

Advanced Spectrum Policy

*Curriculum for the National Radio Astronomy Observatory, National Science Foundation
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Video Playlist (8 videos)

Advanced Spectrum Policy Lectures (NRAO Course)

https://www.youtube.com/playlist?list=PLlbOnBe9IRS_YjElyMEqm_QNFbmlD5_ko

Video

Advanced Spectrum Policy Introduction

https://www.youtube.com/watch?v=QoYm_8a1Q8w&list=PLlbOnBe9IRS_YjElyMEqm_QNFbmlD5_ko&index=1

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1. Lecture 1: Panel on Radio Astronomy Spectrum Policy and Management

Video

Advanced Spectrum Policy Lecture 1: NRAO Panel Discussion

https://www.youtube.com/watch?v=JKP7fuc-hNI&list=PLlbQnBe9IRS_YjElyMEqm_QNFbmld5_ko&index=2

On February 21, 2025, a panel of experts from the National Radio Astronomy Observatory discussed current issues and activities in spectrum policy. The panel featured three experts from the National Radio Astronomy Observatory (NRAO): Harvey Liszt (NRAO Spectrum Manager), Chris De Pree (Deputy Spectrum Manager), and Sheldon Wasik (Zone Regulatory Services Coordinator).



Figure 1.1. Panel Discussion with NRAO Spectrum Policy Experts¹

They gathered to discuss spectrum management challenges for radio astronomy. Harvey represents radio astronomy internationally at the ITU-R, while Chris focuses on internal monitoring of radio frequency interference (RFI) and coordinates with satellite operators. Sheldon manages coordination in the National Radio Quiet Zone and conducts propagation analysis.

1.1. Learning Objectives

Statement

Understand the unique spectrum management challenges faced by the radio astronomy community, including interference sources, coordination mechanisms, and policy tensions with commercial and defense interests. Explore innovative solutions and international frameworks addressing growing space congestion and radio frequency interference (RFI).

1.2. Radio Astronomy's Unique Spectrum Challenges

¹ Video available here: <https://techpolicyinstitute-org.zoom.us/rec/share/3pN2ZQfd1dWnXpgs2GdfAoky7ZLCV4V5r4h1ktPKuODPclhshpofAv1RsPDyXlHK.OgEzdtceJbAmsPym?startTime=1740153862000>.

Passcode: &^7&5alq.

Radio astronomy faces unique spectrum challenges as it operates across the entire radio spectrum but only has allocations in very small parts of it. Below 86 GHz, only about 2% of the spectrum is protected for radio astronomy. This creates a difficult situation as radio telescopes are billions of times more sensitive than typical commercial transmission levels, making them extremely vulnerable to interference. The telescopes must follow natural phenomena across different frequencies, including red-shifted signals from the early universe.

Telescopes include, among others, the Atacama Large Millimeter/submillimeter Array located in the Atacama Desert in Chile, the Very Long Baseline Array (VLBA) of telescopes stationed across 5,351 miles, and the Very Large Array (VLA) which is the most advanced array of telescopes on Earth spanning across 22 miles.²

NRAO TELESCOPES

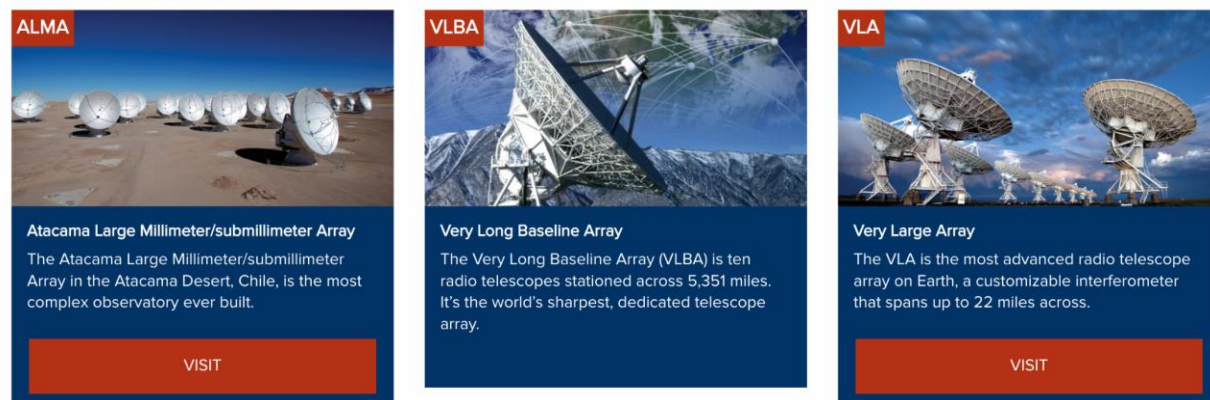


Figure 1.2. NRAO Telescopes³

1.2.1. The National Radio Quiet Zone

The National Radio Quiet Zone, covering about 13,000 square miles in West Virginia and Virginia, provides unique protection for radio astronomy. Within this zone, all permanent fixed transmitters must coordinate with NRAO before receiving FCC or NTIA licenses. Sheldon runs propagation analyses based on power flux density values to evaluate potential interference. The coordination encompasses public safety systems, cell towers, microwave links, and other technologies. Radio telescopes generally point upward, giving them reduced sensitivity to the horizon, which helps with terrestrial coordination.

“The NRQZ was established by the Federal Communications Commission (FCC) in [Docket No. 11745](#) (November 19, 1958) and by the Interdepartment Radio Advisory Committee (IRAC) in Document 3867/2 (March 26, 1958) to minimize possible harmful interference to the National Radio Astronomy Observatory (NRAO) in Green Bank, WV and the radio receiving facilities for

² NRAO, National Radio Astronomy Observatory Telescopes, <https://public.nrao.edu/>.

³ NRAO, National Radio Astronomy Observatory Telescopes, <https://public.nrao.edu/>.

1.2.2. Coordination Beyond Protected Zones

At sites outside the National Radio Quiet Zone, coordination becomes more challenging as operators aren't required to work with NRAO. For example, at the Very Large Array in New Mexico, the team reaches out to cell phone carriers and other operators for voluntary mitigation efforts. Modern radio astronomy doesn't observe in narrow protected bands but uses receivers with 4–8 GHz bandwidths that inevitably cross bands allocated to other users, making RFI management essential everywhere.

Multiple Choice Question

Radio astronomy is resilient to radio frequency interference from satellite and space development because of its large array antennas and highly specialized radio engineers. (False. Radio astronomy requires quiet zones for highly sensitive antennas that are able to detect light and electromagnetic waves from distant planets and constellations.)

1.2.3. Types of Interference

Radio telescopes experience various types of interference: narrow band, broadband, intermittent, constant, ground-based, and increasingly sky-based from aviation and satellites. The biggest challenge with space-based transmissions is the lack of protection mechanisms compared to terrestrial sources. However, the National Science Foundation has established cooperative agreements with several satellite constellation companies that require them to work with observatories, especially those in the Radio Quiet Zone.

1.2.4. Innovative Private Coordination Solutions

NRAO has developed innovative coordination methods with satellite operators like SpaceX. They created an "operational data sharing" system that publicly shares real-time data about telescope activities, including pointing position, frequency band, and observation timing. Satellite operators can query this system and, depending on their capabilities, avoid transmitting in those specific bands during observations. This allows radio astronomy to recover use of spectrum that has been licensed to others without completely restricting the satellite operators' service.

1.2.5. The Sensitivity Challenge

Radio astronomy telescopes are extraordinarily sensitive, measuring signals in micro-Janskys, which are millions of times weaker than typical commercial service levels. This extreme sensitivity is what allows astronomers to detect distant cosmic phenomena but also makes the telescopes highly vulnerable to interference. Historically, astronomers have addressed this by locating observatories in remote locations at great expense, but

the proliferation of satellites means there are no longer any truly radio-quiet locations on Earth.

1.3. Space Congestion and Growing Challenges

Space has become increasingly congested for radio astronomy. Where once the largest satellite constellation was Iridium with 66 satellites, SpaceX now has over 6,600 satellites in orbit. These newer satellites are also much larger and more powerful, with SpaceX Generation 2 satellites weighing nearly a ton compared to the much lighter Generation 1 satellites. The burden on both the electromagnetic spectrum and the Earth's environment has increased dramatically with this expansion in satellite technology.

1.3.1. Unintended Electromagnetic Radiation

Beyond the known frequencies used by satellite systems, radio astronomers also detect unintended electromagnetic radiation (UEMR) from onboard electronics. Recent research has documented this issue with telescopes like LOFAR in Europe detecting radiation around 180 MHz from satellites. Despite satellites passing lab tests, the extreme sensitivity of radio telescopes picks up this background electronic noise, creating additional challenges that are difficult to manage.

1.3.2. Coordination Complexities with Multiple Operators

As more satellite constellations from different companies enter orbit, new coordination challenges emerge. Each constellation presents unique problems based on orbit type (geostationary vs. low Earth orbit), movement patterns, and frequency ranges. Understanding the specific interference patterns is critical to developing mitigation techniques. The increasing diversity of satellite systems and their expanding use of different frequency bands create a more complex interference environment for radio astronomy.

1.3.3. New Interference Calculation Methods

Cell phone operators are now facing similar interference concerns from neighboring countries' satellites, requiring them to adopt the same aggregate interference calculation methods that radio astronomy has used for years. The signal levels used for direct satellite-to-cell phone communication are approximately 10,000 times stronger than what SpaceX needs for home broadband, creating new challenges for spectrum management across services.

Multiple Choice Question

Direct satellite-to-cell phone communication uses signal levels approximately 10,000 times stronger than those used by SpaceX for home broadband. (True. There are concerns for interference from higher powered radio users disrupting passive radio observation.)

1.4. Radar Interference and Coordination

Orbiting radars used for Earth mapping pose a particular threat to radio astronomy as they can potentially burn out receivers if telescopes point too close to them. Coordination for these systems has been limited, though some progress has been made. IUCAF recently established an agreement with the European Space Administration to prevent their 94 GHz radar from illuminating radio telescopes working at that frequency, creating a 25 km exclusion zone with minimal impact on their operations.

Multiple Choice Question

Orbiting Earth-mapping radars pose no threat to radio astronomy because they operate at completely different frequencies. (False. They pose a significant threat and can damage receivers if not properly coordinated.)

1.4.1. NRAO's Radar Development

Interestingly, NRAO is in the early stages of developing radar systems for mapping celestial objects, which will reverse the usual situation by directing power toward satellites. This development may require new coordination approaches where satellite operators need to know where NRAO's radar transmitters are pointing to avoid interference with their systems.

1.4.2. Commercialization of Federal Spectrum

Another emerging challenge is the increased commercialization of frequency bands previously reserved for federal use. Similar to the Citizens Broadband Radio Service (CBRS) transition, parts of the spectrum that have been relatively quiet near radio astronomy sites may become more congested as they open to commercial users. This requires new approaches to incentivize coordination and protect radio astronomy operations while allowing commercial entities to meet their communication needs.

1.4.3. Competing Interests in Spectrum Allocation

The panel noted the competing interests in spectrum allocation, including defense needs. As the commercial sector eyes frequency bands currently allocated to groups like the Department of Defense, questions arise about the appropriate balance. These federal users may utilize the spectrum less intensively near radio astronomy sites, which has benefited observatories, but commercial users would likely create more consistent interference.

1.5. Other Topics

1.5.1. Spectrum Encroachment at Higher Frequencies

Looking to the future, a significant challenge is the encroachment of active services into higher frequency ranges (above 230 GHz) where radio astronomy has traditionally operated alone. As solid-state sources improve and more sensitive receivers are developed, commercial interests are moving into these previously unallocated frequency bands. The spectrum above 275 GHz is currently unallocated but will need to be addressed soon as technology advances.

1.5.2. The Next Generation Very Large Array

NRAO's Next Generation Very Large Array (ngVLA) will present new spectrum management challenges as it operates from 1 to potentially 120 GHz across approximately 260 telescopes spread throughout the American Southwest and into Mexico. This distributed array will require extensive coordination to understand and manage the RFI environment across numerous sites in different regulatory jurisdictions.



Figure 1.4. ngVLA (Art Credit: Sophia Dagnello, NRAO/AUI/NSF)⁵

⁵ NRAO, "The Next Generation Very Large Array – ngVLA," <https://public.nrao.edu/ngvla/>; NRAO, "\$21 Million NSF Award Will Bring ngVLA Design to Life," September 14, 2023, <https://public.nrao.edu/news/21-mil-nsf-ngvla-design-award/>.



What is the ngVLA? Why does it matter to science?

Figure 1.5. ngVLA Explainer Video⁶

1.5.3. Consumer Electronics and Increasing RFI

The proliferation of electronics in everyday life is creating more sources of radio frequency interference. Modern vehicles, especially electric ones, generate so much interference that many don't include AM radios anymore. Self-driving technology, radar mapping for cars, and other electronics are pushing into higher frequency ranges that were previously unaffected, creating new potential sources of interference for radio astronomy.

1.5.4. International Coordination Frameworks

International coordination remains critical for radio astronomy. Organizations like the ITU maintain databases of telescope locations, and these records have been recently updated to support coordination efforts. As radio astronomy facilities expand globally, these international frameworks will become increasingly important for protecting observations from interference.

The fundamental challenge for spectrum policy in the next decade will be balancing the needs of passive scientific users like radio astronomy with the explosive growth in commercial applications. Finding technical and regulatory solutions that allow both to coexist will require innovative approaches to coordination, creative use of technology, and collaborative efforts across the spectrum community.

⁶ NRAO, "Discoveries of Tomorrow: Envisioning the Next Generation VLA," <https://vimeo.com/280254012>.

1.6. In the News

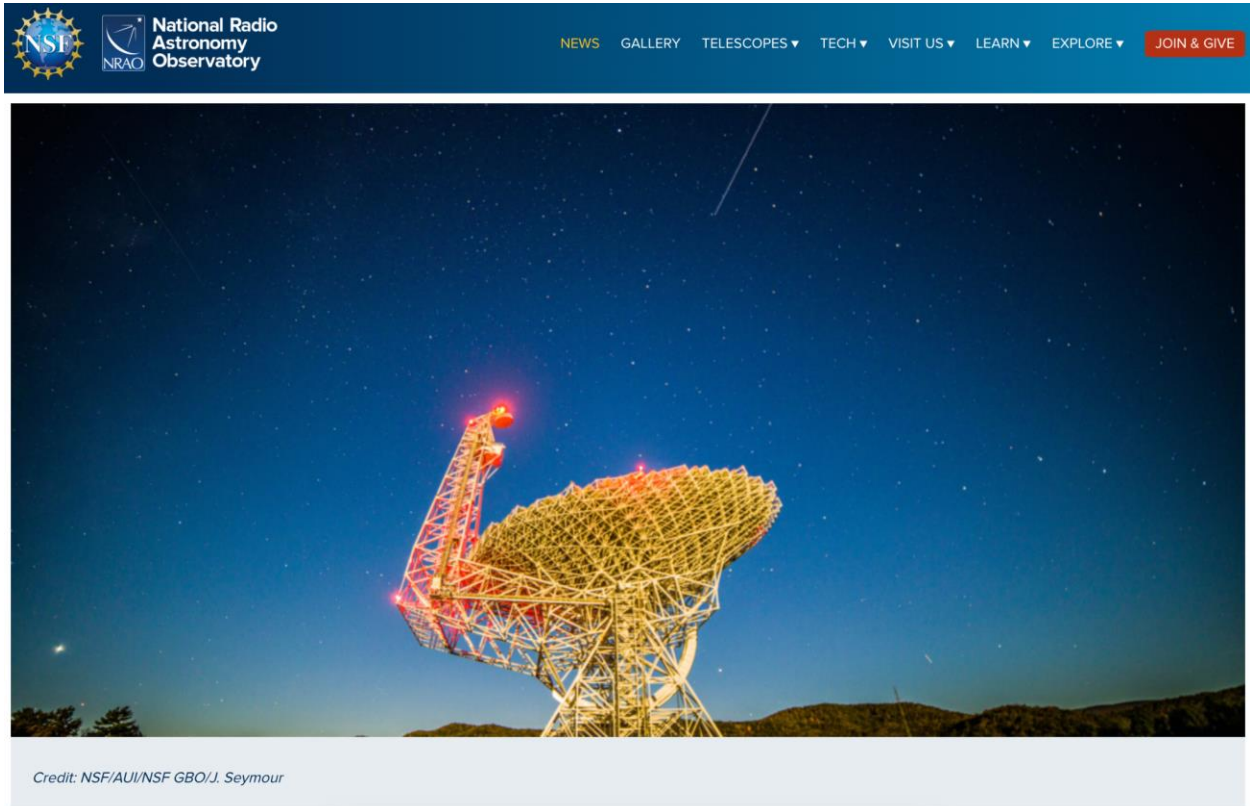


Figure 1.6. Satellite Operators Coordinate with Astronomers⁷

1.7. Assignment

Fill in the Blank

Read about the Q&A with Harvey Liszt at <https://council.science/blog/rising-conflicts-for-radio-and-space-astronomy/>. What are some of the international agreements that have been signed as key accomplishments of IUCAF?

1.8. Reading List

⁷ NRAO, News Release, “Astronomers, Satellite Internet Provider Develop New System to Share the Sky,” Aug 9, 2024, <https://public.nrao.edu/news/astronomers-satellite-internet-provider-develops-new-system-to-share-the-sky/>

List

- NRAO, National Radio Quiet Zone (NRQZ), <https://info.nrao.edu/do/spectrum-management/national-radio-quiet-zone-nrqz-1>
- NRAO, The Next Generation Very Large Array – ngVLA, <https://public.nrao.edu/ngvla/>
- Rising Concerns for Radio and Space Astronomy: Q&A with Harvey Liszt, Mar. 23, 2021, <https://council.science/blog/rising-conflicts-for-radio-and-space-astronomy/>

2. Lecture 2: Federal Spectrum Policy

Video

Advanced Spectrum Policy Lecture 2: Federal Spectrum Policy

https://www.youtube.com/watch?v=J-lzOEIMCMY&list=PLIbQnBe9IRS_YjElyMEqm_QNFbmld5_ko&index=3

In this lecture, we will discuss institutions that manage spectrum policy, starting with the White House. The Executive Office of the President has the Office of Science and Technology Policy (OSTP) and also includes other staff who monitor spectrum policy issues from the National Security Council and Office of Management and Budget.

Recently, the White House released the National Spectrum Strategy 2024 which was accompanied by an Implementation Plan and Research and Development Plan. This output was discussed at the NTIA's annual Spectrum Symposium. The U.S. Department of Commerce agency NTIA manages federal spectrum policy while the Federal Communications Commission as an independent agency manages commercial spectrum policy. We will discuss in more detail the NTIA and FCC in the next lecture.

Next, we discuss Congressional oversight of spectrum policy by two main subcommittees, the U.S. House of Representatives Energy and Commerce Committee Subcommittee on Technology and the U.S. Senate Commerce Committee Subcommittee on Telecommunications.

Last, we recognize the importance of research institutions in the development of spectrum policy. Various educational programs and policy research are conducted by academics, scholars, lawyers, economists, and engineers.

2.1. Learning Objectives

Statement

Analyze the key components of the 2024 National Spectrum Strategy and its implementation, including the roles of federal agencies and Congress in shaping U.S. spectrum policy. Understand how research institutions and oversight bodies contribute to the development and governance of national spectrum initiatives.

2.2. National Spectrum Strategy 2024

2.2.1. National Spectrum Strategy 2024 (Nov. 13, 2023)

The National Spectrum Strategy (NSS),⁸ prepared by the NTIA under the Biden Administration, is a comprehensive approach to modernize spectrum policy and maintain U.S. leadership in wireless technologies. The NSS emphasizes collaboration between government agencies and the private sector, establishing four pillars focused on creating a spectrum pipeline, long-term collaborative planning, fostering technological innovation in spectrum access and management, and expanding spectrum expertise and awareness.

The NSS identifies specific spectrum bands for study and establishes a framework for future planning and technology development, the strategy aims to expand access to advanced wireless networks, boost competitiveness, and enhance national security. Ultimately, this document serves as a blueprint for a whole-of-nation effort to address current and future spectrum needs.

The NSS was required by Presidential Memorandum entitled Modernizing United States Spectrum Policy and Establishing a National Spectrum Strategy.⁹ For more on a summary of the NSS, visit the NSS webpage.¹⁰

⁸ National Spectrum Strategy, Nov. 13, 2023,

https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf

⁹ Modernizing United States Spectrum Policy and Establishing a National Spectrum Strategy, A Presidential Document by the Executive Office of the President on 11/17/2023,

<https://www.federalregister.gov/documents/2023/11/17/2023-25627/modernizing-united-states-spectrum-policy-and-establishing-a-national-spectrum-strategy>

¹⁰ NTIA, National Spectrum Strategy, <https://www.ntia.gov/programs-and-initiatives/national-spectrum-strategy>

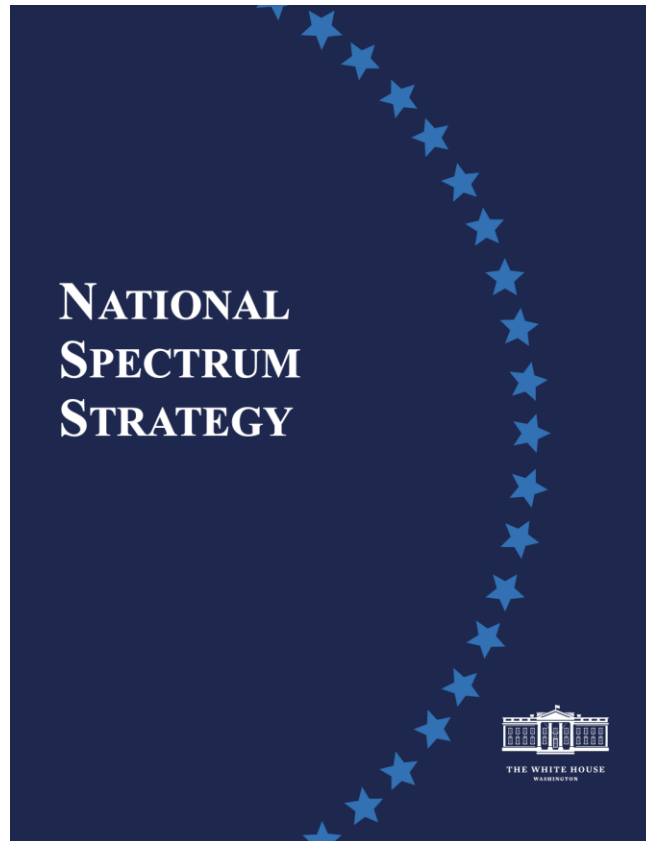


Figure 2.1. National Spectrum Strategy



Table 1: Ongoing Efforts to Study Spectrum Bands	
Focus	Status
Supplemental Coverage from Space	In March 2023, the FCC proposed a new regulatory framework for supplemental terrestrial wireless coverage from space, through which satellite operators and terrestrial providers would coordinate to operate space stations on currently licensed, flexible-use spectrum to expand coverage to the terrestrial provider’s subscribers.
5030-5091 MHz	In January 2023, the FCC sought comment on service rules to support safety-critical unmanned aircraft system (UAS) communications links, including control and non-payload communication (CNPC) operations in the band, noting that service rules to facilitate UAS likely will require development in phases.
12 GHz	In May 2023, the FCC took steps to expand the use of 1,050 megahertz of mid-band spectrum by a diverse set of users. Specifically, the FCC ensured that current and future satellite services will be preserved and protected in the 12.2-12.7 GHz band (the “Lower 12 GHz band”), while exploring expanded fixed licensed or unlicensed use of the band. The FCC is further considering options for flexible use of the 12.7-13.25 GHz band (the “Upper 12 GHz band”), which has in-band and adjacent-band federal operations that may need to be protected.
42 GHz	In June 2023, the FCC began the next phase of a proceeding to explore how spectrum in the 42 GHz band (42-42.5 GHz) might be made available through one of several innovative, non-exclusive spectrum access models.
60 GHz	In May 2023, the FCC adopted rules expanding opportunities for unlicensed mobile radar operations in the 57-71 GHz band. The new rules permit mobile field disturbance sensor operations throughout the 60 GHz band and established technical rules for pulse radars. The rule changes also allow unlicensed radars to operate on unmanned aircraft in the 60-64 GHz segment of the band when operated at certain low-flying altitudes.

Figure 2.2. Ongoing Efforts to Study Spectrum Bands¹¹

¹¹ National Spectrum Strategy, Nov. 13, 2023, at p. 5, https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf.

Taken together, this input has led to the identification of the following five spectrum bands meriting in-depth study in the near term. This approximately 2,790 megahertz of spectrum represents a mix of bands for potential expanded governmental and non-governmental use for an array of advanced, next-generation applications and services:

- Lower 3 GHz (3.1-3.45 GHz): Pursuant to the Infrastructure Investment and Jobs Act of 2021, the Department of Defense (DoD) has studied the possibility of sharing this 350 megahertz of spectrum with the private sector. DoD's studies helped to determine whether this band should be reallocated for shared Federal and non-Federal use and licensed through auction. DoD determined that sharing is feasible if certain advanced interference-mitigation features and a coordination framework to facilitate spectrum sharing are put in place. The Departments of Commerce and Defense will co-lead any follow-on studies to the Emerging Mid-band Radar Spectrum Study (EMBRSS) that focus on future use of the 3.1-3.45 GHz band. Additional studies will explore dynamic spectrum sharing and other opportunities for private-sector access in the band, while ensuring DoD and other Federal mission capabilities are preserved, with any necessary changes.
- 5030-5091 MHz: The FCC, in coordination with NTIA and the Federal Aviation Administration, is expected to take near-term action to facilitate limited deployment of UAS in this band. Thereafter, this 61 megahertz of spectrum will be studied so that the FCC can optimize UAS spectrum access across the band while avoiding harmful interference to other protected in-band and adjacent-band operations.
- 7125-8400 MHz: This 1,275 megahertz of spectrum will be studied for wireless broadband use (on a licensed and/or unlicensed basis), though some sub-bands eventually may be studied for other uses. There are, however, a variety of mission-critical Federal operations in this band (including Fixed, Fixed Satellite, Mobile, Mobile Satellite, Space Research, Earth Exploration Satellite, and Meteorological Satellite services) that will make it challenging to repurpose portions of the band while protecting incumbent users from harmful interference.
- 18.1-18.6 GHz: This 500 megahertz of spectrum will be studied for expanded Federal and non-Federal satellite operations, consistent with the U.S. position at the 2023 World Radiocommunication Conference (WRC-23), which would add space-to-space allocations to this band (among others). Fixed Satellite Service downlink operations are currently authorized in the band. In addition, non-Federal Fixed Service is authorized in the 18.1-18.3 GHz segment of the band.
- 37.0-37.6 GHz: Building on prior collaborative efforts of NTIA, DoD and the FCC, this 600 megahertz of spectrum will be further studied to implement a co-equal, shared-use framework allowing Federal and non-Federal users to deploy operations in the band.

Figure 2.3. 2,790 MHz of Spectrum Meriting Further Study¹²

2.2.2. National Spectrum Strategy Implementation Plan 2024 (Mar. 12, 2024)

¹² *Id.* at 6–7.

The National Spectrum Strategy Implementation Plan,¹³ is a detailed roadmap for achieving the goals outlined in the broader National Spectrum Strategy. It is organized around four key pillars aimed at ensuring U.S. leadership in wireless technologies, fostering long-term collaborative spectrum planning, promoting innovation in spectrum access and management, and expanding expertise in the field.

For each strategic objective within these pillars, the plan identifies specific, measurable outcomes, along with the responsible federal agencies, contributing stakeholders, and estimated timelines for completion, emphasizing a commitment to a transparent and collaborative approach to spectrum management.

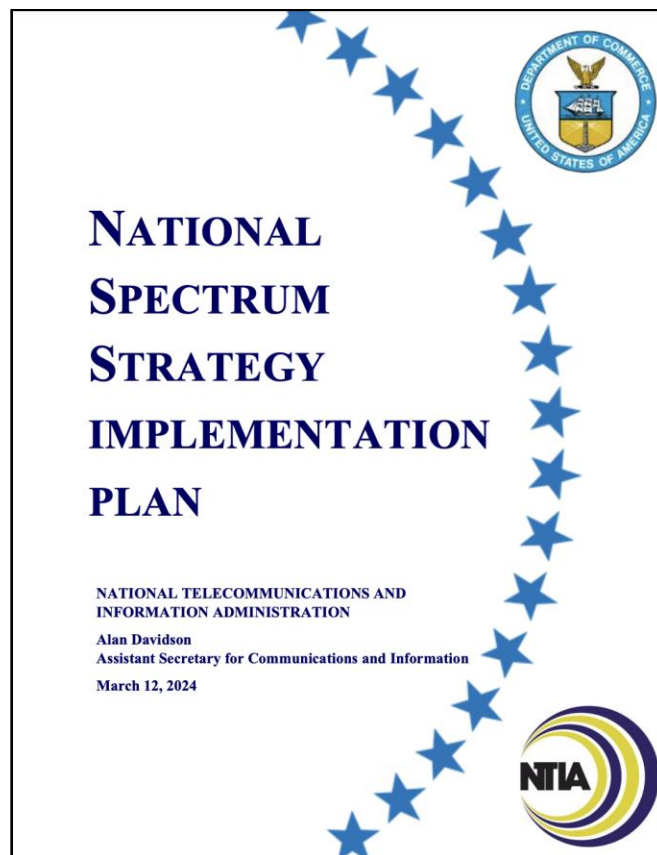


Figure 2.4. National Spectrum Strategy Implementation Plan

¹³ National Spectrum Strategy Implementation Plan, Mar. 12, 2024, <https://www.ntia.gov/sites/default/files/publications/national-spectrum-strategy-implementation-plan.pdf>.

Organizational Structure

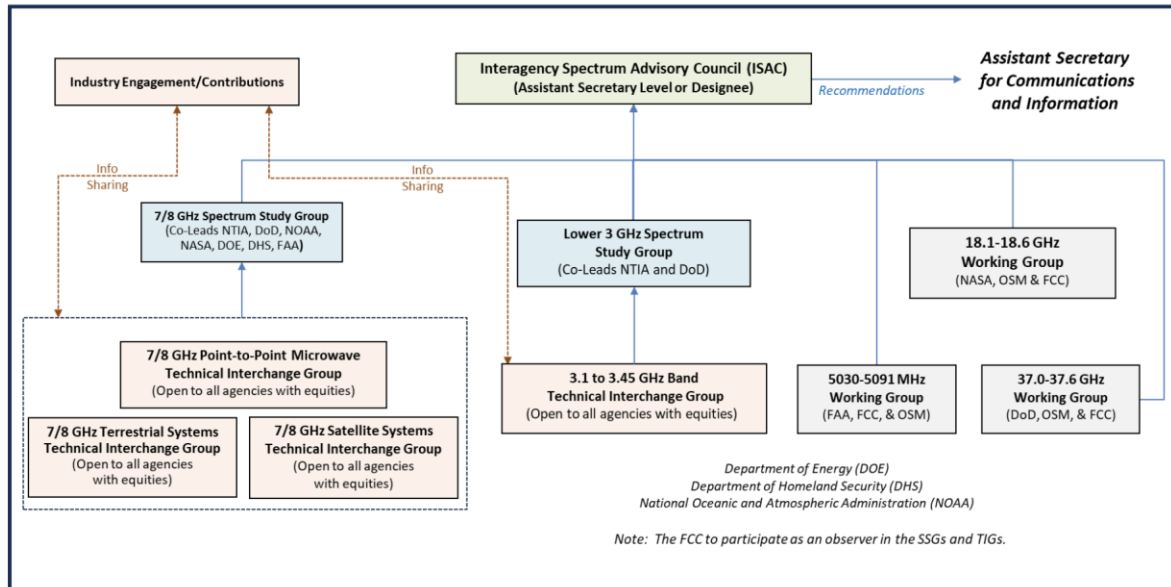


Figure 2.5. Organizational Structure for Implementation Plan¹⁴

2.2.3. National Spectrum Research & Development Plan (Oct. 2024)

The National Spectrum Research and Development Plan,¹⁵ is the U.S. government's strategy for advancing innovation in the use and management of radio frequencies. Prepared by the Networking and Information Technology Research and Development (NITRD) Subcommittee under the National Science and Technology Council (NSTC), it identifies key research areas and priorities aimed at improving spectrum efficiency and access.

The plan addresses both fundamental and use-inspired research, along with crucial accelerators like public datasets and testbeds, and proposes organizational improvements to foster collaboration and progress in spectrum technology and policy. This report serves as a guide for government support in spectrum-related R&D, intending to shape private-sector efforts and promote continued U.S. leadership in this vital domain.

¹⁴ *Id.* at A-2.

¹⁵ National Spectrum Research and Development Plan, Oct. 2024, <https://www.nitrd.gov/pubs/National-Spectrum-RD-Plan-2024.pdf>.

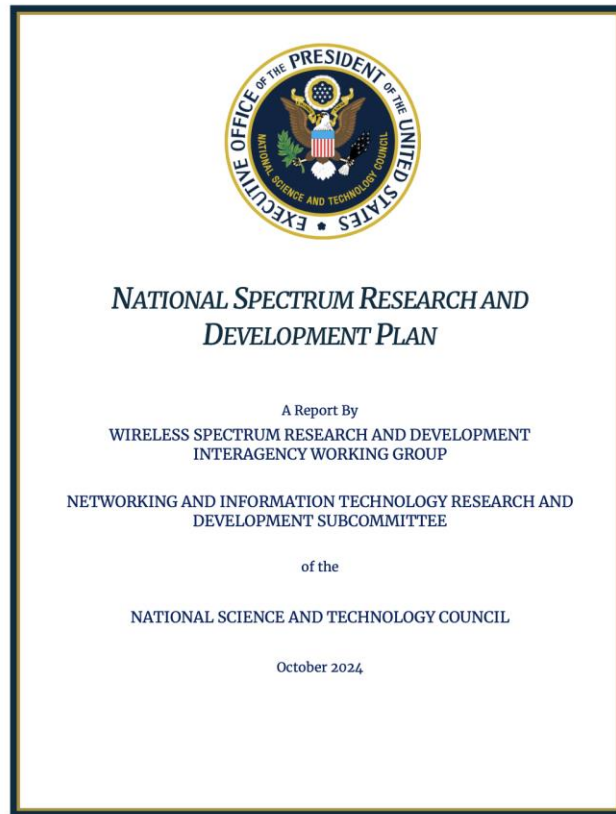


Figure 2.6. National Spectrum Research and Development Plan

This Plan identifies key opportunities for spectrum-related research and development. Thirteen opportunities were identified as the highest priority.

Highest priority innovation areas for use-inspired research:

- Interference and Noise Resilience
- Interference Impact Prediction
- Sharing with Critical Systems
- Regulatory Options
- Advanced Spectrum Management Processes

Highest priority innovation areas for fundamental research:

- Agile Front Ends and Antennas
- Spectrum Utilization Optimization
- Undesired Signal Prediction
- Spectrum Sharing Control
- Cost of Interference

Highest priority research accelerators:

- Public Datasets
- Testbeds and Testing Frameworks
- Spectrum Technology Readiness Level (TRL) Pipeline Review

Highest priority organizational improvements:

- Researcher Rotations into Regulatory Organizations
- Focused Research to Inform Regulatory Decisions
- Band Studies as Transition Opportunities
- Spectrum Engineering Task Force

Figure 2.7. Thirteen Highest Priority Areas for R&D¹⁶

¹⁶ National Spectrum Research and Development Plan, Oct. 2024, at v, <https://www.nitrd.gov/pubs/National-Spectrum-RD-Plan-2024.pdf>.

Spotlight 2.2: Artificial Intelligence and Machine Learning (AI/ML) in Spectrum R&D

AI/ML capabilities are a tool applicable to many of the key innovation areas listed in this National Spectrum R&D Plan. Some potential AI/ML applications include:

Agile front ends and antennas	Accelerate exploration of innovative hardware designs
Receiver interference rejection	Integrate diverse sensed and received data streams, control sophisticated rejection strategies
Millimeter wave and above	Integrate diverse situational awareness data, use it to overcome propagation challenges
Flexible waveform capabilities	Control waveform adaptation, synthesize new waveforms
Reliable service from variable spectrum	Predict imminent changes in spectrum availability
Propagation modeling	Incorporate new information sources such as big-data GIS, foliage maps, high-resolution topography, and building data
Spectrum situational awareness at scale	Interpretation and interpolation of available data streams, control available resources for maximum situation awareness payoff
Spectrum data analysis	Analyze spectrum data in real time to drive automated decisions for efficient spectrum usage
Safe sharing of sensitive information	Generate synthetic data that preserves critical information while obscuring sensitive information
Spectrum sharing control	Detect and respond to failures and attacks
Fast interference management	Detect interference, analyze source, plan response

Figure 2.8. Spotlight 2.2: Artificial Intelligence and Machine Learning (AI/ML) in Spectrum R&D¹⁷

¹⁷ *Id.* at 13.

Part 5: Index of Spectrum R&D Opportunities

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Figure 2.9. Index of Spectrum R&D Topics¹⁸

Multiple Choice Question

The National Spectrum Strategy of 2024 was followed by an Implementation Plan and a Research and Development Plan which further described the steps that the federal government would take to conduct studies and find additional spectrum. (True. The Implementation Plan and Research and Development Plan were released in the months following the National Spectrum Strategy.)

¹⁸ *Id.* at 38–39.

2.2.4. 2024 NTIA Spectrum Symposium

The NTIA has hosted an annual spectrum symposium for the last 6 years to convene spectrum policy experts. The 2024 NTIA Spectrum Symposium focused on the National Spectrum Strategy release and implementation of the strategy.¹⁹ Video recordings of the morning²⁰ and afternoon²¹ sessions are available online.

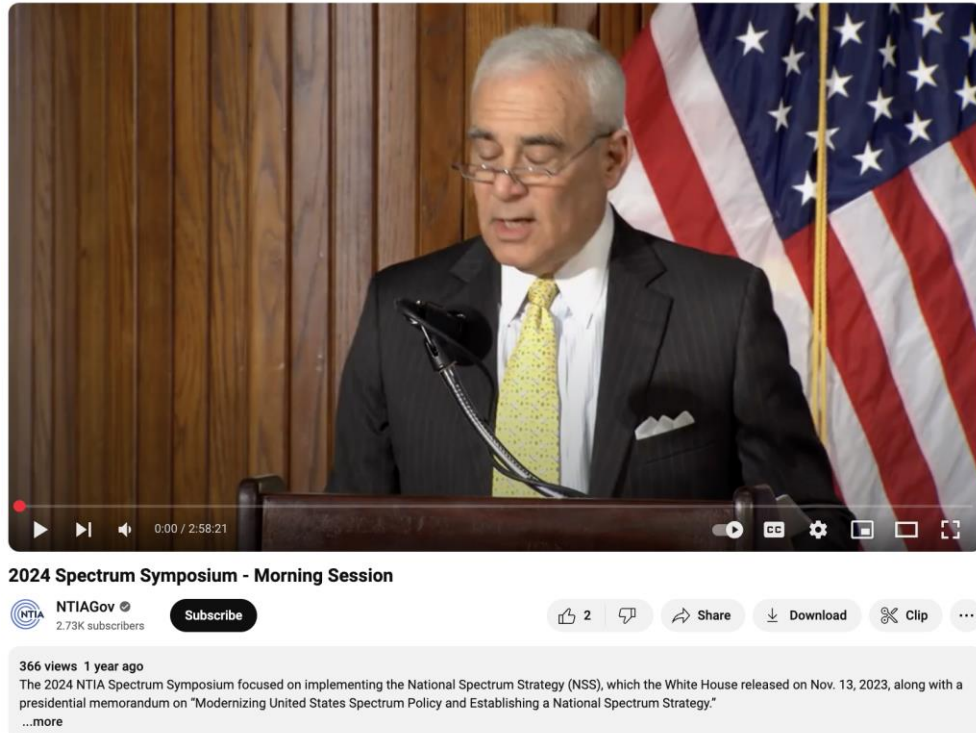


Figure 2.10. Morning Session of the 2024 NTIA Spectrum Symposium

¹⁹ 2024 NTIA Spectrum Policy Symposium, <https://www.ntia.gov/events-and-meetings/2024/2024-ntia-spectrum-policy-symposium>

²⁰ Morning Session, 2024 NTIA Spectrum Symposium, Feb. 1, 2024, <https://www.youtube.com/watch?v=nuDBtpmnoCo>

²¹ Afternoon Session, 2024 NTIA Spectrum Symposium, Feb. 1, 2024, <https://www.youtube.com/watch?v=ssCZx-BIve4>.



2024 Spectrum Symposium - Afternoon Session



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The 2024 NTIA Spectrum Symposium focused on implementing the National Spectrum Strategy (NSS), which the White House released on Nov. 13, 2023, along with a presidential memorandum on "Modernizing United States Spectrum Policy and Establishing a National Spectrum Strategy."
...more

Figure 2.11. Afternoon Session of the 2024 NTIA Spectrum Symposium

2.3. Congressional Oversight

2.3.1. U.S. House of Representatives Energy and Commerce Committee, Subcommittee on Communications



Figure 2.12. U.S. House E&C Committee Hearing on “American Leadership in Wireless Technology”²²

2.3.2. Senate Commerce Committee Subcommittee on Telecommunications

²² House Committee on Energy and Commerce, “C&T Subcommittee Hearing: Strengthening American Leadership in Wireless Technology.” Jan. 23, 2025, <https://www.youtube.com/watch?v=83sZKRdh94w>.



