PRESIDENTIAL TRANSITION: PRIORITY TOPIC MEMO
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MITRE | Center for Data-Driven Policy

INNOVATING SPECTRUM MANAGEMENT FOR NATIONAL SECURITY AND ECONOMIC PROSPERITY

By leading spectrum management reform, the next administration will secure national safety, drive economic growth, and enhance U.S. global leadership.

The Case for Action

Electromagnetic spectrum is a critical national resource, required for wireless telecommunications and radio services, making it vital to our nation's economy, global competitiveness, and national security. Modern society depends on reliable spectrum access for a wide array of functions, from text messages, telephone calls, and social media to GPS navigation, web browsing, safe air travel, weather forecasting, public safety, national security, autonomous vehicles, and space exploration. Spectrum use is integral to nearly every aspect of daily life.

Currently, the spectrum management process faces challenges due to increasing demand and competition for access. Experts agree on the need for reform, but political challenges persist due to misaligned economic incentives. To address this, we need comprehensive solutions that integrate technological, economic, and policy strategies, enabling the United States to efficiently accommodate growing spectrum demands.

Dynamic spectrum sharing (DSS) is a spectrum sharing method that involves autonomously shifting spectrum access of independent systems rapidly to permit them to operate in close proximity in terms of frequency, space, and time, thereby preventing harmful interference. This presents a sustainable, whole-of-nation approach to optimizing spectrum resources that allows more efficient and effective use while supporting a diverse range of applications. By managing spectrum access to enable both active and passive users to coexist, we can meet increasing demand. Although challenging, this approach is achievable and necessary for future progress.

Key Challenges and Opportunities

The current spectrum management process is unsustainable, with increasing demand and competition making existing methods inadequate. Increasing spectrum access today involves relocating some or all federal users (incumbents) out of a particular band that had previously been reserved solely for federal use to auction the spectrum for commercial use. This process is slow, costly, and inflexible. Rapid spectrum access is crucial for maintaining competitiveness and security.

Challenges include political and economic barriers, with misaligned incentives creating tension between federal and commercial users. Additionally, new solutions need to advance from early stages of technological readiness to wide deployment.

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MITRE's mission-driven teams are dedicated to solving problems for a safer world. Through our public-private partnerships and federally funded R&D centers, we work across government and in partnership with industry to tackle challenges to the safety, stability, and well-being of our nation.

Opportunities lie in implementing advanced DSS solutions to offer more efficient and real-time resource allocation and capacity optimization. This approach supports diverse applications and enhances national security by prioritizing critical functions.

The next administration can drive change by leading efforts in spectrum innovation; fostering collaboration among stakeholders; and advancing the National Spectrum Strategy (NSS)[1] and its Implementation Plan,[2] which in Pillar 3 calls for "Unprecedented Spectrum Innovation, Access, and Management through Technology Development." By overcoming these challenges, the United States can secure its position as a global leader in spectrum management, thereby boosting its competitiveness and strengthening national security.

Data-Driven Recommendations to Improve Spectrum Sharing

1. PILOT A NATIONWIDE DSS PLATFORM

The NSS calls for a "moonshot" effort to advance research in DSS, highlighting the need for common spectrum platforms with band-specific use cases. The U.S. government should collaborate with industry and other countries to scale this effort into a nationwide pilot with international interoperability, initially in one band and then expanding to other bands. Advanced sharing solutions should enable dynamic resource allocation, real-time network issue detection, and capacity optimization. Effective sharing requires assessing interference risks to national security systems, prioritizing spectrum use, and mapping dependencies on frequency bands.

2. DEVELOP A REGIONAL ARTIFICIAL INTELLIGENCE (AI)–ENABLED OPEN INTERFACE–BASED DSS SOLUTION BY 2030

The government is funding efforts to use open interfaces to integrate 5G/6G radio access networks (RANs)[3,4] for multiple use cases, but these use cases are not currently focused on spectrum sharing. The test infrastructure built for these efforts could be leveraged to test AI-enabled applications for DSS. We recommend resourcing and incentivizing the regional deployment of an open-interface RAN with AI embedded in every layer of the architecture stack. This will prototype DSS between incumbents and 5G networks.

3. ENCOURAGE PRIVATE INVESTMENT IN ADVANCED TECHNOLOGIES

Promote investment in advanced antennas, cognitive transceivers, open interfaces, and radio frequency (RF) microelectronics. This will enable commercial entities to use AI/machine learning (ML)–enabled open-interface RANs (O/AI-RAN) to autonomously manage spectrum usage, minimizing the impact on incumbent operations in congested environments domestically and contested environments internationally.

