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Concrete National Security Benefits of Spectrum Allocation for Commercial 5G

Part 1: Trusted Supply Chain

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In an ongoing paper series, the CSIS Strategic Technologies Program has explored the national security implications of spectrum allocation. The series argues that it is a national security imperative for the United States to make spectrum available for licensed 5G and future-generation wireless technologies to secure its position as the leader in trusted network technologies, especially as autocracies, led by China, seek to dominate. As **previous CSIS analysis** has observed, China has adopted an aggressive strategy to lead in technology, particularly 5G and future-generation networks and applications. Since spectrum is critical to the future of the networks and applications that their societies rely on, the security of the United States and its allies depends on leading and fostering trusted partnerships in this arena.

Continuing with this area of focus, this two-part paper examines the concrete national security impacts of commercial licensed spectrum availability: Below, Part 1 explores the reasons why spectrum allocation for commercial 5G is indispensable for developing trusted technology. Part 2 will explore why commercial spectrum is crucial to U.S. and allied military operations and capabilities.

Spectrum Availability and the Development of a Trusted Technology Supply Chain

Commercial spectrum allocation is critical to the security of the United States and its allies, as it is indispensable to the future of the networks and applications on which their societies depend. These networks and applications will be designed either to advance the principles that support the United

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States and its market-democratic allies or to serve the control and suppression efforts of the deepening autocratic alliance of China, Russia, Iran, and North Korea.

The security of the United States as a market democracy is at stake. Successive administrations and Congresses have taken meaningful actions to address this threat, and now the United States must leverage spectrum policy in favor of its core principles—dynamism, innovation, and freedom—rather than surveillance, control, and oppression. This will require maximizing all critical uses of spectrum, from weapons and defense systems to commercial 5G and next-generation wireless networks, including both local wireless connectivity and wide-area coverage.

To secure its core national interests, the United States must lead the world in all these areas. However, it is currently in danger of falling behind China in mid-band licensed spectrum, which supports wide-area coverage and is essential for bringing mobile services and technologies to every part of the country. This shortfall poses a grave threat to the security of U.S. and allied network infrastructure.

Addressing this severe licensed spectrum shortage while maintaining the United States' world-leading position in both defense systems and local wireless connectivity will be challenging. However, the United States is fully capable of achieving difficult technical feats, especially at the intersection of military capabilities and commercial strength.

One example from the spectrum arena took place in the late 1990s, when the Department of Defense partnered with major industry players to develop and scale the RFID tag system for real-time global tracking of supply shipments, revolutionizing supply chains and inventory management. This example is one of many reasons the United States leads the world in both military force projection capabilities and commercial dynamism.

The United States must apply that type of solutions-oriented action to spectrum policy. Spectrum availability is an optimization challenge, not a scarcity problem. The invisible radio waves that make up the radiofrequency spectrum are a critical natural resource, and government and industry can either debate the scarcity of this resource or collaborate to optimize its allocation and efficient use.

The security of the United States and its allies depends on making the right choice, as there is a direct relationship between spectrum availability and the ability of manufacturers and innovators to enhance and expand the state of wireless technologies. Spectrum is the lifeblood of the wireless ecosystem, serving as a core component of the technology landscape and the interrelated processes of technological development. While this relationship is not perfectly linear or sequential, U.S. security interests directly depend on the availability of spectrum.

Wireless research and development, technology design, standards, and intellectual property—along with hardware, software, and the applications they enable—are specific to particular spectrum bands. This means that the wireless network supply chain—whether trusted or untrusted—is also tied to these particular bands. Therefore, commercial 5G spectrum availability in the United States is a countermeasure to the threat of Huawei, ZTE, TikTok, and other China-based "national champions."

In the future, engineers may develop the technology that in some cases minimizes the direct connection between specific spectrum bands and technology design, but that is not the current reality. That is one

reason why the United States has had to spend billions of dollars (and counting) to "rip and replace" Huawei and ZTE equipment from its infrastructure, as these China-backed companies were in many cases the only suppliers building radios for the spectrum bands used by small U.S. carriers. The United States cannot let that happen again.