Ted Cruz Leads Senate Commerce Committee Hearing About Delayed Spectrum Auctions And PRC Competition



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The Senate Commerce Committee held a hearing entitled, "America Offline? How Spectrum Auction Delays Give China the Edge and Cost Us Jobs."

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Figure 2.13. Senate Commerce Committee Hearing on Spectrum Auction Delays²³

²³ Senate Commerce Committee, Hearing on Spectrum Auction Delays, Feb. 19, 2025, <https://www.youtube.com/watch?v=jpNPjPHODiU>.

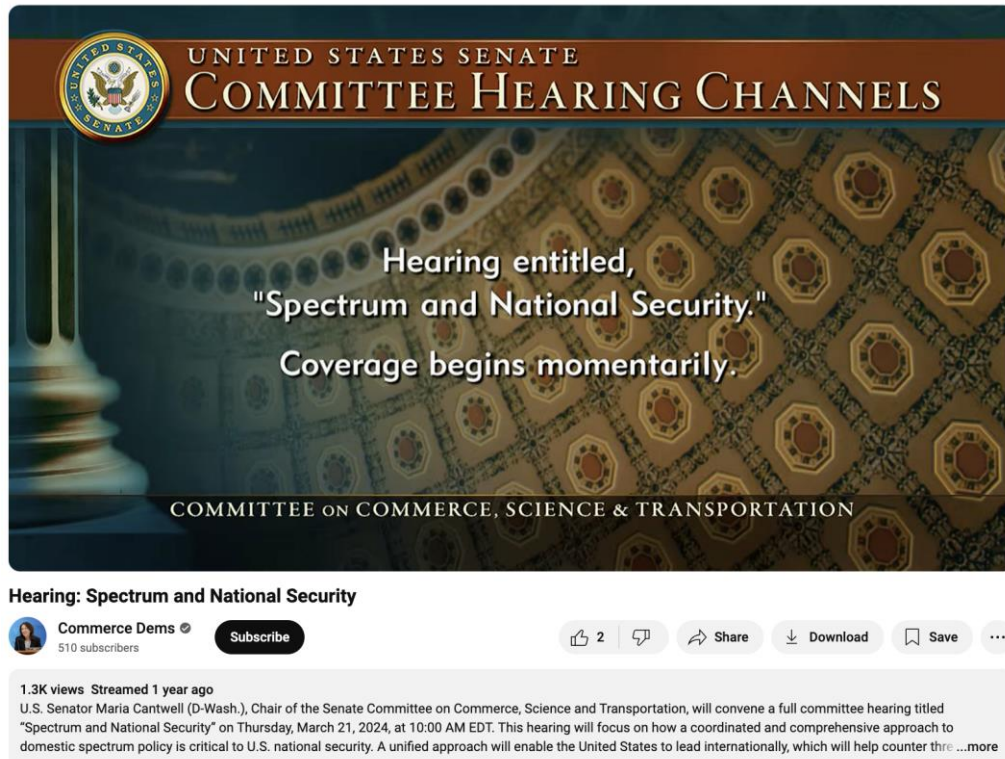
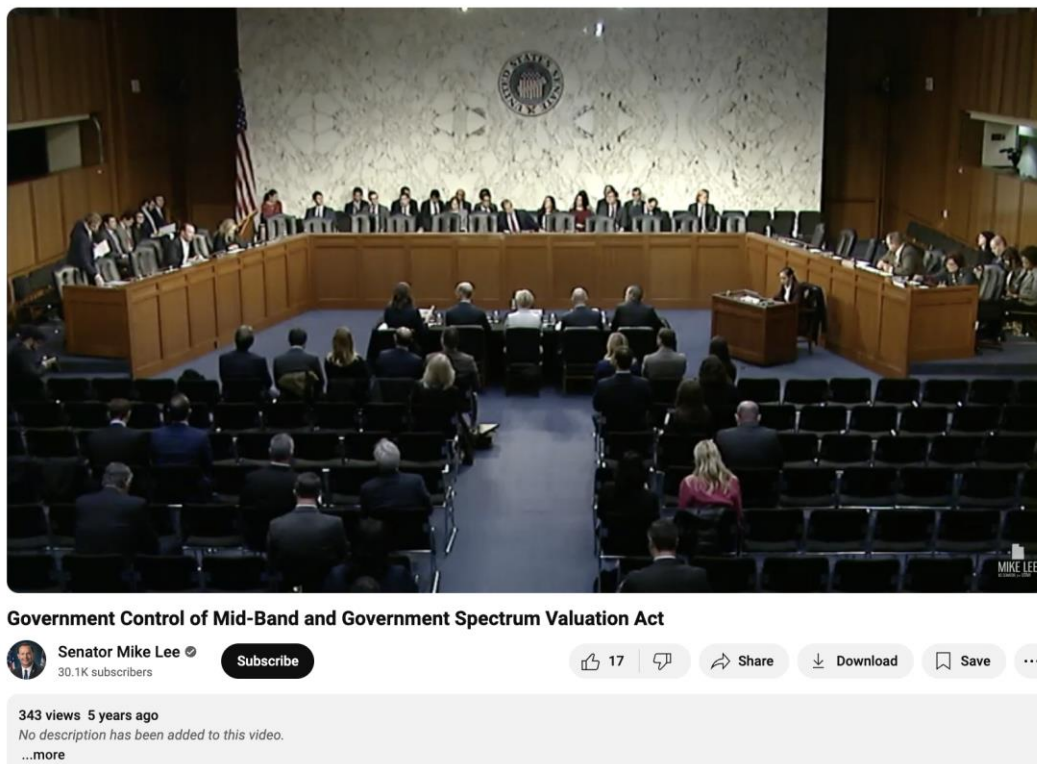


Figure 2.14. Senate Commerce Committee Hearing on “Spectrum and National Security”²⁴



²⁴ Senate Commerce Committee, Hearing on Spectrum and National Security, <https://www.youtube.com/watch?v=UUkb3aNygDc>.

Figure 2.15. Senate Commerce Committee Hearing on Mid-Band Spectrum and Government Spectrum Valuation Act²⁵

2.4. Research Institutions

Research institutions such as the Technology Policy Institute contribute to educational and research efforts in spectrum policy.

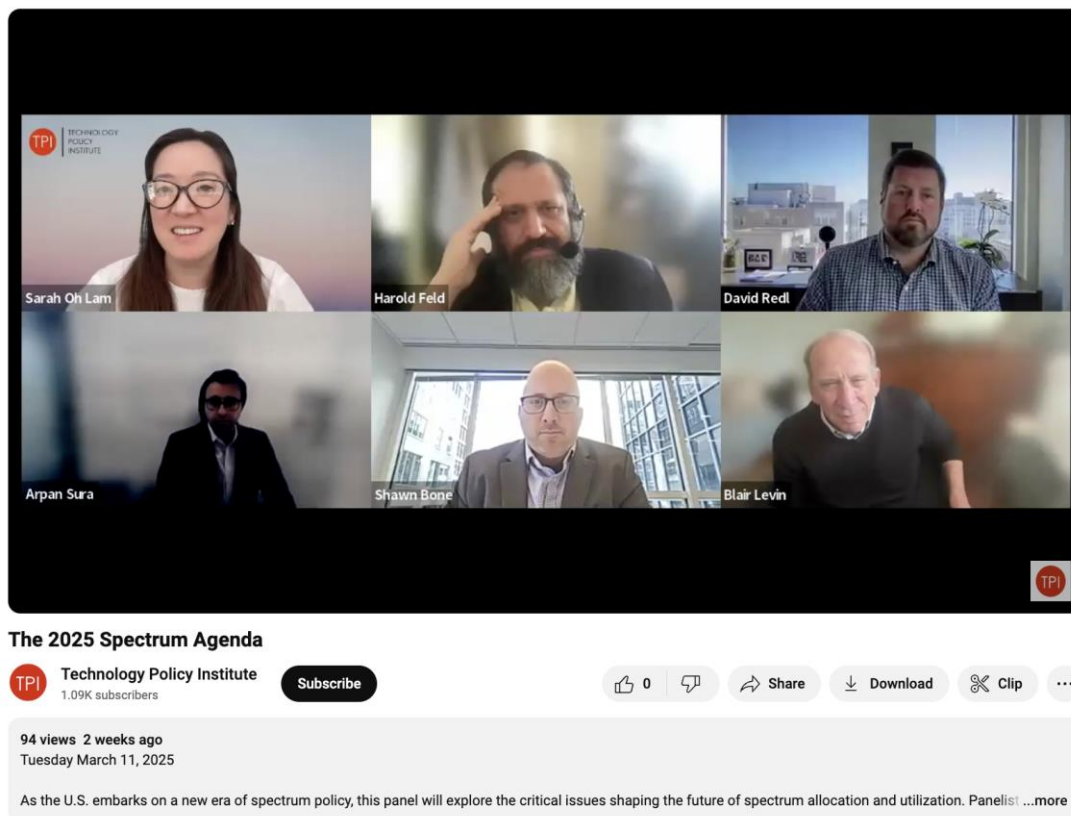


Figure 2.16. Technology Policy Institute Panel on the 2025 Spectrum Agenda²⁶

²⁵ Senate Commerce Committee Hearing on Mid-Band and Government Spectrum Valuation Act, <https://www.youtube.com/watch?v=l-kqZRXYHjg>.

²⁶ Technology Policy Institute, Panel on the 2025 Spectrum Agenda, Mar. 11, 2025, <https://www.youtube.com/watch?v=1PEhhqjccE0&list=PLIbQnBe9lRS8gL5lbTtAbu504fVczfuzm>.

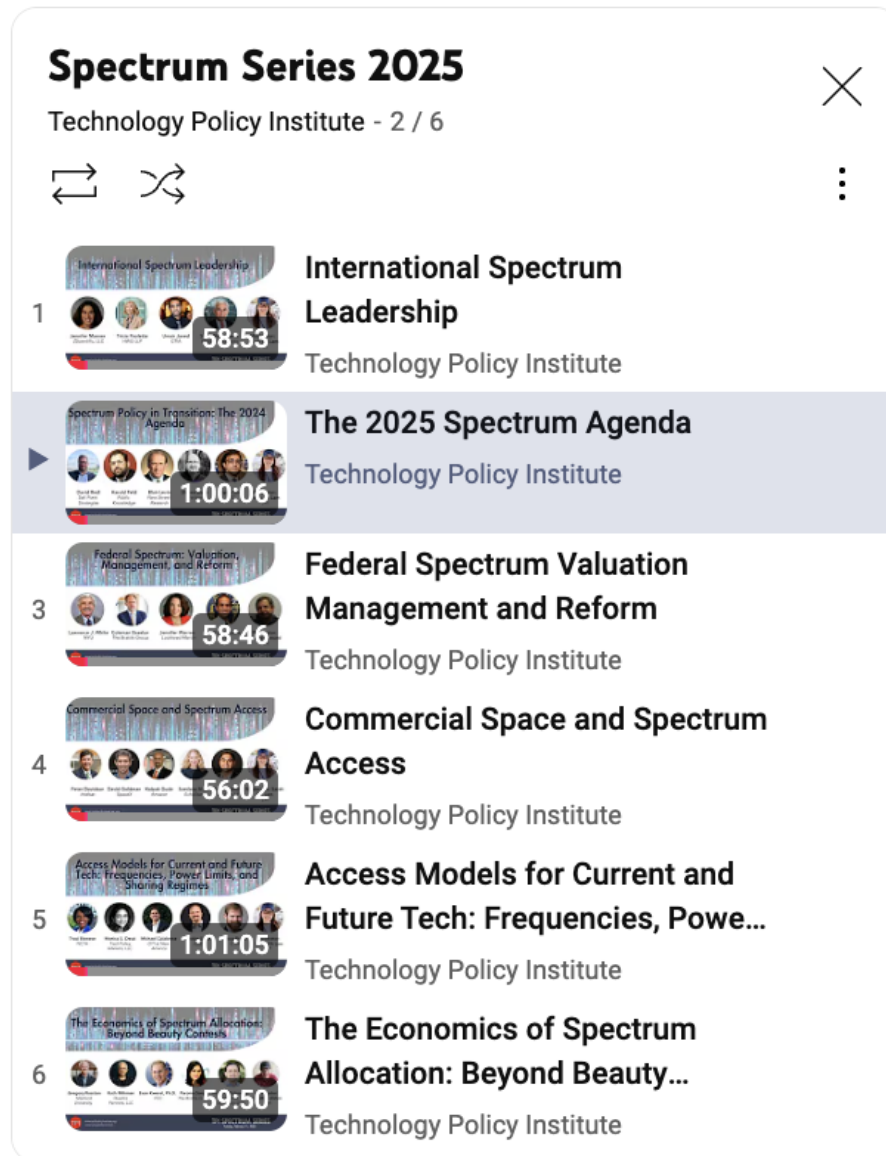


Figure 2.17. Technology Policy Institute Spectrum Series²⁷

2.5. In the News

²⁷ Technology Policy Institute, Winter Spectrum Series, Panels, <https://www.youtube.com/watch?v=kbFYWLk8BIg&list=PLIbQnBe9lRS8gL5lbTtAbu504fVczfuzm>.

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Editorial Report: Navigating the 5G cloud-native

NTIA releases implementation plan for National Spectrum Strategy

By **Kelly Hill** March 12, 2024

Figure 2.18. NTIA Releases National Spectrum Strategy²⁸

2.6. Assignment

Fill in the Blank

Read the National Spectrum Strategy, Implementation Plan, and R&D Plan. National Spectrum Strategy, Nov. 13, 2023,

²⁸ Kelly Hill, “NTIA Releases Implementation Plan for National Spectrum Strategy,” RCR Wireless, Mar. 20, 2024, <https://www.rcrwireless.com/20240312/featured/ntia-releases-implementation-plan-for-national-spectrum-strategy>.

33

https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf; National Spectrum Strategy Implementation Plan, Mar. 12, 2024, <https://www.ntia.gov/sites/default/files/publications/national-spectrum-strategy-implementation-plan.pdf>; National Spectrum Research and Development Plan, Oct. 2024, <https://www.nitrd.gov/pubs/National-Spectrum-RD-Plan-2024.pdf>.

How do you think the federal government will decide on priorities and which bands to release to the commercial sector? Will the process be fast or slow? What do you think about the R&D Plan?

2.7. Reading List

File Attachments

- National Spectrum Strategy, Nov. 13, 2023, https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf
- National Spectrum Strategy Implementation Plan, Mar. 12, 2024, <https://www.ntia.gov/sites/default/files/publications/national-spectrum-strategy-implementation-plan.pdf>.
- National Spectrum Research and Development Plan, Oct. 2024, <https://www.nitrd.gov/pubs/National-Spectrum-RD-Plan-2024.pdf>.
- Modernizing United States Spectrum Policy and Establishing a National Spectrum Strategy, A Presidential Document by the Executive Office of the President on 11/17/2023, <https://www.federalregister.gov/documents/2023/11/17/2023-25627/modernizing-united-states-spectrum-policy-and-establishing-a-national-spectrum-strategy>

Lecture 3: Federal Agencies FCC and NTIA and OSTP

Concepts: Structure, responsibilities, independent agency structure and subagency of the Department of Commerce, organizational chart, federal and non-federal spectrum users, spectrum reauthorization authority, ULS universal licensing system database at FCC, experimental license database

Spectrum in the News: Headlines (FAA altimeter/C-Band)

Case Study: Altimeters

3. Lecture 3: FCC and NTIA and OSTP

Video

Advanced Spectrum Policy Lecture 3: FCC and NTIA and OSTP

https://www.youtube.com/watch?v=GBpXUUXmHng&list=PLlbQnBe9IRS_YjElyMEqm_QNFbmld5_ko&index=4

In this lecture, we will review the structure, responsibilities, and independent agency structure of the Federal Communications Commission, structure of the National Telecommunications and Information Administration in the Department of Commerce, and the role of the OSTP at the White House. We will go over the organizational charts of these agencies and how each of them process radio spectrum licenses for federal and non-federal spectrum users. We will go over some main tools of each of the agencies including the Universal Licensing System (ULS), Electronic File System (ECFS), and spectrum auction facilities. We will also discuss the IRAC committee within the NTIA that is used to manage interagency spectrum allocations as well as the CSMAC committee that brings together commercial and federal spectrum users.

While the FCC and NTIA have distinct roles, their collaboration is essential to maintaining a balanced and efficient spectrum management system in the United States. As demand for wireless technologies like 5G, Wi-Fi, and satellite services continues to grow, the coordination between these two agencies ensures that spectrum resources are allocated fairly and used in a way that supports innovation, economic growth, national security, and public benefit.

3.1. Learning Objectives

Statement

Examine the roles and organizational structures of the FCC, NTIA, and OSTP in federal spectrum management, including tools like licensing databases and comment systems. Understand interagency coordination through mechanisms such as the FCC-NTIA Memorandum of Understanding and advisory bodies like IRAC and CSMAC.

3.2. Federal Communications Commission (FCC)

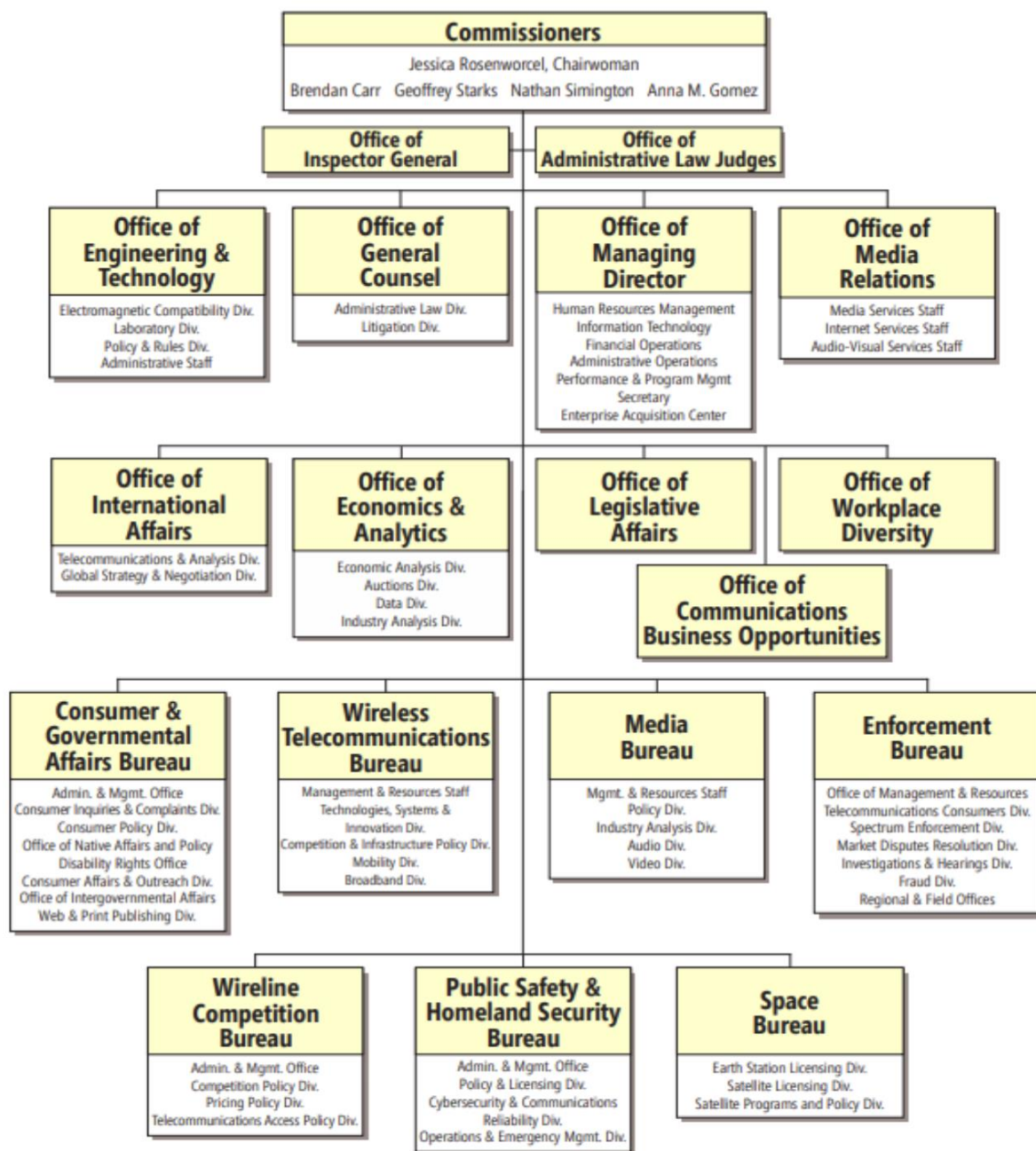
The Federal Communications Commission (FCC) is an independent agency of the U.S. government responsible for overseeing and managing the use of the radio frequency spectrum for non-federal users. This includes commercial entities such as wireless carriers, broadcasters, satellite companies, and private users, as well as state and local governments. The FCC allocates different frequency bands for specific types of services, develops rules and regulations to govern how those bands can be used, and issues licenses to users, often through competitive auctions. A major part of its mission is to promote efficient spectrum use and prevent harmful interference between different spectrum users, ensuring that the radio spectrum—an essential and finite resource—is accessible and reliable for a wide range of communication needs.

3.2.1. FCC Organizational Chart

The FCC's organizational chart²⁹ shows that a Chairman leads the agency and has 4 other Commissioners who vote on regulatory matters. The Chairman directs the offices and bureaus which administer the FCC's mandates under the 1996 Telecommunications Act and other communications laws. The Wireless and Wireline Bureaus manage mobile service matters and fixed broadband matters. The Space Bureau focuses on satellite licensing and international matters. The Media Bureau focuses on broadcasting regulations.

The Office of Economics and Analysis, Office of Engineering, and the Wireless Bureau have spectrum auction expertise with economists and engineers.

²⁹ FCC Organizational Chart (2024), <https://www.fcc.gov/about-fcc/jobs-internships/new-employee-orientation>.



Organizational Charts of the FCC

Figure 3.1. Organizational Chart of the FCC (2024)³⁰

³⁰ FCC Organizational Chart (2024), <https://www.fcc.gov/about-fcc/jobs-internships/new-employee-orientation>.

3.2.2. Universal Licensing System Database (ULS)

The FCC's Universal Licensing System Database³¹ contains an advanced search tool that provides visibility into all spectrum licenses across frequency bands, services, and geographies. The ULS shows the breadth of the spectrum allocation table with service specific search, specialized search, and advanced license searches based on state, zip code, license code, dates of grant or last action, license status, radio service code, and more. The ULS also includes historical data and information on secondary leases. Buildout deadlines are included in license data, as well as different market geographies, antenna structure registrations, facility identification numbers, and auction information.

License Search [? HELP](#)

The ULS License Search enables you to search for a wide range of licenses in the Universal Licensing System. The License Search here provides access to the most basic attributes of a license. You can also specify more attributes combinations with the [Advanced Search](#) and search within services like [Amateur](#) using service-specific criteria. Please be aware that some combinations of search criteria may result in a longer wait.

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By Call Sign ▾ =

☐ exact matches only

[Advanced License Search](#)

Advanced Search	Service Specific Search	Specialized Search
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Figure 3.2. FCC's Universal Licensing System³²

³¹ FCC ULS, <https://wireless2.fcc.gov/UlsApp/UlsSearch/searchLicense.jsp>.

³² FCC ULS, <https://wireless2.fcc.gov/UlsApp/UlsSearch/searchLicense.jsp>.

Fill in the Blank

Go to the FCC's Universal License System webpage. Explore the database for spectrum licenses by service or customized criteria. What do you notice about the spectrum licenses? How much information is required by applicants and why does the FCC keep track of all these details for licensees?

3.2.3. Electronic Comment Filing System (ECFS)

The FCC's Electronic Comment Filing System (ECFS)³³ is the administrative docket and official record of FCC proceedings from 1992 to today. The ECFS is open to the public to retrieve documents and selected pre-1992 documents as well.

According to the Administrative Procedure Act and rulemaking procedures, the FCC posts its notices of proposed rulemakings (NPRM), notice of inquiry (NOI), reports and orders (R&O), and collected comments from the public to the ECFS.³⁴

Each of the FCC's proceedings is categorized by the bureau that it belongs to and has identifying proceeding numbers assigned. The FCC makes available a list of the popular proceedings.³⁵ A category of "Express Reply" has been made available for the general public to submit short comments whereas most industry stakeholders submit longer, more developed comments with expert reports in the proceedings.

³³ FCC ECFS, <https://www.fcc.gov/ecfs/search/search-filings>.

³⁴ See, e.g., <https://docs.fcc.gov/public/attachments/DA-25-219A1.pdf>.

³⁵ FCC ECFS Popular Proceedings, <https://www.fcc.gov/ecfs/search/browse-popular-proceedings>.

Welcome to the FCC's Electronic Comment Filing System

ECFS serves as the repository for official records in the FCC's docketed proceedings from 1992 to the present. The public can use ECFS to retrieve any document in the system, including selected pre-1992 documents.

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Proceeding(s)

Name(s) of Filer(s)

Law Firm

Attorney/Author/Submitter Name(s)

Date Received Range

From	To
MM/DD/YYYY	MM/DD/YYYY

Posted Date Range

From	To
MM/DD/YYYY	MM/DD/YYYY

+ ADVANCED SEARCH

Figure 3.3. FCC's Electronic Comment Filing System³⁶

Fill in the Blank

Go to the FCC's Electronic Comment Filing System webpage. Explore the list of FCC ECFS Popular Proceedings, <https://www.fcc.gov/ecfs/search/browse-popular-proceedings>.

Why do you think the FCC processes comments in an administrative docket? List a few proceedings that you have heard of, and if not any, list one or two dockets that are relevant to you. What do you notice about the comments filed? Who filed comments and how did the FCC respond?

³⁶ FCC ECFS, <https://www.fcc.gov/ecfs/search/search-filings>.

3.2.4. Spectrum Auctions

The FCC has held auctions for spectrum licenses since 1994, with over 100 auctions and over \$200 billion in gross proceeds.³⁷ These completed spectrum auctions represent market demand for radio spectrum licenses and a supply of spectrum use rights for the private sector and commercial use facilitated by the FCC.

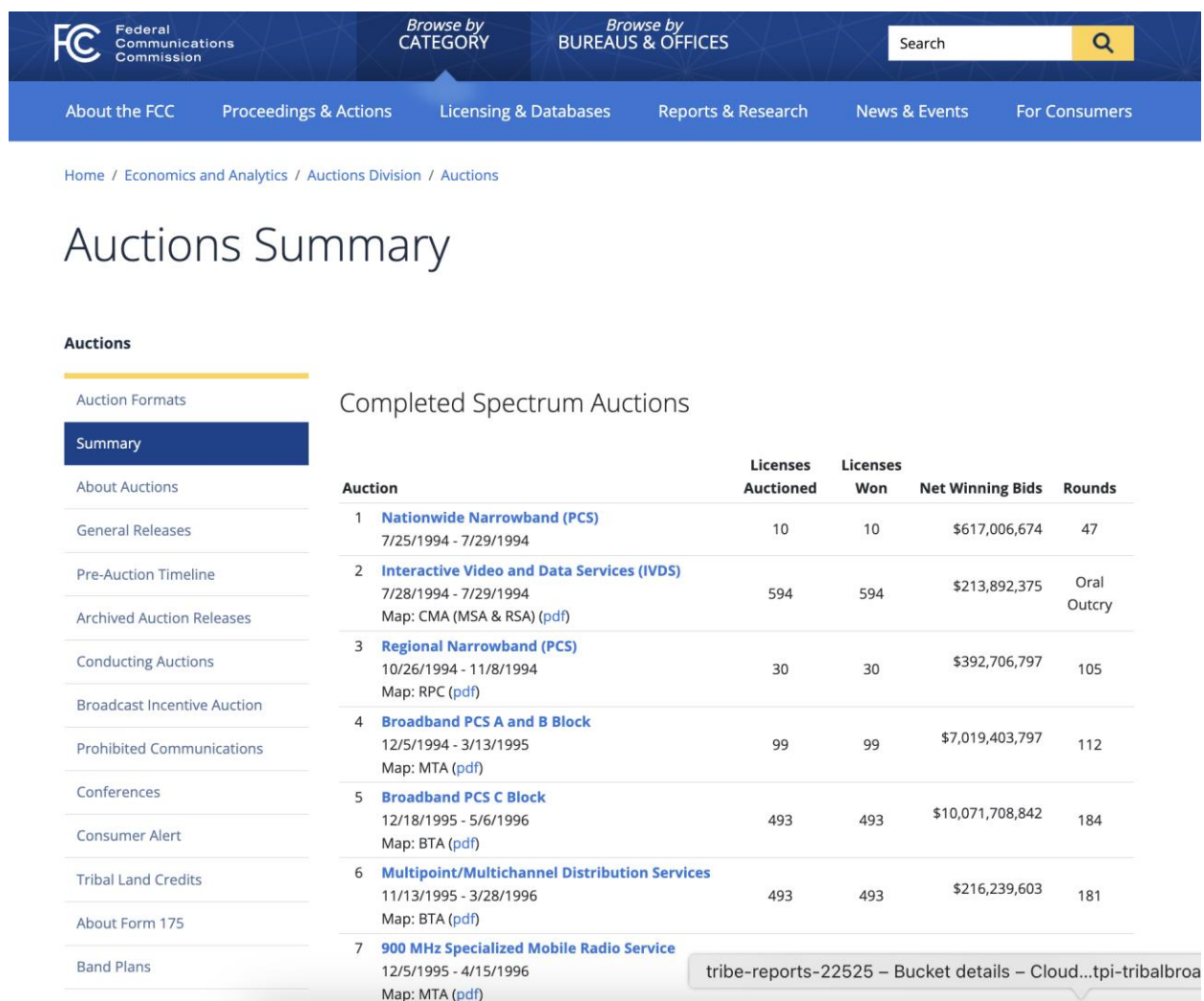


Figure 3.4. FCC Auctions Summary³⁸

³⁷ FCC Auctions Summary, <https://www.fcc.gov/auctions-summary>.

³⁸ FCC Auctions Summary, <https://www.fcc.gov/auctions-summary>.

Multiple Choice

The FCC conducts lotteries to determine among many competing radio spectrum users who should get which bands and what frequencies and what the terms of those licenses will be. (False. Since 1994, the FCC has conducted spectrum auctions rather than lotteries to allocate spectrum licenses to non-federal uses).

Multiple Choice

The United States has run spectrum auctions since 2004 when computing power was powerful enough to handle the second price auctions and billions of dollars of bids. (False. Spectrum auctions started in 1994 and were codified in the 1996 Telecommunications Act.)

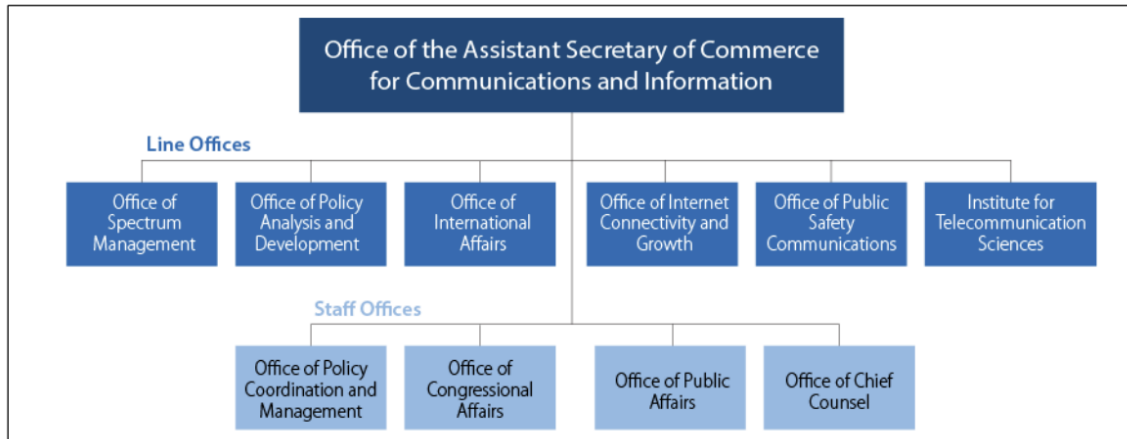
3.3. National Telecommunications and Information Administration (NTIA)

The National Telecommunications and Information Administration (NTIA), on the other hand, operates within the U.S. Department of Commerce and is responsible for managing spectrum use by federal government agencies. This includes critical users such as the Department of Defense, the Federal Aviation Administration, and NASA, which rely on spectrum for national security, public safety, and scientific operations. The NTIA coordinates closely with the FCC to ensure that federal and non-federal spectrum users can coexist without interference. Additionally, the NTIA leads spectrum policy development for the Executive Branch and represents the United States in international negotiations on spectrum issues, such as those conducted by the International Telecommunication Union (ITU).

3.3.1. NTIA Organization Chart

The NTIA's organization chart shows the structure of the agency tasked with federal spectrum management within the U.S. Department of Commerce.

Figure I. Organization Chart of NTIA



Source: CRS based on NTIA, *Organization Chart*, at <https://www.ntia.doc.gov/offices>.

Figure 3.5. Organization Chart of NTIA (Source: CRS)³⁹

The framework, however, for U.S. spectrum management involves interagency coordination and a number of other entities that facilitate decision-making across the federal government.

³⁹ Congressional Research Service, "The National Telecommunications and Information Administration (NTIA): Current Roles and Programs," CRS Report No. R47075, April 20, 2022, <https://sgp.fas.org/crs/misc/R47075.pdf>.

U.S. Spectrum Management Framework

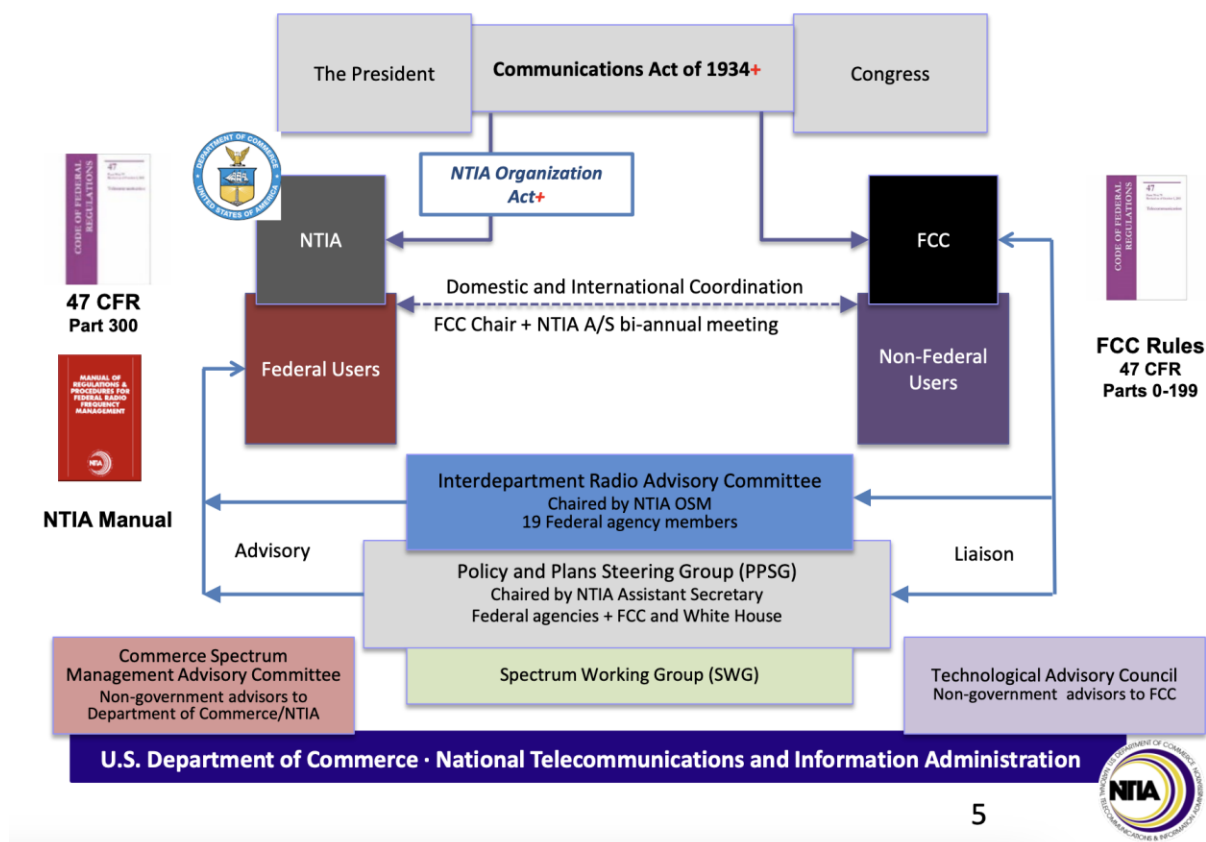
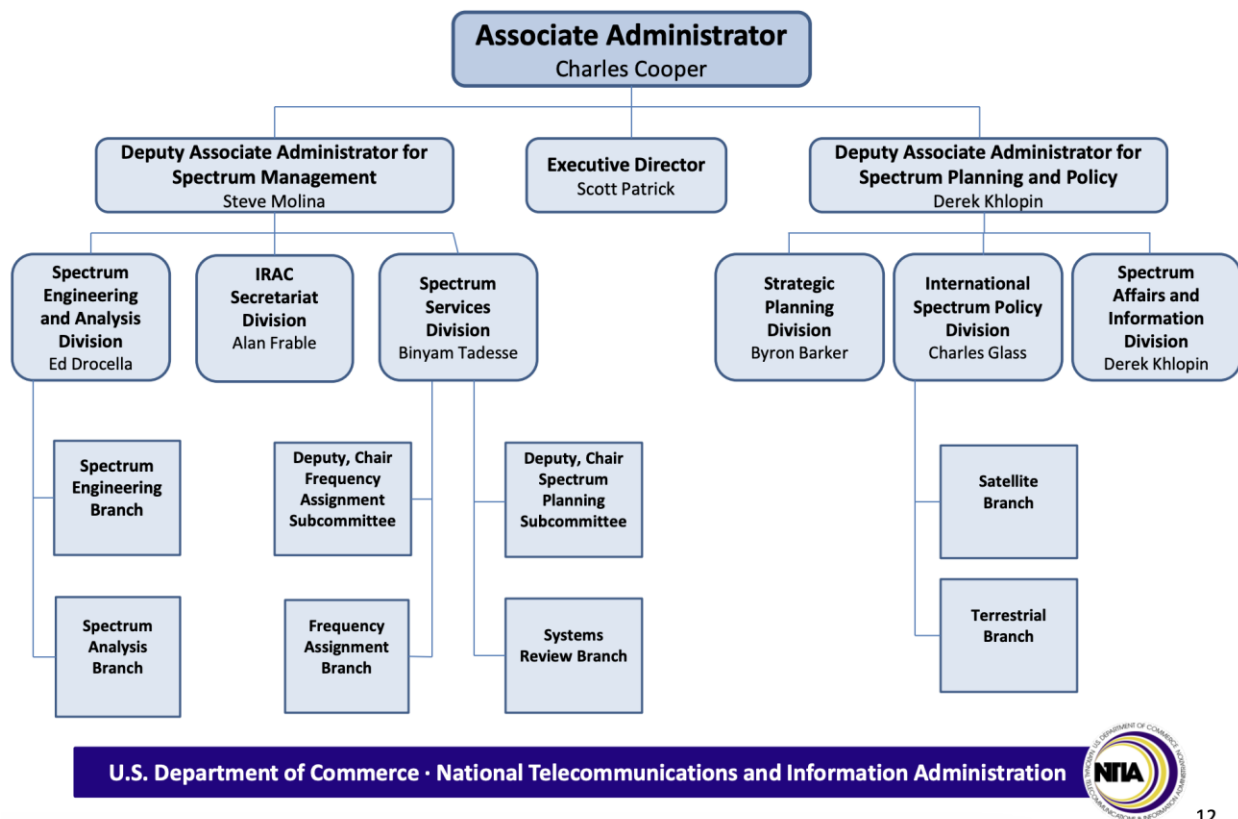


Figure 3.6. U.S. Spectrum Management Framework⁴⁰

⁴⁰ John Alden, "The U.S. Federal Government: Spectrum Management Processes," NTIA Office of Spectrum Management, at 5, https://ustti.org/wp-content/uploads/2023/07/Day-1-4_Alden_Federal-Spectrum-Management_draft.pdf.

Office of Spectrum Management



12

Figure 3.7. Office of Spectrum Management Organization Chart⁴¹

3.3.2. IRAC

The Interdepartment Radio Advisory Committee (IRAC) was established in 1922 and has been where federal spectrum allocations are determined between agencies. It is chaired by the NTIA and includes representatives from each of the federal agencies that use radio spectrum.

The members include the Dept. of Agriculture, Air Force, Army, Coast Guard, Dept. of Commerce, Dept. of Energy, Federal Aviation Administration, Dept. of Homeland Security, Dept. of the Interior, Dept. of Justice, National Aeronautics and Space Administration, Navy, National Science Foundation, Dept. of State, Dept. of Transportation, Dept. of the Treasury, United States Agency for Global Media, United States Postal Service, Dept. of Veterans Affairs, and as liaison, the Federal Communications Commission.⁴²

⁴¹ *Id.* at 12.

