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Request for Information on the National Spectrum Research and Development Plan

CableLabs

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Networking and Information Technology Research
and Development National Coordination Office
National Science Foundation
2415 Eisenhower Avenue
Alexandria, VA 22314

Re: *Request for Information on the National Spectrum Research and Development Plan*

CableLabs appreciates the opportunity to provide input to the Networking and Information Technology Research and Development (NITRD) National Coordination Office (NCO), National Science Foundation on the National Spectrum Research and Development Plan (R&D Plan). CableLabs, as the non-profit research and development lab for the broadband industry, is heavily invested in research and development (R&D) regarding spectrum and innovative uses.

We look forward to the recommendations made in the R&D plan for government investments in spectrum-related research covering critical innovation areas necessary to advance the United States' leadership in efficient and diverse uses of spectrum to benefit consumers and national security and address the questions posed in the Request for Information in the order presented.

1. **Recommendations on strategies for conducting spectrum research in a manner that minimizes unnecessary duplication, ensures that all essential spectrum research areas are sufficiently explored, and achieves measurable advancements in state-of-the-art spectrum science and engineering.**

CableLabs recommends that the federal government balance R&D funding among private sector interested parties including academia, non-profit R&D organizations, and the diverse set of wireless entities serving users via spectrum. CableLabs further recommends allocating spectrum R&D funding to non-Department of Defense agencies in order to increase the accessibility of funding by small or non-profit organizations and encourage R&D that advances consumer focused spectrum uses in addition to the unique DoD spectrum uses.

To encourage new R&D instead of repetitive R&D, a shared repository or database of R&D findings, measurements, and underlying data is key. This would not only avoid duplicative R&D but would enable a diverse set of stakeholders to identify new problems and R&D focus areas in a timely manner.

As discussed in the National Spectrum Strategy Implementation Plan and in our comments below, public access to data regarding spectrum usage (including across time, frequency, geographic location, and power levels) by Federal and non-Federal users is foundational to spectrum sharing and innovation R&D. Understanding the baseline of any spectrum band and the existing users is necessary to develop measurable advancements such as efficient and effective sharing mechanisms and new solutions for existing users to increase efficient use of spectrum.

2. Recommended priority areas for spectrum research and development, as well as productive directions for advancing the state-of-the-art in those areas.

CableLabs recommends the following areas in order of priority for research and development in the near term:

- **Dynamic spectrum access and management** are integral to implementing innovative sharing frameworks and enabling quicker deployment of non-Federal uses in the bands identified in the National Spectrum Strategy. In particular, the 3.1 GHz and 7/8 GHz bands identified in the National Spectrum Strategy represent good candidate bands for dynamic spectrum access and management systems to protect mission critical DoD systems while allowing co-existence of new non-Federal uses to benefit consumers. Following best practices for any spectrum band study, co-existence should always be studied in parallel to other proposed options.

  Dynamic spectrum access and management R&D work is already underway in the development of systems such as incumbent informing capabilities and further evolution to spectrum access systems (such as those used in the 3.5 GHz band) or contention-based protocols. By prioritizing improvements to these existing systems, the Federal government will enable results-based R&D that leads to real-world deployments of innovative spectrum use. This focus area should also include R&D to enable automatic and rapid mitigation of harmful interference problems as this is a core task of dynamic spectrum management systems.

  Dynamic spectrum access and management systems, including those with near-real time mitigation of harmful interference, can benefit from the use of artificial intelligence and machine learning. These tools can enable finely tuned propagation and protection models based on the local environment and the ability to consistently update and learn about changing factors.

- **Spectrum situational awareness at scale** does not exist today, creating a significant gap between those with access to certain information and those without access. Spectrum situational awareness is often unavailable to the private sector and the Federal government. There is no one data source that provides accurate information regarding the time, location, and frequency of spectrum use by existing users, nor technical parameters of deployments. This information is key to creating a baseline for focused modeling of sharing frameworks and efficiency improvements. We support the efforts detailed in the National Spectrum Strategy Implementation plan to close this gap with appropriate protections for classified information, with the request that as much information as possible is shared with non-Federal R&D participants and future spectrum access and management organizations.

- **Modeling for coexistence analysis** is key to sharing spectrum. As stated by the Department of Defense and the National Spectrum Strategy, sharing spectrum is the way forward. Modeling needs to be updated to reflect real world parameters and usage, including: spectrum situational awareness, less conservative propagation models that

reflect advances in the understanding of signal propagation, clutter, and diverse use cases. Deployment of new uses in the 6 GHz and 3.5 GHz bands revealed the importance of accurate modeling based on accurate data and the need to model innovative use cases, not the well-known standard high-power deployments. R&D exploring and implementing the lessons learned from these bands should be a priority in modeling.

- **Spectrum utilization efficiency** is a frequently identified concern. Certain spectrum use technology is reaching the end of its life cycle and spectrum users will only benefit from adoption of technological advances in spectrum utilization. Studies of efficiency of use are critical to determining sharing frameworks, modeling, new solutions, and could identify spectrum users who need federal funding to update spectrum use technology. This should include R&D for tools or techniques that allow existing or new spectrum use systems to become more resilient to interference from various sources. As detailed in the National Spectrum Strategy, the RF environment is currently crowded with only an increasing demand for additional spectrum to be shared for new uses leading to the need for these tools and techniques.