4. REAFFIRM SUPPORT FOR THE ARTEMIS ACCORDS AND LUNANET

Establish U.S. leadership in lunar infrastructure development by supporting the Artemis Accords and LunaNet. This will position the United States at the forefront of position, navigation, and timing (PNT) and networking, systems, and standards—similar to the role that the Global Positioning System (GPS) and the internet play on Earth.

5. REINVIGORATE RECEIVER STANDARDS TO REDUCE SUSCEPTIBILITY TO INTERFERENCE FROM ADJACENT BANDS

Although interference from adjacent bands cannot be managed by typical in-band sharing solutions, improving receiver standards can significantly reduce this interference. Establish clear guidance for receiver design and procurement, supported by standards, testing methods, and recommended best practices to proactively avoid interference issues.

6. STRENGTHEN COLLABORATION WITH STAKEHOLDERS

Develop a more efficient process for collaboration that prioritizes U.S. interests and extends globally to influence international spectrum decisions. Use technical and social science data, multi-partner engagement, and decision-analysis practices to align stakeholder groups and form sustainable public-private partnerships. Internationally harmonized solutions will benefit globally interdependent industries like civil aviation and equipment manufacturing and will improve interoperability for multi-national military operations.

Implementation Considerations

Implementing the proposed recommendations will face challenges related to consensus building, funding, and advancing technology readiness from early stages to wide deployment. To address these challenges effectively, the next administration can take the following actions.

SHORT TERM
START NOW: IMPACT EXPECTED IN ONE TO TWO YEARS

1. **REAUTHORIZE THE FEDERAL COMMUNICATIONS COMMISSION (FCC)'S AUCTION AUTHORITY**
   Auctions serve as a mechanism to efficiently assign spectrum licenses. This is an important economic and policy tool to both exclusive licensing, as shown by the C-band auction,[5] as well as spectrum sharing, as demonstrated by the Citizens Broadband Radio Service (CBRS) and 3.45–3.55 GHz auctions. This authority should be untangled from other legislative proposals and political issues.

2. **LEVERAGE ONGOING NSS EFFORTS**
   Establish a collaboration environment focused on building and deploying a technical solution accepted by multiple stakeholders. Radio Dynamic Zones (RDZs) enable automatic spectrum management. As part of the National Science Foundation Spectrum Innovation Initiative: National Radio Dynamic Zones (NRDZ) program, MITRE's NRDZ-as-a-Service will support RDZ creation to protect incumbents and experimenters from interference. This should be a collaborative effort, co-led by the National Telecommunications and Information Administration (NTIA) and FCC, with participation from other federal agencies, industry representatives, and other key stakeholders (e.g., state, local, and tribal governments).

3. **INCENTIVIZE ADOPTION OF O/AI-RAN**
   Align with recent initiatives, such as NTIA's 2023 Notice of Funding Opportunity (NOFO)[6] on Open RAN R&D and testing, and incentivize adoption of O/AI-RAN as the best technical approach to implement spectrum sharing. Focus funding opportunities on spectrum-sharing initiatives leveraging O/AI-RAN. Support international collaborative standards-setting bodies like the O-RAN Alliance and the Artificial Intelligence – RAN Alliance.

LONG TERM
START NOW: IMPACT EXPECTED IN THREE OR MORE YEARS

1. **DEVELOP A PLAN FOR TRUSTED INFORMATION SHARING**
   Address national security, proprietary information, and cybersecurity vulnerabilities for nationwide spectrum-sharing platforms. Key stakeholders include NTIA, FCC, Executive Office of the President, federal agencies, and industry representatives.

2. **BUILD AN ADVANCED COLLABORATION FRAMEWORK**
   Unite key stakeholder goals and align incentives with a playbook to aid implementation. Promote interdisciplinary research to further improve multistakeholder collaboration.

3. **CREATE A SANDBOX FOR ECONOMIC MODELS**
   The Department of Commerce (particularly NTIA) and the FCC should create a sandbox to test market dynamics of innovative economic models and incentives. This could include exploring federal revenue stream modeling and tradeoffs between dollar and payment streams, transaction costs, and potential taxation.

MITRE Resources and Support

MITRE offers unique expertise and resources to enhance the next administration's understanding and implementation of these recommended spectrum management reforms. Our deep knowledge of, and experience in, spectrum technologies, cloud computing, AI, ML, and big data analytics, as well as cybersecurity and risk assessment, enable us to be a valuable partner in advancing these data-driven recommendations.