⁴² NTIA, IRAC, <https://www.ntia.gov/page/interdepartment-radio-advisory-committee-irac>.

The IRAC has subcommittees including the IRAC Secretariat and the Radio Conference Subcommittee (RCS), Space Systems Subcommittee (SSS), Spectrum Planning Subcommittee (SPS), and the Technical Subcommittee (TSC).

The IRAC's activities are governed by the "Redbook" which is the Manual of Regulations for Federal Radiofrequency Spectrum Management. This manual helps agencies know how to apply for spectrum assignments and the procedures for coordination of federal radio frequencies.

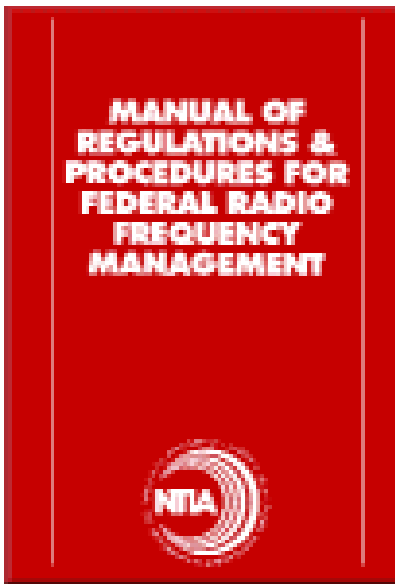


Figure 3.8. Manual of Regulations and Procedures for Federal Radio Frequency Management ("Redbook")⁴³

Multiple Choice

The NTIA has a manual called a "bluebook" that contains regulations and policies around federal agency management of radio spectrum. (False. It's a manual called the "redbook").

⁴³ NTIA, Manual of Regulations and Procedures for Federal Radio Frequency Management ("Redbook"), <https://www.ntia.gov/publications/redbook-manual>.

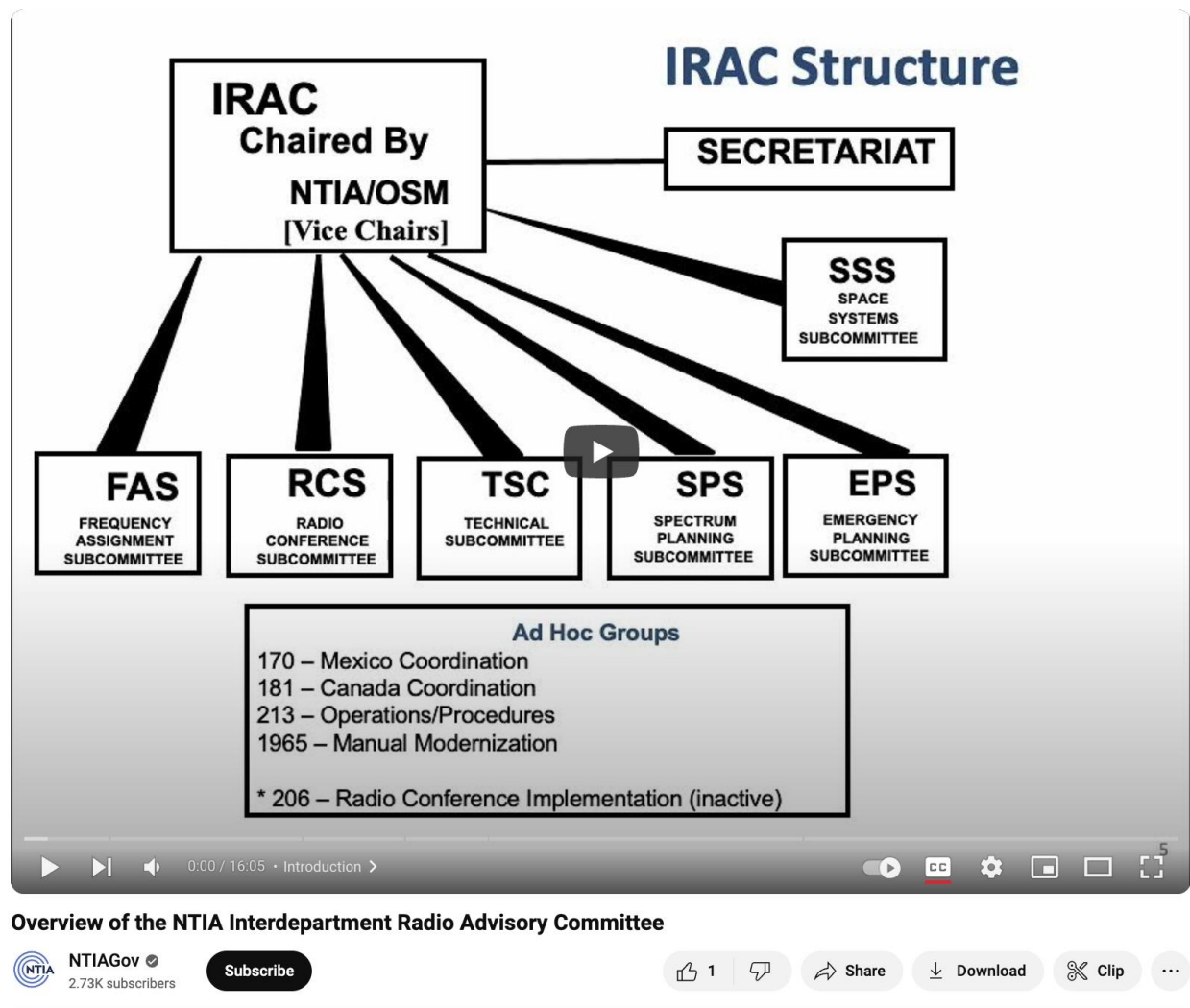


Figure 3.9. Overview of the NTIA Interdepartment Radio Advisory Committee (IRAC)⁴⁴

Multiple Choice

The NTIA relies on the Interdepartment Radio Advisory Committee (IRAC) to run auctions between federal agencies to determine who gets which spectrum bands and for what time frames they are permitted to use the spectrum. (False. Federal spectrum is not auctioned by the IRAC, but the IRAC runs an internal process to determine spectrum allocations among federal users).

3.3.3. Spectrum Table NTIA

⁴⁴ Overview of the NTIA Interdepartment Radio Advisory Committee, <https://www.youtube.com/watch?v=-TwvDfd6Xys>.

[illegible]

The NTIA also maintains a Table of Frequency Allocations which includes the international table and regional allocations next to the United States allocations and service descriptions.⁴⁶

⁴⁶ NTIA Table of Frequency Allocations, 2021 Edition, Revised 2023, https://www.ntia.gov/sites/default/files/2023-11/4_2021_edition_rev_2023.pdf.

Table of Frequency Allocations						Page 1
International Table			United States Table		FCC Rule Part(s)	
Region 1 Table	Region 2 Table	Region 3 Table	Federal Table	Non-Federal Table		
Below 8.3 (Not Allocated)			Below 8.3 (Not Allocated)			
5.53 5.54			5.53 5.54			
8.3-9			8.3-9			
METEOROLOGICAL AIDS 5.54A 5.54B 5.54C			METEOROLOGICAL AIDS 5.54A			
9-11.3			9-11.3			
METEOROLOGICAL AIDS 5.54A			METEOROLOGICAL AIDS 5.54A			
RADIONAVIGATION			RADIONAVIGATION US18			
11.3-14			11.3-14			
RADIONAVIGATION			RADIONAVIGATION US18			
14-19.95			14-19.95			
FIXED			FIXED			
MARITIME MOBILE 5.57			MARITIME MOBILE 5.57			
5.55 5.56			US2			
19.95-20.05			19.95-20.05			
STANDARD FREQUENCY AND TIME SIGNAL (20 kHz)			STANDARD FREQUENCY AND TIME SIGNAL (20 kHz)			
20.05-70			20.05-59			
FIXED			FIXED			
MARITIME MOBILE 5.57			MARITIME MOBILE 5.57			
			US2			
			59-61			
			STANDARD FREQUENCY AND TIME SIGNAL (60 kHz)			
			US2			
			61-70			
			FIXED			
			MARITIME MOBILE 5.57			
			US2			
5.56 5.58			61-70			
			FIXED			
70-72			70-90			
RADIONAVIGATION 5.60			FIXED			
			MARITIME MOBILE 5.57			
			MARITIME RADIONAVIGATION 5.60			
			Radiolocation			
72-84			70-72			
FIXED			RADIONAVIGATION 5.60			
MARITIME MOBILE 5.57			Fixed			
RADIONAVIGATION 5.60			Maritime mobile 5.57			
5.56			5.59			
84-86			72-84			
RADIONAVIGATION 5.60			FIXED			
			MARITIME MOBILE 5.57			
			RADIONAVIGATION 5.60			
			5.59			
			84-86			
			RADIONAVIGATION 5.60			
			Fixed			
			Maritime mobile 5.57			
			5.59			
			70-90			
			FIXED			
			MARITIME MOBILE 5.57			
			Radiolocation			
			70-90			
			FIXED			
			Radiolocation			
						Private Land Mobile (90)

4.1.3

4-4

January 2021 Edition (Rev. 1/2023)

Figure 3.11. Table of Frequency Allocations⁴⁷

For certain bands, detailed channel plans are included in the NTIA's table as well.

Figure 1: The 4400-4940 MHz Channel Plan

4400 - 4940 MHz CHANNEL PLAN																							
Lower Band												Upper Band											
4.400 GHz												4.940 GHz											
4.670 GHz												4.700 GHz											
4 GHz Channel Bandwidths												4 GHz Channel Bandwidths											
A1 A2 A3 A4 A5 A6												A1' A2' A3' A4' A5' A6'											
40.00 MHz (A)												40.00 MHz (A)											
30.00 MHz (B)												30.00 MHz (B)											
20.00 MHz (C)												20.00 MHz (C)											
10.00 MHz (D)												10.00 MHz (D)											
5.00 MHz (E)												5.00 MHz (E)											
2.50 MHz (F)												2.50 MHz (F)											
1.25 MHz (G)												1.25 MHz (G)											
One-Way Applications												One-Way Applications											

⁴⁷ NTIA Table of Frequency Allocations, 2021 Edition, Revised 2023, at 4-4, https://www.ntia.gov/sites/default/files/2023-11/4_2021_edition_rev_2023.pdf.

Figure 3.12. 4400–4940 MHz Channel Plan⁴⁸

3.3.4. NTIA CSMAC

The CSMAC is the Commerce Spectrum Management Advisory Committee (CSMAC) and advises the Assistant Secretary for Communications and Information at NTIA of spectrum issues. It's a group of 30 spectrum experts appointed as "Special Government Employees," from outside the Federal government who are selected based on their expertise and ability to meaningfully advise NTIA on spectrum decisions. The committee was created in 2004 and members apply to join the committee for 2-year terms.

A record of CSMAC meetings is posted going back to 2006.⁴⁹ The CSMAC serves various functions with notable assistance in identifying government spectrum that can be repurposed for commercial use. In 2012, it was used to help identify 500 MHz of federal spectrum that could be cleared for commercial use.⁵⁰

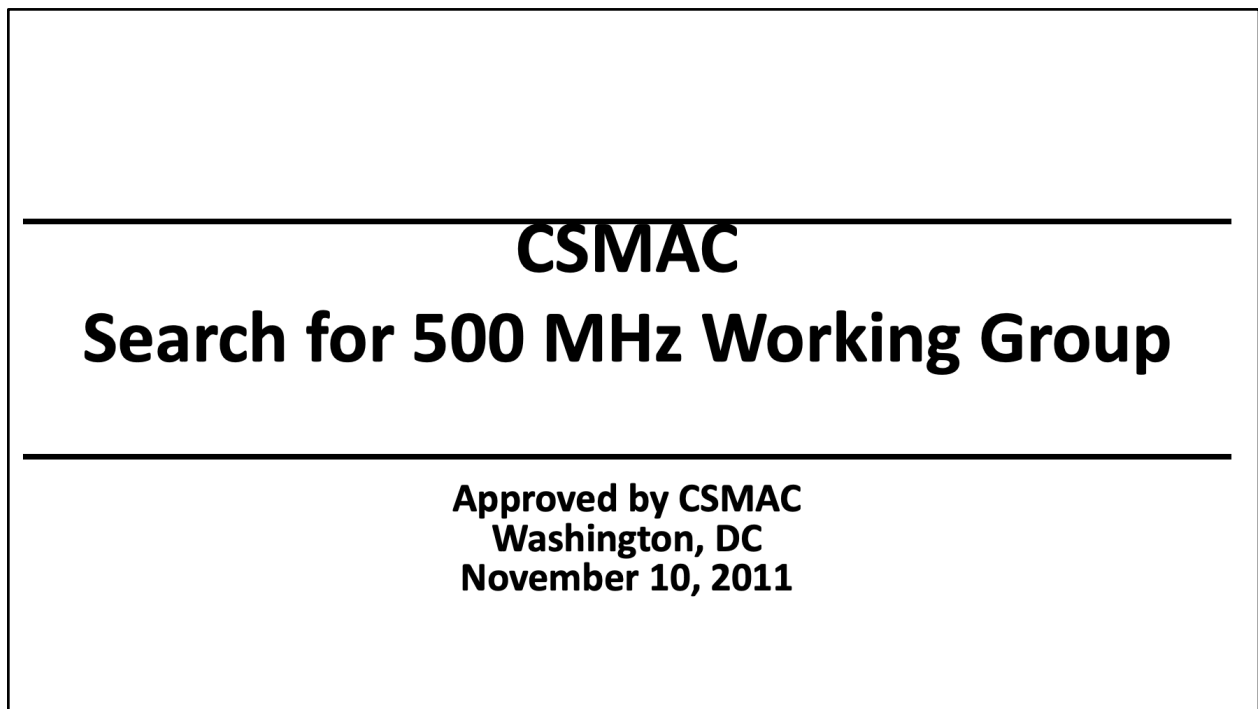


Figure 3.13. CSMAC Working Group Report

⁴⁸ Id. at 4-262.

⁴⁹ NTIA CSMAC Meetings, <https://www.ntia.gov/meetings/CSMAC>.

⁵⁰ NTIA CSMAC, <https://www.ntia.gov/category/csmac>.

https://www.ntia.gov/files/ntia/publications/csmac_search_1755-1850_recommendations_final.pdf

CSMAC meeting proceedings are also available for public viewing on YouTube. The morning⁵¹ and afternoon⁵² sessions are available.

Multiple Choice

The Commerce Spectrum Management Advisory Committee (CSMAC) advises the Assistant Secretary for Communications and Information at NTIA. It's a group of 30 spectrum experts appointed as "Special Government Employees," from outside the Federal government. (True. Federal spectrum policy involves many industry stakeholders whether they are neighboring users of spectrum or whether they are developers of technology used by the federal government and committees such as CSMAC are important ways that industry can advise policymakers at NTIA).



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⁵¹ NTIA CSMAC Meeting Part 1, 2018, <https://www.youtube.com/watch?v=qObBfJ7ayz4>.

⁵² NTIA CSMAC Meeting Part 2, 2018, <https://www.youtube.com/watch?v=sch3IEJ2Wis>.

Figure 3.14. CSMAC Meeting (July 2018)⁵³

3.4. FCC and NTIA Memorandum of Understanding (Aug. 2022)

The FCC and NTIA have a Memorandum of Understanding⁵⁴ that outlines their cooperation in federal spectrum management. The FCC is an independent agency which operates separately from NTIA which is an agency of the U.S. Department of Commerce. While the NTIA Act requires the NTIA administrator to meet with the FCC chair biannually, the MOU outlines the framework for compliance with this requirement.

The NTIA is the sole agency responsible for Federal spectrum authorizations and the President's principal spectrum advisor. The FCC and NTIA jointly manage radio spectrum uses in the public interest. The MOU outlines expectations for the FCC and NTIA staff to meet monthly and to give each other notice of proposed actions that could have impacts on federal users. Likewise, NTIA also is expected to give notice to the FCC for federal uses that impact non-federal radio licensees.

This MOU was drafted in 2003 and renews every 4 years.

⁵³ NTIA CSMAC Meeting Part 1, 2018, <https://www.youtube.com/watch?v=qQbBfj7ayz4>.

⁵⁴ FCC and NTIA Memorandum of Understanding (Aug. 2022), https://www.ntia.gov/sites/default/files/publications/ntia-fcc-spectrum_mou-8.2022.pdf.

**MEMORANDUM OF UNDERSTANDING
BETWEEN THE
FEDERAL COMMUNICATIONS COMMISSION
AND THE
NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION**

This Memorandum of Understanding (MOU) relates to increased coordination between Federal spectrum management agencies to promote the efficient use of the radio spectrum in the public interest.

I. Parties

This MOU constitutes an agreement between the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA), U.S. Department of Commerce.

II. Authorities

The NTIA Act requires the Assistant Secretary for Communications and Information and the Chair of the FCC to meet, at least biannually, to conduct joint spectrum planning with respect to certain issues.¹ The MOU establishes a framework for compliance with this statutory requirement. FCC authority to enter into the MOU arises from the provision of the Communications Act of 1934, as amended, empowering the FCC to perform any and all acts necessary to execute its functions,² as well as provisions establishing the FCC's authority to regulate non-Federal Government use of spectrum.³ NTIA authority to enter into the MOU arises from the provision of the NTIA Act empowering NTIA to develop, in cooperation with the FCC, plans for improved management of all electromagnetic spectrum resources,⁴ as well as provisions of the NTIA Act and the Communications Act establishing NTIA's authority to regulate Federal Government use of spectrum,⁵ advise the President on telecommunications

¹ 47 U.S.C. § 922 ("The Assistant Secretary and the Chairman of the Commission shall meet, at least biannually, to conduct joint spectrum planning . . .").

² 47 U.S.C. § 154(i) ("The Commission may perform any and all acts, make such rules and regulations, and issue such orders, not inconsistent with this Act, as may be necessary in the execution of its functions.").

³ See 47 U.S.C. § 151 (creating the FCC for the purpose of regulating interstate and foreign commerce by wire and radio); 47 U.S.C. § 301 (stating the Act's purpose of maintaining Federal Government control of the radio spectrum and requiring that no person transmit radio signals except pursuant to a license granted under the Act); 47 U.S.C. §

Figure 3.15. Memorandum of Understanding Between the FCC and NTIA (2022)

Multiple Choice

The FCC and NTIA have joint jurisdiction of federal and non-federal spectrum. True or False? (False. NTIA has jurisdiction over federal spectrum and FCC has jurisdiction over non-federal spectrum with a memorandum of understanding for coordination between the two).

3.5. White House Office of Science & Technology Policy (OSTP)

The White House Office of Science and Technology Policy has a central role in directing the President's agenda in spectrum policy in coordination with the Secretary of Commerce and the Administrator of the NTIA. Other spectrum policy experts may be found among the staff of the National Security Council, National Economic Council, and Office of Management and Budget as well.

The National Security Council has influence on spectrum policy as coordination between the Department of Defense and other public safety federal agencies often is needed in addition to the NTIA's spectrum management roles. The Office of Management and Budget gets involved with spectrum asset valuation and any scoring or decisions related to the Spectrum Relocation Fund.

Multiple Choice

The National Security Council does not participate in spectrum policy decisions. (False. It does play a role, particularly in coordinating with the Department of Defense and public safety agencies.)

The Spectrum Relocation Fund (SRF) was created in 2004 to reimburse federal agencies with relocation and clearing costs related to freeing up spectrum for commercial use. It was a part of the goal to find 500 MHz of federal spectrum by 2020 for commercial use. The SRF has gone through some adjustments since then, notably in 2015,⁵⁵ to make it more flexible for the purposes it was created for.

The Commercial Spectrum Enhancement Act (2023) required a report from NTIA that details the current state of the SRF and other efforts to find federal spectrum for more efficient use.⁵⁶

Multiple Choice

The Office of Science and Technology Policy coordinates executive direction for federal spectrum policy from the White House while the NTIA is a subagency within the U.S. Department of Commerce. Both are important for directing interagency spectrum coordination. (True. While the Secretary of Commerce directs the NTIA which has an administrator, there are many occasions where the White House weighs in on decisions between agencies such as the Department of Defense and sets national policy.)

⁵⁵ NTIA, Updating Spectrum Relocation Fund to Enable Innovation and Flexibility in Spectrum Use, 2015, <https://www.ntia.gov/blog/2015/updating-spectrum-relocation-fund-enable-innovation-flexibility-spectrum-use>

⁵⁶ NTIA, 2023 Commercial Spectrum Enhancement Act Report, <https://www.ntia.gov/report/2024/2023-commercial-spectrum-enhancement-act-csea-report>

Multiple Choice

The White House Office of Science and Technology Policy plays a leading role in coordinating the President's spectrum policy agenda. (True. The OSTP is typically the office with spectrum policy expertise from the White House.)



2024 NSF Spectrum Week - Day 4 - Joint Spectrum Week and IEEE DySPAN - Keynote: Austin Bonner; Panel



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In 2024, the U.S. National Science Foundation (NSF) hosted its second Spectrum Week event, co-locating NSF SpectrumX, SWIFT, and NRDZ center meetings and cross-collaboration sessions with NSMA, WSRD, and IEEE DySPAN.

...more

Figure 3.16. NSF Spectrum Week Keynote Address by Austin Bonner, OSTP⁵⁷

3.6. In the News

⁵⁷ 2024 NSF Spectrum Week – Day 4, Joint Spectrum Week and IEEE DySPAN – Keynote: Austin Bonner, <https://www.youtube.com/watch?v=M7Ouj30rmWQ>.

FCC sets stage for SpaceX and wireless industry C-band showdown

by Jason Rainbow February 7, 2025



Analysts anticipate another clash between the interests of terrestrial wireless providers and satellite operators over C-band spectrum. Credit: SES

Figure 3.17. SpaceNews Headline on Spectrum Auction Showdown⁵⁸

3.7. Assignment

Fill in the Blank

⁵⁸ "FCC Sets Stage for SpaceX and Wireless Industry C-Band Showdown," Space News, Feb. 7, 2024, <https://spacenews.com/fcc-sets-stage-for-spacex-and-wireless-industry-c-band-showdown/>.

Read the FCC and NTIA MOU. Memorandum of Understanding Between the FCC and NTIA (2022), https://www.ntia.gov/sites/default/files/publications/ntia-fcc-spectrum_mou-8.2022.pdf. Can you think of examples where federal and non-federal/commercial spectrum users may have conflicts or interference disputes that would put the FCC and NTIA at odds with each other? Where does the OSTP or White House fit into this MOU?

3.8. Reading List

File Attachments

- Manual of Regulations and Procedures for Federal Radio Frequency Management (Redbook), <https://www.ntia.gov/publications/redbook-manual>
- Memorandum of Understanding Between the FCC and NTIA (2022), https://www.ntia.gov/sites/default/files/publications/ntia-fcc-spectrum_mou-8.2022.pdf.

4. Lecture 4: FCC Rulemaking Process

Video

Advanced Spectrum Policy Lecture 4: FCC Rulemaking Process

https://www.youtube.com/watch?v=TpOaBRDwoA8&list=PLIbQnBe9IRS_YjEJyMEqm_QNFbmlld5_ko&index=5

The Federal Communications Commission (FCC) primarily uses a "notice and comment" rulemaking process to create or modify regulations. This involves informing the public about proposed rules and soliciting their feedback. The FCC then analyzes these comments to develop the final rules. This process is designed to ensure public participation, especially from individuals and small businesses.

4.1. Learning Objectives

Statement

Understand the FCC rulemaking process under the Administrative Procedure Act, including how rules are proposed, reviewed, and challenged. Learn how to draft,

submit, and evaluate effective public comments to influence spectrum-related policy decisions.

4.2. Rulemaking Process

The FCC's rulemaking process is well-established with hundreds of communications lawyers who file comments, read orders, and submit expert reports for consideration by the FCC. The Federal Communications Bar Association is the main professional association for lawyers who practice before the FCC in filing these comments.

Multiple Choice

The only way that industry stakeholders and organizations can give input into federal spectrum policy is by visiting the FCC and NTIA regulators and conducting meetings. (False. The administrative process mostly involves administrative filings and comments in the FCC's Electronic Comment Filing System and the NTIA's regulatory docket).

4.2.1. Administrative Procedure Act

The Administrative Procedure Act (APA)⁵⁹ governs how federal agencies create rules. It outlines both formal and informal (notice-and-comment) rulemaking procedures, with most rules issued through the informal process. The report briefly explains various rulemaking methods—including formal, informal, hybrid, direct final, and negotiated rulemaking—and the legal standards for changing or repealing rules. It also covers how courts review agency rules and notes exceptions to APA procedures, such as the "good cause" exception and rules about policy statements, interpretive rules, and procedural rules.

⁵⁹ 5 U.S.C. § 551(1). See generally 5 U.S.C. §§ 551-59, 701-06 (2012).

5 USC PART I, CHAPTER 5, SUBCHAPTER II: ADMINISTRATIVE PROCEDURE

From Title 5—GOVERNMENT ORGANIZATION AND EMPLOYEES

PART I—THE AGENCIES GENERALLY

CHAPTER 5—ADMINISTRATIVE PROCEDURE

SUBCHAPTER II—ADMINISTRATIVE PROCEDURE

STATUTORY NOTES AND RELATED SUBSIDIARIES

SHORT TITLE

The provisions of this subchapter and chapter 7 of this title were originally enacted by act [June 11, 1946, ch. 324, 60 Stat. 237](#), popularly known as the "Administrative Procedure Act". That Act was repealed as part of the general revision of this title by Pub. L. 89–554 and its provisions incorporated into this subchapter and chapter 7 hereof.

§551. Definitions

For the purpose of this subchapter—

(1) "agency" means each authority of the Government of the United States, whether or not it is within or subject to review by another agency, but does not include—

- (A) the Congress;
- (B) the courts of the United States;
- (C) the governments of the territories or possessions of the United States;
- (D) the government of the District of Columbia;

or except as to the requirements of section 552 of this title—

- (E) agencies composed of representatives of the parties or of representatives of organizations of the parties to the disputes determined by them;
- (F) courts martial and military commissions;
- (G) military authority exercised in the field in time of war or in occupied territory; or
- (H) functions conferred by sections 1738, 1739, 1743, and 1744 of title 12; subchapter II of chapter 471 of title 49; or sections 1884, 1891–1902, and former section 1641(b)(2), of title 50, appendix; ¹

Figure 4.1. Administrative Procedure Act⁶⁰

A general overview of the federal rulemaking process is important to understand the procedural posture of administrative dockets, proceedings, and comments filed with the FCC and NTIA.⁶¹ Federal regulations typically begin with an act of Congress and serve to implement laws by detailing specific requirements. The terms "rule" and "regulation" are used interchangeably. The Administrative Procedure Act (APA) defines a rule as an agency statement meant to implement or interpret law or policy.

4.2.2. Starting a Rulemaking

The FCC starts a rulemaking process based on several causes. A Congressional statute may direct the agency to open a rulemaking. The agency itself can identify a need for a

⁶⁰ See generally 5 U.S.C. §§ 551–59, 701–06 (2012).

⁶¹ Congressional Research Service, "The Federal Rulemaking Process: An Overview," June 17, 2013, CRS Report No. RL32240, <https://sgp.fas.org/crs/misc/RL32240.pdf>.

rule and open a rulemaking. The FCC can also receive a petition from interested parties to open a rulemaking.⁶²

The rulemaking process includes various types of submissions and orders such as the Notice of Inquiry (NOI) which typically starts the process of opening a docket, a Notice for Proposed Rulemaking (NPRM) which sets out the specific questions that the agency is seeking comments, and later the agency's Report and Order (R&O) which issues the agency's decisions based on the comments submitted. There are various other filing types such as Reply Comments, Second, Third, and Fourth Reports and Order, Petition for Reconsideration, Orders on Reconsideration, Further Notices for Proposed Rulemaking (FNPRM), and Ex Parte meeting notices that are posted in the dockets.

The rulemaking process is governed by legal requirements under the Administrative Procedure Act and the FCC is constrained to its statutory authority as defined by Congress. The agency is required to read and consider each comment and explain in its order that it took the comments into consideration.

⁶² Overview of the FCC's Rulemaking Process, NTIA, Suzanne Tetrault, ISART 2022 Tutorial Series, <https://www.youtube.com/watch?v=LHRKwfDbw18&t=1s>.



PUBLIC NOTICE

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Internet: <http://www.fcc.gov>

DA 25-219

Released: March 12, 2025

IN RE: DELETE, DELETE, DELETE

GN Docket No. 25-133

Comments Due: Friday, April 11, 2025

Reply Comments Due: Monday, April 28, 2025

Through a series of Executive Orders, President Trump has called on administrative agencies to unleash prosperity through deregulation and ensure that they are efficiently delivering great results for the American people.¹

By this Public Notice, the Federal Communications Commission (Commission or FCC) is taking action to promote the policies outlined by President Trump in those Executive Orders. Specifically, we are seeking public input on identifying FCC rules for the purpose of alleviating unnecessary regulatory burdens. We seek comment on deregulatory initiatives that would facilitate and encourage American firms' investment in modernizing their networks, developing infrastructure, and offering innovative and advanced capabilities. The Communications Act directs the FCC to regularly review its rules to identify and eliminate those that are unnecessary in light of current circumstances,² recognizing that in addition to imposing unnecessary burdens,³ unnecessary rules may stand in the way of deployment, expansion, competition, and technological innovation

¹ See, e.g., *Executive Order 14192 of January 31, 2025, Unleashing Prosperity Through Deregulation*, 24 Fed. Reg. 9065 (Feb. 6, 2025); see also *Executive Order 14219 of February 19, 2025, Ensuring Lawful Governance and Implementing the President's "Department of Government Efficiency" Deregulatory Initiative*, 36 Fed. Reg. 10583 (Feb. 25, 2025).

² See, e.g., 47 U.S.C. § 161 (directing the Commission periodically to review rules applicable to telecommunications carriers to "determine whether any such regulation is no longer necessary in the public interest as the result of

Figure 4.2. FCC Public Notice of Seeking Public Input in Docket No. 25-133⁶³

⁶³ In the Re: Delete, Delete, Delete, GN Docket No. 25-133, Mar. 12, 2025, <https://docs.fcc.gov/public/attachments/DA-25-219A1.pdf>.



Figure 4.3. Overview of the FCC's Rulemaking Process⁶⁴

4.2.3. Judicial Review of Agency Rulemaking

Judicial review of agency rulemaking is embodied in the Administrative Procedure Act. Article III courts can set aside agency action and hold it unlawful under different circumstances, notably if the agency's actions are arbitrary, capricious, or an abuse of discretion.⁶⁵

Multiple Choice

If a federal agency makes decisions beyond the scope of their statutory authority or in an arbitrary and capricious manner, the only recourse is to vote the elected officials out of office and to change the rules after an election. (False. Under the Administrative Procedure Act, the harmed party can bring a federal lawsuit against an agency to dispute

⁶⁴ NTIA, Overview of the FCC's Rulemaking Process, <https://www.youtube.com/watch?v=LHRKwfDbw18&t=1s>.

⁶⁵ Congressional Research Service, A Brief Overview of Rulemaking and Judicial Review, Mar. 27, 2017, CRS Report No. R41546, at p. 13, https://www.congress.gov/crs_external_products/R/PDF/R41546/R41546.13.pdf.

its rulemaking decision. The agency can then defend itself and appeals can go up through the federal appellate courts and all the way to the Supreme Court.)

Judicial Review of Agency Rulemaking

As a general matter, there is a “strong presumption that Congress intends judicial review of administrative action.”¹¹⁸ This presumption is embodied in the APA, which provides that “final agency action for which there is no other adequate remedy in a court [is] subject to judicial review.”¹¹⁹ The APA excludes judicial review in two situations—instances where (1) other “statutes preclude judicial review” or (2) “agency action is committed to agency discretion by law.”¹²⁰

The APA provides that courts may hold unlawful and set aside agency actions under a number of circumstances.¹²¹ Specifically, the APA states the following:

The reviewing court shall ... hold unlawful and set aside agency action, findings, and conclusions found to be –
(A) arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law;
(B) contrary to constitutional right, power, privilege, or immunity;
(C) in excess of statutory jurisdiction, authority, or limitations, or short of statutory right;
(D) without observance of procedure required by law;
(E) unsupported by substantial evidence in a case subject to sections 556 and 557 of this title
or otherwise reviewed on the record of an agency hearing provided by statute; or
(F) unwarranted by the facts to the extent that the facts are subject to trial de novo by the reviewing court.
In making the foregoing determinations, the court shall review the whole record or those parts of it cited by a party, and due account shall be taken of the rule of prejudicial error.¹²²

This provision indicates that the type of judicial review may differ depending on whether the court is reviewing formal or informal rulemakings. Specifically, cases subject to § 556 and § 557 are subject to “substantial evidence” review, whereas other agency actions are subject to “arbitrary and capricious” review.¹²³ Congress has sometimes, however, required informal, notice-and-comment rulemakings to be reviewed under the substantial evidence test.¹²⁴ However, some have argued that the two standards are the same, and commentators have stated that “the

¹¹⁸ *Bowen v. Mich. Acad. of Family Phys.*, 476 U.S. 667, 670 (1986); see also *Gutierrez De Martinez v. Lamagno*, 515 U.S. 417, 424 (1995) (quoting *Bowen*, 476 U.S. at 670). “The presumption favoring judicial review of administrative action ... may be overcome by specific language or specific legislative history that is a reliable indicator of congressional intent.” *Block v. Comm. Nutrition Inst.*, 467 U.S. 340, 349 (1984). “The congressional intent necessary to overcome the presumption may also be inferred from contemporaneous judicial construction barring review and the congressional acquiescence in it ... or from the collective import of legislative and judicial history behind a particular statute,” or from “inferences of intent drawn from the statutory scheme as a whole.” *Id.*

¹¹⁹ 5 U.S.C. §§ 702, 704. Judicial review may be invoked under the APA if a plaintiff is “adversely affected or aggrieved” by any final agency action “within the meaning” of the statute at issue. *Id.* at § 702. This brief report does not discuss issues of standing, ripeness, finality of agency action, or exhaustion of administrative remedies.

¹²⁰ *Id.* at § 701(a); see *Sackett v. EPA*, 566 U.S. 120, 126-31 (2012) (holding that the Clean Water Act does not preclude judicial review under the APA of an EPA compliance order, which the court found was a “final agency action for which there is no adequate remedy other than APA review,” and noting that the Court does “not look ‘only [to] [a statute’s] express language’” in determining whether “a particular statute precludes judicial review”).

¹²¹ 5 U.S.C. §§ 701-706.

¹²² *Id.* at § 706(2).

¹²³ *Id.* For further discussion of judicial review under the APA, see CRS Report R44699, *An Introduction to Judicial Review of Federal Agency Action*, by Jared P. Cole.

¹²⁴ See, e.g., 15 U.S.C. § 57a(e)(3)(A).

Figure 4.4. Judicial Review of Agency Rulemaking⁶⁶

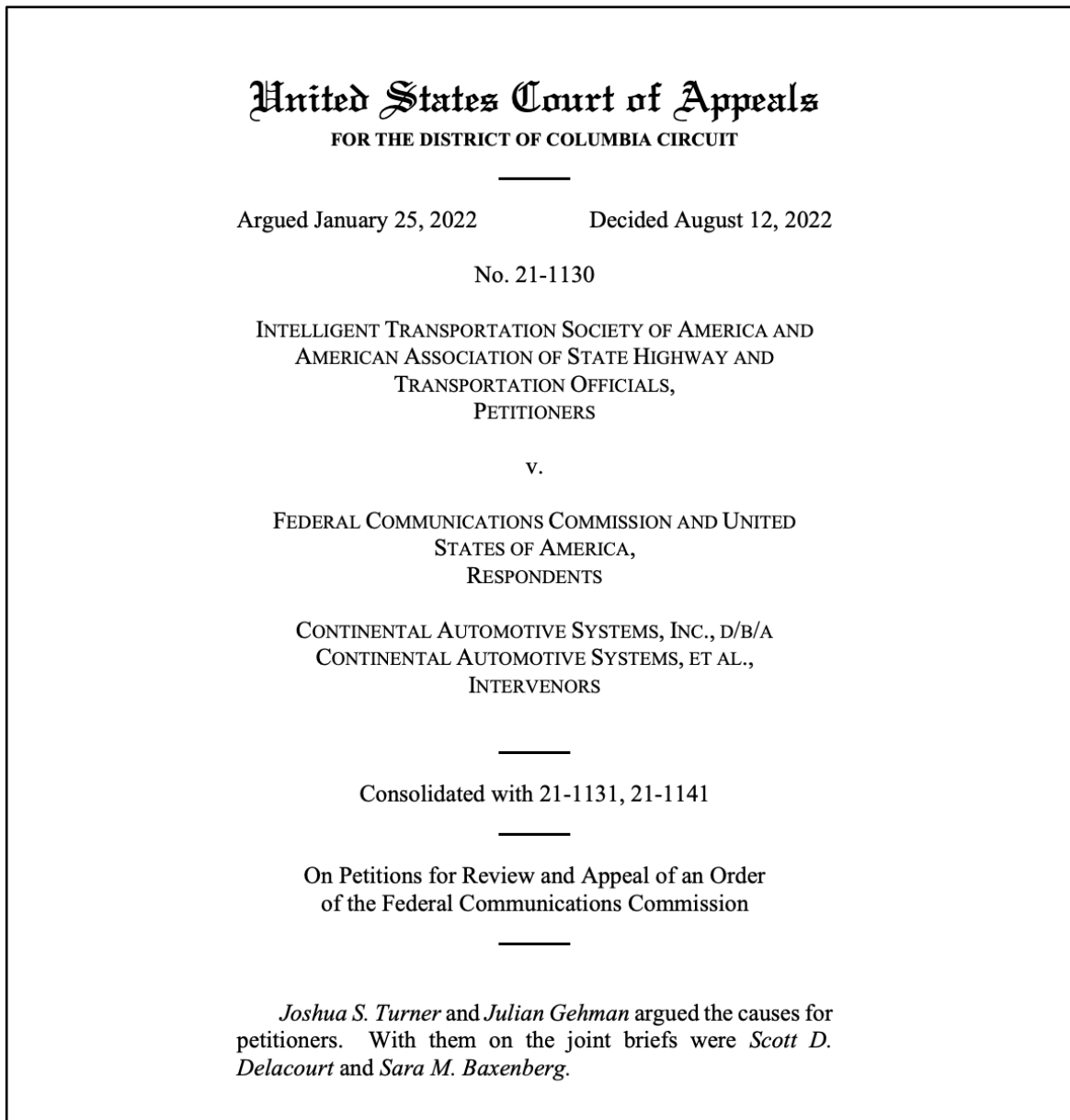


Figure 4.5. *ITS v. FCC* Decision by the D.C. Circuit⁶⁷

*Intelligent Transportation Society of America v. FCC*⁶⁸ is an example of litigation around a spectrum allocation order by the FCC that was appealed up to the U.S. Court of Appeals

⁶⁶ Congressional Research Service, “A Brief Overview of Rulemaking and Judicial Review,” Mar. 27, 2017, CRS Report No. R41546, at p. 13, https://www.congress.gov/crs_external_products/R/PDF/R41546/R41546.13.pdf.

⁶⁷ *Intelligent Transportation Society of America v. FCC*, No. 21-1130, Aug. 12, 2022, <https://media.cadc.uscourts.gov/opinions/docs/2022/08/21-1130-1959069.pdf>.

⁶⁸ *Intelligent Transportation Society of America v. FCC*, No. 21-1130, Aug. 12, 2022, <https://media.cadc.uscourts.gov/opinions/docs/2022/08/21-1130-1959069.pdf>.

for the District of Columbia Circuit. The FCC reallocated 45 MHz of spectrum in the 5.9 GHz Band Order (2020)⁶⁹ and it was upheld in 2022 by the court in the face of a legal challenge that the order violated the 1998 Transportation Equity Act for the 21st Century which had allocated 75 MHz for intelligent transportation systems and amateur radio. The D.C. Circuit upheld the FCC's broad authority and expertise to reallocate spectrum bands. The court found the statute did not give the Department of Transportation a veto over the FCC on spectrum allocation management decisions.⁷⁰

FCC agency actions have been litigated up to federal appellate courts in the D.C. Circuit, 2nd Circuit, 3rd Circuit, 5th Circuit, 10th Circuit, and the Supreme Court in several cases.⁷¹ Two cases that were heard before the Supreme Court are briefly described below, namely, *City of Arlington v. FCC*, No. 11-1545 and *FCC v. Fox Television Stations*, No. 10-1293.

The screenshot shows the FCC's website with a blue header. The header includes the FCC logo, the text 'Federal Communications Commission', and two navigation options: 'Browse by CATEGORY' and 'Browse by BUREAUS & OFFICES'. Below the header is a blue navigation bar with links: 'About the FCC', 'Proceedings & Actions', 'Licensing & Databases', 'Reports & Research', and 'New'. The main content area has a breadcrumb trail 'Home / General Counsel' and a large title 'Archive of Major Court Cases of the FCC'. Below the title is a list of cases, each preceded by a square bullet point:

- [Huawei Tech. v. FCC, No. 19-60896 \(5th Cir.\)](#)
- [United States Telecom Association, No. 15-1063 \(D.C. Cir.\)](#)
- [City of Arlington v. FCC, No. 11-1545 \(Sup. Ct.\)](#)
- [In Re: FCC 11-161, No. 11-9900 \(10th Cir.\)](#)
- [Verizon v. FCC, No. 11-1355 \(D.C. Cir.\)](#)
- [FCC v. Fox Television Stations, Inc., No. 10-1293 \(Supreme Court\)](#)
- [FCC v. AT&T, Inc., No. 09-1279 \(Supreme Court\)](#)
- [Fox Television Stations, Inc., et al. v. FCC, No 06-1760-ag\(L\) \(2nd Cir.\)](#)
- [Prometheus Radio Project v. FCC, No. 08-3078 \(3rd Cir.\)](#)

Figure 4.6. Major Court Cases of the FCC⁷²

⁶⁹ FCC, 5.9 GHz Band Order, Nov. 18, 2020, <https://www.fcc.gov/document/fcc-modernizes-59-ghz-band-improve-wi-fi-and-automotive-safety>.