3. Recommendations on grand challenge problems for spectrum R&D.

As detailed above, the underlying issue creating significant barriers to all spectrum R&D is lack of information about existing spectrum use. Access to accurate and detailed information regarding current spectrum usage, including time, location, frequency, and technical parameters of deployments will be a game changer in multiple areas of spectrum research, a building block for creating new spectrum access and management systems, interference mitigation techniques, and enabling access to spectrum by new users more quickly.

Success or failure in this area is easy to measure and progress can be measured by data available for each band. Gathering and providing access to this information, in a system that protects classified information and allows real time updates by spectrum users requires a state-of-the-art solution.

4. Recommendations on spectrum R&D accelerators.

Shared public datasets are key to any future spectrum R&D projects. As we mentioned above, data regarding current spectrum utilization is critical not only to future spectrum sharing frameworks in specific bands, but also innovative technology solutions that will enable more efficient use of spectrum. The National Spectrum Strategy Implementation Plan focuses on collecting information from Federal spectrum users, but licensed private sector users should also be required to update spectrum usage and deployment data, whether through the Federal Communications Commission's Universal Licensing System or a new database that can host and provide information about all users in a particular band.

Benchmarks and competitions are a source of inspiration to the R&D community and eventual real-world spectrum users. These tools set expectations and goals that are measurable along with incentives to solving problems that may not warrant priority attention. CableLabs' experience hosting NTIA's 5G Challenge showed that competition participants are willing to reach stretch

goals, work in a collaborative manner, and contribute to the maturity of an ecosystem because they were provided a platform, technical support, and monetary incentives. Through the 5G Challenge, competitors participated in the first successful proof of an end-to-end mobility connection on a multi-vendor Open RAN system. Outside the 5G Challenge, these vendors had no reason to put resources into interoperability with other vendors or the goal of an end-to-end mobility connection. Similar achievements can be reached in the areas of dynamic spectrum sharing, access, management, and harmful interference mitigation if the proper tools, technical support, and incentives are provided to participants.

Testbeds, research infrastructure, and collaboration support can provide a similar incentive to parties to reach significant state-of-the-art successes in the area of spectrum R&D. Neutral testbeds that provide a platform and resources without bias towards a particular use case give the community an opportunity that individual parties may not have. This also directly leads to support for collaboration and ongoing coordination. Spectrum R&D projects do not cease at the end of a grant or contract. Instead, the lessons learned and protocols or technologies developed are to be shared with the larger ecosystem to advance new, efficient, and diverse uses of spectrum.

5. Recommendations on near-term Federal activities.

All of the recommendations above require significant resources, including funding, information technology infrastructure, process development, collaboration guidelines, and input from various stakeholders. Near-term the government can focus on providing accessible funding for R&D in priority areas as recommended by commenters and evaluated by NITRD NCO.

Collection of information from Federal agencies, as detailed in the National Spectrum Strategy Implementation Plan, and updates of private sector data can be accomplished in the near-term as well.

Setting up guidelines and infrastructure for coordination between Federal and non-Federal spectrum users and R&D organizations, with considerations of diversity of interests and the necessary protection of classified information is a near-term achievable task. The National Spectrum Strategy Implementation Plan proposes a structure that may limit the participation of interested stakeholders and that structure may need to be updated to encourage and facilitate R&D.

6. Recommendations on a process to refine and enhance the R&D plan on an ongoing basis.

Spectrum R&D, including problem statements and solutions, is incredibly dynamic. Therefore, the R&D Plan will need to be equally nimble to keep up with the new technologies and use cases released every year. We hope to see the R&D plan impact the spectrum R&D ecosystem early, thus we recommended seeking comment again in 18 months with the goal of updating the plan in 2 years, and on a regular schedule moving forward. The targeted questions in this RFI are a constructive framework for gathering information and the next round of comments could also focus on successes, failures, and lessons learned.

7. Proposed definition of "Dynamic Spectrum Sharing."

Spectrum sharing comes in many varieties, not all of which would be considered dynamic, but all bring an increased value to the use of spectrum and should be deployed based on the characteristics of each specific band and the nature of the critical incumbencies in that band. We recommend that a key component of "dynamic spectrum sharing" is the ability to accept and process data and make decisions in near real time and propose this definition:

> Coexistence of multiple use cases by distinct users in a particular band managed by a system with the information and authority to react near real time to the needs of priority users and mitigate harmful interference and can onboard new users in a timely manner.

Examples of dynamic spectrum sharing under this definition include incumbent informing capabilities with near real-time data inputs provided by sensing, or time, location, and frequency priority use reservation inputs; real-time sensing of spectrum usage; contention-based protocols; and any combination of those sharing mechanisms with a proper management system or management protocol.

Conclusion

CableLabs looks forward to the National Spectrum Strategy R&D Plan and the inspiring innovative results of future R&D in this area.

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Respectfully submitted,

/s Mark Walker
Mark Walker
Vice President, Technology Policy
CableLabs
[redacted]

/s Jessica Almond
Jessica Almond
Director, Technology Policy
CableLabs
[redacted]