Testimony of

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Before the

House Committee on Science, Space and Technology

Subcommittee on Technology and Innovation

On

"AVOIDING THE SPECTRUM CRUNCH: GROWING THE WIRELESS ECONOMY THROUGH INNOVATION"

April 18, 2012

Introduction

Chairman Quayle, Ranking Member Edwards, and members of the subcommittee, I want to thank you for the opportunity to testify before the House Science, Space, and Technology Subcommittee on Technology and Innovation. I realize the importance of this topic: "Avoiding the Spectrum Crunch: Growing the Wireless Economy through Innovation," and there is much at stake for the future national security and the economy, based on how the spectrum crisis is handled today.

My name is Dr. Rangam Subramanian. I am the Chief Wireless Strategist at the Idaho National Laboratory (INL), Idaho Falls, Idaho.

In my testimony today, I will address the following:

- Current status of the wireless spectrum situation in our nation
- Impact of limited wireless spectrum on America's global competitiveness
- The three major challenges to solving the wireless spectrum problem
- My role and opinions on the activities of the national Wireless Spectrum R&D (WSRD), Senior Steering Group (SSG) that was initiated by the White House, Office of the Science and Technology Policy (OSTP)
- The spectrum sharing research, experimentation, and demonstration capabilities at the INL supporting wireless innovation in the nation.

Current Status and Impact on Competitiveness:

Wireless spectrum is a limited natural resource. There is only so much spectrum available and yet the demand continues to grow. In fact, wireless communications is a critical common technology imperative that will greatly influence the growth of all key economic sectors, as well as our national security. Wireless spectrum crunch will impact the national defense systems, emergency and first responder communications, Smartgrid energy infrastructure, electric vehicles and intelligent transportation systems, advanced manufacturing systems, financial industry, medical devices, consumer electronic devices, and others. It is the increased use of the wireless spectrum for all these economic and defense sectors that is already causing "spectrum crunch"; it is starting to be felt by many Americans across the nation.

Statistics reflect the exponential growth of mobile devices and the resulting explosion in data traffic, or wireless spectrum usage. One of these statistics suggests that there will be 50 billion mobile connections globally by 2020, with the mobile multimedia data usage increasing by 60% per year. By 2016, the demand for commercial wireless spectrum usage in the United States is expected to see a 10-fold growth. To keep up with consumer demand, wireless industry in the United States has requested 800 MHz of additional spectrum. However, the Federal Communications Commission (FCC) in its National Broadband Plan, released in March 2010,

stated that there is little unallocated spectrum available for new exclusive allocations. Hence, one or a combination of the following is required: sharing spectrum, possibly repurposing spectrum usage to different bands enabled by efficient usage technologies, and research on high-frequency usage. The Spectrum crunch situation has forced the national priority call for spectrum technology innovation and experimentation.

The demand for additional spectrum is not restricted to the United States. Globally, the European Union, Singapore, and China are experiencing the same limitations; however, they are already aggressively seeking innovative solutions and developing technological patents that will solve their spectrum availability challenge and, importantly, further their market share in related industries. With appropriate government support through policies, a national technology development strategy, and funding, the United States can establish global leadership in this crucial area. This support will empower technical achievements, grow the economy, develop job opportunities and increase assurance of national wireless communications security.

NITRD WSRD SSG Support for Technology Development and Experimentation

In June 2010, the *Presidential Memorandum: Unleashing the Wireless Broadband Revolution*, was issued. This enabled the establishment of the National Information Technology R&D (NITRD) Wireless Spectrum Research and Development (WSRD) Senior Steering Group (SSG), in November 2010. The WSRD group represents 16 agencies and is chartered to assist the Secretary of Commerce in creating and implementing the plan to facilitate the research, development, experimentation, and testing required yielding innovative spectrum-sharing technologies. I am an active member of this group.