⁷⁰ Seth L. Cooper, Upholds FCC's 5.9 GHz Order Reallocating Spectrum for Unlicensed Use, Sept. 12, 2022, <https://fedsoc.org/commentary/fedsoc-blog/d-c-circuit-upholds-fcc-s-5-9-ghz-order-reallocating-spectrum-for-unlicensed-use>.

⁷¹ FCC, Archive of Major Court Cases of the FCC, <https://www.fcc.gov/archive-major-court-cases-fcc>.

⁷² FCC, Archive of Major Court Cases of the FCC, <https://www.fcc.gov/archive-major-court-cases-fcc>.

In *City of Arlington v. FCC*,⁷³ the FCC set time limits on zoning decisions at the municipal level for building wireless towers or attaching wireless equipment to buildings. The local governments said that the FCC did not have the power under its governing statute to do so. In a 6–3 decision in favor of the FCC, the Supreme Court held that the court should defer to the agency’s interpretation of its jurisdiction under the *Chevron* doctrine.

In *FCC v. Fox Television Stations*,⁷⁴ the FCC almost fined Fox for indecency for allowing Cher and Nicole Richie for vulgarity that was not bleeped during a live broadcast in 2002 and 2003 during an awards show. In a unanimous decision, the Supreme Court held that the FCC’s standards were vague and that the agency did not give TV stations proper notice that they would be penalized for fleeting expletives.

4.3. Filing Comments

The first step in filing comments in a regulatory proceeding is to find the docket in the ECFS to view the FCC’s NPRM and to view other filer’s comments. For example, in the case above on the 5.9 GHz Order, we can look up Docket No. 19–138.⁷⁵

Figure 4.7. ECFS Docket No. 19–138 from the 5.9 GHz Order⁷⁶

⁷³ *City of Arlington v. FCC*, 569 U.S. 290 (2013), <https://www.oyez.org/cases/2012/11-1545>.

⁷⁴ *FCC v. Fox Television Stations*, 567 U.S. ___ (2012), <https://www.oyez.org/cases/2011/10-1293>.

⁷⁵ [https://www.fcc.gov/ecfs/search/search-filings/results?q=\(proceedings.name:\(%2219-138%22\)\)](https://www.fcc.gov/ecfs/search/search-filings/results?q=(proceedings.name:(%2219-138%22)))

⁷⁶ [https://www.fcc.gov/ecfs/search/search-filings/results?q=\(proceedings.name:\(%2219-138%22\)\)](https://www.fcc.gov/ecfs/search/search-filings/results?q=(proceedings.name:(%2219-138%22)))

Fill in the Blank

Go to the ECFS on the FCC webpage. Find the 5.9 GHz Order docket no. 19-138. Look through the comments filed. What do you notice about the FCC's docket? Who are the filers? What types of comments are filed?

In the 5.9 GHz Docket, you can see many different filings from stakeholders and ex parte notices which disclose in-person meetings with the FCC staff. A few notable filings include a letter from the NTIA on technical specifications for the band⁷⁷ and the petitioners the Intelligent Transportation Society.⁷⁸ There are also many filings from automotive associations, car part manufacturers, chip manufacturers, and more.⁷⁹

⁷⁷ <https://www.fcc.gov/ecfs/search/search-filings/filing/1060767641685>

⁷⁸ <https://www.fcc.gov/ecfs/search/search-filings/filing/10706717221155>

⁷⁹ <https://www.fcc.gov/ecfs/search/search-filings/filing/107050745008634>



UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and
Information Administration
Washington, D.C. 20230

June 7, 2024

Mr. Ronald T. Repasi
Chief, Office of Engineering and Technology (OET)
Federal Communications Commission
45 L Street, NE
Washington, DC 20554

Mr. Joel Taubenblatt
Chief, Wireless Telecommunications Bureau (WTB)
Federal Communications Commission
45 L Street, NE
Washington, DC 20554

Re: Use of the 5.850-5.925 GHz Band ET Docket No. 19-138

Dear Messrs. Repasi and Taubenblatt:

The National Telecommunications and Information Administration (NTIA), on behalf of the Executive Branch and consistent with its responsibility to ensure that the views of the Executive Branch are effectively presented to the Commission,¹ provides this additional information in response to the Further Notice of Proposed Rulemaking (FNPRM) in the above-captioned proceeding.² The Intelligent Transportation System holds the important promise of improving transportation safety and mobility by integrating advanced communications technologies into vehicles and infrastructure, and the Commission has responsibly crafted responsive regulations. The connected vehicle ecosystem of the future will make the nation's transportation system more flexible, resilient, and safe, and it requires clear technical and operational rules governing devices using C-V2X (cellular-to-vehicle-everything tailored using the 4G Long-Term Evolution capabilities) technology.

NTIA's comments below address three specific areas related to the protection of federal radiolocation systems: (1) general provisions for C-V2X technical and service rules; (2) C-V2X roadside unit (RSU) equivalent isotropically-radiated power (EIRP) limits; and (3) EIRP limits for C-V2X on-board units (OBUs).

¹ 47 USC § 902(b)(2)(J).

Figure 4.8. NTIA Letter Filed with the FCC in the 5.9 GHz Order⁸⁰

⁸⁰ <https://www.fcc.gov/ecfs/search/search-filings/filing/1060767641685>

July 5, 2024

Ronald T. Repasi
Chief, Office of Engineering and Technology
Federal Communications Commission
45 L Street NE
Washington, DC 20554

Re: Use of the 5.850-5.925 GHz Band; ET Docket No. 19-138, DA 24-538

Introduction

The Intelligent Transportation Society of America (ITS America) is grateful for the opportunity to comment on the Federal Communication Commission's (FCC) proposed rule regarding the use of geofencing in cellular-vehicle-to-everything (C-V2X) on-board units to reduce out-of-band emission power limits around specified federal radiolocation services. As the nation's leading advocate for the technological modernization of our transportation system by focusing on advancing research and deployment of intelligent transportation technology, ITS America works to make transportation safer, greener, and smarter for all.

ITS America was founded in 1991 as an advisory council to USDOT on technology innovation and emerging transportation technologies. ITS America is the only organization in the country that represents all sectors – public, private, academic, and nonprofit – to advance transportation technology. Our membership includes state and city departments of transportation, transit agencies, metropolitan planning organizations, automotive manufacturers, technology companies, engineering firms, automotive suppliers, insurance companies, and research and academic universities. Our vision is one of a better future transformed by transportation technology and innovation and our work accelerates the deployment of technology that saves lives, promotes sustainability, and advances more equitable transportation.

Supporting the deployment of vehicle-to-everything (V2X) technologies represent a crucial component of ITS America's mission, as these technologies are particularly suited to significantly reduce the more than 40,000 lives lost on American roads on an annual basis. ITS America's members are eager to deploy these technologies as soon as possible to bolster their efforts to proactively improve transportation safety, as well as numerous additional outcomes related to improving mobility for all road users. Such deployment depends on the work being done by the FCC to finalize the Second Report and Order governing the rules for C-V2X technologies in the 5.9 GHz band. The Second Report and Order is a critical component of establishing the regulatory certainty needed to fully deploy a cooperative technology such as C-V2X at scale, and ITS America's members are in full agreement that the Second Report and Order is needed as soon as possible.

To that end, ITS America appreciates the efforts of the Commission, the National Telecommunications and Information Administration (NTIA), and the United States Department of Transportation (USDOT) to move quickly to address any outstanding barriers to the completion

Page | 1

Figure 4.9. Intelligent Transportation Society Filing with the FCC in the 5.9 GHz Order⁸¹

⁸¹ <https://www.fcc.gov/ecfs/search/search-filings/filing/10706717221155>



July 5, 2024

Via ECFS

Marlene Dortch
Secretary
Federal Communications Commission
45 L Street NE
Washington, DC 20554

Re: Use of the 5.850-5.925 GHz Band - ET Docket No. 19-138

Dear Secretary Dortch:

The 5G Automotive Association (“5GAA”), the American Association of State Highway and Transportation Officials (“AASHTO”), the Institute of Transportation Engineers (“ITE”), and the Wireless Infrastructure Association (“WIA”), leading associations of public and commercial interests that represent the automotive industry, infrastructure owner-operators, and wireless technology companies in the deployment of Cellular Vehicle-to-Everything (“C-V2X”) technology to provide transformative roadway safety improvements, hereby respond to the FCC’s Public Notice seeking further comment on C-V2X On-Board Unit (“OBU”) power levels.¹

As explained below, our associations support the recommendations from the National Telecommunications and Information Administration (“NTIA”) to protect federal radiolocation systems in the 5.9 GHz band by allowing OBUs to use geofencing to enable operations above the power levels the FCC authorized under waiver authority.²

The FCC Should Adopt Rules Allowing OBUs Equipped with Geofencing Technology to Transmit with Up to 33 dBm EIRP Within ± 5 Degrees of the Horizontal Plane. NTIA has stated that OBUs without geofencing technology can operate with up to 33 dBm EIRP above 5 degrees elevation and with up to 27 dBm EIRP within ± 5 degrees of the horizontal in the upper 20 MHz channel in the Intelligent Transportation Services (“ITS”) band (*i.e.*, 5905-5925

¹ See *Office of Engineering and Technology Seeks Additional Comment On On-Board Unit Power Limits For C-V2X Operations*, Public Notice, DA 24-538 (rel. June 11, 2024) (“Public Notice”).

² See *id.* at 2, n.5.

Figure 4.10. 5G Automotive Association Letter filed with FCC in the 5.9 GHz Order⁸²

Fill in the Blank

⁸² <https://www.fcc.gov/ecfs/search/search-filings/filing/107050745008634>

What do you observe about these three sample FCC filings? How do the commenters begin their filings and what do you notice about the content of the documents?

4.3.1. Drafting and Submitting a Comment

The FCC launched “ECFS Express” to enable citizens to submit comments with minimal input in an easy form into the FCC record.⁸³

Unlike the standard ECFS, which allows for more detailed submissions (including attachments) and is meant for users who engage with specific proceedings, ECFS Express is meant for citizen access. It requires minimal input, enabling users to submit comments quickly and easily without needing to navigate complex filing requirements.

Through ECFS Express, citizens can submit brief, typed comments directly into a text box, which are then entered into the FCC’s official record for consideration in relevant proceedings. The standard ECFS remains available for more detailed or technical submissions, such as those from industry stakeholders, legal representatives, or individuals who wish to upload supporting documents. Both systems ensure that comments become part of the public record, which the FCC reviews when developing or amending its regulations.

The screenshot shows the FCC's 'Submit an Express Comment' form. At the top is the FCC logo and navigation links: 'Filings & Proceedings', 'Submit a FILING', 'Check Filing STATUS', and 'User HELP'. Below these are three tabs: 'Standard Filing', 'Express Comment' (which is highlighted), and 'Non-Docketed Filing'. The main heading is 'Submit an Express Comment'. Below this is a progress bar with three steps: 1. COMMENT, 2. REVIEW, and 3. CONFIRMATION. The form fields include: '*Proceeding(s): Specify the FCC proceeding(s) to which your filing refers' (text box), '*Name(s) of Filer(s): Enter the name(s) of the persons or entities whose views the filing represents' (text box), 'Primary Contact E-Mail: For confirmation receipt (Optional)' (text box with 'email@email.com' entered), '*Address' (text box with an 'International' checkbox), 'Address 2' (text box), '*City' (text box), and '*State' (text box).

⁸³ <https://docs.fcc.gov/public/attachments/DOC-230234A1.doc>.

Figure 4.11. ECFS Express Comment Submission Form⁸⁴

The screenshot displays the ECFS Express Comment Submission Form interface. At the top, there is a navigation bar with links for 'Filings & Proceedings', 'Submit a FILING', 'Check Filing STATUS', and 'User HELP'. Below this is a search bar with options to 'Search for Filings', 'Search for Proceedings', and 'Browse Popular Proceedings'. The main content area is divided into two sections: 'Filters' on the left and 'Filings' on the right. The 'Filters' section includes 'DATE POSTED', 'DATE RECEIVED', 'EXCLUDE', and 'TOP PROCEEDINGS'. The 'Filings' section shows a list of filings with details like 'Received: 04/07/2025', 'Posted: 04/07/2025', and buttons for 'EXPRESS' and 'COMMENT'.

Figure 4.12. Express Comments in the 5.9 GHz Order⁸⁵

There are critiques about the efficacy of express comments, however. These citizen comments do not amount to votes in a legislative sense, even if they convey or communicate some level of engagement by the general public. Oftentimes these campaigns may not truly represent understanding of the issues where people indiscriminately click to send their form letters through automated means, or in some cases, fake names and profiles are submitted with “astroturf” or robot comments. Commentators have questioned the usefulness of express comments and whether they represent meaningful input in the rulemaking process.⁸⁶

Multiple Choice

Anyone can file a comment in the FCC or NTIA’s regulatory dockets when they ask for comments on rulemaking proceedings. (True. The FCC established an Express Docket in order to help citizens with short comments submit their feedback into the record.)

⁸⁴ FCC, “Submit an Express Comment,” <https://www.fcc.gov/ecfs/filings/express>.

⁸⁵ [https://www.fcc.gov/ecfs/search/search-filings/results?q=\(proceedings.name:\(%2219-138%22\)\)](https://www.fcc.gov/ecfs/search/search-filings/results?q=(proceedings.name:(%2219-138%22)))

⁸⁶ Scott Wallsten, Does It Matter if Millions of People Send Comments to the FCC?, June 16, 2017, <https://techpolicyinstitute.org/publications/broadband/net-neutrality/does-it-matter-if-millions-of-people-send-comments-to-the-fcc/>.

Fill in the Blank

Go to the FCC site to “Submit an Express Comment,” <https://www.fcc.gov/ecfs/filings/express>. Select a proceeding from the FCC’s list of popular proceedings, FCC ECFS Popular Proceedings, <https://www.fcc.gov/ecfs/search/browse-popular-proceedings>. File an express comment that reflects your recommendations or views on the proceeding.

4.3.2. Preparing Effective Comments

The FCC has posted guidance on what constitutes effective comments.⁸⁷ The FCC suggests that comments directly address the agency questions raised in the NPRM, organized in sections that correspond to the NPRM. Clear explanation and support for the view with reasoning and basis for the position are important for the FCC to consider in its rulemaking process. Additional evidence or data in supplemental documents and expert reports are helpful to support positions explained in the comment. Real world examples of concerns are important to raise and with specificity. It is important as well that the commenter understand the FCC’s scope of authority to know whether alternatives proposed or suggested rules would be possible under the law.

⁸⁷ FCC, Rulemaking Process, FAQs, <https://www.fcc.gov/about-fcc/rulemaking-process>.



How do I prepare effective comments?

We encourage you to challenge our and other commenters' factual assumptions; applications of data and research; analytical methodologies; analysis; or factual, technical, and policy conclusions. We want you to suggest reasonable alternatives to our proposals and to the proposals of other commenters.

The following list is intended to provide helpful suggestions on how to make your comments more effective and more useful to us in crafting a well reasoned decision that is likely to be upheld by the courts. Except for the requirement that the docket number be placed on any comments, the following suggestions are not mandatory requirements.

- a. **Docket ID.** You must identify the docket number for the rulemaking document on which you are commenting so that the Commission and other members of the public can place and find it in the correct file. The docket number is provided near the very top of the NPRM.
- b. **Typewritten documents.** We prefer typewritten and word-processed documents; otherwise the reviewer may not be able read your handwriting. We do not require this, however, because we recognize that not everyone may have access to a typewriter or computer.
- c. **Electronic submissions.** We prefer that comments be submitted electronically. We recognize that everyone does not have easy Internet access, so we do not require electronic submission.
- d. **Agency questions.** We want your comments on any part of the proposal on which you wish to comment. However, we almost always ask questions or raise issues in rulemaking proposals on subjects where we especially need more information. Please answer those questions if you have useful information on them.
- e. **Organized comments.** It is helpful if you organize your comments by the specific headings or by specific sections in the NPRM. This will help the public and the agency review the comments more easily and effectively.
- f. **Clear explanation and support for views.** You should explain your views and reasoning as clearly as possible; provide the basis for your assumptions; and provide supporting evidence or data, wherever possible, to support your views. By supporting your arguments, you are more likely to persuade us to accept them. If you do not, and we do not have separate data to support your submission, we cannot rely on it since we are required to provide the basis for our final decisions.
- g. **Alternatives.** If you disagree with a proposed rule, you should provide specific alternatives to help us ensure that, if we agree with your concerns, we can effectively implement your suggestions. In addition, you should provide an analysis of how your alternative(s) would better serve the public interest than our proposal.
- h. **Examples of concerns.** You should provide specific examples to illustrate your concerns. Real world examples or possibilities can help us better understand those concerns.
- i. **Statutory limitations.** In preparing your comments, you should consider the requirements and limitations of the statutory authority under which the Commission is making its proposal. You may be objecting to a proposal over which the agency has no discretion; the agency may be required to issue a final rule with that provision. You may also be proposing an alternative that the agency has no authority to implement.

Figure 4.13. FCC FAQ: How Do I Prepare Effective Comments?⁸⁸

⁸⁸ FCC, Rulemaking Process, FAQs, <https://www.fcc.gov/about-fcc/rulemaking-process>.

Multiple Choice

The FCC reads every comment and takes them into account in rulemaking proceedings, but sets guidelines for what makes an effective comment with substantive recommendations, evidence, expert reports, and legal support. (True. The Administrative Procedure Act governs the federal rulemaking process and directs the FCC to receive comments on rulemaking proceedings).

4.4. Case Study: Broadcast Incentive Auction

Congress authorized the FCC to conduct incentive auctions on February 22, 2012, directing the implementation of an incentive auction of broadcast television spectrum in the Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, §§ 6402, 6403, 125 Stat. 156 (2012) (Spectrum Act).⁸⁹ This statute followed the 2010 National Broadband Plan which suggested the use of an incentive auction to transition broadcast TV spectrum to broadband use.⁹⁰

The reverse auction 1001 involved television broadcast stations to determine how much they could reap from selling their spectrum, while the forward auction 1002 sold those licenses to wireless providers in flexible-use licenses with geographic shapes amenable to mobile service.

But before getting to the auctions which took place in 2016 and 2017, a significant amount of work was needed to clear out the users of analog TV sets through the digital television converter box program, and then to create a band plan that would be agreeable to the TV stations which would repack their operations into more efficient bands, as well as to potential new bidders who would bid for rights to new flexible-use licenses in the 600 MHz bands.

⁸⁹ <https://www.congress.gov/112/plaws/publ96/PLAW-112publ96.pdf>.

⁹⁰ National Broadband Plan 2010, <https://transition.fcc.gov/national-broadband-plan/national-broadband-plan.pdf>.

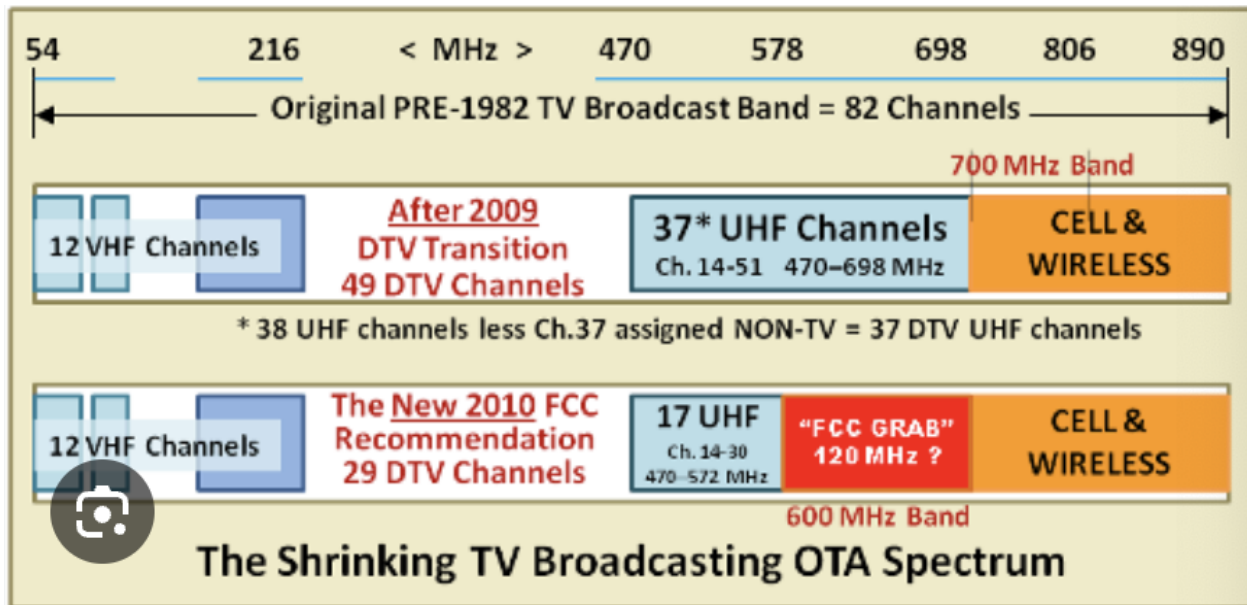


Figure 4.14. TV Broadcast Over-the-Air Spectrum Bands⁹¹



Figure 4.15. Digital TV Converter Box Program⁹²

⁹¹ <https://stopthecap.com/2012/09/11/fcc-prepares-to-sacrifice-free-over-the-air-uhf-tv-channels-for-lucrative-wireless-auctions/>.

⁹² https://en.wikipedia.org/wiki/Coupon-eligible_converter_box.

*Exhibit 5-E:
Actions and
Timeline to Fulfill
300 Megahertz
Goal by 2015*

Band	Key Actions and Timing	Megahertz Made Available for Terrestrial Broadband
WCS	2010—Order	20
AWS 2/3 ⁶¹	2010—Order 2011—Auction	60
D Block	2010—Order 2011—Auction	10
Mobile Satellite Services (MSS)	2010—L-Band and Big LEO Orders 2011—S-Band Order	90
Broadcast TV ⁶²	2011—Order 2012/13—Auction 2015—Band transition/clearing	120
Total		300

Figure 4.16. National Broadband Plan of 2010 with Timeline for 2015 Spectrum Needs⁹³

The FCC initiated the Notice for Proposed Rulemaking in October 2012 which formally began the process of administering the rules and the auction.

⁹³ Id. at 84.



Figure 4.17. Broadcast Incentive Auction Rulemaking Timeline⁹⁴

⁹⁴ FCC, Broadcast Incentive Auction, <https://www.fcc.gov/about-fcc/fcc-initiatives/incentive-auctions/resources>.

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of	)	
	)	
Expanding the Economic and Innovation	)	Docket No. 12-268
Opportunities of Spectrum Through Incentive	)	
Auctions	)	

NOTICE OF PROPOSED RULEMAKING

Adopted: September 28, 2012

Released: October 2, 2012

Comment Date: December 21, 2012

Reply Comment Date: February 19, 2013

By the Commission: Chairman Genachowski and Commissioners McDowell, Clyburn, and Rosenworcel
issuing separate statements; Commissioner Pai approving in part, concurring in part
and issuing a statement.

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Figure 4.18. Broadcast Incentive Auction NPRM 2012⁹⁵

⁹⁵ Broadcast Incentive Auction NPRM, In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Notice of Proposed Rulemaking, GN Docket No. 12-268, October 2, 2012, <https://docs.fcc.gov/public/attachments/FCC-12-118A1.pdf>.

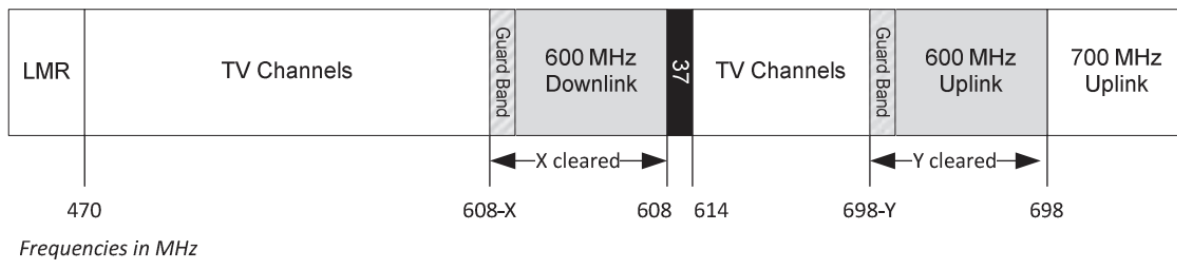


Figure 4. 600 MHz Band Plan

Figure 4.19. Broadcast Incentive Auction 600 MHz Band Plan in NPRM 2012⁹⁶

2	42	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	11	A	B	11	A	B	700 MHz UL					
3	48	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	7	A	B	C	11	A	B	C	700 MHz UL				
4	60	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	9	A	B	C	D	11	A	B	C	D	700 MHz UL				
5	72	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	11	A	B	C	D	E	11	A	B	C	D	E	700 MHz UL				
6	78	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	7	A	B	C	D	E	F	11	A	B	C	D	E	F	700 MHz UL			
7	84	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	3	A	B	C	D	E	F	G	11	A	B	C	D	E	F	G	700 MHz UL		
8	108	21	22	23	24	25	26	27	28	29	30	31	32	11	A	B	3	37	3	C	D	F	F	G	H	11	A	B	C	D	E	F	G	H	700 MHz UL		
9	114	21	22	23	24	25	26	27	28	29	30	31	7	A	B	C	D	F	3	37	3	E	F	G	H	I	11	A	B	C	D	E	F	G	H	I	700 MHz UL
10	126	21	22	23	24	25	26	27	28	29	9	A	B	C	D	E	F	3	37	3	G	H	I	J	11	A	B	C	D	E	F	G	H	I	J	700 MHz UL	
11	138	21	22	23	24	25	26	27	11	A	B	C	D	E	F	G	H	3	37	3	I	J	K	11	A	B	C	D	E	F	G	H	I	J	K	700 MHz UL	
12	144	21	22	23	24	25	26	A	B	C	D	E	F	G	H	I	J	3	37	3	K	L	11	A	B	C	D	E	F	G	H	I	J	K	L	700 MHz UL	

Figure 23. Band Plan Scenarios

Figure 4.20. Scenarios for 600 MHz Band Plan in Report and Order 2014⁹⁷

⁹⁶ Broadcast Incentive Auction NPRM, In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Notice of Proposed Rulemaking, GN Docket No. 12 – 268, October 2, 2012, *id.*, at 46, <https://docs.fcc.gov/public/attachments/FCC-12-118A1.pdf>.

⁹⁷ Broadcast Incentive Auction R&O, In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Report and Order, GN Docket No. 12 – 268, June 2, 2014, <https://docs.fcc.gov/public/attachments/FCC-15-69A1.pdf>.

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of	)	
	)	
Expanding the Economic and Innovation	)	GN Docket No. 12-268
Opportunities of Spectrum Through Incentive	)	
Auctions	)	

REPORT AND ORDER

Adopted: May 15, 2014

Released: June 2, 2014

By the Commission:

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Figure 4.21. Broadcast Incentive Auction Report and Order 2014⁹⁸

⁹⁸ Broadcast Incentive Auction R&O, In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Report and Order, GN Docket No. 12-268, June 2, 2014, <https://docs.fcc.gov/public/attachments/FCC-15-69A1.pdf>.

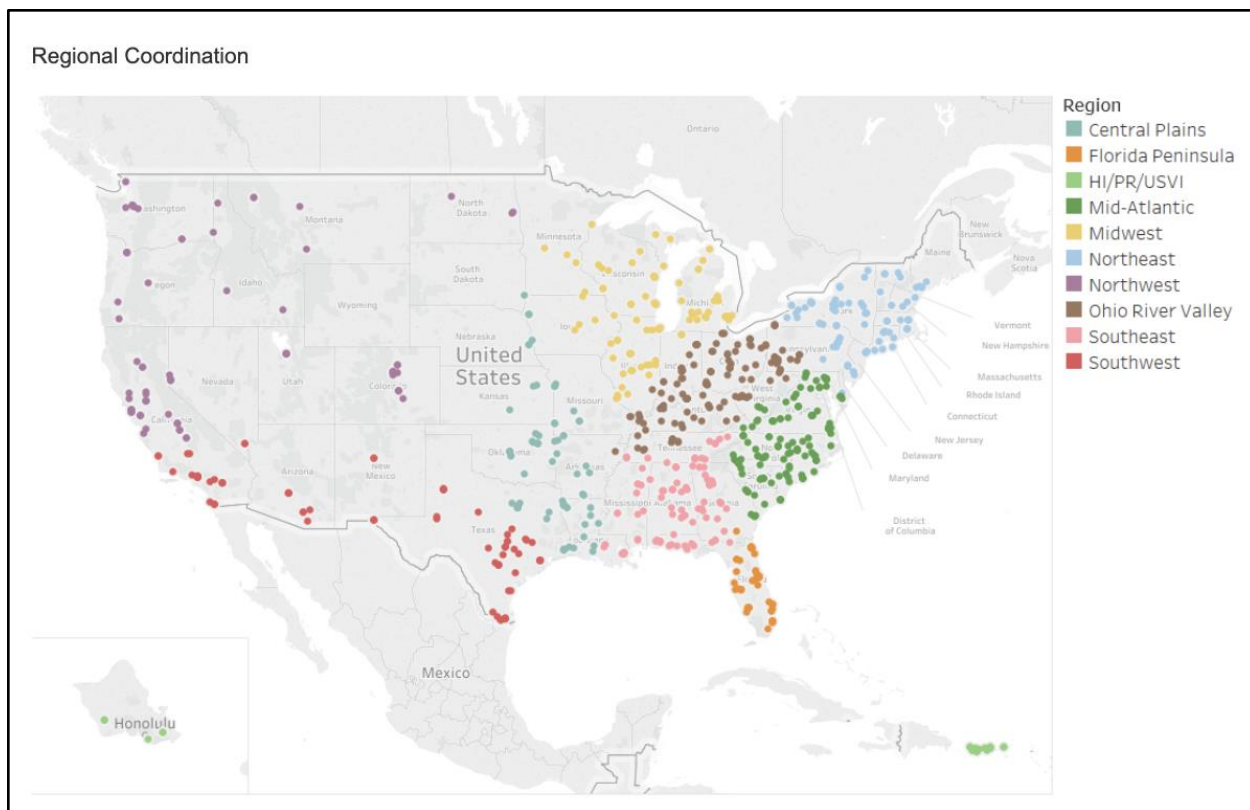


Figure 4.22. Broadcast Incentive Auction Regional Coordination⁹⁹

⁹⁹ FCC, Incentive Auctions, Transition Schedule, <https://www.fcc.gov/about-fcc/fcc-initiatives/incentive-auctions/transition-schedule>.

APPENDIX D
Commenter Short Names

Short name	Name of Filer
4 NY Broadcasters	American Broadcasting Companies, Inc., WBNG License, Inc., United Communications
4G Americas	4G Americas
A. Weiss	Adrienne Weiss
ACTBN	Action Community Television Broadcasting Network, Inc.
Affiliates Associations	ABC Television Affiliates Association, CBS Television Network Affiliates Association
AIC	Azteca International Corporation
Alcatel-Lucent	Alcatel-Lucent
Alcatel-Lucent et al.	Alcatel-Lucent, AT&T, Ericsson, Intel, NAB, Qualcomm and VZ
American Tower	American Tower Corporation
Anon. Broadcaster 1	Anonymous Broadcast Licensees
Anon. Broadcaster 2	Prospective Reverse Auction Participant
Anon. Broadcaster 3	Broadcaster for the Promotion of Channel Sharing Arrangements
Anon. Broadcaster 4	Broadcast Licensee
Anon. Citizen	Anonymous
Anon. Part 90	Blooston Part 90 Licensees
APTS [see joint comments PTV]	Association of Public Television Stations
ASHE	American Society for Healthcare Engineering
AT&T	AT&T, Inc. or AT&T Services, Inc.
ATBA	Advanced Television Broadcasting Alliance
Atlantic Telephone	Atlantic Telephone Membership Corporation
B. Kobb	Bennett Z. Kobb
Bahakel	Bahakel Communications, Ltd.
Belo	Belo Corp.
Block Stations	Lima Communications, Corp./Independence Television Company/WAND TV Partnership/Idaho Independent Television, Inc./West Central Ohio Broadcasting, Inc.
Blooston Rural	Blooston Rural Carriers
Bluegrass	Bluegrass Cellular, Inc.
Boeing	The Boeing Company
Bonten	Bonten Media Group, Inc.
Brattle	The Brattle Group
Broadcast Networks	Broadcast Networks (CBS/FOX.NBCU/Disney/Univision)
Broadcom	Broadcom Corporation
Broadcom/CSR/Marvell	Broadcom, CSR Technology, Inc., and Marvell Semiconductor
Broadway League	The Broadway League, Inc.
C Spire	Cellular South, Inc. (d/b/a C Spire Wireless)
Capitol	Capitol Broadcasting Company, Inc.
Casa	Casa En Denver, Inc.
Cavell, Mertz (see R. Mertz)	Cavell, Mertz & Associates, Inc.
CBS	CBS Corporation

CCA	Competitive Carriers Association
CCB	Carolina Christian Broadcasting, Inc.
CCIA	Computer & Communications Industry Association (CCIA)
CEA	Consumer Electronics Association
Cellular One	Texas 10, LLC d/b/a Cellular One and Central Louisiana Cellular
Channel 32	Channel 32 Montgomery LLC
Chat Mobility	Chat Mobility
Cisco	Cisco Systems, Inc.
CIT	CIT Group, Inc.
Clearwire	Clearwire Corporation
Cohen	COHEN, DIPPELL AND EVERIST, P.C.
Collective Wireless Microphone Interests	Collective Wireless Microphone Interests
Comcast	Comcast
Comcast and NBC Universal	Comcast Corporation and NBC Universal Media, LLC
Comm. Tech	Communications Technologies, Inc.
CompTIA	Computing Technology Industry Association
Copper Valley	Copper Valley Wireless, LLC
Council Tree	Council Tree Investors, Inc.
Cox Media	Cox Media Group
CP Comm.	CP Communications PA, LLC
CPB [see joint comments PTV]	Corporation for Public Broadcasting
CSR	CSR Technology, Inc.
CTI	Community Television, Inc.
CTIA	CTIA - The Wireless Association
D. Honig, MMTC	David Honig (president for MMTC)
Dielectric	Dielectric LLC
DIRECTV/DISH	DIRECTV and DISH Network
DISH	DISH Network Corporation
Disney	The Walt Disney Company
Dispatch	The Dispatch Printing Company, d/b/a the Dispatch Broadcast Group
DTVAmerica	DTVAmerica Corporation
Dynamic Spectrum Alliance	Dynamic Spectrum Alliance
Entravision	Entravision Holdings, LLC
EOBC	Expanding Opportunities for Broadcasters Coalition
Ericsson	Ericsson Inc
FMBC	Fort Myers Broadcasting Company
Free Press	Free Press
GatesAir	GatesAir, Inc.
GEHC	GE Healthcare
Globe	Globe LPTV LLC
Google	Google Inc.
Google/Broadcom	Google Inc. and Broadcom Corporation
Google/Microsoft	Google Inc. and Microsoft Corporation
Grain Management	Grain Management, LLC
Gray TV	Gray Television, Inc.
H. Uhi	Harrison Uhl

Harris Broadcast	Harris Corporation, Broadcast Communications Division or HBC Solutions, Inc. (Harris Broadcast)
HTSC	High Tech Spectrum Coalition (HTSC)
IAA	Incentive Auction Advocates
IBN	INTERNATIONAL BROADCASTING NETWORK
ICN	International Communications Network, Inc.
IEEE 802	IEEE 802 LMSC or IEEE 802 LN/Man Stds Cmte
Intel	Intel Corporation
ITI	Information Technology Industry Council
J. Pavlica	John Pavlica, Jr.
J. Pila	Joshua Pila (LIN)
J. Pratt	Joshua Pratt
Joint Reply of the Commissioner of Baseball, NBA, NFL, NHL, NCAA, NASCAR	Office of the Commissioner of Baseball, National Basketball Association, National Football League, National Hockey League, National Collegiate Athletic Association, and National Association for Stock Car Auto Racing
KAZN	KAZN License, LLC
KLCS	KLCS
KRBK	KRBK, LLC
KSW	King Street Wireless, LP
Leadership Conference	Leadership Conference on Civil and Human Rights
Leap	Leap Wireless International and Cricket Communications
Lectrosonics	Lectrosonics, Inc.
Leggett	Nickolaus E. Leggett
LeSEA	LeSEA Broadcasting Corporation
LIN	LIN Television Corporation
Lincoln	Lincoln Broadcasting, LLC
Local Media	Local Media TV Holdings, LLC
LPTV Spectrum	LPTV Spectrum Rights Coalition
M. Gravino	Michael Gravino
Mako	Mako Communications, LLC
Marvell	Marvell Semiconductor
McBride	McBride Spectrum Partners, LLC
Media General	Media General, Inc.
MetroPCS	MetroPCS Communications, Inc.
Microsoft	Microsoft Corporation
Mike Gravino	Mike Gravino (LPTV Spectrum Rights Coalition)
MMTC	Minority Media and Telecommunications Council (MMTC)
Mobile Future	Mobile Future
Motorola	Motorola, Inc.
Motorola Mobility	Motorola Mobility LLC
MSGPR	MSGPR Ltd Co
NAB	National Association of Broadcasters (NAB)
NABOB	National Association of Black Owned Broadcasters, Inc.
NAS-CORF	National Academy of Sciences -- CORF
NATE	National Association of Tower Erectors
NCTA	National Cable & Telecommunications Association
NERA	NERA Economic Consulting

Neul	Neul Ltd
New America Found.	New America Foundation
NFL	National Football League
NHMC	National Hispanic Media Coalition
Nokia	Nokia Siemens Networks US LLC
NPR	National Public Radio, Inc.
NRAO	National Radio Astronomy Observatory
NRB	National Religious Broadcasters
NTA	National Translator Association
NTCA	National Telecommunications Cooperative Association
NTCA	NTCA-The Rural Broadband Association
NTCA	The Rural Broadband Association (NTCA)
NTIA	National Telecommunications and Information Administration
NYSBA	New York State Broadcasters Association, Inc.
Parker	Parker Broadcasting of Louisiana, LLC
PBS [see joint comments PTV]	Public Broadcasting Service
Performing Arts	Performing Arts Wireless Microphones Working Group
Philips Healthcare	Philips Healthcare
Pioneer	Pioneer Communications, Inc.
PISC	Public Interest Spectrum Coalition (PISC)
Polnet	Polnet Communications Ltd.
Post-Newsweek	Post-Newsweek Stations, Inc.
PTV	Association of Public Television Stations, Corporation for Public Broadcasting, Public Broadcasting Service
Public Knowledge	Public Knowledge
Public Service Wireless	Public Service Wireless Services, Inc.
Public TV Licensees	Public TV Licensees
Qualcomm	QUALCOMM Incorporated
R. Brey	Ronald J Brey
R. Mertz or Cavell, Mertz	Richard H. Mertz (on behalf of Cavell, Mertz & Associates, Inc.)
Raycom	Raycom Media, Inc.
RIM	Research In Motion Corporation
RTG	Rural Telecommunications Group, Inc.
RWA	Rural Wireless Association, Inc.
SAG-AFTRA	SAG-AFTRA, AFL-CIO (Screen Actors Guild-American Federation of Television and Radio Artists)
Samsung	Samsung Electronics America, Inc. and Samsung Telecommunications America, LLC
SBBC	School Board of Broward County, Florida
SBE	Christopher D. Imlay
SEI	SpectrumEvolution, Inc.
Select Spectrum	Select Spectrum, LLC
Sennheiser	Sennheiser Electronic Corporation
Shure	Shure Incorporated
Signal Above	Signal Above, LLC
Sinclair	Sinclair Broadcast Group, Inc.
Sony	Sony Electronics Inc.
Spectrum Bridge	Spectrum Bridge Inc.

