrum; however, auctions can take months or years to prepare, particularly when federal agencies must coordinate the reallocation of federal spectrum for commercial use.
- While Congress tasked the FCC and National Telecommunications and Information Administration with developing a pipeline for reallocating large bands of federal spectrum for licensed commercial use in the next few years, coordination bottlenecks threaten these deadlines; several short- and long-term reform options exist for addressing delays and getting federal spectrum to commercial use faster.

Introduction

Using radio spectrum to communicate wirelessly enables a wide variety of mobile and broadcasting communications, everything from in-home Wi-Fi and connected devices to commercial broadcasting and mobile wireless communications. A key policy challenge for communicating over radio waves is managing harmful interference that disrupts communications. For most services that operate over a wide geographic area, such as broadcasting and mobile wireless communication, spectrum licenses grant exclusive or restricted rights to specific frequencies, giving service providers and their customers

confidence that harmful interference will not disrupt transmissions. For other services with more limited or time-dependent reach, where the cost of assigning licenses would exceed the benefits of enforcement, unlicensed spectrum commons with general rules of operation allow many devices to use the same spectrum at low power levels to minimize harmful interference. While many assignment methods for licensed spectrum have been tried over the past century, auctions have proven to be the most efficient method.

The Federal Communications Commission (FCC) has used auctions to assign licensed spectrum since the 1990s, when Congress first granted the agency authority to do so, with a brief gap from 2022 until auction authority was reauthorized in the One Big Beautiful Bill Act (OBBBA). Using auctions allows the FCC to assign licensed spectrum to the highest bidder, meaning licenses are assigned faster and to providers with strong economic incentive to deploy the spectrum for its highest-value use. Auctions also raise revenue to compensate incumbent users of the spectrum, who will have to share or clear the bands being auctioned, as well as provide revenue for the U.S. Treasury.

Nevertheless, each auction requires months, sometimes years, of preparation. Much of this preparation is due to the need to reallocate spectrum for new uses before it can be auctioned (or made available on an unlicensed basis). Reallocations of spectrum used by state and local governments or commercial users are managed entirely by the FCC. Reallocating federal spectrum, however, requires coordination among multiple agencies, primarily the FCC and National Telecommunications and Information Administration (NTIA), but also the Office of Management and Budget (OMB) and any other federal agencies that hold licenses for the spectrum being auctioned. Some of this preparation work is unavoidable, but coordination bottlenecks, both statutory and bureaucratic, can create unnecessary delays in putting spectrum to its highest-value use for consumers, whether licensed or unlicensed.

Congress, through the OBBBA, tasked the FCC and NTIA with developing a pipeline for reallocating 500 megahertz (MHz) of federal spectrum for licensed commercial use in the next few years. Yet existing coordination bottlenecks threaten the FCC and NTIA's ability to meet these deadlines. Several short- and long-term reform options exist for alleviating these delays and getting federal spectrum to commercial use faster, including reforms to the Commercial Spectrum Enhancement Act as well as structural reforms to how federal spectrum is managed.

Why Auctions?

Wireless communications are enabled by radios, which harness electromagnetic spectrum for communications by altering radio waves to send information between transmitters and

receivers. This radio spectrum can be divided across three dimensions: frequency (the segment of spectrum that a radio uses to transmit or receive, defined by the length of the radio wave), geography (the area over which a radio can reach other radios), and time (when the radio transmits or receives). If too many radios attempt to use the same frequency in the same area at the same time at cross purposes, interference can occur; this interference becomes harmful when it disrupts communications.

Dividing access to radio spectrum across these three dimensions (as well as improving radio technology) can dramatically increase the communications capacity of radio spectrum while minimizing harmful interference. For most services that operate over a wide geographic area (such as broadcasting and mobile wireless communication), assigning exclusive or restricted access licenses to specific radio frequencies in a given area grants both service providers and their customers confidence that harmful interference will not disrupt communications.

Spectrum licenses have been assigned using a variety of methods since the early 20th century, driven by a mix of changing political and commercial factors in wireless communications. (For a more detailed history, see the appendix.) Auctions arose in the 1990s as an assignment method because the FCC's prior methods proved unworkable as the commission allowed more flexible use of the most economically valuable spectrum beyond broadcasting into mobile wireless communications.

