# The National Spectrum Strategy Should Include
# Coordinated Research, Workforce Components

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**Personal Introduction and Disclaimer**

My name is Dr. Nick Laneman. I am Center Director for SpectrumX, the National Science Foundation (NSF) Spectrum Innovation Center[1]. At the University of Notre Dame, I am Founding Director and currently Co-Director of the Wireless Institute[2] in the College of Engineering, and Professor in the Department of Electrical Engineering. Our Wireless Institute maintains memberships in the DoD National Spectrum Consortium[3] as well as the ATIS NextG Alliance[4], and I currently serve on the NextG Alliance Research Council. Finally, I am representing SpectrumX and Notre Dame through a recently-formulated Liaison role with the NTIA Institute for Telecommunication Sciences (ITS)[5].

Although my perspectives shared here have certainly been shaped by interactions with collaborators through these organizations, my comments are my own and do not necessarily reflect the views of any of the organizations with which I am affiliated or the sponsors that have provided funding for my work.

**Overall Recommendation:**

Based upon my experience engaging with the radio spectrum ecosystem and leading SpectrumX to date, I believe that a key component to the success of the National Spectrum Strategy and Implementation Plan will be a paradigm shift in the coordination of both research and development (R&D) activities as well as workforce development (WFD) efforts related to wireless technologies and spectrum management. In particular, I believe the US should create a National Coordination Office (NCO)[6] for Spectrum Innovation in the White House to proactively and holistically drive these two critical activities across government agencies, industry, and academia.

The NCO for Spectrum Innovation would not overstep the regulatory authority of the NTIA  or the FCC, nor would it overstep the funding authorities of the Executive Branch agencies. However, these agencies would help shape the NCO's common strategic, implementation, and

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[1] https://spectrumx.org/
[2] https://wireless.nd.edu/
[3] https://www.nationalspectrumconsortium.org/
[4] https://www.nextgalliance.org/
[5] https://its.ntia.gov/
[6] E. G. Blevins (2023). *The Office of Science and Technology Policy (OSTP): Overview and Issues for Congress* (CRS Report No. R47410). Retrieved from Congressional Research Service website: https://crsreports.congress.gov/product/pdf/R/R47410

assessment agendas and could leverage the outputs of its activities to execute their own responsibilities even more effectively.

**Challenges and Opportunities:**

As we heard during the NTIA Listening Sessions, many industries and sectors are expanding their use of wireless technologies, with futuristic applications, ever more connected people and things, utilizing wider bandwidths and higher frequencies, and putting tremendous pressure on access to the natural resource for wireless, the radio spectrum. The vibrant radio spectrum ecosystem in the US includes numerous innovative companies and industry associations, most federal agencies, key national and international regulators, and leading centers and institutes in academia. As the need for additional R&D, spectrum management, and policy engagement has grown, workforce needs have increasingly gone unmet. These circumstances present significant challenges, but also significant opportunities, to address in the National Spectrum Strategy.

There is a growing list of government entities engaged in research focused on wireless technologies, radio systems and applications, and spectrum management. Representative, though not necessarily exhaustive, examples include:

- NTIA Institute for Telecommunication Sciences (ITS)
- National Institute of Standards and Technology (NIST) Communication Technology Laboratory (CTL)
- Department of Defense (DoD) Labs
- DoD National Spectrum Consortium (NSC)
- Department of Energy (DoE) Labs
- National Aeronautics and Space Administration (NASA)
- National Aeronautics and Space Administration (NCAR)
- National Oceanic and Atmospheric Administration (NOAA)
- National Radio Astronomy Observatory (NRAO)
- NSF Platforms for Advanced Wireless Research (PAWR)
- NSF Spectrum Innovation Initiative (SII) Center (SpectrumX)
- NSF SII National Radio Dynamic Zones (NRDZ)
- NSF Technology, Innovation, and Partnerships (TIP) Directorate

With many of these activities being funded and managed separately, it has become increasingly challenging to track the landscape of spectrum-related R&D, to leverage existing results and facilities rather than potentially duplicating efforts, to identify gaps, and to invest more strategically. Further complicating these issues is the fact that multiple Congressional committees provide oversight for these organizations. Together with a growing number of wireless testbeds and data repositories, the case seems clear that there is an emerging Research and Development Infrastructure (RDI)[7] around Spectrum Innovation, and that strategy

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[7] National Science and Technology Council (2021). *National Strategic Overview for Research and Development Infrastructure*. Retrieved from the White House website: https://www.whitehouse.gov/wp-content/uploads/2021/10/NSTC-NSO-RDI-_REV_FINAL-10-2021.pdf

and coordination around it should be organized in a manner similar to that of other important RDIs. In particular, the NCO would enhance shared funding and use of research infrastructure, and would further promote technology transition from basic and applied research, to prototyping and testing, to commercialization, and to policy impact on an ongoing basis.

With a more coordinated, proactive approach, the NCO could help the ecosystem better anticipate spectrum coexistence issues and rally R&D resources to address priority needs, in particular short-term, focused studies to provide objective inputs to specific domestic and international regulatory proceedings. For example, the recent dust up about potential adjacent channel interference in the C-Band between new cellular 5G deployments and radar altimeters on aircraft could have been addressed earlier, for a less alarming and more cost-effective transition. Another issue closer to home for academic researchers like myself is that it can be quite challenging, even for significant investments like the NSF PAWR testbeds, to obtain experimental spectrum licenses to facilitate research on prototyping and testing of new technologies beyond the lab. Such prototyping and testing capabilities are critical for transitioning concepts from the lab to the marketplace.