Sprint	Sprint Nextel Corporation or Sprint Corporation
SSN	Silver Spring Networks
Stainless	Stainless, LLC
State Broadcaster Associations	Named State Broadcasters Associations
TechAmerica	TechAmerica
TechFreedom	TechFreedom
Thompson Engineering	Jeff C Tappenden
TIA	Telecommunications Industry Association
T-Mobile	T-Mobile USA, Inc.
Tribune	Tribune Company
TTBG	TTBG, LLC
UCC	United Communications Corporation
Univision	Univision Communications Inc.
US Cellular	United States Cellular Corporation or U.S. Cellular Corp
UVM	Una Vez Mas, L.P.
Venture	Venture Technologies Group, LLC
Verizon	Verizon and Verizon Wireless
Vision	Vision Communications, LLC
WatchTV	WatchTV, Inc.
Weigel	Weigel Broadcasting Company
WGAL	WGAL Hearst Television, Inc.
WGAW	Writers Guild of America, West
Wi-Fi Alliance	Wi-Fi Alliance
Wireless Microphone Interests	Wireless Microphone Interests
WISPA	The Wireless Internet Service Providers Association
WISPA	Wireless Internet Service Providers Association
WLFM	WLFM, LLC
WMTS Coalition	The WMTS Coalition
WMTS Coalition	WMTS Coalition
WSA	WhiteSpace Alliance
WSDAG	White Space Database Administrator Group
Young Broadcasting	Young Broadcasting, LLC

Figure 4.23. Broadcast Incentive Auction Commenters¹⁰⁰

The FCC launched a historic “incentive auction” on March 29, 2016, to repurpose broadcast spectrum for modern uses like video streaming and mobile broadband. Mandated by the 2012 Spectrum Act, this auction uniquely leveraged market mechanisms to shift underutilized broadcast frequencies toward more in-demand wireless services, aligning with evolving consumer needs.

The auction balanced the interests of broadcasters and mobile users by allowing stations to earn revenue while continuing to serve their communities. It freed up low-band spectrum, which is especially valuable for wireless broadband due to its wide coverage

¹⁰⁰ Broadcast Incentive Auction R&O, In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Report and Order, GN Docket No. 12-268, June 2, 2014, <https://docs.fcc.gov/public/attachments/FCC-15-69A1.pdf>.

and penetration, thereby helping to alleviate network congestion and laying the foundation for 5G innovation and economic growth.

By its close on March 30, 2017, the auction had reallocated 84 MHz of spectrum and generated \$19.8 billion in revenue. A portion went to broadcasters, while over \$7 billion was earmarked for U.S. deficit reduction. Following the auction, a 39-month transition period began to allow affected TV stations to shift to new channels, with ongoing support and updates provided by the FCC to all stakeholders.

The incentive auction includes a reverse auction — **Auction 1001** — in which broadcasters will offer to voluntarily relinquish some or all of their spectrum usage rights, and a forward auction — **Auction 1002** — of new, flexible-use licenses suitable for providing mobile broadband services.

Reverse Auction

Auction 1001

Relinquishing Broadcast Spectrum Usage Rights

Forward Auction

Auction 1002

New 600 MHz Band Flexible-Use Licenses

Figure 4.24. Auction 1000 with a Reverse Auction 1001 and Forward Auction 1002¹⁰¹

Flashcards

- i. Card 1
 1. Front – Reverse Auction
 2. Back – Auction 1001
- ii. Card 2
 1. Front – Forward Auction
 2. Back – Auction 1002

¹⁰¹ FCC, Auction 1000, <https://www.fcc.gov/auction/1000>.

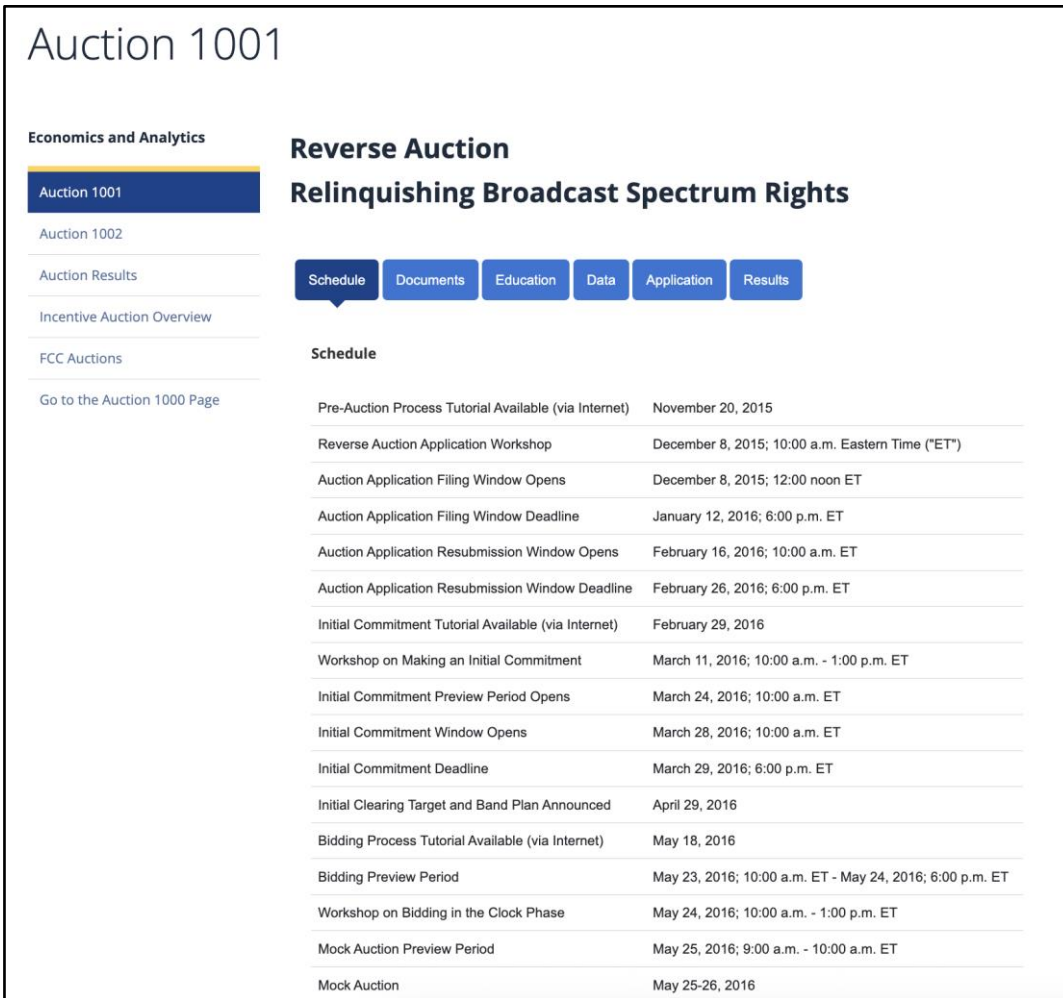


Figure 4.25. Auction 1001 Timeline¹⁰²

¹⁰² FCC, Auction 1001, <https://www.fcc.gov/auction/1001>.

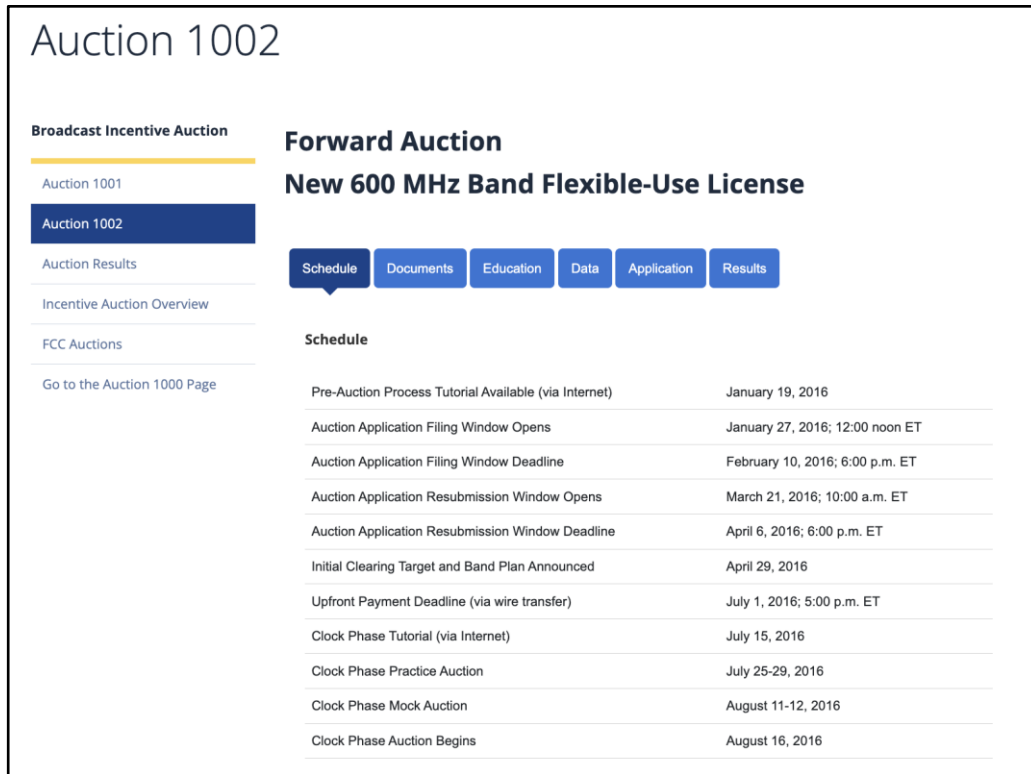


Figure 4.26. Auction 1002 Timeline¹⁰³

Reverse Auction 1001 determined how much TV broadcasters were willing to accept in exchange for relinquishing their spectrum rights, while Forward Auction 1002 sold the repurposed spectrum to wireless providers as flexible-use licenses configured to suit mobile service across defined geographic areas.

Table 1: Bid options for UHF stations

		Currently Held Option		
Status	BIDDING	Go off-air	Move to Low-VHF	Move to High-VHF
		Available Options:	Available Options:	Available Options:
		- Go off-air + (Optional) Proxy Bid Instruction: Continue bidding to Go off-air until the price drops below \$ - Move to Low-VHF + Fallback bid: Go off-air; or Drop out of bidding - Move to High-VHF + Fallback Bid: Go off-air; or Drop out of bidding - Drop out of bidding	- Move to Low-VHF + (Optional) Proxy Bid Instruction: Continue bidding to move to Low-VHF until the price drops below \$ - Move to High-VHF + Fallback Bid: Move to Low-VHF; or Drop out of bidding - Drop out of bidding	- Move to High-VHF + (Optional) Proxy Bid Instruction: Continue bidding to move to High-VHF until the price drops below \$ - Drop out of bidding
	FROZEN – Pending Catch Up	(Optional) Proxy Bid Instruction: Continue bidding to Go off-air until the price drops below \$	(Optional) Proxy Bid Instruction: Continue bidding to Move to Low-VHF until the price drops below \$	(Optional) Proxy Bid Instruction: Continue bidding to Move to High-VHF until the price drops below \$

¹⁰³ FCC, Auction 1002, <https://www.fcc.gov/auction/1002>.

Figure 4.27. Bid Options for UHF Stations¹⁰⁴

Table 2: Bid option for High-VHF stations

		Currently Held Option	
		Go off-air	Move to Low-VHF
Status	BIDDING	Available Options: 1. Go off-air + (Optional) Proxy Bid Instruction: Continue bidding to Go off-air until the price drops below \$ 2. Move to Low-VHF + Fallback bid: Go off-air; or; Drop out of bidding 3. Drop out of bidding	Available Options: 1. Move to Low-VHF + (Optional) Proxy Bid Instruction: Continue bidding to Move to Low-VHF until the price drops below \$ 2. Drop out of bidding
	FROZEN – Currently Infeasible	(Optional) Proxy Bid Instruction: Continue bidding to Go off-air until the price drops below \$	(Optional) Proxy Bid Instruction: Continue bidding to Move to Low-VHF until the price drops below \$
	FROZEN – Pending Catch Up	(Optional) Proxy Bid Instruction: Continue bidding to Go off-air until the price drops below \$	(Optional) Proxy Bid Instruction: Continue bidding to Move to Low-VHF until the price drops below \$

Table 3: Bid options for Low-VHF stations

		Currently Held Option
		Go off-air
Status	BIDDING	Available Options: 1. Go off-air + (Optional) Proxy Bid Instruction: Continue bidding to Go off-air until the price drops below \$ 2. Drop out of bidding
	FROZEN – Currently Infeasible	(Optional) Proxy Bid Instruction: Continue bidding to Go off-air until the price drops below \$
	FROZEN – Pending Catch Up	(Optional) Proxy Bid Instruction: Continue bidding to Go off-air until the price drops below \$

Figure 4.28. Bid Options for High-VHF Stations and Low-VHF Stations¹⁰⁵

¹⁰⁴ Power Auctions, Reverse Auction Clock Phase User Guide, at A4-1, <https://www.fcc.gov/file/3797/download>.

¹⁰⁵ *Id.* at A4-2.

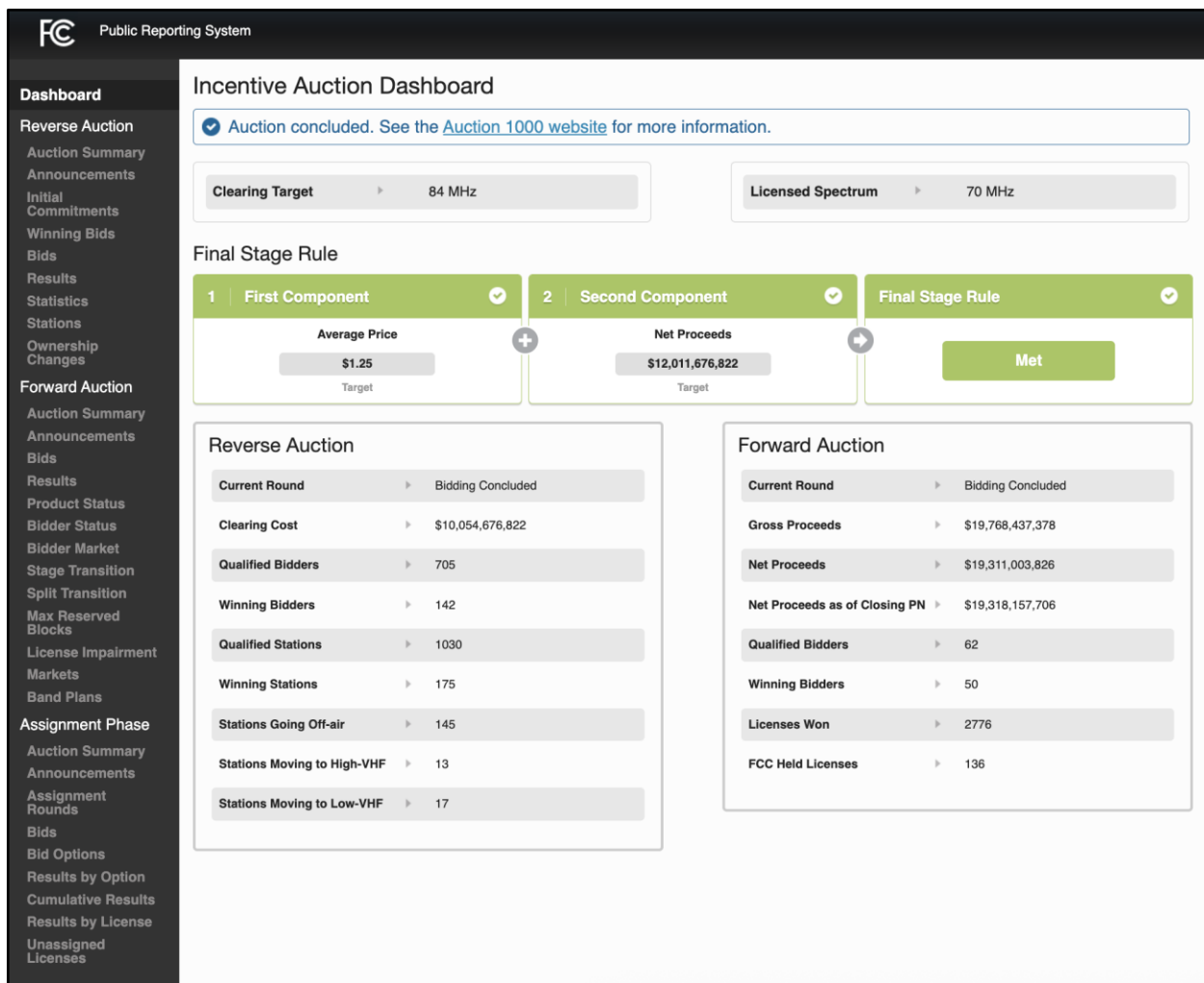


Figure 4.29. Auction Results¹⁰⁶

The Broadcast Television Spectrum Incentive Auction, designated as Auction 1000 by the Federal Communications Commission (FCC), included a reverse auction (Auction 1001) and a forward auction (Auction 1002). This auction, authorized by the Middle Class Tax Relief and Job Creation Act of 2012 (Spectrum Act), aimed to repurpose spectrum from broadcast television for mobile broadband use. Below is a detailed summary of the requested statistics based on available information.

In the Reverse Auction (Auction 1001), the reverse auction cleared payments totaling \$10.05 billion to winning broadcast TV stations that voluntarily relinquished their spectrum usage rights. In the Forward Auction (Auction 1002), the gross proceeds from the forward auction amounted to \$19.8 billion for the licenses created from the released spectrum. The auction yielded a total of \$19.8 billion in revenue, which includes the \$10.05 billion paid to broadcasters, more than \$7 billion deposited to the U.S. Treasury for deficit reduction, and additional funds allocated for other purposes such as a TV Broadcast Relocation Fund.

¹⁰⁶ FCC Auction Reporting System, Auction 1001 and 1002, <https://auctiondata.fcc.gov/public/projects/1000>.

There were 142 winning bidders in the reverse auction, representing the broadcast entities that successfully bid to relinquish their spectrum. There were 50 bidders placing winning bids in the forward auction for the new wireless licenses. At least 142 broadcasters and 50 wireless bidders were involved in the winning bids.

The reverse auction resulted in 175 TV stations successfully relinquishing their spectrum rights, either by going off-air, sharing channels, or moving to different bands.

The post-auction transition involved the relocation of nearly 1,000 broadcast TV stations to new channels as part of the repacking process to clear spectrum for wireless use. This included both stations that participated in the auction and non-participating stations affected by the repacking.

Up to 858 stations were willing to give up their spectrum, suggesting a larger pool of potential participants in the reverse auction, though only 175 were winning bidders.

List

In the forward auction (Auction 1002), 50 bidders placed winning bids for a total of 2,776 of 2,912 licenses offered. The major winners included:

- T-Mobile: Spent \$8 billion for 1,525 licenses.
- Dish: Spent \$6.2 billion for 486 licenses.
- Comcast: Spent \$1.7 billion for 73 licenses.
- AT&T: Spent \$910 million for 23 licenses.
- U.S. Cellular: Spent \$328.6 million for 188 licenses.

Nearly 30 rural and regional carriers also secured licenses, though specific counts are not detailed. Major carriers Verizon and Sprint did not participate in the forward auction.

The auction repurposed 84 megahertz of spectrum, with 70 megahertz allocated for licensed wireless use and 14 megahertz for wireless microphones and unlicensed use. Bidding began on March 29, 2016, with reverse auction applicants committing to initial bid options. Bidding closed on March 30, 2017, with the auction formally closing on April 13, 2017.

The post-auction repacking process commenced in April 2017 and was scheduled to conclude by July 2020, involving a phased approach with ten transition phases. Initial relocation moves began in November 2018. The repacking required modifying towers, moving radio transmitters, manufacturing antennas, and hiring engineering consultants. External factors like weather, local zoning, and permitting processes impacted the timeline. Nearly 1,000 stations were reassigned channels, with most continuing to operate by sharing frequencies or moving to new channels.

In total, broadcaster payments amounted to \$10.05 billion which was paid to 142 winning broadcasters for 175 stations. Over \$7.3 billion from forward auction proceeds was allocated to the U.S. Treasury for deficit reduction after other obligations were met. The TV Broadcast Relocation Fund was established to cover costs for non-participating TV stations involuntarily repacked, with an initial allocation of \$1.75 billion for reimbursements.

The auction was conducted in multiple stages, with each stage consisting of a reverse auction followed by a forward auction. The initial spectrum clearing target was set based on broadcasters' willingness to relinquish spectrum, with a maximum target of 126 megahertz, adjusted downward as needed to meet the final stage rule.

The auction fell short of the National Broadband Plan's goal of repurposing 120 megahertz by 2015, achieving only 70 megahertz by 2020 due to administrative complexities and lower-than-expected demand. The auction was a complex, two-sided process involving a reverse auction to buy back spectrum from broadcasters and a forward auction to sell licenses to wireless carriers. The FCC's projections, based on the earlier AWS-3 auction (\$41.33 billion), overestimated demand, as the final stage rule was met with only \$18.2 billion for 70 megahertz.

The process disrupted broadcast TV, with some stations ceasing operations and others facing significant relocation costs. Critics argued that the auction degraded TV broadcasting's universal coverage and that payouts to broadcasters were unlikely to be reinvested in the industry.

The repacking process was logistically challenging, with external factors like weather and zoning complicating the transition. The FCC's structured approach, while innovative, incurred high administrative costs and missed initial timelines.

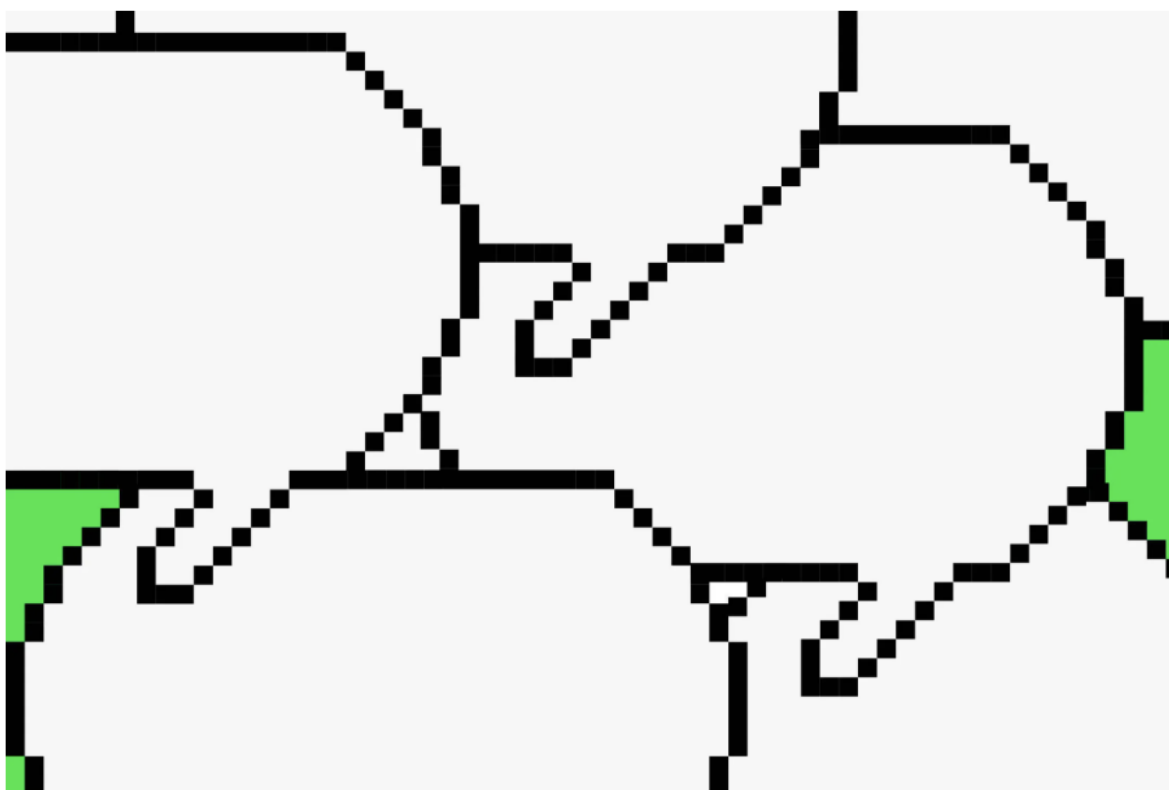
4.5. In the News

ISSIE LAPOWSKY

SECURITY NOV 28, 2017 12:19 PM

How Bots Broke the FCC's Public Comment System

The FCC's net neutrality public comment period was overrun with bots, making it all but impossible for any one voice to be heard. That's not how this is supposed to work.



FRANK AUGUGLIARD

Figure 4.30. Article on Bots Submitting FCC Comments¹⁰⁷

¹⁰⁷ Issie Lapowsky, "How Bots Broke the FCC's Public Comment System," Wired Magazine, Nov. 28, 2017, <https://www.wired.com/story/bots-broke-fcc-public-comment-system/>.

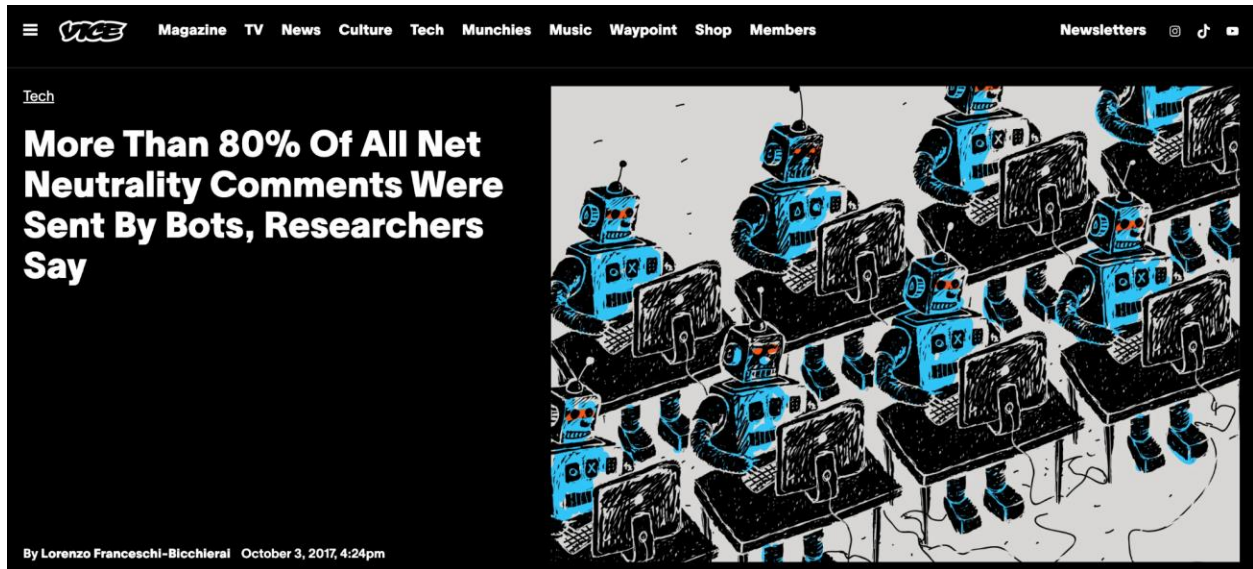


Figure 4.31. Article on Bot Comments to the FCC¹⁰⁸

¹⁰⁸ Lorenzo Franceschi-Bicchierai, "More Than 80% Of All Net Neutrality Comments Were Sent By Bots Researchers Say," Vice Media, October 3, 2017, <https://www.vice.com/en/article/80-percent-net-neutrality-comments-bots-astroturfing/>.

OPINION COMMENTARY Follow

AI May Soon Weigh In on Regulation

How will agencies like the FCC deal with computer-generated public comments?

By Scott Wallsten

Oct. 24, 2023 4:12 pm ET




 25 |
  Gift unlocked article |
  Listen (3 min)
 



Figure 4.32. Commentary on AI and Regulatory Comment Submissions¹⁰⁹

¹⁰⁹ Scott Wallsten, "AI May Soon Weigh In on Regulation", Wall St. J., Oct. 24, 2023, <https://www.wsj.com/opinion/ai-may-soon-weigh-in-on-regulation-artificial-intelligence-agencies-public-comment-periods-766436ec>.

4.6. Assignment

Fill in the Blank

Read the Broadcast Incentive Auction NPRM (2012) and Report and Order (2014) to see the rulemaking process for one of the largest spectrum auctions held by the FCC which involved hundreds of interested parties and comments. Broadcast Incentive Auction NPRM, In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Notice of Proposed Rulemaking, GN Docket No. 12-268, October 2, 2012, <https://docs.fcc.gov/public/attachments/FCC-12-118A1.pdf>; Broadcast Incentive Auction R&O, In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Report and Order, GN Docket No. 12-268, June 2, 2014, <https://docs.fcc.gov/public/attachments/FCC-15-69A1.pdf>.

Why do you think it was necessary to design a forward and reverse auction? What are the incentives of the broadcast stations to holdout and not give up their spectrum? What are the incentives of the bidders for new licenses to seek low prices? How do broadcast stations get compensated for their true valuations? Do broadcast stations have an incentive to seek higher than true valuations for their spectrum?

4.7. Reading List

File Attachments

- Congressional Research Service, “A Brief Overview of Rulemaking and Judicial Review,” Mar. 27, 2017, CRS Report No. R41546, at p. 13, https://www.congress.gov/crs_external_products/R/PDF/R41546/R41546.13.pdf.
- Congressional Research Service, “The Federal Rulemaking Process: An Overview,” June 17, 2013, CRS Report No. RL32240, <https://sgp.fas.org/crs/misc/RL32240.pdf>.
- Broadcast Incentive Auction NPRM, In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Notice of Proposed Rulemaking, GN Docket No. 12-268, October 2, 2012, <https://docs.fcc.gov/public/attachments/FCC-12-118A1.pdf>.
- Broadcast Incentive Auction R&O, In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Report and Order, GN Docket No. 12-268, June 2, 2014, <https://docs.fcc.gov/public/attachments/FCC-15-69A1.pdf>.

5. Lecture 5: Congressional Involvement in Spectrum Policy

Video

Advanced Spectrum Policy Lecture 5: Congressional Involvement in Spectrum Policy
https://www.youtube.com/watch?v=LB723e12ZHo&list=PLlbOnBe9IRS_YjElyMEqm_QN_Fbmld5_ko&index=6

Spectrum policy often requires Congressional involvement to direct the executive branch to conduct studies on certain federal spectrum bands, to find spectrum for auction from the federal sector to private sector, and to authorize the FCC to conduct spectrum auctions. Since federal spectrum auctions can also raise revenue for the Treasury, the Congressional Budget Office is involved in scoring auction bills to estimate the value of the spectrum that could be auctioned.

5.1. Learning Objective

Statement

Explore how Congress shapes spectrum policy through key statutes, including auction authorizations and spectrum reallocation laws. Understand the role of the Congressional Budget Office in scoring and valuing spectrum assets for legislative decision-making.

5.2. Statutes

Multiple Choice

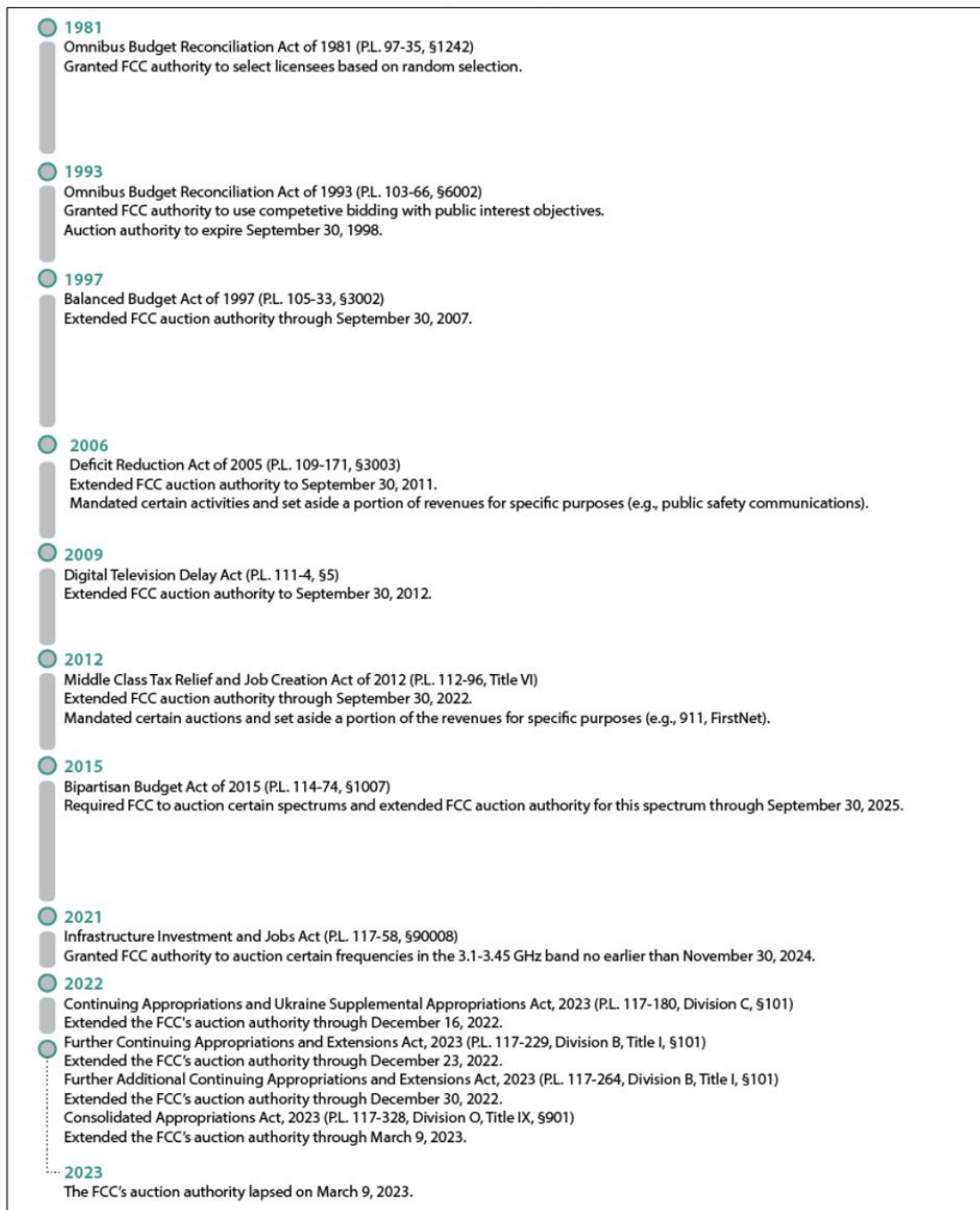
Congressional involvement is needed in national spectrum policy with the committees that do the most oversight being the U.S. House of Representatives Energy and Commerce Committee Subcommittee on Communications and the Senate Commerce Committee Subcommittee on Telecommunications. (True. These two subcommittees are the main committees for spectrum policy oversight and legislation).

5.2.1. Spectrum Auction Reauthorization

The Federal Communications Commission is authorized by Congress to license spectrum rights through auctions or competitive bidding. But as of March 9, 2023, Congress has not reauthorized the FCC to run spectrum auctions. In 2025, it is expected that auction authority will be reauthorized by Congress.

The history of spectrum auction authorization by Congress is rather piecemeal. Over the years the following statutes have authorized auctions for different lengths of time: Omnibus Budget Reconciliation Act of 1981 (P.L. 97-35) (authorized spectrum licenses by lottery); Omnibus Budget Reconciliation Act of 1993 (P.L. 103-66) (authorized spectrum auctions by competitive bidding); Balanced Budget Act of 1997 (P.L. 105-33) (extended FCC auction authority for 10 years); Deficit Reduction Act of 2005 (P.L. 109-171) (extended FCC auction authority for 4 more years); Digital Television Delay Act (P.L. 111-4) (extended FCC auction authority for 1 more year); Middle-Class Tax Relief and Job Creation Act of 2012 (P.L. 112-96) (extended FCC auction authority for 10 more years); four more extensions in the 117th Congress extended auction authority to March 9, 2023, and it has been expired since.

**Figure I. The FCC's Spectrum Auction Authority: Timeline of Changes
(1981-2023)**



Source: CRS.

Figure 5.1. FCC's Spectrum Auction Authority Timeline (Source: CRS)¹¹⁰

5.2.2. Commercial Spectrum Enhancement Act of 2004 (P.L. 108–494) (created the Spectrum Relocation Fund)

The Commercial Spectrum Enhancement Act of 2004 (P.L. 108–494) established the Spectrum Relocation Fund to reimburse federal agencies for costs incurred when vacating spectrum for auction.¹¹¹ Successful commercial bidders fund these relocation costs. The auctions must recover at least 110% of NTIA-projected costs, and any unused funds return to the Treasury after eight years.

5.2.3. Spectrum Act of 2012 (P.L. 112–96) (established the Broadcast Incentive Auctions of 2016)

The Spectrum Act of 2012 (P.L. 112–96) required the establishment of 3 spectrum auctions, one of which was the Broadcast Incentive Auction which began in March 2016.

The most innovative of these three spectrum auctions was the Broadcast Television Spectrum Incentive Auction (Auction 1000), which began on March 29, 2016, and concluded on April 13, 2017. This voluntary, two-sided auction, authorized by Section 6403, involved a reverse auction (Auction 1001) that paid \$10.05 billion to 142 broadcasters for 175 TV stations to relinquish 84 MHz of spectrum, and a forward auction (Auction 1002) that raised \$19.8 billion from 50 bidders for 2,776 wireless licenses, with major winners like T-Mobile (\$8 billion) and Dish (\$6.2 billion). The auction cleared 70 MHz for licensed wireless use and 14 MHz for unlicensed purposes, but fell short of the National Broadband Plan's 120 MHz goal due to lower participation and demand. Nearly 1,000 stations were repacked into new channels by July 2020, supported by a \$1.75 billion relocation fund, though challenges like weather and zoning complicated the process.

The second auction, the H Block Auction (Auction 96), held from January 22 to February 27, 2014, raised \$1.564 billion for 176 licenses in the 1915–1920 MHz and 1995–2000 MHz bands, with Dish Network acquiring all licenses.

The third auction, the AWS-3 Auction (Auction 97), conducted from November 13, 2014, to January 29, 2015, generated \$41.329 billion for 1,614 licenses in the 1695–1710 MHz, 1755–1780 MHz, and 2155–2180 MHz bands, with major carriers like AT&T and Verizon driving high bids. Collectively, these auctions repurposed spectrum for 4G and 5G, funded the FirstNet public safety network, and contributed over \$60 billion to deficit reduction, though the incentive auction faced criticism for disrupting broadcast TV and high administrative costs.

¹¹⁰ Congressional Research Service, "The Federal Communications Commission's Spectrum Auction Authority: History and Options for Reinstatement (Updated September 12, 2023)," CRS Report No. R47578, <https://sgp.fas.org/crs/misc/R47578.pdf>.

¹¹¹ Congressional Research Service, "Framing Spectrum Policy: Legislative Initiatives," CRS Report No. R44433, Oct. 26, 2016, https://www.everycrsreport.com/files/20161026_R44433_8cd6b08a30aebb35670b034ae938d19df2f24da9.pdf.

5.2.4. Spectrum Pipeline Act of 2015 (P.L. 114-74)

The Spectrum Pipeline Act of 2015 (P.L. 114-74) required the release of 130 MHz of spectrum in 3 phases, with a process to begin in 2022.

The first phase required the National Telecommunications and Information Administration (NTIA) to identify 30 MHz of federal spectrum below 3 GHz, excluding the 1675–1695 MHz band used for weather forecasting, for reallocation to non-federal or shared federal-non-federal use, with the process starting no later than January 2022 and auctions commencing by July 2024. The spectrum had to be in contiguous bands of at least 10 MHz to ensure usability for commercial applications.

The second and third phases tasked the Federal Communications Commission (FCC) with identifying two additional 50 MHz tranches of spectrum below 6 GHz for licensed or unlicensed use, with reports due to Congress by January 1, 2022, and January 1, 2024, respectively, outlining federal operations and auction timelines.

The Act prioritized auction proceeds to fund the Spectrum Relocation Fund for research to enhance spectrum efficiency, supporting federal agencies' relocation or sharing efforts. It also amended the NTIA Organization Act to allocate \$500 million from the Spectrum Relocation Fund, with up to 10% of future deposits, for federal entities to conduct research, engineering studies, and planning to improve spectrum use, subject to approval by a Technical Panel.

This legislation complemented the 2012 Spectrum Act by expanding spectrum availability for 5G and Internet of Things applications, fostering innovation, and promoting spectrum sharing, though challenges included coordinating federal and commercial needs and meeting tight deadlines.

Multiple Choice

The Spectrum Relocation Fund was established in 2015 to fund commercial spectrum expansion.(False. The SRF was created in 2004, and amended in 2015.)

Multiple Choice

The SRF was created to help federal agencies cover costs related to moving off certain spectrum bands to allow commercial use. (True. The federal government has unused or underused spectrum that could be used more efficiently by the commercial sector, and when those bands are auctioned off, the Spectrum Relocation Fund would help federal agencies replace and upgrade their radio equipment.)

5.2.5. MOBILE NOW Act of 2018 (P.L. 115–141)

In the MOBILE NOW Act of 2018 (P.L. 115–141), Congress mandated that the Secretary of Commerce, via NTIA and in collaboration with the FCC and affected federal agencies, submit a report by March 23, 2020, assessing the feasibility of sharing the 3.1–3.55 GHz spectrum segment with commercial wireless services.¹¹²

A key provision mandated that the Secretary of Commerce, through the National Telecommunications and Information Administration (NTIA), in collaboration with the Federal Communications Commission (FCC) and affected federal agencies, submit a report to Congress by March 23, 2020, assessing the feasibility of sharing the 3.1–3.55 GHz spectrum band with commercial wireless services. This mid-band spectrum, prized for its balance of coverage and capacity, was largely occupied by federal users, including the Department of Defense for radar and other critical systems. The report was required to evaluate the potential for reallocation or sharing, identify technical and operational challenges, and propose strategies to protect incumbent federal operations while enabling commercial access.