The primary method of assignment for much of the middle 20th century was "comparative hearings" (or "beauty contests"), but it would have taken the commission years to determine mobile wireless license awards in a given area based on the "public interest." The second method the FCC used to assign these new flexible use licenses, lotteries, essentially created a windfall for the winners, who often sold their newly acquired, unpriced license on the secondary market for a tidy profit.

Auctions have three major benefits over their predecessors. First, they allow the FCC to assign licenses faster than the other methods, which means consumers get quicker access to the benefits of services that run over this spectrum. Second, by assigning the spectrum license to the highest bidder, the FCC ensures that licensed spectrum goes to the service provider that values it most and has the most incentive to deploy it to its highest-value use. Third, instead of creating a windfall for the winners of spectrum licenses, the revenue generated by auctions is retained by the U.S. Treasury. Congress granted the FCC auction authority continuously from 1993 through 2023, during which 100 auctions were conducted, raising over $230 billion for the U.S. Treasury and creating trillions of dollars of consumer surplus by enabling and expanding new communications services.

While auctions have proven to be the most efficient method for assigning licensed spectrum, not all spectrum needs to be licensed. Unlicensed spectrum, which like licensed spectrum is allocated to specific bands, enables devices that only need to use spectrum within a small area to operate without the costs entailed with acquiring and enforcing a license. As previous American Action Forum research has detailed, the FCC's "Part 15" rules state that as long as the manufacturers and operators of such devices adhere to low power levels (to limit their geographic range) and agree to accept interference from other authorized sources, they may transmit freely without a license. With unlicensed spectrum, harmful interference is managed through technical limitations on devices (primarily power limits) rather than granting exclusive or restricted access to specific frequencies over a defined geographic area. This enables all kinds of technologies, from Wi-Fi and smart home devices, to private networks that support smart factories. Many consumers and business rely on a broad mix of technologies that use both licensed and unlicensed spectrum, so a good national spectrum policy will balance ensuring both licensed and unlicensed spectrum users have access to adequate spectrum bandwidth.

Indeed, new technological developments and governance arrangements can allow spectrum frequencies in the same geographic area to be dynamically shared among federal, licensed, and unlicensed users. Because there is little remaining "greenfield" spectrum—that is, spectrum that has not yet been assigned to a specific use or user—sharing offers an alternative way for commercial users to access spectrum. One such shared band, the Citizens Broadband Radio Service (CBRS), offers an example of how spectrum sharing arrangements can work. Through a combination of tiered access rights, power limits, and an automated frequency coordinator known as the Spectrum Access System (SAS), users in the CBRS band can get access to spectrum when users with higher priority are not using it. Federal users, primarily coastal radars operated by the U.S. Navy, receive the highest priority access. Commercial users with licenses (assigned through an auction) receive access when and where federal users aren't using the spectrum, while unlicensed users have the lowest priority for access.

Sharing can enable more efficient use of spectrum that would otherwise remain fallow when unused by its primary users, increasing bandwidth at the margin for all users. Yet this dynamic sharing comes with tradeoffs: The same governance mechanisms used for reducing harmful interference (tiered access, power limits, and the SAS) also impose limitations on commercial users, including unreliable access and increased deployment and operational costs. These limitations are reflected in the reduced unit price (measured in dollars paid per MHz multiplied by the population in the license area) bidders were willing to pay for CBRS licenses relative to exclusive licenses. Nonetheless, the CBRS auction demonstrated that licensed users were still willing to pay for restricted licenses to augment their networks.

Experience has also led to relaxation of interference assumptions in the CBRS sharing system, allowing for more commercial access. In the future, CBRS and new spectrum sharing arrangements may benefit from new technologies including artificial intelligence that could more efficiently allocate spectrum among users in real-time, ensuring more reliable access to shared spectrum for commercial users.