Another critical challenge is attracting, preparing, and retaining a large and diverse workforce to fill the many career opportunities in the radio spectrum ecosystem as it evolves, particularly in the government. DoD, NASA, NIST, NTIA, and FCC are each actively recruiting for a substantial number of positions to support their day-to-day spectrum-related R&D, procurement, management, and policy work. Each agency would need additional staffing to support the coordination and collaboration activities envisioned here. DoD, NASA, and NSF are investing in workforce development already, but I believe these efforts would benefit from having the NCO address the problem in a centralized fashion. Furthermore, there is a recent trend that spectrum management is becoming more data-driven and automated, as evidenced by the developments of the Spectrum Access System (SAS) in the CBRS band, Automated Frequency Coordination (AFC) in the 6 GHz WiFi band, and the NTIA's envisioned Incumbent Informing Capability (IIC). This trend requires new skills in data science, machine learning, and cloud computing that far exceed the skills of today's spectrum workforce. Finally, a long standing issue is lack of a spectrum-focused Federal job series and distinct pay scale. Following along the line of the DHS "cybersecurity service" and "career guide"[8] could be a means for creating starting salary ranges that are more competitive with private industry as well as senior positions that pay more than the current Federal salary cap.

I acknowledge that the Networking and Information Technology Research and Development (NITRD)[9] NCO has existed for just over 30 years, and that the Wireless Spectrum Research and Development (WSRD)[10] Interagency Working Group (IWG) has been part of NITRD for just over 12 years. However, the scope of NITRD and the functions of WSRD have been too limited to achieve the levels of coordination that seem to be required in Spectrum Innovation for all use cases, especially for scientific uses as well as civil and defense applications beyond

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[8] https://dhscs.usajobs.gov/assets/pdf/Career_Level_Guide.pdf
[9] https://www.nitrd.gov/
[10] https://www.nitrd.gov/coordination-areas/wsrd/

telecommunications. There is no question that a number of valuable workshops and information-sharing meetings have been conducted by WSRD over the years, some of which have inspired significant program solicitations and funding. What I am suggesting is an elevated and broader mission for something like WSRD, with more substantial responsibilities and funding to accomplish its mission in the form of an NCO at a level similar to NITRD. Furthermore, based upon initial review, the NCO for Spectrum Innovation should borrow new elements from the National Quantum Coordination Office (NQCO)[11], including significant R&D centers, an industry consortium, education and workforce development activities, and public outreach.

**Detailed Recommendations:**

1. As with other NCOs, the coordination office should be managed through the National Science and Technology Council (NTSC), in the Office of Science and Technology Policy (OSTP) of the White House.

2. The NCO should be made responsible for developing a National Spectrum R&D Plan as well as the National Spectrum Workforce Plan through coordination across the radio spectrum ecosystem. These plans should include both strategic and implementation aspects, and should be assessed and updated at least annually in concert with the President's budget request to Congress.

3. The NCO should assist Federal agencies in developing long-term visions for future capabilities, new use cases, and spectrum requirements in consistent formats that can be readily compared with the already prevalent visions for commercial use cases. An important element of these plans should include opportunities to potentially reduce spectrum needs by leveraging other technologies and systems, including commercial deployments.

4. In addition to appropriate Advisory and Steering Committees, the NCO should include one or more Working Groups with representatives from Government, Industry, and Academia. Participants in these groups should be able to receive some support through the NCO in order to justify spending meaningful amounts of their time on these committees. Rather than precluding any individual because of potential or perceived conflicts of interest, the approach should be to include representatives from all stakeholders, even with their associated conflicts, and focus on balancing the groups.

5. The NCO should leverage and integrate, rather than replace, existing organizational structures and capabilities such as the DoD National Spectrum Consortium, NASCTN[12], NASA SPEARS[13], SpectrumX, and the Memorandum of Agreement between NTIA, FCC, and NSF[14].

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[11] https://www.quantum.gov/nqco/
[12] https://www.nist.gov/ctl/nasctn
[13] https://www.nasa.gov/directorates/heo/scan/spectrum/spears
[14] https://www.ntia.doc.gov/files/ntia/blogimages/sii_moa_fcc_nsf_ntia.pdf

6. The NCO should provide funding for technical, policy, and project management staff to support development of strategic plans and implementation plans; engage with stakeholders in government, academia, and industry; and assess and report on progress to the community. Some staff may be directly employed by the NCO, and available as rotators to assist agencies that are short staffed. Other staff may be contracted through their home agencies to support NCO functions.

7. The NCO should develop template terms and conditions for Cooperative Research and Development Agreements (CRADAs) that can accelerate collaborative work across stakeholders. These agreements should enable government staff to reserve time for coordination and collaboration efforts, and should provide funding support to academic faculty and students.

8. The NCO should lead the development of a Federal job series for the future spectrum workforce, and a distinct pay scale associated with such a job series.

9. The NCO should orchestrate and track the development of educational as well as training curricula to prepare learners for the Federal job series as well as spectrum-related careers in industry and academia.

10. The NCO should develop a national campaign to attract students and workers to the field of Spectrum Innovation generally and thereby enhance individual agency efforts. This program should collect statistics, develop promotional materials, organize events, and foster networking and mentoring.

**Summary:**

In summary, I believe that the levels of coordination around R&D and WFD necessary to create a sustainable National Spectrum Strategy and Implementation Plan will require a National Coordination Office (NCO) for Spectrum Innovation. I look forward to questions and discussions about these ideas.