The NTIA's analysis, informed by technical studies and coordination with agencies like the Department of Defense, highlighted the complexity of sharing due to high-power military systems but identified portions of the band, notably 3.45–3.55 GHz, as viable for commercial use with mitigation measures like geographic coordination zones. This effort built on prior spectrum reallocation initiatives, such as the Spectrum Pipeline Act of 2015, and supported the FCC's subsequent auctions, including Auction 110 in 2021, which raised \$22.9 billion for 100 MHz in the 3.45–3.55 GHz band. The MOBILE NOW Act's focus on the 3.1–3.55 GHz band underscored the strategic importance of mid-band spectrum for 5G expansion, though challenges like federal incumbent relocation and interference management persisted.

The Emerging Mid-Band Radar Spectrum Sharing (EMBRSS) was established as an initiative to develop ways to share the 3.1– 3.45 GHz segment and another group called Partnering to Advance Trusted and Holistic Spectrum Solutions (PATHSS) under the National Spectrum Consortium to work with industry and academia to develop ways to share the 3.1–3.45 GHz band.¹¹³

Multiple Choice

Congressional oversight is occasional and not as impactful as the agency actions and White House OSTP reports. (False. Congress plays an important role in drafting legislation to direct the federal agencies in finding spectrum for auction such as mid-band or unlicensed bands.)

¹¹² Congressional Research Service, "Repurposing 3.1–3.55 GHz Spectrum: Issues for Congress," CRS In Focus Report No. IF12351, <https://sgp.fas.org/crs/misc/IF12351.pdf>.

¹¹³ Congressional Research Service, "Repurposing 3.1–3.55 GHz Spectrum: Issues for Congress," CRS In Focus Report No. IF12351, <https://sgp.fas.org/crs/misc/IF12351.pdf>.

5.3. Congressional Budget Office Scoring

The Congressional Budget Office (CBO) plays an important role in determining projected revenues from spectrum auction-related legislation. This “score” by the CBO is part of the budget procedure according to the Senate Pay-As-You-Go Rule (PAYGO Rule) and other budget principles.¹¹⁴



Congressional Budget Office

Cost Estimate

July 25, 2023

At a Glance

H.R. 3565, Spectrum Auction Reauthorization Act of 2023

As ordered reported by the House Committee on Energy and Commerce on May 24, 2023

By Fiscal Year, Millions of Dollars	2023	2023-2028	2023-2033
Direct Spending (Outlays)	0	-8,740	-1,160
Revenues	0	0	0
Increase or Decrease (-) in the Deficit	0	-8,740	-1,160
Spending Subject to Appropriation (Outlays)	0	5	not estimated

Increases <i>net direct spending</i> in any of the four consecutive 10-year periods beginning in 2034? < \$2.5 billion	Statutory pay-as-you-go procedures apply?	Yes
	Mandate Effects	
	Increases <i>on-budget deficits</i> in any of the four consecutive 10-year periods beginning in 2034? < \$5 billion	Contains intergovernmental mandate?
	Contains private-sector mandate?	Yes, Under Threshold

The bill would

- Modify and extend the authority of the Federal Communications Commission (FCC) to auction licenses for commercial use of the electromagnetic spectrum
- Establish a Spectrum Auction Trust Fund to receive a portion of future spectrum auction proceeds
- Authorize the National Telecommunications and Information Administration (NTIA) to spend a portion of auction proceeds on advanced emergency communication services and broadband infrastructure
- Authorize the FCC and NTIA to borrow from the Treasury to support the removal and replacement of communications equipment that threatens national security and to establish a digital equity program
- Impose a private-sector mandate as defined in the Unfunded Mandates Reform Act

¹¹⁴ Framing Spectrum Policy: Legislative Initiatives, Congressional Research Service Report No. R44433, Oct. 26, 2016, https://www.everycrsreport.com/files/20161026_R44433_8cd6b08a30aebb35670b034ae938d19df2f24da9.pdf (“For a discussion of the congressional budget process, see CRS Report RL31943, Budget Enforcement Procedures: The Senate Pay-As-You-Go (PAYGO) Rule, and CRS Report 98-721, Introduction to the Federal Budget Process.”).

Figure 5.2. CBO Cost Estimate for H.R. 3565 (2023)¹¹⁵

Multiple Choice

The Congressional Budget Office with its spectrum valuation expertise runs spectrum auctions for the FCC and NTIA. (False. Spectrum auction authority is authorized by Congress and granted to the Federal Communications Commission by statute. The NTIA or CBO do not run spectrum auctions.)

5.3.1. Spectrum Valuation

The factors that are used by the CBO to estimate projected spectrum auction proceeds are described:

Three key estimates of value considered by the CBO are: quantity of spectrum auctioned; market value of spectrum; and net proceeds. It also considers the historical values of earlier auctions. Spectrum license auctions that were considered in scoring the Spectrum Act were held during the period FY2001–FY2010. They yielded an average MHz–pop¹⁹ of \$0.80, within a range of \$0.55 to \$1.10. Weighing these and other factors, the CBO initially projected that spectrum licenses auctioned during the FY2013–FY2021 period would have an average market value of \$0.70 per megahertz per person. (cite omitted) The score was subsequently revised slightly upwards to cover the period FY2013–FY2022.¹¹⁶

The Congressional Budget Office (CBO) scores legislation involving spectrum auctions, by estimating the net revenue from auctioned spectrum licenses. To establish value, the CBO considers three key factors: the quantity of spectrum auctioned, the market value per megahertz per person (MHz–pop), and the net proceeds after costs. Historical auction data from FY2001–FY2010, which yielded an average MHz–pop of \$0.80 (ranging from \$0.55 to \$1.10), informed the CBO’s initial projection for the Spectrum Act auctions.

For the period FY2013–FY2021, the CBO estimated an average market value of \$0.70 per MHz–pop, later extending this projection to FY2022 with a slight upward revision. The CBO’s original estimate projected \$30 billion in net revenue across three required auctions under the Spectrum Act, balancing historical trends and anticipated market conditions.

Actual auction outcomes varied significantly from the CBO’s initial estimates. The H Block auction, concluded in February 2014, achieved a low \$0.50 MHz–pop with a single bidder,¹¹⁷ while the AWS–3 auction in January 2015 far exceeded expectations at \$2.21

¹¹⁵ CBO Cost Estimate, H.R. 3565 Spectrum Auction Reauthorization Act of 2023, <https://www.cbo.gov/system/files/2023-07/hr3565.pdf>.

¹¹⁶ Congressional Research Service, “Framing Spectrum Policy: Legislative Initiatives,” CRS Report No. R44433, Oct. 26, 2016, <https://sgp.fas.org/crs/misc/R44433.pdf>.

¹¹⁷ Id. at 4.

MHz-pop.¹¹⁸ For the remaining Broadcast Incentive Auction, the CBO estimated \$25 billion in net proceeds, assuming an MHz-pop value similar to the AWS-3's \$2.21, though a February 2015 FCC-commissioned report suggested a lower \$1.50 MHz-pop.¹¹⁹ These estimates faced uncertainties, including unknown quantities of spectrum to be auctioned and broadcaster compensation for relinquishing spectrum, highlighting the complexity of predicting spectrum value amidst fluctuating market dynamics and auction structures.

Multiple Choice

The Office of Management and Budget is responsible for spectrum asset valuation and decisions related to the Spectrum Relocation Fund. (True. OMB has traditionally been an important office for budget assessment of federal spectrum assets and reallocation. The Spectrum Relocation Fund is the collection of proceeds from auctioning federal spectrum for reallocation to commercial use.)

5.4. In the News

¹¹⁸ Id.

¹¹⁹ Id. citing Greenhill, "Incentive Auction Opportunities for Broadcasters," prepared for the Federal Communications Commission, February 2015, https://wireless.fcc.gov/incentiveauctions/learn-program/Incentive_Auction_Opportunities_Book_Information_Sessions_2_5_15.pdf.

OPINION COMMENTARY Follow

America Has Lost Its Lead in 5G

China is surging ahead, and the U.S. needs better infrastructure and new spectrum auctions.

By Ajit Pai

May 4, 2025 4:18 pm ET

↪ 📌 AA 💬 208

🔗 Gift unlocked article



Figure 5.3. Commentary on Need for More Spectrum¹²⁰

¹²⁰ Aji Pai, "America Has Lost Its Lead in 5G," Wall St. J., May 4, 2025, https://www.wsj.com/opinion/america-has-lost-its-lead-in-5g-fcc-tech-telecom-spectrum-auctions-c64d395f?st=eCQfWn&reflink=desktopwebshare_permalink.

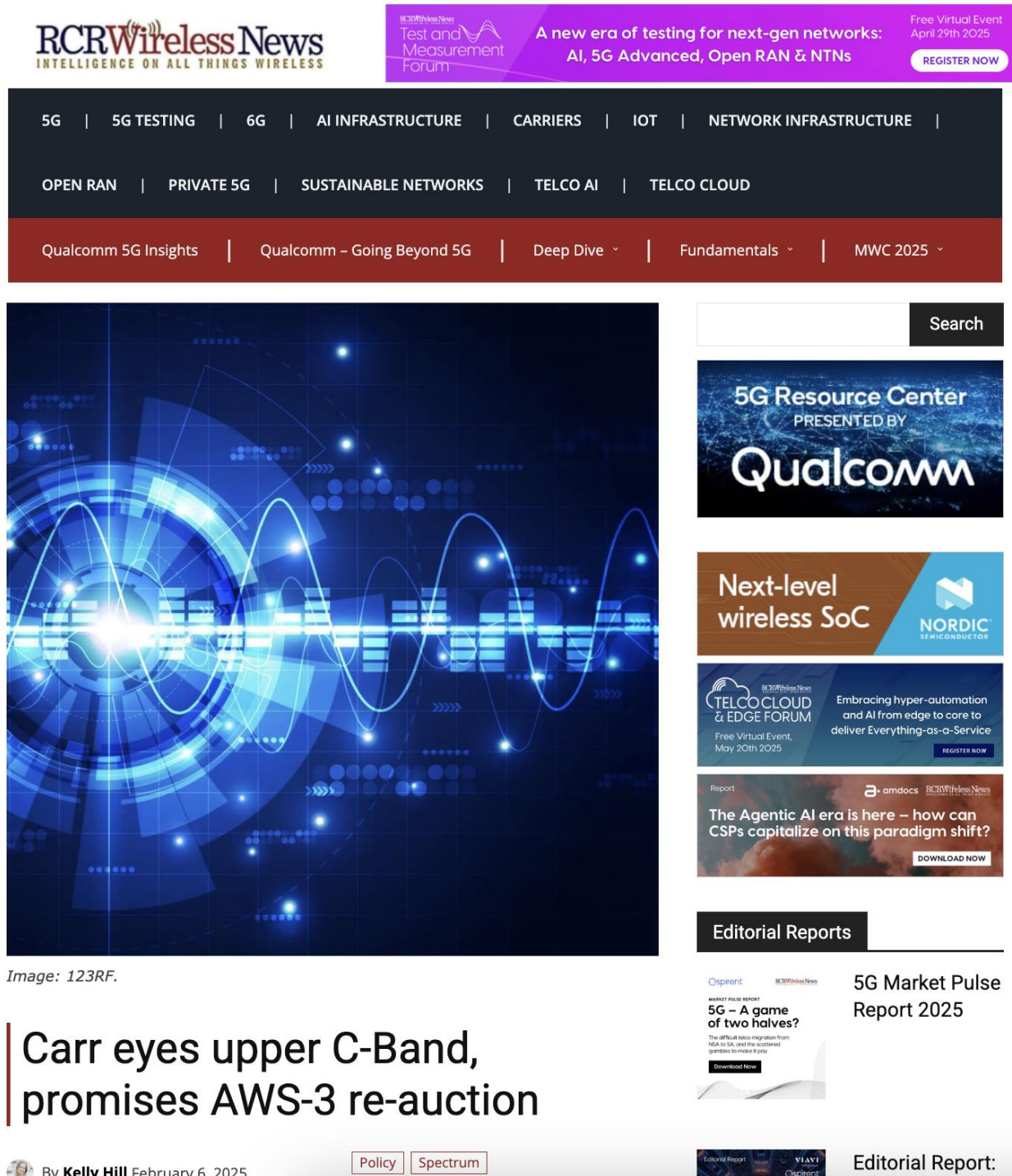


Figure 5.4. Potential Upper C-Band and AWS-3 Re-Auction¹²¹

¹²¹ Kelly Hill, Carr Eyes Upper C-Band, Promises AWS-3 Re-Auction, Feb. 6, 2025, RCR Wireless, <https://www.rcrwireless.com/20250206/policy/upper-c-band-aws-3>.

SPECTRUM

Cruz Still Aiming For Spectrum Pipeline in Reconciliation Bill

The Defense Department has opposed the idea of auction authority with a 'pipeline' of projects for auction.



Jake Neenan

Mar 25, 2025 — 2 min read



Figure 5.5. Spectrum Pipeline in Reconciliation Bill¹²²

¹²² Jake Neenan, "Cruz Still Aiming for Spectrum Pipeline in Reconciliation Bill," Mar. 25, 2025, <https://broadbandbreakfast.com/cruz-still-aiming-for-spectrum-pipeline-in-reconciliation-bill/>.

5.5. Assignment

Fill in the Blank

Read the CRS Report on “Framing Spectrum Policy” and a CBO Cost Estimate of the Spectrum Auction Reauthorization Bill of 2023. CBO Cost Estimate, H.R. 3565 Spectrum Auction Reauthorization Act of 2023, <https://www.cbo.gov/system/files/2023-07/hr3565.pdf>; Congressional Research Service, “Framing Spectrum Policy: Legislative Initiatives,” CRS Report No. R44433, Oct. 26, 2016, https://www.everycrsreport.com/files/20161026_R44433_8cd6b08a30aebb35670b034ae938d19df2f24da9.pdf.

After reviewing the CBO’s estimates on various spectrum bills, how important do you think the CBO’s spectrum valuation scores are to spectrum policy? The CBO estimates spectrum valuations and makes recommendations to Congress, but estimates can be wrong. Is it possible to ever precisely estimate the valuation of spectrum bands before an auction reveals market prices?

5.6. Reading List

File Attachments

- Congressional Research Service, “Framing Spectrum Policy: Legislative Initiatives,” CRS Report No. R44433, Oct. 26, 2016, https://www.everycrsreport.com/files/20161026_R44433_8cd6b08a30aebb35670b034ae938d19df2f24da9.pdf.
- Congressional Research Service, “Repurposing 3.1–3.55 GHz Spectrum: Issues for Congress,” In Focus Report No. IF12351, <https://sgp.fas.org/crs/misc/IF12351.pdf>.
- Congressional Research Service, “FCC Spectrum Auction Authority: Background and Proposals for Extension,” CRS Report No. R47258, Dec. 30, 2022, https://www.congress.gov/crs_external_products/R/PDF/R47258/R47258.17.pdf.
- Congressional Research Service, “Budget Enforcement Procedures: The Senate Pay-As-You-Go (PAYGO) Rule,” CRS Report RL31943, <https://sgp.fas.org/crs/misc/RL31943.pdf>.
- Congressional Research Service, “Introduction to the Federal Budget Process,” CRS Report 98–721, <https://sgp.fas.org/crs/misc/98-721.pdf>.
- Congressional Research Service, “The Federal Communications Commission’s Spectrum Auction Authority: History and Options for Reinstatement (Updated September 12, 2023),” CRS Report No. R47578, <https://sgp.fas.org/crs/misc/R47578.pdf>.

6. Lecture 6: International Spectrum Policy

Video

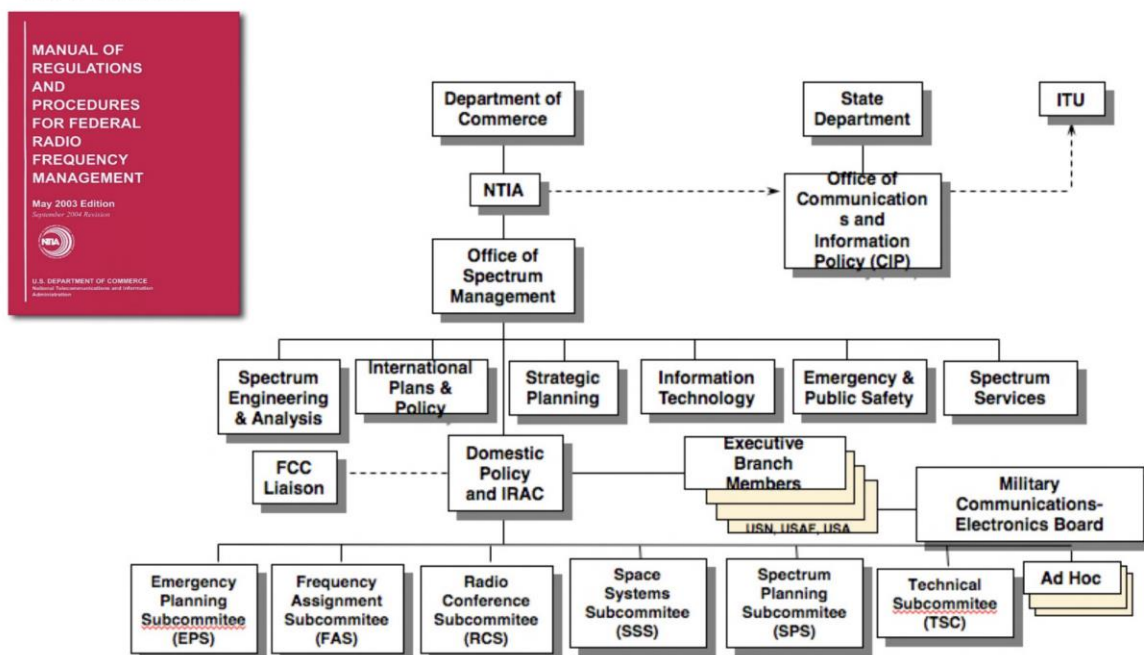
Advanced Spectrum Policy Lecture 6: International Spectrum Policy

https://www.youtube.com/watch?v=6qUmln6Naq8&list=PLlbQnBe9lRS_YjElyMEqm_QNFbmlD5_ko&index=7

For purposes of coordinating with other agencies for preparation for the ITU WRC meetings, this schematic also shows the coordinating activities between NTIA and the U.S. State Department.

NTIA Organization

NTIA Manual



6

Figure 6.1. NTIA Coordination with State Department for ITU¹²³

6.1. Learning Objectives

¹²³ International Committee on Global Navigation Satellite Systems, "Introduction to National Spectrum Agencies and National Applications," <https://www.unoosa.org/pdf/icg/2015/presentations/38.pdf>.

Figure 1: ITU Structure

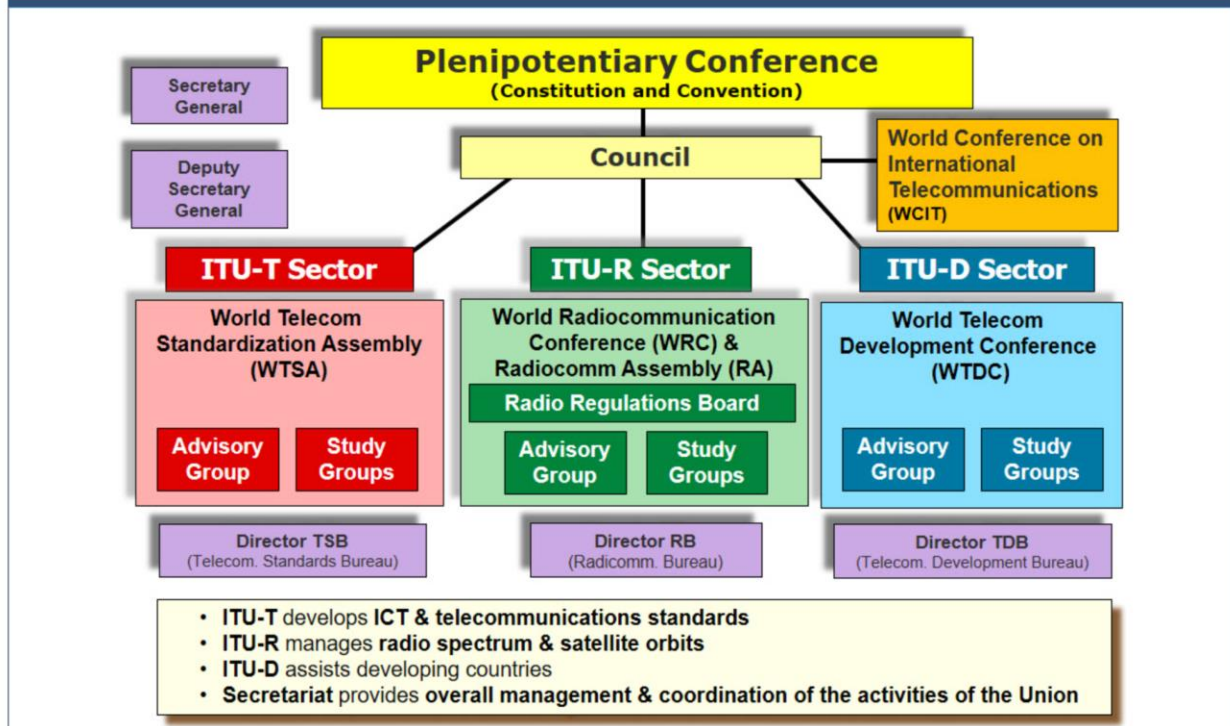


Figure 6.3. WRC in the ITU¹²⁵

The World Radiocommunication Conference (WRC) is organized under the ITU Radiocommunication Sector (ITU-R), which is one of the three sectors of the International Telecommunication Union (ITU). The other two sectors are the ITU Telecommunication Standardization Sector (ITU-T) and the ITU Development Sector (ITU-D). The WRC is a conference convened periodically (typically every three to four years) under the ITU-R to address global radio spectrum management and radiocommunication issues. The Plenipotentiary Conference is the ITU's highest governing body, which sets the overall policies and strategies for the ITU, including for its sectors, but it does not directly oversee the WRC.¹²⁶

Multiple Choice

The United States' involvement in the ITU WRC meetings is voluntary and not required for satellite spectrum licenses since nations can allocate spectrum in their borders without international law. (False. While terrestrial spectrum is within nation-state

¹²⁵ Government of Canada, "ISED's Involvement in the International Telecommunication Union: Evaluation Report," <https://ised-isde.canada.ca/site/audits-evaluations/en/evaluation/iseds-involvement-international-telecommunication-union-evaluation-report>.

¹²⁶ Government of Canada, "ISED's Involvement in the International Telecommunication Union: Evaluation Report," <https://ised-isde.canada.ca/site/audits-evaluations/en/evaluation/iseds-involvement-international-telecommunication-union-evaluation-report>.

borders, the ITU WRC meetings are where global satellite spectrum rights are allocated since satellites orbit around the globe. While satellites may have license to transmit in certain regions, they use the airspace above the earth in a shared manner.)

The WRC updates the Radio Regulations to reflect new technologies, services, and global needs. These regulations include frequency allocations (which bands are assigned to which services, like mobile, satellite, or radio astronomy), technical standards, and procedures to prevent interference between countries and systems.

Each WRC sets an agenda for the next conference, allowing years of preparation, studies, and regional consultations. For instance, WRC-23 (held in 2023) might have paved the way for WRC-27 by identifying future spectrum needs for emerging technologies.

The WRC's decisions are binding on ITU member states, shaping national spectrum policies and influencing everything from smartphone connectivity to weather forecasting. By fostering international cooperation, it ensures that wireless technologies can operate seamlessly across borders, supporting global communication and economic growth.

World Radiocommunication Conferences (WRC)

World Radiocommunication Conference 2023 (WRC-23)

20 NOVEMBER - 15 DECEMBER 2023 DUBAI, UNITED ARAB EMIRATES (UAE)

World Radiocommunication Conference 2019 (WRC-19)

28 OCTOBER - 22 NOVEMBER 2019 SHARM EL-SHEIKH, EGYPT

World Radiocommunication Conference 2015 (WRC-15)

2-27 NOVEMBER 2015 GENEVA, SWITZERLAND

World Radiocommunication Conference 2012 (WRC-12)

23 JANUARY - 17 FEBRUARY 2012 GENEVA, SWITZERLAND

World Radiocommunication Conference 2007 (WRC-07)

22 OCTOBER - 16 NOVEMBER 2007 GENEVA, SWITZERLAND

Figure 6.4. World Radiocommunication Conferences (WRC)¹²⁷

The last 5 WRC meetings have been held in Dubai, United Arab Emirates (WRC-23), Sharm El-Sheikh, Egypt (WRC-19), and Geneva, Switzerland (WRC-15, WRC-12, WRC-07).

Multiple Choice

The WRC meetings are held in Geneva, Switzerland each year in a neutral location in order for countries to be on level footing. (False. The WRC meetings used to be held in Geneva, but the host country pays the costs of hosting the conference and in the last decade or so, the conference has moved from host city to host city. The location for WRC-27 is still to be determined.)

6.2.1. WRC-23

The U.S. delegation went and returned from WRC-23 in Dubai with successes but some losses according to industry reports.

The U.S. delegation was prepared with the WRC Advisory Committee's draft recommendations, a 433 page report, that included input from U.S. stakeholders and government agencies.¹²⁸

Among the draft recommendations are detailed notes on specific agenda items that were slated for WRC-23. For example, Agenda Item 1.1 discusses measures to protect aeronautical and maritime mobile services in the 4800-4990 MHz band.¹²⁹ Agenda Item 1.12 focuses on studies for a potential secondary allocation to the Earth exploration-satellite service around 45 MHz,¹³⁰ while Agenda Item 1.13 considers upgrading the allocation of the 14.8-15.35 GHz band to the space research service.¹³¹ Agenda Item 9 reviews studies on space weather sensors, their characteristics, spectrum needs, and service designations.¹³²

The recommendations also include suggestions for future WRC-27 agenda items to propose at the WRC-23 meeting, such as Agenda Item 10 to identify frequency bands within 7.125 – 15.35 GHz for IMT.¹³³ Different views (View A, View B, View C) are presented

¹²⁷ ITU WRC, World Radiocommunication Conferences (WRC), <https://www.itu.int/en/ITU-R/conferences/wrc/Pages/default.aspx>.

¹²⁸ FCC, OIA Seeks Comment on Recommendations Approved by the WRC Advisory Committee, <https://docs.fcc.gov/public/attachments/DA-23-296A1.pdf>; see also FCC, WRC-23 Advisory Committee, <https://www.fcc.gov/wrc-23-advisory-committee>. For prior WRC Advisory Committee recommendations, see FCC, WRC, <https://www.fcc.gov/wrc-23>.

¹²⁹ Id. at 17.

¹³⁰ Id. at 74.

¹³¹ Id. at 79.

¹³² Id. at 171.

¹³³ Id. at 39.

regarding the FCC's approach to the agenda item proposal for International Mobile Telecommunications (IMT).¹³⁴ Future agenda items also address limits on satellite and fixed services in the 71-76 GHz and 81-86 GHz bands.¹³⁵ Furthermore, Preliminary WRC-27 Agenda Item 2.6 considers regulatory provisions for the recognition and protection of space weather sensors.¹³⁶ Views on a WRC-27 agenda item for studying satellite-to-satellite links in certain mobile-satellite service bands are also included.¹³⁷

¹³⁴ Id. at 37.

¹³⁵ Id. at 73.

¹³⁶ Id. at 204.

¹³⁷ Id. at 147.

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. 2.1)MOD USA/AI 1.7/1

75.2-137.175 MHz

Allocation to services		
Region 1	Region 2	Region 3
117.975-137	AERONAUTICAL MOBILE (R) <u>AERONAUTICAL MOBILE-SATELLITE (R) ADD 5.A17 ADD 5.B17</u> 5.111 5.200 5.201 5.202	

Reasons: Adds an AMS(R)S allocation to the 117.975-137 MHz band.ADD USA/AI 1.7/2

5.A17 In the frequency band 117.975-137 MHz, the use of the aeronautical mobile-satellite (R) service is limited to non-geostationary-satellite systems and is subject to coordination under No. 9.11A. Stations in the aeronautical mobile-satellite (R) service operating in the 117.975-137 MHz frequency band shall not cause harmful interference to, nor claim protection from stations in the aeronautical mobile (R) service. The use of this band by the aeronautical mobile-satellite (R) service shall be limited to systems that operate and are planned in accordance with recognized international aeronautical standards. (WRC-23)

Reasons: To ensure the current and future AM(R)S systems are not constrained.ADD USA/AI 1.7/3

5.B17 In the frequency band 136-137 MHz, space stations operating in the aeronautical mobile-satellite (R) service should ensure that their maximum level of their emissions above 137 MHz does not exceed a pfd of $-166.6 \text{ dB(W/(m}^2 \cdot 14 \text{ kHz))}$. (WRC-23)

Reasons: To ensure the protection of the incumbent services above 137 MHz.Figure 6.5. FCC WRC-23 Advisory Committee Recommendations¹³⁸

At the meetings, there were 4,500 government officials from 193 nations participating in the meetings.¹³⁹ The U.S. delegation was led by Nathaniel Fick, U.S. ambassador at large

¹³⁸ Id.¹³⁹ Sandra Erwin, "U.S. Delegation Stokes Optimism on Wireless and Satellite Goals at WRC-23," Space News, Nov. 20, 2023, <https://spacenews.com/u-s-delegation-stokes-optimism-on-wireless-and-satellite-goals-at-wrc-23/>.

for cyberspace and digital policy. The U.S. delegation included “200 government officials from the State Department, the Federal Communications Commission, the Department of Commerce, the Department of Defense, NASA and the White House.”¹⁴⁰

Multiple Choice

The United States sends a delegation to the WRC meetings with many different policy positions since there are many different industries represented. Each company argues for its own positions at the meetings and negotiates privately. (False. The WRC is a treaty-level meeting where the United States sends a delegation led by the State Department in coordination with the federal agencies and industry participants. Decisions are made to affect the United States as a country and not for companies independently.)

The U.S. Wi-Fi industry was pleased that 6 GHz would be considered for unlicensed usage around the world in the Radio Local Area Network (RLAN) savings clause,¹⁴¹ while the GSMA wireless association interpreted the results as promoting primarily IMT (international mobile technologies) in the below 1 GHz, 3.5 GHz, and 6 GHz bands.¹⁴²



¹⁴⁰ *Id.*

¹⁴¹ Monica Allevan, “U.S. Wi-Fi Industry Declares Victory at WRC-23”, Fierce Network, Dec. 15, 2023, <https://www.fierce-network.com/tech/us-wi-fi-industry-declares-victory-wrc-23>.

¹⁴² GSMA, “GSMA Hails Groundbreaking Spectrum Decisions at WRC-23,” Dec. 15, 2023, <https://www.gsma.com/newsroom/press-release/gsma-hails-groundbreaking-spectrum-decisions-at-wrc-23/>.

Figure 6.6. ITU WRC-23 in Dubai, Nov. 20-Dec. 15, 2023¹⁴³



Figure 6.7. ITU WRC-19 in Sharm El-Sheikh, Egypt, Oct. 28-Nov 22, 2019 (Source: ITU)¹⁴⁴

6.2.2. WRC-27

The FCC is beginning preparations for the next WRC meetings in Docket 24-30. The WRC Advisory Committee is a body of stakeholders that will meet to help the FCC formulate its positions to contribute to the positions of the U.S. delegation as led by the U.S. State Department and WRC Ambassador.

¹⁴³ ITU WRC-23 in Dubai, Nov. 20-Dec. 15, 2023, <https://www.itu.int/wrc-23/>.

¹⁴⁴ ITU WRC-19 in Sharm El-Sheikh, Egypt, Oct. 28-Nov 22, 2019.

Home / International Affairs

WRC-27

World Radiocommunication Conference

WRC-27

WRC-23

WRC-19

WRC-15

WRC-12

The advisory committee provides to the Federal Communications Commission (FCC) public views and recommendations in preparation for the 2027 World Radiocommunication Conference (WRC-27).

Docket 24-30 ([EDOCS](#), [ECFS](#)) World Radiocommunication Conference Advisory Committee for WRC-27

How to Apply for Membership:

To apply for membership on the committee or change representatives on the committee please see the Public Notice [Rechartering and solicitation of members for the WRC Advisory Committee](#)

Public Notices Regarding WAC-27:

2025

- [WRC Advisory Committee Schedules April 15 Meeting](#)

2024

- [Rechartering and solicitation of members for the WRC Advisory Committee](#)
- World Radiocommunication Conference Advisory Committee Meetings
 - [First Meeting](#), June 3, 2024
 - [Second Meeting](#), August 5, 2024
 - [OIA Seeks Comment on Recommendations Approved by the WAC](#)
 - [Third Meeting](#), April 15, 2025
- [Appointments of Jayne Stancavage and Kimberly Baum as Chair and Vice Chair of the Commission's World Radiocommunication Conference Advisory Committee](#)

Figure 6.8. The FCC's WRC-27 Preparations¹⁴⁵

6.2.3. CITEL PCC.II

The U.S. also participates in the CITEL PCC.II meetings which is a regional section of the WRC.¹⁴⁶

¹⁴⁵ FCC, WRC-27, <https://www.fcc.gov/wrc-27>.

¹⁴⁶ FCC, U.S. Contributions Sent to CITEL, PCC.II (WRC-27), <https://www.fcc.gov/us-contributions-sent-citel-pccii-wrc-27-0>.

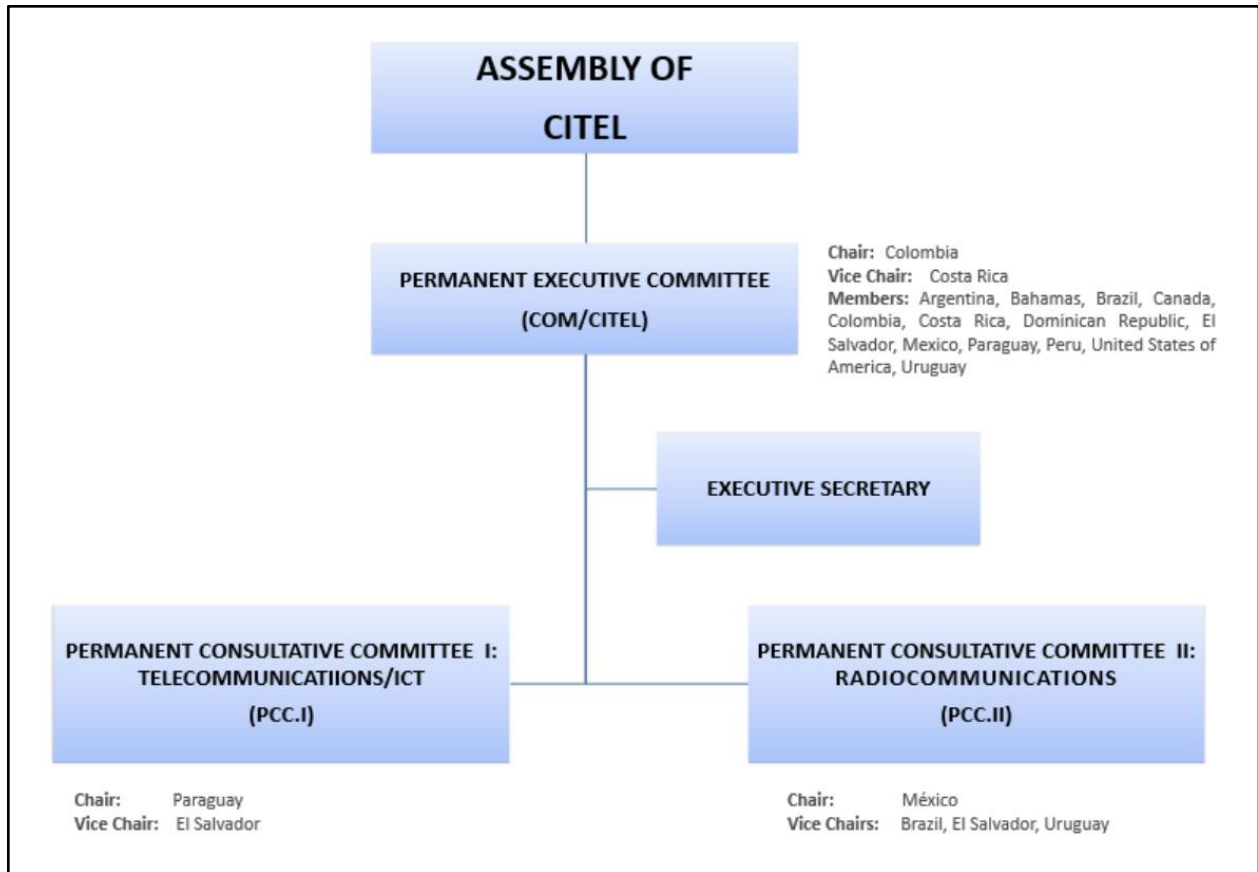


Figure 6.9. CITEL Structure¹⁴⁷

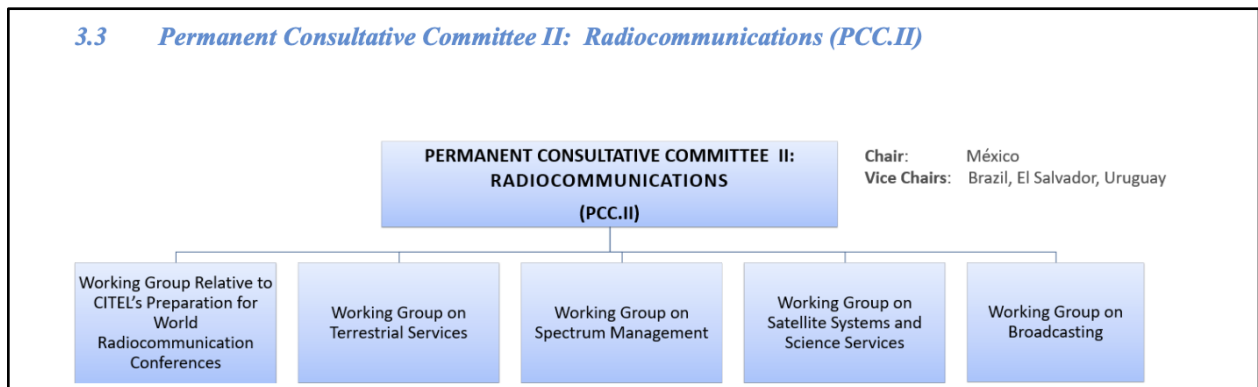


Figure 6.10. PCC.II Structure¹⁴⁸

In the most recent meeting, the U.S. submitted agenda items to the regional meeting related to earth-to-space satellite spectrum, uplink spectrum for fixed satellite service earth station antennas, studies for gateway earth station spectrum for non-geostationary

¹⁴⁷ CITEL, 2021 Annual Report, at 8, <https://scm.oas.org/pdfs/2024/CP49464E.pdf>.

¹⁴⁸ CITEL, 2021 Annual Report, at 13, <https://scm.oas.org/pdfs/2024/CP49464E.pdf>.

satellite orbit (NGSO) systems, and several other agenda items related to new spectrum allocations related to satellite operations.¹⁴⁹

CITEL PCC.II, or the Permanent Consultative Committee II: Radiocommunications, is a key body within the Inter-American Telecommunication Commission (CITEL), an entity of the Organization of American States (OAS). CITEL itself is focused on promoting telecommunications and information and communication technology (ICT) development across the Americas. PCC.II specifically deals with radiocommunications and broadcasting, playing a critical role in coordinating regional preparations for international events like the World Radiocommunication Conference (WRC), organized by the International Telecommunication Union (ITU).

The PCC.II develops common positions and Inter-American Proposals (IAPs) for WRCs, which are submitted to influence revisions to the ITU Radio Regulations—the treaty governing global radio-frequency spectrum and satellite orbit use. PCC.II operates through meetings where member states, including the United States, collaborate with associate members (e.g., industry stakeholders) to negotiate and refine these positions. It's a platform for dialogue, technical studies, and consensus-building ahead of global conferences like WRC-27.

Multiple Choice

The WRC meetings that are held every 4 years are the only meetings where decisions are made, regional meetings such as CITEL PCC.II are not important. (False. The regional meetings that are held in between WRC meetings are important for regions to make decisions that will be brought as regions to the WRC meetings.)

¹⁴⁹ *Id.*

Connecting the Americas: Thoughts from the 43rd Meeting of CITEL-PCC.II

30/04/2024



Written by [César Díaz](#), Head of Telecommunications Affairs

Within the framework of the 43rd Meeting of Permanent Consultative Committee 2 (PCC.II) of the Inter-American Telecommunications Commission (CITEL) held in Montevideo, Uruguay, Internet Technical Community organizations LACNIC, ISOC, ICANN, LACTLD, LAC-IX, LACNOG, and RedClara had the privilege of welcoming to *Casa de Internet* prominent representatives of CITEL Member States and the presidents of various working groups. Discussions focused on topics considered essential for the development of telecommunications in our region.

Figure 6.11. Gatherings at the 43rd Meeting of CITEL-PCC.II (2024)¹⁵⁰

The United States participates in CITEL PCC.II to shape regional and global spectrum policies for WRC-27, scheduled for 2027. As an ITU member state and a leader in telecommunications innovation, the U.S. leverages PCC.II to align its interests with those of the Americas while influencing the international agenda.

