# Spectrum Coexistence for the Marine Corps

## Understanding the Importance of the *National Spectrum Strategy of 2023*

by Mr. Dennis J. Murphy

For the Marine Corps, it is imperative to understand the strategic implications of the *National Spectrum Strategy*, published in November 2023, in the context of modern warfare and defense technology. This strategy, which seeks to revamp spectrum policy for efficiency of the radio frequency (RF) portion of the electromagnetic spectrum (EMS), is a clear indicator of the increasing reliance of both military and civilian sectors on this critical resource.[1] The EMS, a finite and invaluable asset, is now at the forefront of strategic concerns due to its role in enabling quality-of-life enhancements for Americans and ensuring national security.

In the military context, the EMS is indispensable, spanning a range of electromagnetic radiation from radio waves to microwave and millimeter-wave transmissions (e.g., very high frequency/ultra high frequency communication to air traffic control radar to high-resolution mapping). It serves as the backbone for data and information transfer across all warfighting domains. Mastery and flexibility within the EMS are as crucial as physical maneuverability on the battlefield, ensuring our forces maintain superiority across tactical, operational, and strategic dimensions. Unhindered access and capabilities within the EMS are vital for sustaining our operational edge in both national and multinational endeavors.

Today, the Marine Corps experiences many restrictions and constraints when it comes to operating in the EMS. In several cases, Marines are not allowed to operate certain radios in some countries outside of the United States, new plans for spectrum reallocation will prohibit certain radar systems from operating on our bases, and certain electromagnetic warfare systems cannot operate on the land or in the air because of potential interference with commercial systems and first-responder networks. These restrictions thwart efforts for Marines to conduct training, build system proficiency, integrate with other forces, and even command and control their units.

***>Mr. Murphy is a Signals Intelligence–Electromagnetic Warfare Subject-Matter Expert and Senior Technology Advisor for the Technology Branch, Information Maneuver Division, Deputy Commandant for Information.***

The growing demand for RF spectrum, paralleling the global commercial surge for data and bandwidth, has sparked intense competition for spectrum resources. This scenario has prompted the DOD to pivot strategically toward collaborative efforts with commercial entities, seeking cutting-edge solutions for enhanced spectrum access and efficiency.

Key to addressing these challenges are the concepts of spectrum sharing and spectrum coexistence. The National Institute of Standards and Technology defines spectrum sharing as a method to optimize airwave use, allowing various user categories to coexist in the same frequency bands.[2] Spectrum coexistence, meanwhile, enables multiple wireless devices and services to operate concurrently in the same RF band without causing detrimental interference.[3] The key difference between these two approaches is sharing develops modernized allocation techniques for user prioritization in frequency bands and channel spacing, while coexistence allows access anytime anywhere in the frequency bands and channels.

The pursuit of spectrum optimization and efficiency for the Marine Corps necessitates a multifaceted approach, encompassing diverse access scenarios, innovative sharing techniques, and ongoing research to refine these methods. This requires military systems to be "smart" with the capability to work within domestic and international rules, permissions, and laws so they can find, access, and use space in the spectrum without encumbering other users. However, progress hinges on up-

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dating spectrum management policies and laws to align with technological advancements and anticipated spectrum use.

The National Institute of Standards and Technology's Communications Technology Laboratory spearheads research in spectrum sharing, exploring tiered access models and coexistence strategies. This research is vital for policy formation and equipping regulators with tools to manage shared spectrum use, minimizing interference with primary users, including military operations.

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The National Telecommunications and Information Administration, in concert with the Federal Communications Commission and industry stakeholders, plays a pivotal role in managing U.S. RF spectrum usage. Their efforts involve continually updating the allocation plan for the radio spectrum (0-300 GHz) to address evolving domestic and international needs.[4] The United States must also align its strategies with the International Telecommunications Union guidelines, especially considering the challenges posed by nations like China in the 5G and emerging 6G cellular markets.

Discussions at the World Radiocommunication Conference 2023 highlighted global spectrum management priorities that directly impact national security and economic interests. The United States expressed concerns over proposals to prioritize and reallocate mid-band spectrum for commercial 5G and 6G applications, citing security implications and the necessity to protect spectrum used in DOD radar, intelligence, and future military operations.[5]

In addressing future wireless architecture and spectrum demands for the Marine Corps, an integrated approach encompassing aeronautical, terrestrial, and space components is crucial. This encompasses not only traditional RF spectrum but also transmissions using visible light and lasers as well as requiring future systems to have the ability to scrutinize the complexities of governance and natural laws of physics to gain access within the EMS.

To meet future bandwidth requirements, Marine Corps spectrum-dependent systems need advanced multi-band capabilities and the ability to integrate with environments spanning RF to light. Technologies like micro-technology, software-defined radios utilizing artificial intelligence and machine learning algorithms, quantum processing, photonics, and laser communications represent a paradigm shift.[6] These technologies, already in existence and continuing to mature, are critical for keeping pace with projected advancements like Terabyte Internet speeds by 2030 and the potential availability of personal quantum computers by 2035.[7]

Commercial research and testing in these kinds of rapid technological advancement and integration techniques outpace traditional military acquisition cycles, underscoring the necessity of collaboration with academia and the commercial industry. Partnerships with entities like the National Spectrum Consortium are essential to leverage advancements in emerging technologies for military use. However, achieving spectrum coexistence will largely depend on developing government-industry partnerships that are cooperative rather than competitive.

In summary, developing ways to coexist and modernize spectrum usage is foundational to the evolution of future electromagnetic capabilities and operations, crucial for maintaining technological superiority, and necessary for cooperative economic growth. The Marine Corps, in navigating this evolving EMS landscape, must balance military operational needs with the growing demands of the commercial sector. This requires continual innovation, policy evolution, and technological advancement to meet adversarial challenges. Future success hinges on the DOD's articulation of military needs for international spectrum access and reforming the current frequency assignment process to reflect technological advancements. Ultimately, redefining regulatory models will unify diverse spectrum services into a singular, efficient network, enabling military and economic success.

**Notes**


1. U.S. Department of Commerce, *National Spectrum Strategy*, (Washington, DC: 2023).

2. Staff, "Spectrum Sharing," *NIST,* April 5, 2022, https://www.nist.gov/advanced-communications/spectrum-sharing.

3. Staff, "Wireless Coexistence," *NIST,* October 28, 2022, https://www.nist.gov/programs-projects/wireless-coexistence.

4. Staff, "How to Share Spectrum," *NTIA*, n.d., https://www.ntia.gov/book-page/how-spectrum-shared.

5. Theresa Hitchens, "ITU rules meeting: Geopolitical 'Fireworks', DOD Spectrum Challenges," *Breaking Defense,* November 15, 2023, https://breakingdefense.com/2023/11/itu-rules-meeting-geopolitical-fireworks-dod-spectrum-challenges.

6. Hamid Hemmati, *Near-Earth Laser Communications*–2nd edition (Boca Raton, FL: CRC Press, 2021).

7. Staff, "The World in 2030: Top 20 Future Technologies," *Future Business Tech*, January 8, 2022, https://www.futurebusinesstech.com/blog/the-world-in-2030-top-20-future-technologies.