Preparing for Auctions: The Reallocation Bottleneck

Spectrum auctions take months, sometimes years, of preparation and coordination before they are actually conducted. Before a spectrum auction can take place, spectrum bands must be allocated for specific services and classes of users. With little remaining greenfield spectrum left, allocation usually involves either clearing existing users or finding a way for incumbents and new users to share the spectrum. Uniquely, the United States divides the responsibility for spectrum management between two agencies: NTIA, which governs spectrum used by federal agencies, and the FCC, which governs spectrum used by private and non-federal government entities.

While the FCC has, as of late, interpreted its "public interest" mandate to mean maximizing the efficiency of commercial spectrum use, NTIA is instead charged with minimizing harmful interference to federal spectrum operations. Therefore, while federal spectrum supports many important activities, including flight safety, weather monitoring, and defense radar and communications, NTIA and other federal agencies lack the same incentives as commercial users to use spectrum efficiently.

When spectrum being considered for reallocation is not in federal use, the FCC primarily oversees the process. Typically, broad swaths of spectrum will be identified for potential reallocation either through internal FCC advisory bodies such as the Technological Advisory Council or by Congress through statute. Once identified, the commission will follow a typical notice-and-comment rulemaking procedure to reallocate specific spectrum bands, define operational rules for the band (including sharing and interference mitigation) and set up an auction process (if it is to be licensed). When spectrum reallocation involves moving incumbents to new bands, the rules will also define clearing and transition schedules. Incumbents will typically receive some portion of any auction proceeds to offset any costs they incur because of the move, as well as incentive payments if they adhere to clearing and transition schedules. While these reallocation proceedings are often contentious, having a single agency oversee the process allows for more timely decisions on whether and how to reallocate spectrum bands.

When spectrum currently used by federal agencies is being considered for reallocation, the FCC and NTIA need to coordinate, along with OMB and any federal agencies that use the

spectrum being considered. Because agencies lack incentives to offload underused spectrum, reallocation of federal spectrum usually starts with a congressional mandate to study reallocation. The reallocation process, from initial studies to transition costs, is paid from the Spectrum Relocation Fund (SRF), created by Congress in the Commercial Spectrum Enhancement Act (CSEA) of 2004 and funded by auction proceeds. The first step of these studies is to prepare an SRF funding plan, which is submitted to OMB for approval and then to Congress for review. Once approved by OMB and the relevant congressional committees, OMB transfers funds to the agency to complete the study. As with the FCC's process for non-federal spectrum, the study focuses on which bands can be put to commercial use, whether the spectrum can be shared or if the agency will need to fully transition operations out of the band, as well as any harmful interference concerns. Once the study is complete and transition plans finalized, NTIA sends the final report to the FCC. This transfer occurs at least eight months before the auction takes place (after which, the FCC follows the procedures detailed above to reallocate and assign the spectrum for commercial use, including any potential auction).

Meanwhile, the FCC must notify NTIA of the intent to auction spectrum bands at least 18 months in advance of an auction. Additionally, once the FCC identifies specific frequencies it intends to auction, the portion of SRF funding dedicated to funding transition studies is cut off. Prior to 2016, the FCC provided auction notification separately from identification of frequencies for the express purpose of starting the 18-month period without cutting off SRF funding for studies. In 2016, OMB issued guidance interpreting the CSEA suggesting that notification of intent to auction bands also served as identification of specific frequencies, meaning that the auction notification would lead to SRF funds for studies being cut off. Earlier this month, OMB rescinded the 2016 guidance, allowing the FCC to provide notification to NTIA of intent to auction federal spectrum bands without placing SRF study funding in jeopardy.

This interpretive back-and-forth, however, is but one example of how the combination of various notices, review periods, and funding cutoffs in the federal spectrum reallocation process encourages unnecessary delays. Many parts of the process, particularly the 18-month notification period, are relics of the era before spectrum studies were a routine part of federal spectrum reallocations. To be sure, these studies provide important information about potential harmful interference that could occur after transitioning the band to new uses, which benefits everyone, especially future commercial users. No commercial user wants to invest time and resources into acquiring access to and deploying in a band, only to discover that harmful interference reduces the ability to reliably transmit communications over it.