6.3. IEEE and Other Standards Bodies

The Institute of Electrical and Electronics Engineers (IEEE) and other standards bodies significantly influence discussions at the ITU World Radiocommunication Conference (WRC) regarding wireless equipment standards, though their impact is indirect and occurs

¹⁵⁰ LACNIC Blog, "Connecting the Americas: Thoughts from the 43rd Meeting of CITEL-PCC.II," Apr. 30, 2024, <https://blog.lacnic.net/en/connecting-the-americas-thoughts-from-the-43rd-meeting-of-citel-pcc-ii/>.

through technical contributions, advocacy, and the development of standards that shape the global telecommunications ecosystem.

The IEEE, particularly through its 802 LAN/MAN Standards Committee (e.g., IEEE 802.11 for Wi-Fi), develops standards for wireless communication technologies that define how devices operate within specific spectrum bands. These standards, such as IEEE 802.11ax (Wi-Fi 6) or 802.11be (Wi-Fi 7), specify technical parameters like modulation, channel access, and spectrum efficiency.

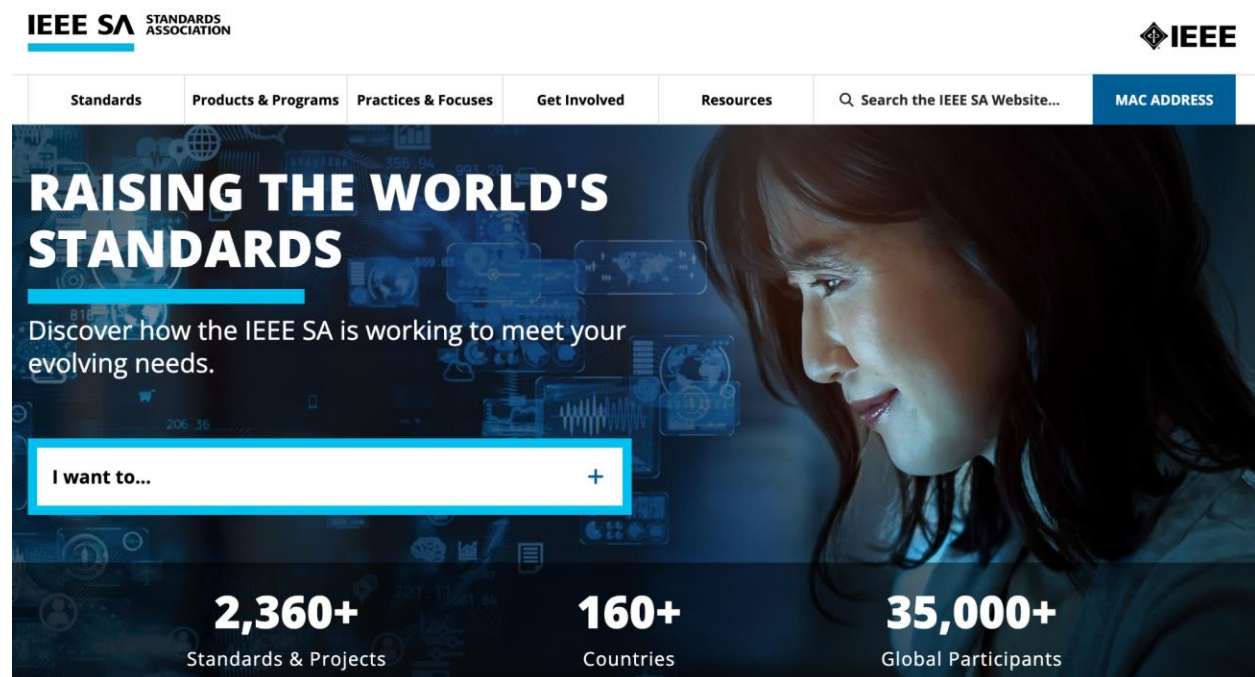


Figure 6.12. IEEE Standards Association¹⁵¹

Other standards bodies such as 3GPP, ETSI, and the Wi-Fi Alliance also influence standards that influence wireless communications policy.

The 3rd Generation Partnership Project (3GPP) develops standards for cellular technologies (e.g., 4G, 5G, and future 6G under the ITU's International Mobile Telecommunications (IMT) framework). 3GPP standards influence WRC agenda items related to IMT spectrum allocations, such as the 3.3–4.2 GHz and 6 GHz bands.

¹⁵¹ IEEE SA, <https://standards.ieee.org/>.

3GPP Global Membership

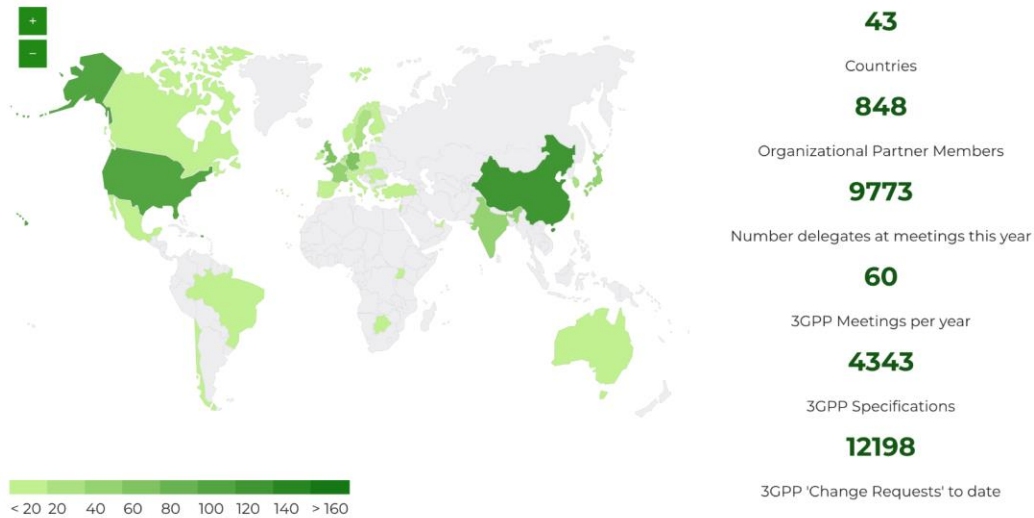


Figure 6.13. 3GPP¹⁵²

The European Telecommunications Standards Institute (ETSI) contributes to standards like those for Reconfigurable Intelligent Surfaces (RIS) and collaborates with ITU-R on harmonized technical specifications.

¹⁵² 3GPP, <https://www.3gpp.org/>.

STANDARDS, SPECIFICATIONS AND REPORTS

ETSI is a key player on the international standards scene and publishes more than 2,500 standards every year. These include the standards that enable key global technologies such as GSM™, 3G, 4G, 5G, DECT™, and many more ICT standards success stories.

ETSI standards are [available for download in PDF](#) free of charge (*the Word version is password protected and accessible for a specific target audience only*).

ETSI produces specifications, standards, reports and guides, each with its own purpose.

- European Standard (EN) – Used when the document is intended to meet needs specific to Europe and requires transposition into national standards, or when the drafting of the document is required under a standardization request from the European Commission (EC)/European Free Trade Association (EFTA). An EN is drafted by a Technical Committee and approved by ETSI's European National Standards Organizations.
 - Harmonised Standards

Harmonised Standards are ENs with a special status. We produce them in response to an EC standardization request. They provide the technical detail necessary to achieve the 'essential requirements' of an EC Directive. They are thus key enablers of the European Single Market. We produced and continue to produce numerous Harmonised Standards in support of several EC mandates and policies.
- European standardization deliverables – Any other technical specification than a European standard, adopted by a European standardization organization for repeated or continuous application and with which compliance is not compulsory.
- ETSI Standard (ES) – Used when the document contains technical requirements. An ES is submitted to the whole ETSI membership for approval.
- ETSI Guide (EG) – Used for guidance to ETSI in general on the handling of specific technical standardization activities. It is submitted to the whole ETSI membership for approval.

Figure 6.14. ETSI¹⁵³

The Wi-Fi Alliance ensures interoperability of IEEE 802.11-based devices and advocates for unlicensed spectrum, influencing WRC debates on bands like 6 GHz.

¹⁵³ ETSI, <https://www.etsi.org/standards/types-of-standards>.

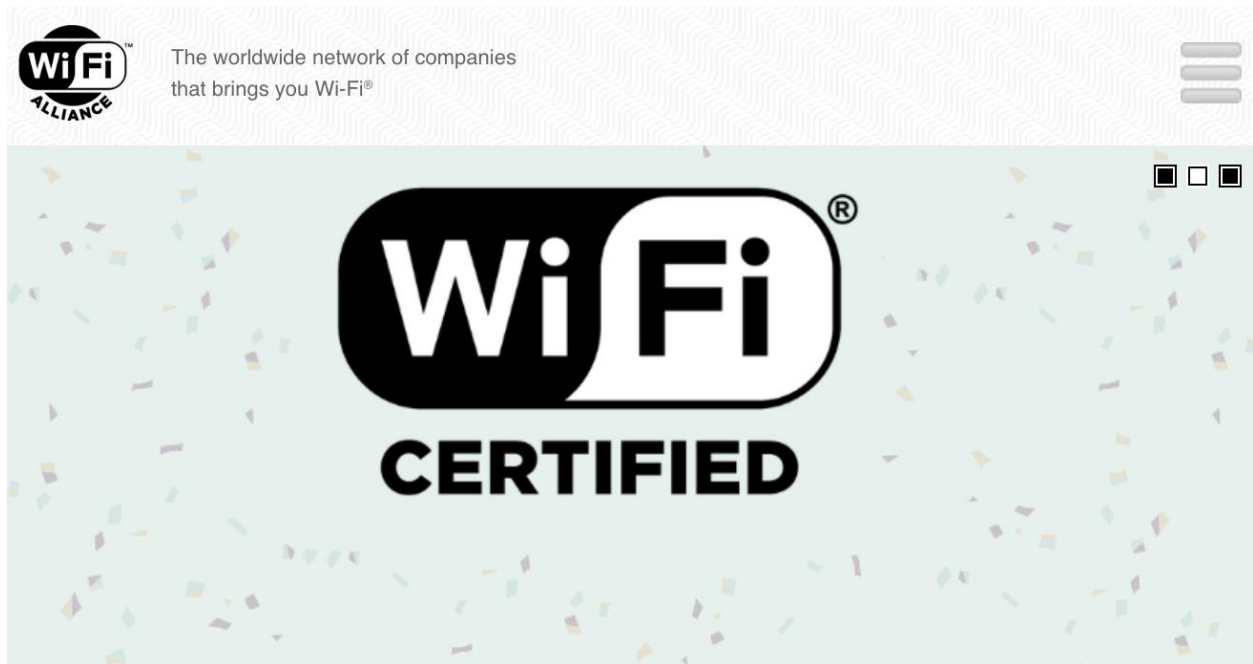


Figure 6.15. Wi-Fi Alliance¹⁵⁴

These standards shape the technical feasibility and market viability of technologies proposed for spectrum allocation at WRC. For example, IEEE 802.11's compatibility with unlicensed spectrum influences WRC discussions on whether bands like 6 GHz should be allocated for unlicensed use (e.g., Wi-Fi) or licensed IMT (e.g., 5G).

6.4. In the News

¹⁵⁴ Wi-Fi Alliance, <https://www.wi-fi.org/>.

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WIRELESS

Op-Ed: US must prepare for China to host World Radio Conference

By Dean Bubley · Feb 28, 2025 7:00am

Op-Ed

5G spectrum

international telecommunications union



Figure 6.16. Op-Ed on WRC-27 Location¹⁵⁵

¹⁵⁵ Dean Bubley, U.S. Must Prepare for China to Host the World Radio Conference, Fierce Network, Feb. 28, 2025, <https://www.fierce-network.com/wireless/op-ed-us-must-prepare-china-host-world-radio-conference>.

Policy & Politics

U.S. delegation stokes optimism on wireless and satellite goals at WRC-23

Jessica Rosenworcel, chair of the FCC, said a key goal of the U.S. delegation is to “foster continued growth and U.S. leadership in the space economy.”

by Sandra Erwin November 20, 2023



The World Radiocommunication Conference (WRC-23) kicked off Nov. 20, 2023, at the Dubai World Trade Center. Credit: @AhmedMohammed

Figure 6.17. WRC-23 News¹⁵⁶

¹⁵⁶ Sandra Erwin, “U.S. Delegation Stokes Optimism on Wireless and Satellite Goals at WRC-23,” Space News, Nov. 20, 2023, <https://spacenews.com/u-s-delegation-stokes-optimism-on-wireless-and-satellite-goals-at-wrc-23/>.

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WIRELESS

U.S. Wi-Fi industry declares victory at WRC-23

By Monica Allevan · Dec 15, 2023 7:21pm

Wi-Fi

Federal Communications Commission (FCC)

WiFiForward

Wi-Fi Alliance



✓ The 2023 World Radiocommunication Conference (WRC-23) wrapped up December 15 in

Figure 6.18. Wi-Fi Industry Views on WRC-23¹⁵⁷

¹⁵⁷ Monica Allevan, "U.S. Wi-Fi Industry Declares Victory at WRC-23", Fierce Network, Dec. 15, 2023, <https://www.fierce-network.com/tech/us-wi-fi-industry-declares-victory-wrc-23>.

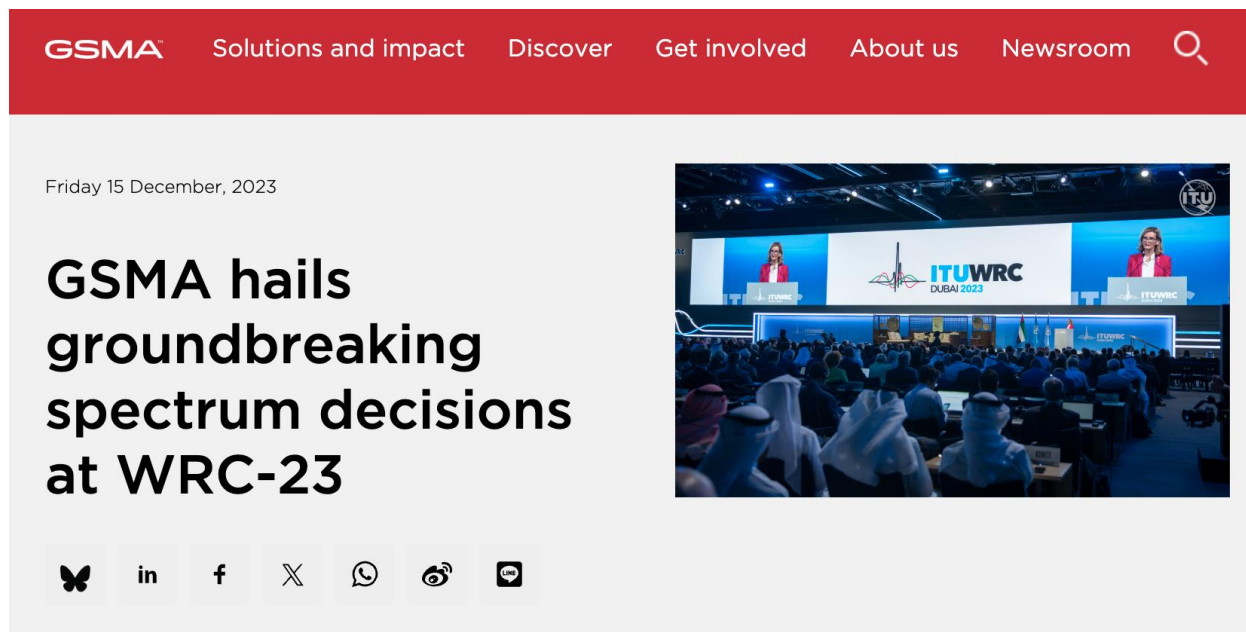


Figure 6.19. GSMA Statement on WRC-23¹⁵⁸

6.5. Assignment

Fill in the Blank

Read the draft proposal for the work of the WRC conference. FCC, OIA Seeks Comment on Recommendations Approved by the WRC Advisory Committee, <https://docs.fcc.gov/public/attachments/DA-23-296A1.pdf>;

Why is it necessary for the ITU WRC nations to make such technical decisions at the international treaty-level? Can these global spectrum issues be resolved in bilateral or multilateral forums or are these technical spectrum details necessarily international in nature? On page 15, for example, you see major companies agreeing or disagreeing with a proposed position. How do the FCC and State Department decide between conflicting positions?

6.6. Reading List

File Attachments

¹⁵⁸ GSMA, "GSMA Hails Groundbreaking Spectrum Decisions at WRC-23," Dec. 15, 2023, <https://www.gsma.com/newsroom/press-release/gsma-hails-groundbreaking-spectrum-decisions-at-wrc-23/>.

- Allocation of ITU-R Preparatory Work for WRC-27, <https://www.cv.nrao.edu/~hlszt/rfi/MyWrc27Agenda.pdf>.
- FCC, U.S. Contributions Sent to CITEI, PCC.II (WRC-27), <https://www.fcc.gov/us-contributions-sent-citel-pccii-wrc-27-0>.
- FCC, OIA Seeks Comment on Recommendations Approved by the WRC Advisory Committee, <https://docs.fcc.gov/public/attachments/DA-23-296A1.pdf>.

7. Lecture 7: Competition and New Use Cases

Video

Advanced Spectrum Policy Lecture 7: Competition and New Use Cases

https://www.youtube.com/watch?v=CXiMD_Z22A4&list=PLIbQnBe9IRS_YjElyMEqm_QNFbmlD5_ko&index=8

The FCC promotes new use cases and competition in spectrum use through experimental licensing, innovation zones, and considerations of new use cases. Dynamic spectrum sharing and other novel sharing band plans have been released with the most recent notable system in the Citizens Broadband Radio Service (CBRS).

7.1. Learning Objective

Statement

Analyze emerging spectrum use cases enabled by frameworks like the Experimental Licensing System and Citizens Broadband Radio Service (CBRS). Understand the tiered access model, auction outcomes, and real-world deployment of CBRS devices in promoting competition and innovation.

7.2. FCC Experimental Licensing System (ELS)

The FCC issues experimental licenses and special temporary authority (STA) to spectrum users through the Office of Engineering and Technology (OET). The applications and licenses are searchable on the Experimental Licensing System (ELS).

The Federal Communications Commission (FCC) issues experimental licenses under Part 5 of Title 47 of the Code of Federal Regulations to facilitate research, development, and testing of new radio technologies, services, or devices. These licenses are intended for experimentation, product development, market trials, and demonstrations without providing commercial services. They allow innovators to test radio frequency (RF)

equipment in real-world conditions on a non-interference basis, ensuring that new technologies can be developed without disrupting existing services.

The Experimental Radio Service was formalized to encourage technical innovation and the development of new communication technologies while maintaining regulatory oversight to prevent interference with authorized services. The intent was to provide a controlled environment for testing novel ideas, fostering advancements in telecommunications, and ensuring public safety by regulating experimental use of the spectrum.

The Experimental Radio Service traces its roots to the Radio Act of 1927, which established the Federal Radio Commission (predecessor to the FCC) and emphasized the need to manage the spectrum for public interest. The specific rules for the Experimental Radio Service, as we know them today, were significantly revised and codified in 1998 (63 FR 64199, November 19, 1998) to streamline processes, promote innovation, and reduce regulatory burdens while protecting public safety frequencies.



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OET

Office of Engineering and Technology

[OET Home Page](#)

[FCC > FCC E-filing > ELS](#)

OET Experimental Licensing System

Filing Options

[Form 405 - License Renewal](#)

[Form 442 - New License/Modification of License](#)

[Form 702 - Assignment of License](#)

[Form 703 - Transfer of Control](#)

[Special Temporary Authority](#)

[Add Attachments](#)

[Reply to Correspondence](#)

[Amend/Complete Application](#)

[Return to 159 Form](#)

[File an Informal Objection](#)

Reports

[Application Status](#)

[Call Sign Search](#)

[Generic Search](#)

[Point Radius Search](#)

Miscellaneous

[Get FRN](#)

[ELS Notification Website](#)

[Innovation Zone Portal](#)

[User's Manual](#)

[Get Software](#)

[FAQ](#)

Welcome and thank you for visiting the OET Experimental Licensing Branch Electronic Filing Home Page. The pages to the left are designed to provide the public a means to electronically file and report on the various Experimental Licensing Applications.

Notes of Interest:

Please update your browser bookmarks for the Experimental Licensing System (ELS) to our new location: <https://apps.fcc.gov/els> at your earliest convenience.

Fee applications should be paid using the Form 159 at the time of filing to avoid fee system problems. Applicants should use the Return to 159 form link if needed. Applications not paid within 10 days of filing may need to be dismissed and refiled if there are any fee payment complications.

 Add this RSS feed to your reader to receive notifications of ELS license and Special Temporary Authority grants.

There are several free online services that will convert Microsoft Word and Excel documents to Adobe PDF. Some examples include, but are not limited to:

- [Doc 2 PDF](#)
- [Primo Online](#)

You may also purchase license software to convert documents to PDF by visiting [Adobe](#).

Innovation Zones:

Information for the FCC Innovation Zones can be found at the following page: [On the login page under the "Quick Search" section, click the link, "Innovation Zone Experiments"](#)

STA FILERS: [Please review these guidelines](#) before completing an Application for Special Temporary Authority.

Forgot to pay for your application or need a copy of the FCC Form 159? Select the Return to 159 link on the menu. Please note that this feature is available only if your application is not in a final status.

Credit card payment over the Web is available. This can be used for any type of submission, and is the preferred method of payment for short-turnaround STAs.

FILING OF CLASSIFIED APPLICATIONS:

Applications that are classified (CONFIDENTIAL OR SECRET) for National Security purposes must be filed as follows:

Figure 7.1. OET Experimental Licensing System¹⁵⁹

STAs are granted by the FCC to permit temporary operation of radio facilities for a limited period (typically up to 6 months, renewable under certain conditions) under specific circumstances. These include emergencies (e.g., natural disasters), restoration or relocation of facilities, temporary non-recurring services, or extraordinary situations where delay would harm the public interest. STAs allow operators to deviate from standard licensing requirements or operate without a full license temporarily.

The STA mechanism was designed to provide flexibility in urgent or unique situations where immediate operation is necessary, and the normal licensing process would be too slow. It ensures continuity of communication services during crises, supports temporary experimental operations, and allows quick response to unforeseen events like equipment failures or natural disasters.

The STA framework is part of the FCC's broader licensing authority, with specific procedures outlined in regulations like 47 CFR § 1.931 and § 5.61. While the concept of temporary authorizations existed since the FCC's formation in 1934 under the Communications Act, the modern STA process was refined with the adoption of electronic filing systems and updated rules in the late 1990s and early 2000s (e.g., electronic filing mandated by January 1, 2004, per 47 CFR § 5.61).

Multiple Choice

The FCC's Experimental Licensing regime allows spectrum users to access any spectrum bands just as long as their use is low power and for short periods of time. (False. Applicants need to apply to use certain bands and can gain Special Temporary Authority to use the spectrum without interference to licensed users)

¹⁵⁹ FCC, OET Experimental Licensing System, <https://apps.fcc.gov/oetcf/els/index.cfm>.



Displaying title 47, up to date as of 4/11/2025. Title 47 was last amended 4/11/2025. [view historical versions](#)

Enter a search term or CFR reference (eg. fishing or 1 CFR 1.1)



Title 47 / Chapter I / Subchapter A / Part 1 / Subpart F / Application
Requirements and Procedures / § 1.931

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ECFR CONTENT

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EDITORIAL NOTE ON PART 1

Editorial Note: Nomenclature changes to part 1 appear at [63 FR 54077](#), Oct. 8, 1998.

§ 1.931 Application for special temporary authority.

(a) **Wireless Telecommunications Services.**

(1) In circumstances requiring immediate or temporary use of station in the Wireless Telecommunications Services, carriers may request special temporary authority (STA) to operate new or modified equipment. Such requests must be filed electronically using FCC Form 601 and must contain complete details about the proposed operation and the circumstances that fully justify and necessitate the grant of STA. Such requests should be filed in time to be received by the Commission at least 10 days prior to the date of proposed operation or, where an extension is sought, 10 days prior to the expiration date of the existing STA. Requests received less than 10 days prior to the desired date of operation may be given expedited consideration only if compelling reasons are given for the delay in submitting the request. Otherwise, such late-filed requests are considered in turn, but action might not be taken prior to the desired date of operation. Requests for STA for operation of a station used in a Contraband Interdiction System, as defined in [§ 1.9003](#), will be afforded expedited consideration if filed at least one day prior to the desired date of operation. Requests for STA must be accompanied by the proper filing fee.

(2) Grant without Public Notice. STA may be granted without being listed in a Public Notice, or prior to 30 days after such listing, if:

(i) The STA is to be valid for 30 days or less and the applicant does not plan to file an application for regular authorization of the subject operation;

(ii) The STA is to be valid for 60 days or less, pending the filing of an application for regular authorization of the subject operation;

(iii) The STA is to allow interim operation to facilitate completion of authorized construction or to provide substantially the same service as previously authorized;

Figure 7.2. 47 CFR § 1.931¹⁶⁰

FCC guidance documents, such as the “WTB Special Temporary Authority and Waiver Request Filing Guide” (2021), detail STA procedures and use cases, reflecting their practical application.

The FCC issues public notices or orders for specific STA grants or experimental licenses, especially for high-profile cases (e.g., emergency STAs during hurricanes or experimental

¹⁶⁰ 47 CFR § 1.931, <https://www.ecfr.gov/current/title-47/chapter-I/subchapter-A/part-1/subpart-F/subject-group-ECFR8fff3365c42ee1/section-1.931>.

licenses for space missions). These are available via the FCC's Electronic Comment Filing System (ECFS) or OET's ELS.

The screenshot shows the FCC's website interface. At the top, there's a navigation bar with the FCC logo, "Browse by CATEGORY", "Browse by BUREAUS & OFFICES", and a search bar. Below this is a secondary navigation bar with links: "About the FCC", "Proceedings & Actions", "Licensing & Databases", "Reports & Research", "News & Events", and "For Consumers". The main content area has a breadcrumb trail: "Home / Reports & Research / Guides". The title "Special Temporary Authority Licensing" is prominently displayed. Below the title is the sub-header "Special Temporary Authority". The text explains that the FCC grants STA to permit immediate or temporary operation of certain radio facilities during emergencies or other urgent conditions. It lists four circumstances under which STA may be granted: 1. In emergency situations, such as natural disasters; 2. To permit restoration or relocation of existing facilities to continue communication service; 3. For a temporary, non-recurring service where a regular authorization is not appropriate; 4. In other situations involving circumstances which are of such extraordinary nature that delay in the instruction of temporary operation would seriously prejudice the public interest. Below this list are six buttons: "STA Term", "STA Conditions", "Forms & Fees", "Payment", "Fee Exemptions", and "Instructions for Electronic Filing". The text continues, stating that STAs are granted with a fixed expiration date, usually six months, and that they do not have grace periods. It also mentions that the Commission may grant extensions of an STA for a period of 180 days, but the applicant must show that extraordinary circumstances warrant such an extension. At the bottom, it says "Date Last Updated/Reviewed: Thursday, March 30, 2017" and "Tags: Licensing & Registration - Wireless Services". A blue arrow points to the right.

Home / Reports & Research / Guides

Special Temporary Authority Licensing

Special Temporary Authority

The Federal Communications Commission (FCC) grants Special Temporary Authority (STA) to permit immediate or temporary operation of certain radio facilities during emergencies or other urgent conditions. Few radio services can file manually, most are required to file electronically, refer to 47 C.F.R. § 1.913 for electronic filing requirements.

STA may be granted in the following circumstances:

1. In emergency situations, such as natural disasters;
2. To permit restoration or relocation of existing facilities to continue communication service;
3. For a temporary, non-recurring service where a regular authorization is not appropriate;
4. In other situations involving circumstances which are of such extraordinary nature that delay in the instruction of temporary operation would seriously prejudice the public interest. For more information on STAs, refer to 47 C.F.R. § 1.931.

[STA Term](#) [STA Conditions](#) [Forms & Fees](#) [Payment](#) [Fee Exemptions](#) [Instructions for Electronic Filing](#)

STAs are granted with a fixed expiration date, usually six months, or for the term necessary to cover a special event, etc. STAs do not have grace periods and are valid only through their expiration date. [See instructions for how to file an STA.](#)

The Commission may grant extensions of an STA for a period of 180 days, but the applicant must show that extraordinary circumstances warrant such an extension. Such requests, other than those for market-based service licenses (i.e., services where licenses are issued through an auction), should be filed electronically using FCC Form 601 Main Form with a purpose of Renewal/Modification. Market-based services STAs must be filed manually.

[→](#)

Date Last Updated/Reviewed: Thursday, March 30, 2017

Tags:
[Licensing & Registration - Wireless Services](#)

Figure 7.3. Special Temporary Authority (STA) Licensing¹⁶¹

Some broadcast stations have exploited silent STAs to avoid license forfeiture under the Telecommunications Act of 1996, operating minimally to maintain licenses without full service. The FCC initiated a crackdown in 2018 to address this loophole.

Experimental licenses and STAs serve as critical tools for innovation and emergency response in the FCC's spectrum management framework. Experimental licenses, rooted in the 1927 Radio Act and modernized in 1998, enable R&D for new technologies, while STAs, formalized under the 1934 Communications Act, provide flexibility for urgent or temporary operations. Their uses span from testing cutting-edge 6G networks to restoring broadcast

¹⁶¹ FCC, Special Temporary Authority Licensing, <https://www.fcc.gov/research-reports/guides/special-temporary-authority-licensing>.

services after disasters, offering benefits like innovation, rapid response, and cost-effectiveness. While FCC reports are not centralized, databases like the ELS and rulemaking orders provide detailed insights. Critical scrutiny reveals challenges like potential abuse and access barriers, but these mechanisms remain vital for advancing telecommunications and serving the public interest.

7.3. Citizens Broadband Radio Service

In 2015, the FCC established the Citizens Broadband Radio Service (CBRS) to enable shared commercial use of the 3550–3700 MHz (3.5 GHz) band. Governed by Part 96 of the FCC’s rules, CBRS uses a three-tiered access framework to coordinate federal and non-federal use.¹⁶²

7.3.1. Tiered Access Model

The three tiers are (1) Incumbent Access: Protects existing users, primarily Department of Defense (DoD) radar systems; (2) Priority Access: Licensed users with guaranteed access to specific spectrum portions; (3) and General Authorized Access (GAA): Opportunistic, unlicensed use of available spectrum.

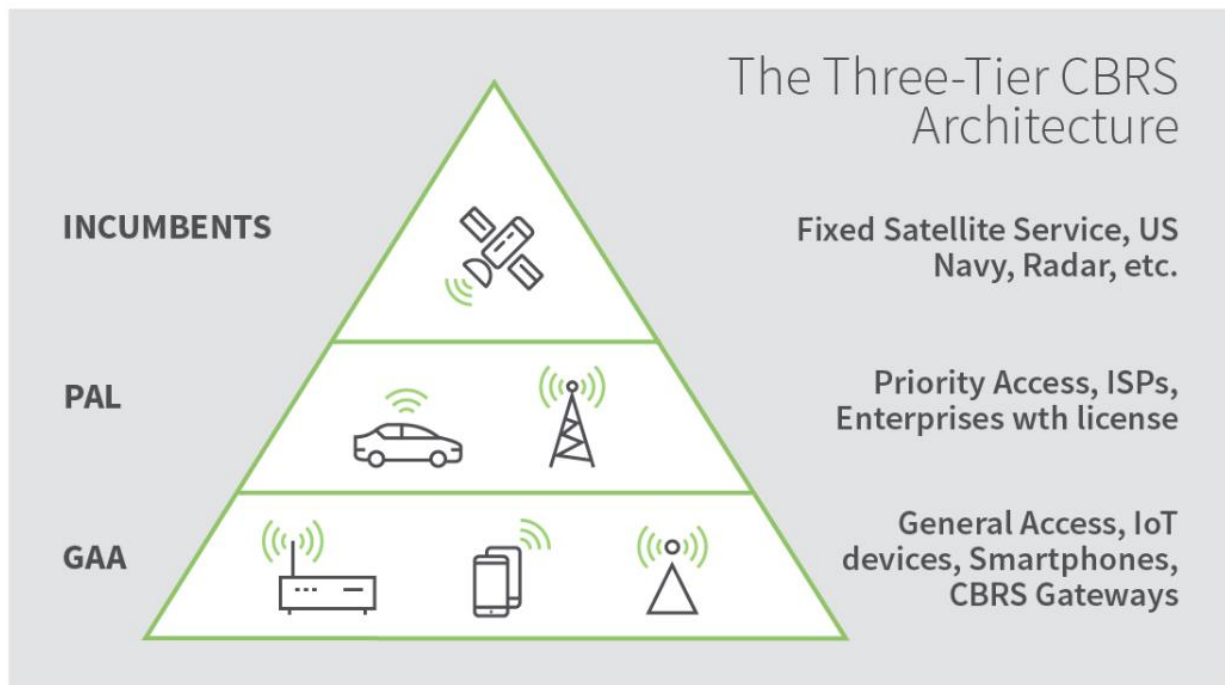


Figure 7.4. Three-Tier CBRS Architecture (Source: 5GStore)¹⁶³

¹⁶² FCC, Citizens Broadband Radio Service, <https://www.fcc.gov/wireless/bureau-divisions/mobility-division/citizens-band-radio-service-cbrs>.

¹⁶³ 5GStore, “CBRS: Revolutionizing Wireless Communication with Shared Spectrum,” July 24, 2023, <https://5gstore.com/blog/2023/07/24/cbrs-revolutionizing-wireless-communication-with-shared-spectrum/>.

Flashcards

- iii. Card 1
 - 1. Front - Incumbents
 - 2. Back - Fixed Satellite Service, US Navy, Radar, etc
- iv. Card 2
 - 1. Front - PAL
 - 2. Back - Priority Access, ISPs, Enterprises with license
- v. Card 3
 - 1. Front - GAA
 - 2. Back - General Access, IoT devices, Smartphones, CBRS Gateways

Spectrum access is managed by an automated Spectrum Access System (SAS), which coordinates operations among tiers to prevent interference. The SAS may use data from an Environmental Sensing Capability (ESC), a sensor network that detects DoD radar signals in or near the 3.5 GHz band and relays this information to the SAS. Both SAS and ESC systems require FCC approval.

The FCC's Wireless Telecommunications Bureau and Office of Engineering and Technology, in collaboration with the National Telecommunications and Information Administration (NTIA) and the DoD, approved four ESC sensor registrations: CommScope, Federated Wireless, Inc., Google, and Key Bridge.

For further details on the CBRS and 3.5 GHz band history, refer to FCC dockets 12-354, 17-258, 15-319, and 19-244 in EDOCS or ECFS.

3.5 GHz Band Overview

Wireless Telecommunications

3.5 GHz Band Overview

Releases

3.5Ghz Band – Protected Fixed Satellite Service (FSS) Earth Stations

3.5 GHz Band - Protected FSS Earth Station API Specification Version 1

3.5Ghz Band – Protected Fixed Satellite Service (FSS) Earth Stations API

In 2015, the Commission adopted rules for shared commercial use of the 3550-3700 MHz band (3.5 GHz band). The Commission established the Citizens Broadband Radio Service (CBRS) and created a three-tiered access and authorization framework to accommodate shared federal and non-federal use of the band. Rules governing the Citizens Broadband Radio Service are found in Part 96 of the Commission's rules.

Access and operations will be managed by an automated frequency coordinator, known as a Spectrum Access System (SAS). When managing spectrum access, SASs may incorporate information from an Environmental Sensing Capability (ESC), a sensor network that detects transmissions from Department of Defense radar systems and transmits that information to the SAS. Both SASs and ESCs must be approved by the Commission. SASs will coordinate operations between and among users in three tiers of authorization in the 3.5 GHz band: Incumbent Access, Priority Access, and General Authorized Access.

For more information about the history of 3.5 GHz band and Citizens Broadband Radio Service, search EDOCS or ECFS for Docket Numbers 12-354, 17-258, 15-319, and 19-244.

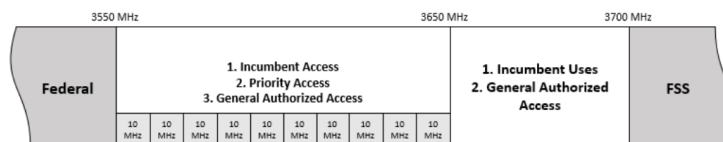


Figure 7.5. Citizens Broadband Radio Service (CBRS)¹⁶⁴

Multiple Choice

The Citizens Broadband Radio Service has four tiers that gives amateur radio users access to all of the CBRS bands at lower power, with three other tiers for general, priority access, and incumbent fixed services. (False. There are only three tiers in the CBRS sharing regime, amateur radio users are not in the scheme).

7.3.2. Auction 105 Results

FCC conducted Auction 105 for the CBRS licenses. Auction 105, conducted by the Federal Communications Commission, was a landmark event that auctioned Priority Access

¹⁶⁴ FCC, Citizens Broadband Radio Service, <https://www.fcc.gov/wireless/bureau-divisions/mobility-division/citizens-band-radio-service-cbrs>.

Licenses (PALs) in the 3550–3650 MHz band, critical for advancing 5G wireless, IoT, and other spectrum-based services in the United States. Running from July 23 to August 25, 2020, it offered an unprecedented 22,631 licenses—the most ever in a single FCC auction—across 76 bidding rounds, attracting 271 qualified bidders. This auction underscored the FCC’s commitment to expanding mid-band spectrum access, fostering innovation, and enhancing connectivity nationwide.

Multiple Choice

The CBRS spectrum bands were allocated through a lottery in order to make sure that spectrum users had fair access to the areas around incumbents such as military radar units on the coasts. (False. The FCC held Auction 105 to auction the CBRS bands.)

The auction resulted in 228 winning bidders securing 20,625 licenses, generating gross proceeds of \$4,585,663,345, with net proceeds of \$4,543,232,339 after \$42,431,006 in bidding credit discounts.¹⁶⁵ The FCC retained 2,006 licenses, reflecting strategic spectrum management. Auction 105’s success, driven by its scale and economic impact, has positioned the 3.5 GHz band as a cornerstone for next-generation wireless services, enabling robust deployment of 5G and IoT applications to meet growing connectivity demands.

¹⁶⁵ FCC, Auction 105 Results, <https://auctiondata.fcc.gov/public/projects/auction105>.

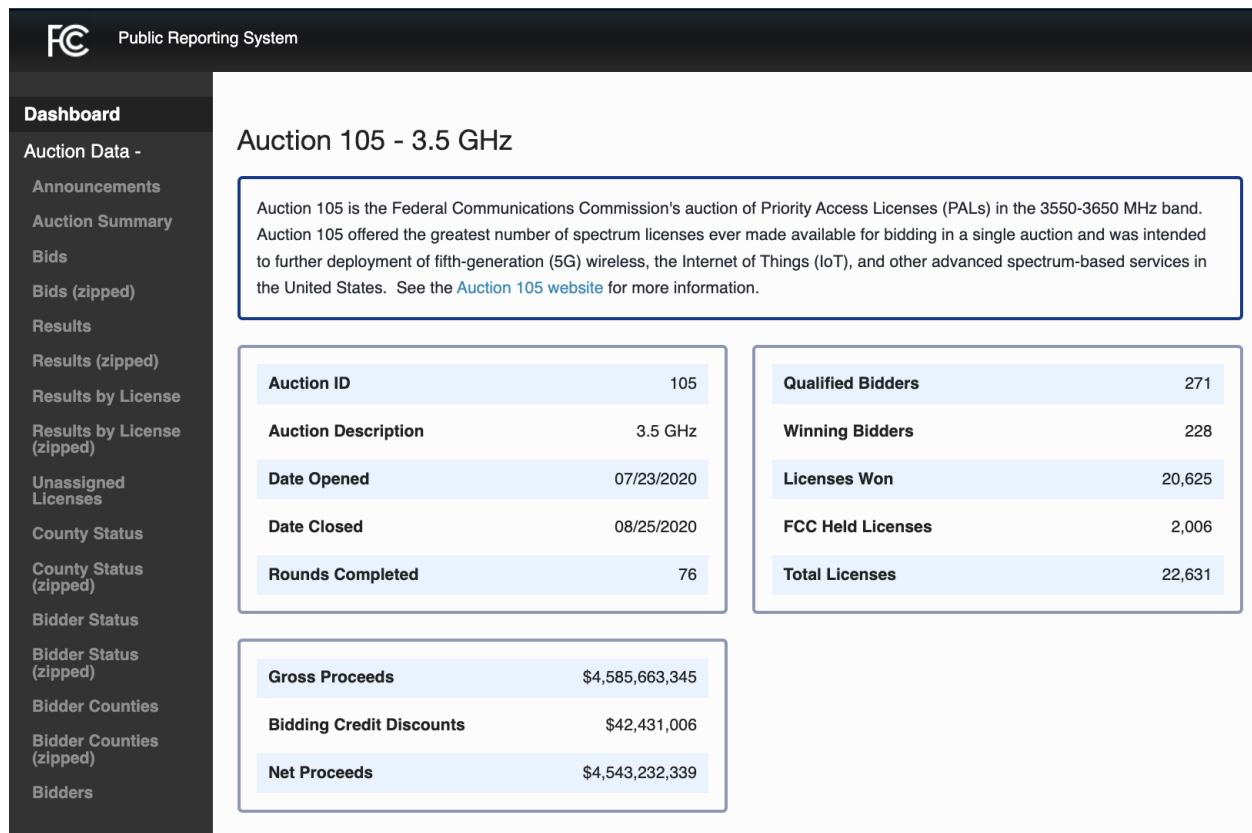


Figure 7.6. Auction 105 CBRS Results¹⁶⁶

¹⁶⁶ FCC, Auction 105 Results, <https://auctiondata.fcc.gov/public/projects/auction105>.

