

Antiquated command-and-control governance and utilization of the spectrum must end. A framework for a more collaborative approach is required to successfully meet the needs of both the federal government within the national security environment and commercial industries.

DOD Reallocation Efforts

In order to maintain communications domination, war fighters require worldwide, on-demand spectrum access. We can see from recent operations in Iraq and Afghanistan that the ability for a commander to project force is dependent on the ability to exploit technology. Historically, this has not been an issue.

Yet, today, with the emergence of new technologies, the demand from both federal and commercial consumers, transitioning to wireless infrastructures, has obstructed the DoD's ability to navigate freely in the utilization of this resource both at home and internationally.

In a slow-changing regulatory and administrative atmosphere, U.S. spectrum policy has become a dynamic environment for all stakeholders demanding more access to resources. Realizing the positive economic impact of federal reallocation, government officials systematically call for reallocation from federal users, primarily the DoD, as

far back as 1993. The Omnibus Budget Reconciliation Act of 1993 reallocated 235 MHz of federal allocated spectrum to be auctioned off to the private sector (Congress 1993). Four years later, in the Balanced Budget Act of 1997, an additional 20 MHz of federal spectrum was called to be transferred to the Federal Communications Commission for reallocation.

In 2002, the FCC formed the Spectrum Policy Task Force to help with identifying and evaluating changes in spectrum policy. This commission was tasked with providing guidance in making spectrum regulation more market-oriented, moving towards unlicensed device or commons models, and minimizing regulatory intervention. In November 2002, the SPTF released a report that recommended moving certain parts of the spectrum from a command-and-control infrastructure to both unlicensed and licensed flexible-use policies.

In June of 2010, President Barak Obama released a memorandum stating that, "America's future competitiveness and global technology leadership depend, in part, upon the availability of additional spectrum." He continued to call for the FCC and the National Telecommunications and Information Administration to release a plan to free up 500 MHz of spectrum for commercial use in the next

10 years. This memorandum states that the ability to communicate is not the only utility of spectrum. Governance of this resource directly affects the economic strength and stability of the nation via the U.S. wireless industry. In May 2012, in response to the Presidential memorandum, a report was released detailing the relationship of spectrum to the economy through empirical data.

The report states that if an additional 500 MHz of spectrum could become available for commercial use over the next ten years, it could mean an increase of \$166 billion for U.S. gross domestic product, and boost economic revenues to \$36.7 billion. Also, the wireless industry was responsible for 3.8 million jobs as of 2011, which was an increase of 200,000 over the previous six years, accounting for 2.6% of all U.S. employment. The implications of both the Presidential memorandum and the empirical analysis legitimize the importance of proper governance mechanisms controlling spectrum in the United States.

2014 Spectrum Strategy

In February 2014, DoD Chief Information Officer, Terri Takai, released the latest DoD strategy for addressing the demand for spectrum access, specifically as it applies to achieving national security goals. *Electromagnetic Spectrum*

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Strategy: A Call to Action sets short-term and long-term goals for the DoD.

Analysis of this strategy finds, through consideration of the language used and priorities presented, that the DoD may be prepared to vacate the 500 MHz of spectrum as laid out in the President's direction of 2010, but would prefer not to lose any current capabilities. Analysis of this latest strategy finds that the DoD is providing an alternative solution by advocating a type of commons governance approach for future operation of spectrum. For example, throughout this research project, the National Military Strategy is often referenced as saying, "The Joint Force must ensure access, freedom of maneuver, and the ability to project power globally through all domains," and it specifies these domains as land, air, sea, space and cyberspace.

The latest DoD Spectrum Strategy also makes this reference and raises a point often overlooked by federal authorities – that is, spectrum transcends all of these domains. The access to spectrum is a force multiplier, and the denial of spectrum to the enemy is of significant importance to battle space superiority. Essentially, the DoD is placing spectrum, and access to it, as a priority over all other domains – a perspective that is not often shared by regulators and administrative offices.

With the release of this strategy, the DoD is making yet another attempt to educate regulators on the critical importance of accessing spectrum when needed to ensure that the United States is both capable and ready to defend and protect the nation against all threats and quickly secure and maintain information superiority no matter what the future of conflict or stability operations may hold.

This strategy seems to be more of a mission statement and less of a plan. The DoD has set forth a number of goals and objectives to actively monitor and be involved with spectrum changes both operationally and administratively in this document; however, the tools required to do so are still being developed as the document states that, "A Roadmap and Action Plan will be

developed to supplement this strategy."

The DoD has realized that a more involved role in discussions concerning regulation both domestically and internationally will allow the department to shape the allocations of and thinking about spectrum both now and in the future. The DoD can no longer deal with reallocation, and will experience a severe impact to current and future operations-combat or peacekeeping, if the current regulatory processes continue unchanged. Collective action seems to be almost required in investigating possible solutions to supporting both DoD and commercial needs for access to spectrum.

Afghanistan: A Missed Opportunity

As an example, Afghanistan has begun selling sections of spectrum through licenses to technology developers, preventing U.S. and coalition forces from operating in critical spectrum that is required to sustain both combat and support missions in the country. While respecting Afghanistan's requirement to bolster their economy through revenue received from spectrum licensing fees, the United States should also encourage the Afghan Ministry of Communications and the Afghanistan Telecom Regulatory Authority towards a common regime of spectrum governance, given the current state of the nation's technological infrastructure and the opportunity to spread allocation out geographically.