- **Spectrum Convergence and 5G Platforms:** MITRE has collaborative lab environments for testing and evaluating new use cases, vertical markets, and interoperability among multi-vendor solutions to help address spectrum-sharing challenges for federal sponsors.
- **Certified Open Testing and Integration Center (OTIC):** As part of the O-RAN Alliance, MITRE delivers state-of-the art 5G systems and test equipment for comprehensive interoperability and security testing. We also use lessons learned and data-driven analyses from the OTIC to improve open, secure, and interoperable networks in the public interest.

- **Whole-of-Nation Approach:** Through our Assemble™ workflow, MITRE fosters collaboration among government, industry, nonprofits, and academia, which can be applied to bridge the gap between traditional static spectrum access and DSS.
- **Economic, Policy, and Regulation Capabilities:** MITRE has a suite of data-driven capabilities to facilitate economic performance and technology policy decisions:
  - **Policy Platform:** Focuses on innovating how government agencies generate policy, including domestic and international spectrum policy and regulation
  - **Spectrum Valuation Tool:** Forecasts the potential market (i.e., auction) value of spectrum based on specific bands and circumstances[7]
  - **Spectrum Macroeconomic Model:** Estimates national economic impacts of spectrum decisions (e.g., impact on GDP)[8]
- **Risk Assessment:** MITRE supports data-driven decisions with tools like the ATT&CK® (Adversarial Tactics, Techniques, and Common Knowledge) framework[9] for developing threat models and enhancing cybersecurity measures. The FiGHT™ (5G Hierarchy of Threats) framework[10] assesses 5G security by identifying threats and necessary mitigations for secure systems and spectrum sharing. RISSM (Risk-Informed Spectrum Sharing Management) is a MITRE-developed capability that aids in addressing interference and risk factors in spectrum management through economic, decision theory, and engineering risk analysis. The System of Trust™ evaluates supply chain risks by defining supplier and product attributes, and recommending mitigations. Additionally, MITRE's NOPAS (Navigation Operational and Planning Agility Suite) detects GPS service loss and proposes alternative navigation solutions, assessing threats and suggesting mitigation strategies.

About the Center for Data-Driven Policy

The Center for Data-Driven Policy, bolstered by the extensive expertise of MITRE's approximately 10,000 employees, provides impartial, evidence-based, and nonpartisan insights to inform government policy decisions. MITRE, which operates several federally funded research and development centers, is prohibited from lobbying. Furthermore, we do not develop products, have no owners or shareholders, and do not compete with industry. This unique position, combined with MITRE's unwavering commitment to scientific integrity and to work in the public interest, empowers the Center to conduct thorough policy analyses free from political or commercial pressures that could influence our decision-making process, technical findings, or policy recommendations. This ensures our approach and recommendations remain genuinely objective and data-driven.

Connect with us at policy@mitre.org.

Endnotes

[1] https://www.ntia.gov/issues/national-spectrum-strategy

[2] https://www.whitehouse.gov/wp-content/uploads/2024/10/National-Spectrum-RD-Plan-2024.pdf

[3] https://about.dish.com/2024-01-10-DISH-Wireless-Awarded-50-Million-NTIA-Grant-for-5G-Open-RAN-Integration-and-Deployment-Center

[4] https://www.ntia.gov/press-release/2024/biden-harris-administration-awards-42m-wireless-innovation

[5] https://www.mitre.org/news-insights/publication/c-band-spectrum-auction-retrospective-and-prospective-observations

[6] https://www.ntia.gov/program/innovation-fund/grant-programs/round-1-2023/program-documentation/nofo-1

[7] S. S. M. Hanson, L. Z. Ribeiro, C. A. Kahn, J. McQueston, C. Freeberg, and S. L. Giles, "A Model for Spectrum Valuation," 2019 IEEE/AIAA 38th Digital Avionics Systems Conference (DASC), San Diego, CA, USA, 2019, pp. 1-9, doi: 10.1109/DASC43569.2019.9081695, https://ieeexplore.ieee.org/document/9081695

[8] C. Kahn, D. Brown, S. Hanson, Z. Hussein, J. McQueston, and H. Nam, "A Macroeconomic Model of Federal and Commercial Spectrum Usage," Journal of Information Policy 30 December 2022, 12, 387-431, https://doi.org/10.5325/jinfopoli.12.2022.0009

[9] https://attack.mitre.org/

[10] https://fight.mitre.org/