FC Public Reporting System										
Dashboard Auction Data - Announcements Auction Summary Bids Bids (zipped) Results Results (zipped) Results by License Results by License (zipped) Unassigned Licenses County Status County Status (zipped) Bidder Status Bidder Status (zipped) Bidder Counties Bidder Counties (zipped) Bidders	Auction 105 - 3.5 GHz: Auction Data - Bids Search Download CSV (654028 rows) Your request exceeds the limit of 9000 records. Please add filters (e.g. a specific round number) to reduce the number of records to download To customize your report, you can click on [x] to hide columns in the table below.									
	Auction ID	Round	Bidder	FRN	Market	Market Name	Bidding Units	Quantity	Price	Price Point
	Showing first 1000 of 654028 rows									
	105	76	Wetterhorn Wireless L.L.C.	0029527702	AK-020	Anchorage	2,900	2	\$117,000	1.00
	105	76	Verizon Wireless Network Procurement LP	0029515327	AK-020	Anchorage	2,900	4	\$117,000	1.00
	105	76	SAL Spectrum, LLC	0017163254	AK-020	Anchorage	2,900	1	\$117,000	1.00
	105	76	Wetterhorn Wireless L.L.C.	0029527702	AK-050	Bethel	170	2	\$3,800	1.00
	105	76	Wetterhorn Wireless L.L.C.	0029527702	AK-068	Denali	50	1	\$1,100	1.00
	105	76	Wetterhorn Wireless L.L.C.	0029527702	AK-090	Fairbanks North Star	980	2	\$22,000	1.00
	105	76	Alaska Communications Internet, LLC	0022389845	AK-105	Hoonah-Angoon	50	4	\$2,400	1.00
	105	76	Snowcloud Services, LLC	0022113310	AK-105	Hoonah-Angoon	50	3	\$2,400	1.00
	105	76	Wetterhorn Wireless L.L.C.	0029527702	AK-110	Juneau	310	1	\$24,000	1.00
	105	76	Alaska Communications Internet, LLC	0022389845	AK-110	Juneau	310	4	\$24,000	1.00
	105	76	Snowcloud Services, LLC	0022113310	AK-110	Juneau	310	2	\$24,000	1.00
	105	76	SPITwSPOTS, Inc	0022431860	AK-122	Kenai Peninsula	550	0	\$115,000	0.00

Figure 7.7. Auction 105 CBRS Bids¹⁶⁷

The top 20 bidders in Auction 105 included Verizon, Dish, Charter, and Comcast.¹⁶⁸ The FCC's 2020 3.5 GHz CBRS spectrum auction (Auction 105) saw Verizon lead as the top spender, investing heavily to secure 557 Priority Access Licenses (PALs) to bolster its 4G and 5G network capacity, particularly in urban markets. Other major winners included Dish Network, which acquired 5,492 licenses for \$913 million, aiming for a nationwide 5G footprint, and cable giants Comcast, Charter Communications, and Cox, spending \$458 million, \$464 million, and \$213 million respectively. These cable companies plan to leverage CBRS spectrum to build their own wireless networks, reducing reliance on MVNO agreements with carriers like Verizon, though FCC rules prevented winners from discussing specific plans at the time.

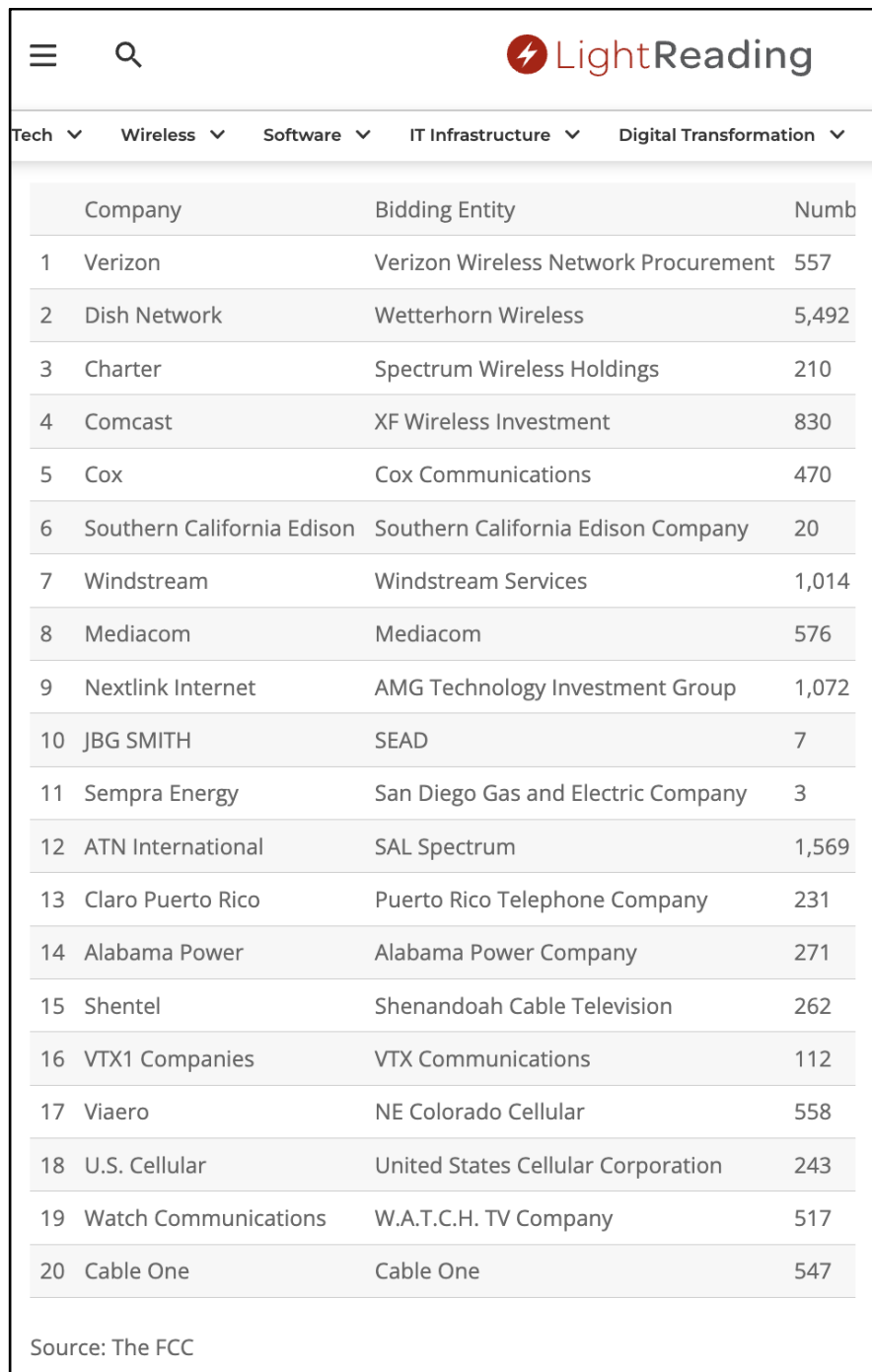
Beyond the major players, the auction attracted diverse bidders among over 200 winners, including smaller cable operators like Cable One, Shentel, and Mediacom, and telecom providers like Windstream and U.S. Cellular, who likely aimed to enhance mobile or fixed wireless services.¹⁶⁹ Unexpected participants, such as utility providers (Sempra Energy, Southern California Edison, Alabama Power) and real estate firm JBG SMITH, also secured

¹⁶⁷ FCC, Auction 105 Results, <https://auctiondata.fcc.gov/public/projects/auction105/reports/bids>.

¹⁶⁸ Mike Dano, "Verizon, Dish, Charter, Comcast: Here Are The 20 Biggest CBRS Auction Winners", LightReading, Sept. 2, 2020, <https://www.lightreading.com/5g/verizon-dish-charter-comcast-here-are-the-20-biggest-cbrs-auction-winners>.

¹⁶⁹ Id.

spectrum, eyeing private wireless networks for utility monitoring or indoor connectivity.¹⁷⁰ The auction's broad participation highlights the CBRS band's versatility for 5G, IoT, and private network applications.



	Company	Bidding Entity	Numb
1	Verizon	Verizon Wireless Network Procurement	557
2	Dish Network	Wetterhorn Wireless	5,492
3	Charter	Spectrum Wireless Holdings	210
4	Comcast	XF Wireless Investment	830
5	Cox	Cox Communications	470
6	Southern California Edison	Southern California Edison Company	20
7	Windstream	Windstream Services	1,014
8	Mediacom	Mediacom	576
9	Nextlink Internet	AMG Technology Investment Group	1,072
10	JBG SMITH	SEAD	7
11	Sempra Energy	San Diego Gas and Electric Company	3
12	ATN International	SAL Spectrum	1,569
13	Claro Puerto Rico	Puerto Rico Telephone Company	231
14	Alabama Power	Alabama Power Company	271
15	Shentel	Shenandoah Cable Television	262
16	VTX1 Companies	VTX Communications	112
17	Viaero	NE Colorado Cellular	558
18	U.S. Cellular	United States Cellular Corporation	243
19	Watch Communications	W.A.T.C.H. TV Company	517
20	Cable One	Cable One	547

Source: The FCC

Figure 7.8. Twenty Biggest CBRS Auction Winners¹⁷¹

¹⁷⁰ Id.

¹⁷¹ Mike Dano, "Verizon, Dish, Charter, Comcast: Here are the 20 biggest CBRS Auction Winners," Sept. 2, 2020, LightReading, <https://www.lightreading.com/5g/verizon-dish-charter-comcast-here-are-the-20-biggest-cbrs-auction-winners>.



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Evolving Spectrum-Sharing Regulation through Data-, Science-, and Technology-Driven Analysis and Decision-Making

Citizens Broadband Radio Service

How NTIA, the FCC, DoD, and Industry worked together to create a successful framework for sharing spectrum between Federal and commercial incumbents, new licensed entrants, and new unlicensed entrants.

Analyst at the Institute
for Telecommunication Sciences (ITS),

Rebecca Dorch
Senior Spectrum Policy Analyst



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Figure 7.9. ISART 2022: Citizens Broadband Radio Service (CBRS) as a Case Study¹⁷²

7.3.3. CBRS Device Deployment

In the years since CBRS was established, a few studies have tracked the usage and deployment on the CBRS bands. In November 2024, the NTIA issued a report on aggregate CBRS data between 2021 and 2024.¹⁷³

¹⁷² ISART 2022, Putting the Spectrum Sharing Regulatory Process All Together – CBRS as a Case Study, Rebecca Dorch, <https://www.youtube.com/watch?v=n8x6NhOk3Cs>.

¹⁷³ NTIA, Douglas M. Boulware and Anthony W. Romaniello, “An Analysis of Aggregate CBRS SAS Data from April 2021 to July 2024,” NTIA Report 25–575, <https://www.ntia.gov/report/2024/analysis-aggregate-cbrs-sas-data-april-2021-july-2024>; and <https://www.ntia.gov/sites/default/files/reports/an-analysis-of-aggregate-cbrs-sas-data-from-april-2021-to-july-2024.pdf>.

An Analysis of Aggregate CBRS SAS Data from April 2021 to July 2024

**Douglas M. Boulware
Anthony W. Romaniello**



Technical Report

Figure 7.10. NTIA Aggregate CBRS SAS Data Report 2021–2024¹⁷⁴

¹⁷⁴ Id.

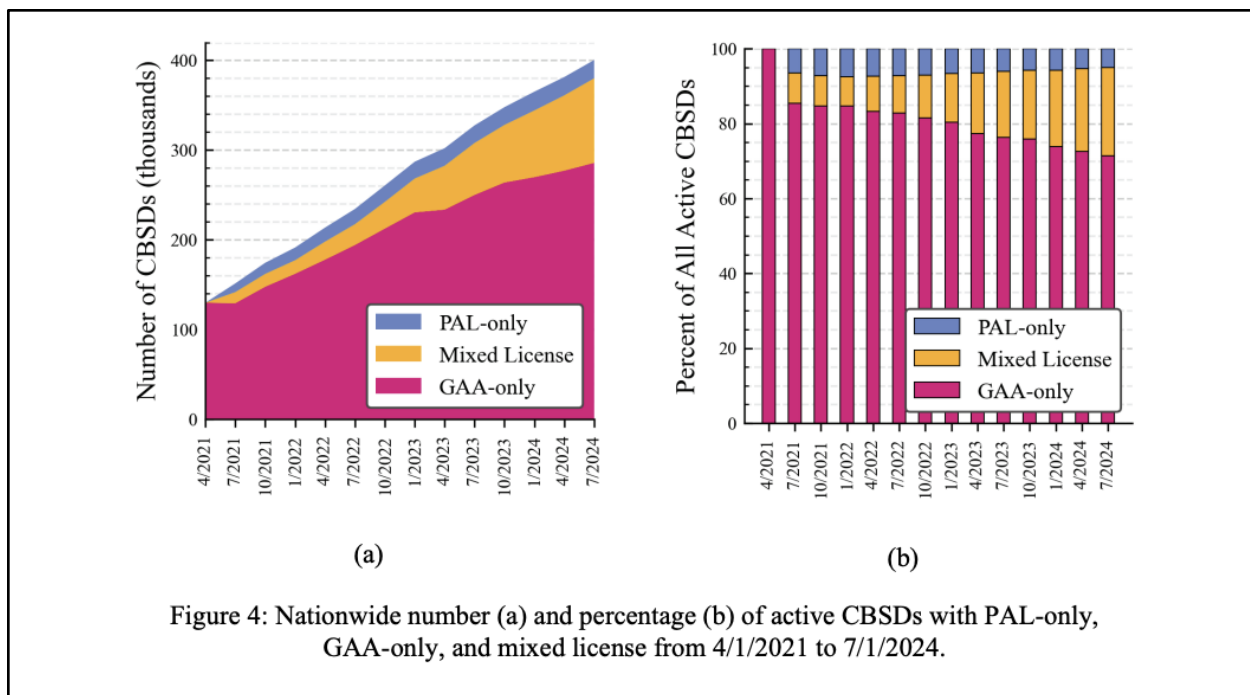


Figure 7.11. Nationwide Number of Active CBRS Devices¹⁷⁵

¹⁷⁵ Id. at 4.

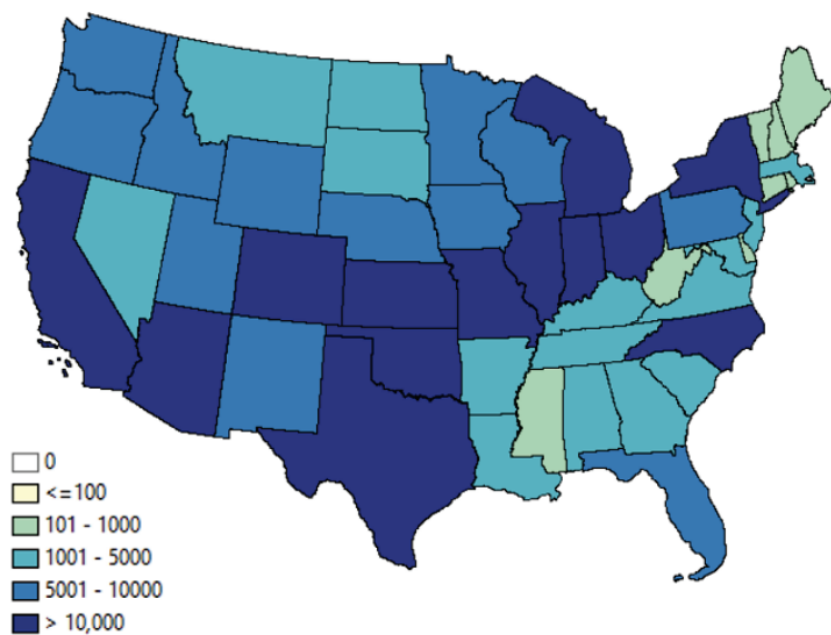


Figure 19: Number of active CBSDs by state for CONUS on 7/1/2024.

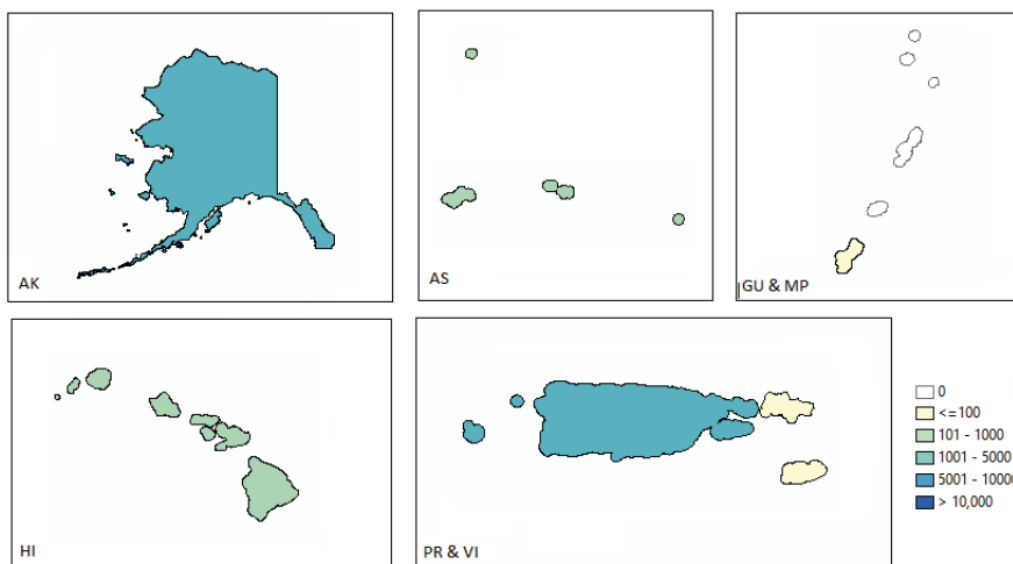


Figure 20: Number of active CBSDs by state and island area for OCONUS on 7/1/2024.

Figure 7.12. Map of Active CBRS Devices by State¹⁷⁶

¹⁷⁶ Id. at 19.

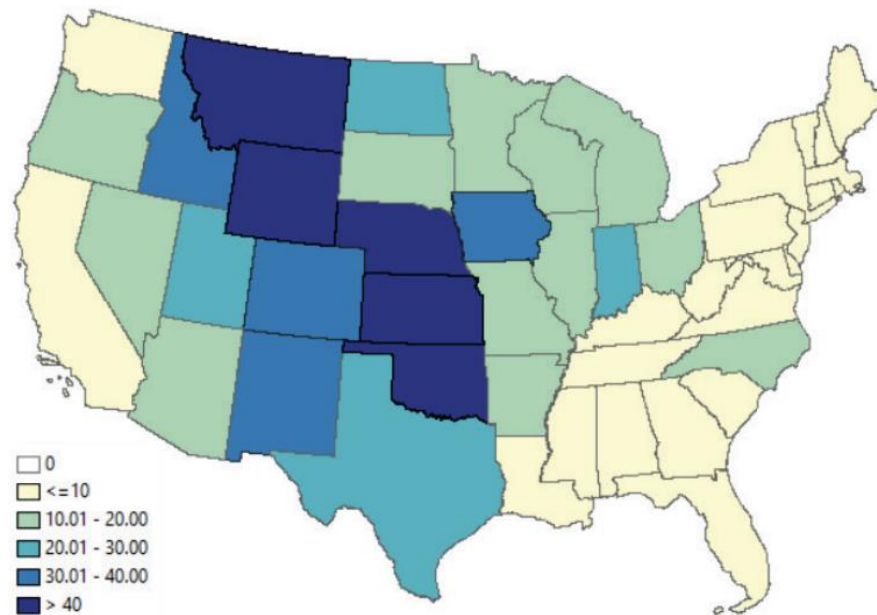


Figure 23: Number of active CBSDs per 10,000 people by state for CONUS on 7/1/2024.

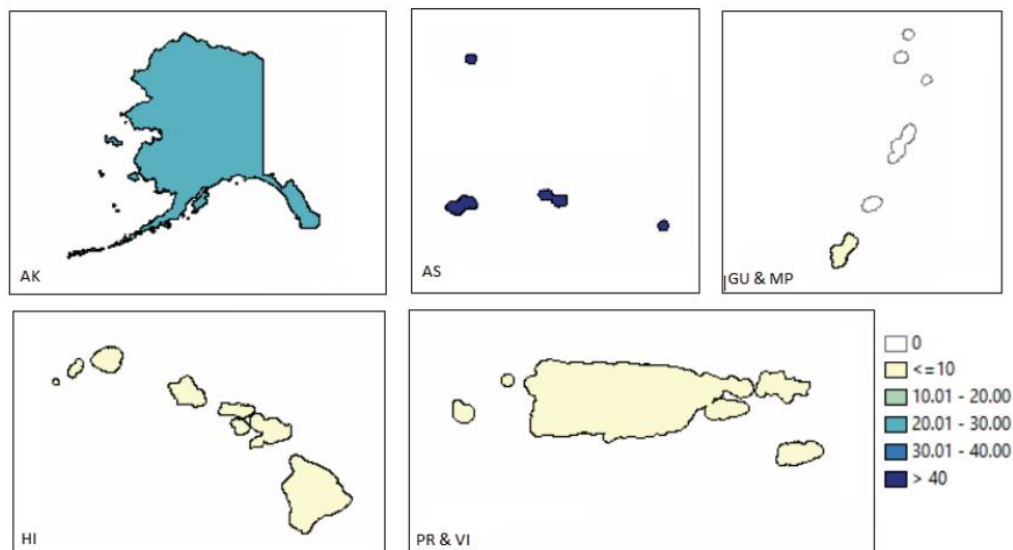


Figure 24: Number of active CBSDs per 10,000 people by state and island area for OCONUS on 7/1/2024.

Figure 7.13. Map of Active CBRS Devices by State by 10,000 People¹⁷⁷

¹⁷⁷ Id. at 21.

7.4. In the News

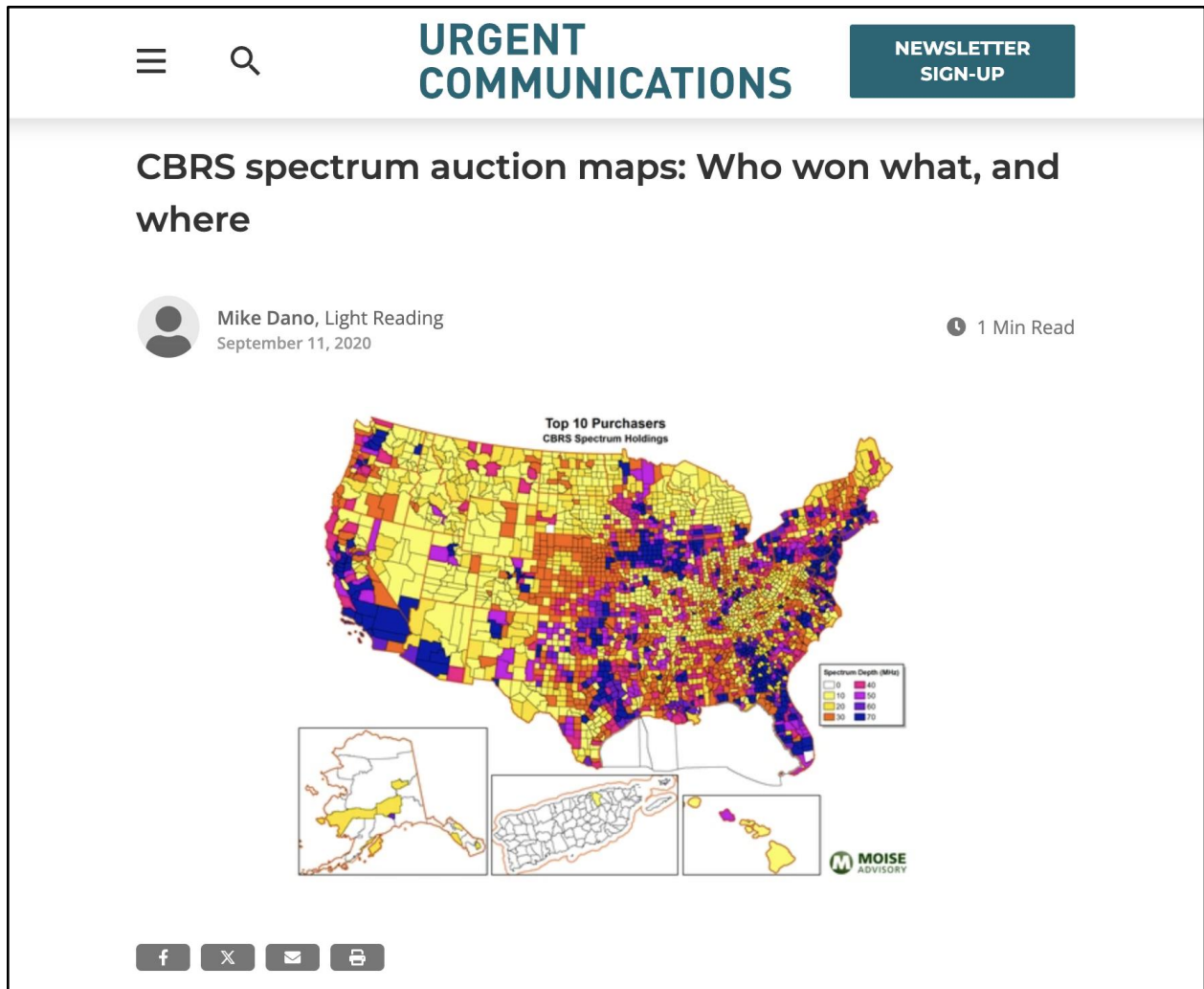


Figure 7.14. CBRS Spectrum Auction Maps¹⁷⁸

¹⁷⁸ Mike Dano, "CBRS Spectrum Auction Maps: Who Won What, and Where", Urgent Communications, Sept. 11, 2020, <https://urgentcomm.com/coverage-interference/cbrs-spectrum-auction-maps-who-won-what-and-where>.



DoD reportedly enlists in AT&T's plan to blow up CBRS band

A new proposal from the Pentagon would move existing CBRS spectrum users – including Charter and Comcast – to another band. That would free up 100MHz of spectrum for 5G.



Mike Dano, Editorial Director, 5G & Mobile Strategies

May 1, 2025

4 Min Read



(SOURCE: JEREMY CHRISTENSEN/ALAMY STOCK PHOTO)



The US Department of Defense (DoD) reportedly has signed on to AT&T's proposal to move existing 3.5GHz CBRS users to another band so that the band can be re-allocated to 5G.

The move would represent a blow to the nation's existing CBRS spectrum users, most notably cable companies like Comcast and Charter Communications. Charter's CEO Chris Winfrey recently said the company has reached the "full deployment phase" for its planned CBRS network, having deployed thousands of CBRS radios in parts of North Carolina, Alabama and Georgia. However, the cable industry's overall usage of CBRS so far remains relatively low.

Figure 7.15, Proposal to Reallocate CBRS to Flexible Use¹⁷⁹

¹⁷⁹ Mike Dano, "DoD Reportedly Enlists in AT&T's Plan to Blow Up CBRS Band," Light Reading, May 1, 2025, <https://www.lightreading.com/5g/dod-reportedly-enlists-in-at-t-s-plan-to-blow-up-cbrs-band>.

7.5. Assignment

Fill in the Blank

Read the 2024 CBRS Report from NTIA. NTIA, Douglas M. Boulware and Anthony W. Romaniello, "An Analysis of Aggregate CBRS SAS Data from April 2021 to July 2024," NTIA Report 25-575, <https://www.ntia.gov/report/2024/analysis-aggregate-cbrs-sas-data-april-2021-july-2024>; and <https://www.ntia.gov/sites/default/files/reports/an-analysis-of-aggregate-cbrs-sas-data-from-april-2021-to-july-2024.pdf>.

Does the band look like it has successful deployments? Is it a good use of the spectrum? How would you evaluate spectrum efficiency or the opportunity costs of using the spectrum a different way?

7.6. Reading List

File Attachment

- NTIA, Douglas M. Boulware and Anthony W. Romaniello, "An Analysis of Aggregate CBRS SAS Data from April 2021 to July 2024," NTIA Report 25-575, <https://www.ntia.gov/report/2024/analysis-aggregate-cbrs-sas-data-april-2021-july-2024>; and <https://www.ntia.gov/sites/default/files/reports/an-analysis-of-aggregate-cbrs-sas-data-from-april-2021-to-july-2024.pdf>.

8. Mid-Term Exam and Final Exam - Without Answers

The course will include a mid-term and final assessment and an essay assignment. The mid-term will be ten true/false questions after Lecture 3 and the final assessment will be twenty multiple choice questions after Lecture 7.

8.1. Mid-Term Exam - True or False

1. The FCC and NTIA have joint jurisdiction of federal and non-federal spectrum.
2. Radio astronomy is resilient to radio frequency interference from satellite and space development because of its large array antennas and highly specialized radio engineers.
3. The Office of Science and Technology Policy coordinates executive direction for federal spectrum policy from the White House while the NTIA is a subagency within the U.S. Department of Commerce. Both are important for directing interagency spectrum coordination.

4. The NTIA has a manual called a “bluebook” that contains regulations and policies around federal agency management of radio spectrum.
5. Congressional involvement is needed in national spectrum policy with the committees that do the most oversight being the U.S. House of Representatives Energy and Commerce Committee Subcommittee on Communications and the Senate Commerce Committee Subcommittee on Telecommunications.
6. The National Spectrum Strategy of 2024 was followed by an Implementation Plan and a Research and Development Plan which further described the steps that the federal government would take to conduct studies and find additional spectrum.
7. The only way that industry stakeholders and organizations can give input into federal spectrum policy is by visiting the FCC and NTIA regulators and conducting meetings.
8. The FCC conducts lotteries to determine among many competing radio spectrum users who should get which bands and what frequencies and what the terms of those licenses will be.
9. The NTIA relies on the Interdepartment Radio Advisory Committee (IRAC) to run auctions between federal agencies to determine who gets which spectrum bands and for what time frames they are permitted to use the spectrum.
10. The Commerce Spectrum Management Advisory Committee (CSMAC) advises the Assistant Secretary for Communications and Information at NTIA. It’s a group of 30 spectrum experts appointed as "Special Government Employees," from outside the Federal government.

8.2. Final Exam - True or False

1. The FCC’s Experimental Licensing regime allows spectrum users to access any spectrum bands just as long as their use is low power and for short periods of time.
2. The Citizens Broadband Radio Service has four tiers that gives amateur radio users access to all of the CBRS bands at lower power, with three other tiers for general, priority access, and incumbent fixed services.
3. The CBRS spectrum bands were allocated through a lottery in order to make sure that spectrum users had fair access to the areas around incumbents such as military radar units on the coasts.
4. The United States’ involvement in the ITU WRC meetings is voluntary and not required for satellite spectrum licenses since nations can allocate spectrum in their borders without international law.
5. The WRC meetings are held in Geneva, Switzerland each year in a neutral location in order for countries to be on level footing.
6. The United States sends a delegation to the WRC meetings with many different policy positions since there are many different industries represented. Each company argues for its own positions at the meetings and negotiates privately.
7. The WRC meetings that are held every 4 years are the only meetings where decisions are made, regional meetings such as CITEL PCC.II are not important.
8. The Congressional Budget Office with its spectrum valuation expertise runs spectrum auctions for the FCC and NTIA.
9. The United States has run spectrum auctions since 2004 when computing power was powerful enough to handle the second price auctions and billions of dollars of bids.

10. Anyone can file a comment in the FCC or NTIA's regulatory dockets when they ask for comments on rulemaking proceedings.
11. The FCC reads every comment and takes them into account in rulemaking proceedings, but sets guidelines for what makes an effective comment with substantive recommendations, evidence, expert reports, and legal support.
12. If a federal agency makes decisions beyond the scope of their statutory authority or in an arbitrary and capricious manner, the only recourse is to vote the elected officials out of office and to change the rules after an election.
13. Congressional oversight is occasional and not as impactful as the agency actions and White House OSTP reports.
14. The White House Office of Science and Technology Policy plays a leading role in coordinating the President's spectrum policy agenda.
15. The National Security Council does not participate in spectrum policy decisions.
16. The Office of Management and Budget is responsible for spectrum asset valuation and decisions related to the Spectrum Relocation Fund.
17. The Spectrum Relocation Fund was established in 2015 to fund commercial spectrum expansion.
18. The SRF was created to help federal agencies cover costs related to moving off certain spectrum bands to allow commercial use.
19. Direct satellite-to-cell phone communication uses signal levels approximately 10,000 times stronger than those used by SpaceX for home broadband.
20. Orbiting Earth-mapping radars pose no threat to radio astronomy because they operate at completely different frequencies.

9. Mid-Term Exam and Final Exam – With Answers

The course will include a mid-term and final assessment and an essay assignment. The mid-term will be ten true/false questions and the final assessment will be twenty multiple choice questions.

9.1. Mid-Term Exam

1. The FCC and NTIA have joint jurisdiction of federal and non-federal spectrum. True or False? (False. NTIA has jurisdiction over federal spectrum and FCC has jurisdiction over non-federal spectrum with a memorandum of understanding for coordination between the two)
2. Radio astronomy is resilient to radio frequency interference from satellite and space development because of its large array antennas and highly specialized radio engineers. (False. Radio astronomy requires quiet zones for highly sensitive antennas that are able to detect light and electromagnetic waves from distant planets and constellations.)
3. The Office of Science and Technology Policy coordinates executive direction for federal spectrum policy from the White House while the NTIA is a subagency within the U.S. Department of Commerce. Both are important for directing interagency spectrum coordination. (True. While the Secretary of Commerce directs the NTIA which has an administrator, there are many occasions where the

White House weighs in on decisions between agencies such as the Department of Defense and sets national policy.)

4. The NTIA has a manual called a “bluebook” that contains regulations and policies around federal agency management of radio spectrum. (False. It’s a manual called the “redbook”).
5. Congressional involvement is needed in national spectrum policy with the committees that do the most oversight being the U.S. House of Representatives Energy and Commerce Committee Subcommittee on Communications and the Senate Commerce Committee Subcommittee on Telecommunications. (True. These two subcommittees are the main committees for spectrum policy oversight and legislation).
6. The National Spectrum Strategy of 2024 was followed by an Implementation Plan and a Research and Development Plan which further described the steps that the federal government would take to conduct studies and find additional spectrum. (True. The Implementation Plan and Research and Development Plan were released in the months following the National Spectrum Strategy.)
7. The only way that industry stakeholders and organizations can give input into federal spectrum policy is by visiting the FCC and NTIA regulators and conducting meetings. (False. The administrative process mostly involves administrative filings and comments in the FCC’s Electronic Comment Filing System and the NTIA’s regulatory docket).
8. The FCC conducts lotteries to determine among many competing radio spectrum users who should get which bands and what frequencies and what the terms of those licenses will be. (False. Since 1994, the FCC has conducted spectrum auctions rather than lotteries to allocate spectrum licenses to non-federal uses).
9. The NTIA relies on the Interdepartment Radio Advisory Committee (IRAC) to run auctions between federal agencies to determine who gets which spectrum bands and for what time frames they are permitted to use the spectrum. (False. Federal spectrum is not auctioned by the IRAC, but the IRAC runs an internal process to determine spectrum allocations among federal users).
10. The Commerce Spectrum Management Advisory Committee (CSMAC) advises the Assistant Secretary for Communications and Information at NTIA. It’s a group of 30 spectrum experts appointed as “Special Government Employees,” from outside the Federal government. (True. Federal spectrum policy involves many industry stakeholders whether they are neighboring users of spectrum or whether they are developers of technology used by the federal government and committees such as CSMAC are important ways that industry can advise policymakers at NTIA).

9.2. Final Exam

1. The FCC’s Experimental Licensing regime allows spectrum users to access any spectrum bands just as long as their use is low power and for short periods of time. (False. Applicants need to apply to use certain bands and can gain Special Temporary Authority to use the spectrum without interference to licensed users)
2. The Citizens Broadband Radio Service has four tiers that gives amateur radio users access to all of the CBRS bands at lower power, with three other tiers for general, priority access, and incumbent fixed services. (False. There are only three tiers in the CBRS sharing regime, amateur radio users are not in the scheme).

3. The CBRS spectrum bands were allocated through a lottery in order to make sure that spectrum users had fair access to the areas around incumbents such as military radar units on the coasts. (False. The FCC held Auction 105 to auction the CBRS bands.)
4. The United States' involvement in the ITU WRC meetings is voluntary and not required for satellite spectrum licenses since nations can allocate spectrum in their borders without international law. (False. While terrestrial spectrum is within nation-state borders, the ITU WRC meetings are where global satellite spectrum rights are allocated since satellites orbit around the globe. While satellites may have license to transmit in certain regions, they use the airspace above the earth in a shared manner.)
5. The WRC meetings are held in Geneva, Switzerland each year in a neutral location in order for countries to be on level footing. (False. The WRC meetings used to be held in Geneva, but the host country pays the costs of hosting the conference and in the last decade or so, the conference has moved from host city to host city. The location for WRC-27 is still to be determined.)
6. The United States sends a delegation to the WRC meetings with many different policy positions since there are many different industries represented. Each company argues for its own positions at the meetings and negotiates privately. (False. The WRC is a treaty-level meeting where the United States sends a delegation led by the State Department in coordination with the federal agencies and industry participants. Decisions are made to affect the United States as a country and not for companies independently.)
7. The WRC meetings that are held every 4 years are the only meetings where decisions are made, regional meetings such as CITEL PCC.II are not important. (False. The regional meetings that are held in between WRC meetings are important for regions to make decisions that will be brought as regions to the WRC meetings.)
8. The Congressional Budget Office with its spectrum valuation expertise runs spectrum auctions for the FCC and NTIA. (False. Spectrum auction authority is authorized by Congress and granted to the Federal Communications Commission by statute. The NTIA or CBO do not run spectrum auctions.)
9. The United States has run spectrum auctions since 2004 when computing power was powerful enough to handle the second price auctions and billions of dollars of bids. (False. Spectrum auctions started in 1994 and were codified in the 1996 Telecommunications Act.)
10. Anyone can file a comment in the FCC or NTIA's regulatory dockets when they ask for comments on rulemaking proceedings. (True. The FCC established an Express Docket in order to help citizens with short comments submit their feedback into the record.)
11. The FCC reads every comment and takes them into account in rulemaking proceedings, but sets guidelines for what makes an effective comment with substantive recommendations, evidence, expert reports, and legal support. (True. The Administrative Procedure Act governs the federal rulemaking process and directs the FCC to receive comments on rulemaking proceedings).
12. If a federal agency makes decisions beyond the scope of their statutory authority or in an arbitrary and capricious manner, the only recourse is to vote the elected officials out of office and to change the rules after an election. (False. Under the Administrative Procedure Act, the harmed party can bring a federal lawsuit against

an agency to dispute its rulemaking decision. The agency can then defend itself and appeals can go up through the federal appellate courts and all the way to the Supreme Court.)

13. Congressional oversight is occasional and not as impactful as the agency actions and White House OSTP reports. (False. Congress plays an important role in drafting legislation to direct the federal agencies in finding spectrum for auction such as mid-band or unlicensed bands.)
14. The White House Office of Science and Technology Policy plays a leading role in coordinating the President's spectrum policy agenda. (True. The OSTP is typically the office with spectrum policy expertise from the White House.)
15. The National Security Council does not participate in spectrum policy decisions. (False. It does play a role, particularly in coordinating with the Department of Defense and public safety agencies.)
16. The Office of Management and Budget is responsible for spectrum asset valuation and decisions related to the Spectrum Relocation Fund. (True. OMB has traditionally been an important office for budget assessment of federal spectrum assets and reallocation. The Spectrum Relocation Fund is the collection of proceeds from auctioning federal spectrum for reallocation to commercial use.)
17. The Spectrum Relocation Fund was established in 2015 to fund commercial spectrum expansion. (False. The SRF was created in 2004, and amended in 2015.)
18. The SRF was created to help federal agencies cover costs related to moving off certain spectrum bands to allow commercial use. (True. The federal government has unused or underused spectrum that could be used more efficiently by the commercial sector, and when those bands are auctioned off, the Spectrum Relocation Fund would help federal agencies replace and upgrade their radio equipment.)
19. Direct satellite-to-cell phone communication uses signal levels approximately 10,000 times stronger than those used by SpaceX for home broadband. (True. There are concerns for interference from higher powered radio users disrupting passive radio observation.)
20. Orbiting Earth-mapping radars pose no threat to radio astronomy because they operate at completely different frequencies. (False. They pose a significant threat and can damage receivers if not properly coordinated.)

10. Essay Assignment

The course will include an essay assignment on global spectrum policy.

Write an essay on the institutions governing spectrum policy at the federal and international level. Discuss the division of responsibilities for spectrum management between the FCC and NTIA, and analyze how coordination is achieved between federal and non-federal spectrum users. In your answer, address the roles of the White House, Congress, advisory committees such as CSMAC and IRAC, and the administrative processes for public and industry input. Provide examples of both collaboration and conflict in spectrum management, and reflect on the significance of recent policy

initiatives like the National Spectrum Strategy of 2024 and its subsequent implementation plans.