To maximize the benefits of these studies while reducing the timeline, Congress could consider reforming the processes in CSEA. Potential reforms include reducing or eliminating notice and review periods, allowing SRF funding intended for studies to continue after frequencies are identified for auction, and standardizing spectrum study procedures and timelines. These would ensure that the carrots (SRF planning funding) and sticks (clear timelines for preparing transition plans) in the process are not misaligned.

Beyond making the federal spectrum transition process easier, Congress could also provide better incentives to federal agencies to voluntarily share or transition spectrum so it doesn't have to mandate reallocation through statute. For example, Congress could permit agencies to trade their own spectrum licenses on a secondary spectrum market, as private spectrum licensees are able to. This could allow for "overlay auctions," where commercial users could bid for licenses to share federal spectrum with agencies. Alternatively, Congress could require NTIA to charge agencies the economic value of their licensed spectrum, rather than the nominal fee they are currently charged, to help agencies understand the economic tradeoff of holding spectrum that is not being put to the highest-value use. Congress could also consider combining federal and non-federal spectrum allocation decisions under one agency with one mandate. Providing better incentives for agencies to voluntarily share or transition spectrum would have benefits for making more of both licensed and unlicensed spectrum available for commercial use at a time when demand for spectrum bandwidth is rapidly increasing.

The Return of Auction Authority

After a two-year lapse, Congress reauthorized the FCC's auction authority in OBBBA through 2034. Along with this reauthorization, Congress tasked the FCC with identifying 300 MHz of non-federal spectrum to reallocate for licensed flexible use, including at least 100 MHz in what is known as the "upper C-band" to be auctioned by 2027. It further required the commission and NTIA to identify an additional 500 MHz of federal spectrum to reallocate for licensed commercial use, with deadlines for auctions of identified spectrum (200 MHz by 2029 and the remainder by 2033). Finally, OBBBA provided funding to NTIA to conduct studies of three bands with significant federal spectrum operations, and publish biennial reports that assess the economic value of all federal spectrum broken down by 100 MHz bands.

The FCC has already identified 160 MHz of non-federal spectrum in the upper C-band, currently held by satellite operators, to auction by OBBBA's 2027 deadline. The preparation for this auction was completed in record time, even though the FCC had to coordinate with the Federal Aviation Administration over concerns that opening this band up to mobile wireless communications would disrupt radar altimeters used by commercial airplanes

during takeoff and landing. This auction will complement an earlier auction of the "lower C-band," creating a nearly 400 MHz continuous band of spectrum for mobile wireless communications. Because of the value of this spectrum, it is expected to attract tens of billions of dollars of bids; after transition costs are paid to incumbent satellite operators to move and airlines to update their altimeters, most of the proceeds will be retained by the U.S. Treasury.

Meanwhile, NTIA is making progress on four studies of different spectrum bands currently in federal use (1675–1695 MHz, 2700–2900 MHz, 4400–4900 MHz, and 7125–7400 MHz) that have the potential to meet or exceed their statutory mandate of identifying 500 MHz of federal spectrum for reallocation. Only 5 MHz of spectrum (1675–1680 MHz), however, has been identified for reallocation so far. Earlier this month, the FCC took advantage of new OMB guidance on SRF to issue its notification of intent to auction spectrum in the 1600 MHz, 2700 MHz, and lower 7000 MHz bands in 2028, which will allow the FCC to meet Chairman Brendan Carr's goal of holding three auctions that year. Whether these auctions will happen in 2028 still depends on NTIA completing studies and providing the FCC with transition plan reports in a timely manner.

Auctions continue to be the most efficient manner of assigning licensed spectrum, but delays and inefficiencies add years to the process. Delays in getting licensed spectrum to auction means reduced consumer benefits due to foregone services. Congress can provide oversight to ensure both agencies meet their deadlines under OBBBA and consider further reforms to federal spectrum reallocation that would benefit both licensed and unlicensed spectrum.