While the United States has been relatively successful with status quo regulatory mechanisms it is easily conjectured that change is necessary. Afghanistan operations offer a clear example. Afghanistan will certainly experience the same issues of resource scarcity and congestion that the United States is experiencing today if progress towards a more technologically friendly environment is not anticipated and managed. As regulators in Afghanistan begin to fully understand the importance of this resource, they will also continue to realize

then they are certainly destined to experience the same resource scarcity and possible negative impacts to their national security environment. Understanding this reality and developing Afghanistan as a leader in spectrum efficiency and technology development overall, will heighten its presence as a regional power in the Middle East and invite corporations and other governments to invest in the nation's stability and success.

Recommendations and Conclusion

Increased dependence on spectrum will only continue and regulators need to understand the impacts to the both the economy and national security environments if reallocation from DoD continues in the future. A common regime of governance will support both the commercial industry and federal agencies, primarily the DoD, for accessing spectrum when and where required. The federal government and FCC will still have a role to play, a role by setting technological standards for equipment that can operate in a given spectrum band – standards that promote efficiency and occupy the least amount of spectrum to conduct operations, whether those operations are for commercial companies or the DoD.

Investing in technology and aggressively developing existing technologies can serve as a partial solution to spectrum scarcity and, by extension, reallocation efforts. For example, transitioning from fixed-frequency transmissions to spread spectrum technology. Spread spectrum is not a new technology; however, development within spread spectrum is advancing rapidly. Spread spectrum systems are adaptable; they allow for a signal to be intentionally distributed over a large portion of spectrum. Spread spectrum systems utilize a variety of other technologies to achieve these means, including frequency and time hopping and utilization of code to distribute transmissions through Code Division Multiple Access.

Cognitive radio, another promising technology that has been recently developed,

accesses spectrum opportunistically. The system detects unused spectrum in a licensed band and operates within it. Once the incumbent transmission is detected, it will vacate that spectrum, thereby eliminating the possibility of interference, and making it possible for multiple users to occupy the same spectrum. Cognitive radio also utilizes technology such as Software-Defined Radio, where traditional hardware components of a system are replaced with software. This dynamic process allows for updating and modification of signal processing. Instead of expensive hardware modifications or investing in totally new systems, SDR can enable the DoD and commercial industry to manipulate signals more efficiently as technology becomes available.

These are only a few examples of how the advancement of technology and systems can overcome the perceived problem of spectrum scarcity. The interference that users receive or are responsible for is a product of the technology that they use, not the spectrum itself. Focusing on technologies that are more efficient for all spectrum stakeholders is vital for the creation of "more" resource.

Technology is relative. Through the development of new technologies, access to spectrum can change. Regulation of spectrum was created out of necessity. As Eli Noam stated in an article for *Telecommunications Policy*, "Change the technology and the economics and the law of spectrum use must change too." Once it has been demonstrated that a common environment is possible, regulation and policy will begin to change. The DoD cannot continue relinquishing spectrum for the stimulus of the U.S. economy.

While the DoD is not going to pay for spectrum access like commercial industries, there will have to be collaboration in the development of new technologies that allow for shared access to this resource.

Dynamic spectrum access and spread spectrum technologies are only partial solutions here. Spread spectrum technologies

support the argument that spectrum scarcity, like technology, is a relative issue. It is because of spectrum scarcity that reallocation efforts are being taken. As these technologies develop and the risk for harmful interference diminishes, regulatory authorities will be more receptive to policy change.

There is no easy solution to this problem. The DoD is continually being called upon to relinquish spectrum allocations to the FCC for auction to commercial entities. Technology is certainly a partial solution. Private companies are developing technologies that efficiently utilize spectrum. Accordingly, it would be wise for the DoD to be part of that development so that everyone is looking for more efficient utilization. As outlined in their most recent Spectrum Strategy, the DoD understands that participation on every level of regulation and the development of technologies will give them a louder voice in discussions.

While the DoD's access to spectrum on-demand is of critical importance to national defense, that argument is often reactionary and will not deter future reallocation efforts.

Changing the governance regime in the United States is an impractical solution, but changing the historical predispositions on spectrum and the possibilities of common usage can alter the current landscape for both commercial industry and national defense.

The DoD is both the federal government's greatest occupier of spectrum and the department most capable of understanding and efficiently utilizing this resource effectively. While auctioning off more spectrum may be more beneficial for collecting revenue to counter the national deficit, no dollar amount can be placed on the importance of the DoD's ability to meet national security objectives, maintain a technological edge over any current or future adversary, and also drive future capabilities and spectrum access requirements of our allies through technology.

Defense outweighs monetary stimulus with respect to spectrum access. Risking the DoD's ability to defend U.S. interests should be avoided at all costs. Diminishing capability through antiquated regulatory process and spectrum reallocation hurts both training and operational capability for the DoD to succeed in its mission of supporting national security

objectives.

Creating an environment that fosters a collaborative effort to create technologies that will encourage and allow simultaneous use of the same spectrum is critically important to reducing the necessity for reallocation while servicing the needs of both the commercial and defense industries.

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ACRONYM QuickScan

ATRA - Afghanistan Telecom Regulatory Authority
CDMA - Code Division Multiple Access
CIO - Chief Information Officer
CR - Cognitive Radio
DoD - Department of Defense
FCC - Federal Communications Commission
GDP - Gross Domestic Product
NMS - National Military Strategy
NTIA - National Telecommunications and Information Administration
SDR - Software Defined Radio
SPTF - Spectrum Policy Task Force