I believe the Wireless Spectrum R&D national steering group has effectively collaborated with the government agencies to develop an inventory of the research initiatives on spectrum sharing technologies being conducted by the government. The steering group also created an inventory of national test beds that can support technology innovation. Two workshops co-chaired by colleagues from the National Telecommunications and Information Administration (NTIA), National Science Foundation (NSF), Defense Advanced Research Projects Agency (DARPA), DOJ (Department of Justice), and I were conducted with technical experts and stakeholders from industry, academia, and government. These workshops were conducted to identify key gaps within the national R&D portfolio on wireless spectrum sharing innovation, to understand the nation’s experimentation needs in these areas, and to identify research capabilities in industry and academia. I believe work of the SSG is critical to the nation and will continue to advance collaboration among the key government and industry stakeholders for advancing spectrum sharing innovation.

Key Challenges to Solving Spectrum Crunch

There are three key challenges to solving the spectrum crunch:

1. Need for a National Approach
2. Strategy and Technology Development
3. Funding and Collaboration Support.

A National Approach for Spectrum Sharing

One approach to spectrum sharing is to allow sharing based on real-world testing and evaluation in full-scale outdoor test beds—while meeting proper standards and protocols—to determine where sharing may feasibly occur in a secure and reliable manner without disrupting current applications. Through such an approach, immediate attention could be given to those frequency bands that are in high demand and resolve the inherent challenges of and trust and security needed for different sharing models, such as government to government, government to industry, or industry to industry. Additionally, the requisite business models could be created to encourage further growth of the spectrum sharing approach.

Repurposing, on the other hand, also involves new hardware, software development and experimentation. But, because repurposing might only be a short-term solution, the risks of having to share spectrum in the long run remain. As detailed in the 1755-1850 MHz spectral band study released by the NTIA on March 27, 2012, it is expected to cost various agencies $18.5 billion to repurpose government applications just for this 95 MHz band. Hence, besides research innovation and experimentation to exploit higher spectral frequencies for wider deployments, sharing spectrum wherever possible offers the best long-term path below the 4 GHz of commonly usable frequency spectrum.

Some of the most important governmental efforts in support of the spectrum sharing or spectrum repurposing opportunities can be summarized as follows:

- The NTIA and the FCC have been working for a few years to identify the most suitable bands for spectrum repurposing or sharing and repursposing, coordinating their studies with several agencies
- The recent Middle Class Tax Relief and Job Creation Act of 2012, HR3630, has also identified specific bands for sharing and repurposing, such as the 1675–1710 MHz, 1755–1770 MHz, 2025–2110 MHz, and the TV White Space. HR3630 has also requested studying very high frequencies for experimentation and potential deployment.

Strategy and Technology Development

Some of the drivers for technology development and a framework for R&D, standardization, and realistic experimentation are summarized below.

The wireless carriers, equipment manufacturers, devices, and applications developers are financially and competitively driven to show return on investment. This reality has left the cellular industry scrambling to find interim solutions, including offloading mobile data traffic using WiFi-like local area networking techniques to landline infrastructure where possible. As announced recently by the chief executive officer of one the leading carriers, consumers are being forced to pay more for less, as evidenced with the removal of unlimited data plans for their mobile consumers.

Meanwhile, the equipment manufacturers are focused on supporting the deployment of the fourth generation, Long Term Evolution (LTE) technology by the leading national carriers and are not ready to invest in spectrum sharing R&D. Regarding academia, several institutions in the nation are working on various theoretical aspects of spectrum sharing research, modeling and simulation, and conducting evaluations in indoor laboratories. Some of the national laboratories are focusing on wireless technologies as they relate to sensors and other specific application areas. INL is primarily supporting DOD applications, spectrum sharing R&D, and testing to a limited extent, due to funding constraints. Research on wireless cyber security is a critical aspect that needs attention from the beginning. In the landline networks, cyber security issues were researched and understood long after large-scale deployment. Today the wireless security issues are not well understood. It is critical that there is both industry and academia focus on wireless spectrum sharing security research to better characterize the challenges, as well as to enable innovation and experimentation.