Appendix: A Brief History of Spectrum License Assignment

When Guglielmo Marconi in 1895 first successfully used radio spectrum to send and receive a message in Morse code between two devices not connected by a wire, he didn't have to worry about interfering with anyone else's communications as no one else owned a radio. Congress enacted the first Radio Act less than 20 years later, requiring the then Department of Commerce and Labor to issue licenses for radios with the goal of "minimizing interference," although few enough people owned and used radios that there was little interference to manage. By 1920, with the dawn of radio broadcasting, the now Department of Commerce set up some parameters for licenses, allocating certain bands for specific uses, and generally offering licenses on a "priority-in-use" basis (essentially, granting licenses to the first to broadcast on a given frequency in a given area).

The succeeding Radio Act of 1927 and Communications Act of 1934 shifted away from this common law, property-based system to a more centralized system of spectrum licensing,

first through the Federal Radio Commission and then through the FCC. Born out of a court decision that limited the Department of Commerce's enforcement abilities under the first Radio Act and a subsequent period of "chaos in broadcasting," spectrum license assignments were now to be determined through "comparative hearings" (or "beauty contests"), where bureaucrats and political appointees were charged with assigning spectrum licenses to applicants based on their ability to meet "public interest, convenience[,] or necessity." What became known as the "public interest standard," effectuated through these comparative hearings, exclusively governed spectrum licensure for the next five decades. This assignment method erected enormous barriers to entry, limiting competition to large broadcasting networks and delaying alternative technologies for broadcasting, such as FM Radio, sometimes by decades. Furthermore, it subjected those who were lucky enough to get licenses to a unique content regulation scheme that would not be permitted in any other communications medium.

Proposals to assign spectrum instead based on who valued its use most highly began to emerge as early as 1951, when Leo Herzel, a law student at the University of Chicago, suggested licenses be leased to the highest bidder. Eight years later, future Nobel Prize winner Ronald Coase amplified Herzel's arguments in a now famous article analogizing spectrum to any other scarce resource, proposing a mix of general regulations delineating how spectrum can be used alongside a market mechanism for trading rights to spectrum. Congress, the FCC, and the broadcasting industry all resisted these proposals; after all, the political assignment of spectrum rights enhanced both Congress' and the FCC's power over the speech of broadcasters, and bestowed broadcasters with access to a valuable resource at very little (if any) monetary cost.

Eventually, the dawn of mobile wireless communications made assigning licenses by comparative hearing untenable. Unlike broadcasting, which typically only needs a few, high-powered based stations, mobile wireless would need many, lower-powered base stations over a larger area to provide consistent service. When the FCC finally made plans to allow mobile wireless communications nationwide, each of the 734 wireless markets the FCC delineated would receive two licenses: one reserved for incumbent landline telephone companies and another for entrants, both to be determined by "beauty contest" (some markets had multiple incumbent landline providers). The FCC received 135 applications from entrants for the first 30 wireless markets, or an average of over four per market. Applications were often voluminous, under the theory that more detail about their business model demonstrated that awarding the license to them was in the "public interest." The FCC was unable to keep pace with the pressure to assign licenses in a timely manner under these circumstances; many applicants simply settled with each other privately over who would withdraw their applications and who would win the license. The remaining 704

markets were assigned using lotteries, an assignment method Congress had authorized for the first time in 1980.

Even lotteries proved difficult to administer. Because eligibility for the lotteries required applicants to demonstrate the ability to actually build out the infrastructure necessary to provide wireless communications service commercially, applications were still long. Furthermore, because the winner of a lottery would essentially receive a windfall from the government, it incentivized "application mills," where speculators would find an engineering firm willing to vouch for their ability to build out (for a price), when of course their intention was often to sell their newly acquired spectrum rights on the secondary market (a practice the FCC routinely allowed).

Lotteries did ultimately grant licenses faster than comparative hearings would have, but also granted the winners huge financial windfalls that, if the spectrum had been auctioned, would instead have accrued to the U.S. Treasury. In the political climate of the 1990s, when deficit reduction was a top concern for politicians and voters alike, this did not go unnoticed. In 1993, over four decades after they were first proposed, Congress finally authorized the FCC to assign licensed spectrum for wireless mobile communications by auction, with proceeds to be retained by the U.S. Treasury. A year later, the first auctions were held for spectrum that expanded the capacity of existing wireless mobile communications networks, assigning licenses even faster than lotteries.