Another key component of a technology strategy is standards development. Standardization of technologies is in its infancy. In the telecommunications industry, it takes about 8–10 years for large-scale technology development, and that is after standards are established. For spectrum sharing technologies standardization, there are limited global efforts, including those being led by the International Telecommunications Union (ITU) and by the Institute of Electrical and Electronics Engineers (IEEE). National agencies are actively working on adopting broadband for customized applications, such as for public safety, the power grid, transportation systems, etc. These new applications and the associated unknown risks warrant realistic experimental testing and evaluation to standards-based protocols.

Experimentation in realistic outdoor test beds helps build credibility for all stakeholders and rule-making agencies. This was clearly stated by industry and academia during the second national workshop conducted by the national Wireless Spectrum R&D steering group in January 2012.

There are multiple Department of Defense wireless testing ranges that are focused on operational testing and classification requirements. There are also smaller ranges, which while they have

some utility, are limited in their ability to enable real-world test environments—some are close to the city and others, typically in academic institutions, are limited to indoor WiFi test facilities. What is missing is a facility that is isolated from urban and military congestion and provides users with a low radio frequency noise environment for conducting experiments on a range of equipment and devices in various spectral bands. INL provides such a facility as described later in this testimony.

Funding and Collaboration Support

The nation is faced with the spectrum crisis, yet there is currently insufficient funding to accelerate innovation and experimentation. Without technologies to validate spectrum sharing trust and security, it is not possible to build the required government-industry support for collaboration.

The recently enacted HR3630 represents progress by recommending spectrum sharing and repurposing study and analysis on specific spectral bands by the NTIA and the FCC. It is critical that appropriate funding be made available to include research and, full-scale test and evaluation based on applicable standards and protocols to make spectrum sharing a reality. Also, in this regard, designation of key facilities, such as national test beds or National User facilities, is much needed.

Spectrum Sharing R&D and Full scale Testing at Idaho National Laboratory

INL has established a research portfolio on multiple areas of spectrum sharing innovation such as dynamic spectrum access and white space sharing platforms, and wireless R&D related to SCADA devices and smart grid. Located on an 890-square-mile site in an isolated location, INL provides a very low noise environment for wireless R&D, Demonstration, and Deployment. The Laboratory has 2G (Second Generation)/3G (Third Generation) and WiMAX (Worldwide Interoperability for Microwave Access) carrier grade equipment, along with 60 miles of fiber optic links, 200 miles of roads, microwave, and satellite communications facilities. INL is an NTIA 7.11 licensed experimental station and is working with the FCC for commercial experimentation license. After visiting the INL wireless experimentation facility, the national Wireless Spectrum R&D Senior Steering Group commended that “The Idaho National Laboratory represents a unique opportunity for unfettered development and testing of advanced spectrum-using technologies.” INL is in a unique position to provide the bridge between the government, industry, and academia, and to accelerate and improve the quality of research and experimentation, and support the national standards, policy, and rule making organizations.

Summary:

The responsiveness of the nation to this spectrum crunch challenge will have a significant bearing on economic growth and national security. The government has taken some important steps to enable resolving the spectrum crunch issues, including the following:

- The FCC and NTIA are endeavoring to identify bands of spectrum for research purposes
- HR3630 ruling identifies specific wireless spectrum bands to share
- White House OSTP launching the Wireless Spectrum R&D Senior Steering Group to facilitate research, experimentation, and collaboration in the nation.

However, a comprehensive national approach towards spectrum sharing, accelerated technology development, establishment of national testbed facilities and appropriate funding support are needed. This will ensure developing solutions to solve the spectrum crunch issues, ensure future growth of the key economic sectors are not impeded by the lack of spectrum and help establish global leadership on spectrum sharing innovation.

INL, with its strong capabilities in wireless R&D and its full scale wireless test bed, stands ready to support this national initiative on spectrum sharing.

Thank you for the opportunity to testify.