It is a national security imperative to ensure commercial spectrum availability for 5G and future-generation wireless technologies to maintain the U.S. position as the leader in trusted network technologies, especially as autocratic nations seek to dominate. China's aggressive and well-funded strategy to lead in technology, particularly 5G and future-generation networks and applications, highlights the significant impacts that spectrum access and technology processes have on the security of the wireless supply chain and the applications it enables.

There are two elements of the current spectrum environment that are becoming security setbacks for the United States: (1) global harmonization and scale, and (2) U.S. capacity.

First, global harmonization and scale are essential for a trusted supply chain. The specific spectral frequencies available to commercial operators are indispensable for developing a trusted and commercially viable equipment market in a harmonized environment. Wireless antennas, radios, and other network components are typically designed to operate within a band-specific framework. While future advancements in chipsets, software, and artificial intelligence (AI) may enable wireless radios and equipment to operate without regard to spectrum-specific design, the ability of network equipment to communicate across different frequency "languages" is unlikely to be achieved in the near term, if ever. This emphasizes the need for trusted and harmonized frequency availability, as well as leadership from the United States and its allies.

Global harmonization of spectrum bands creates global scale for technology development, giving developers designing for a large global market significant tangible and intangible advantages over those creating bespoke solutions for smaller markets. The more that U.S. spectrum use is harmonized with that of allies and global markets, the more scale trusted suppliers have for secure technology development. In short, the United States needs global technology development to occur in the spectrum bands it operates in—that is, in its frequency "language"—but it risks ceding that position to China and its untrusted suppliers.

China understands that leadership begins with the availability of licensed mid-band spectrum for wide-area coverage; today, it has 2.5 times the access to these frequencies compared to the United States. For market positioning and scale, China aims for its developers to design equipment that operates on the most widely used mid-band frequencies, putting it on a path to adopt—or even lead—globally harmonized spectrum.

Meanwhile, the United States is becoming a mid-band spectrum "island," operating largely outside the core globally harmonized spectrum bands. If this trajectory continues, the U.S. technology ecosystem will be confined to a U.S.-only spectrum "dialect" that lacks global influence and scale.

As a result, China-based national champions like Huawei and ZTE would gain significant advantages across various critical use cases and architectures. Connected vehicles are a prime example. The Department of Commerce's Bureau of Industry and Security (BIS) is currently assessing this

marketplace to determine the threat foreign adversaries pose over essential communications technologies and services related to such vehicles. BIS is also proposing a rule to regulate transactions that could otherwise allow untrusted China-based suppliers to become embedded in this technology.

While targeted restrictions like those that may come out of this BIS rulemaking proceeding can be valuable, as in the "rip-and-replace" context, they are both costly and insufficient. U.S. and allied technology developers must be able to compete with China-based developers at the same capacity and scale in the first place. The availability of harmonized spectrum is indispensable to that goal.

Second, U.S. spectrum capacity is essential to developing and maintaining a trusted supply chain. As the National Telecommunications and Information Administration (NTIA) recently emphasized in its **National Spectrum Strategy Implementation Plan**, "U.S. leadership in next-generation technologies and services requires greater spectrum access for both the private and public sectors in the near- and medium-term." U.S. wireless companies need sufficient spectrum resources to collaborate with like-minded nations in innovating and manufacturing advanced wireless technologies and components—including chipsets, software, radios, and more—for use in both the commercial and federal sectors. However, the United States is currently deficient in this critical network input for licensed wide-area coverage, which will run out of capacity in the coming years unless urgent action is taken to address the shortage.

Consider local wireless connectivity (e.g., WiFi in a building, home, or office campus) as the "capillaries" of the wireless ecosystem, drawing on broadband service to nourish local applications and network functions. U.S. wireless capillaries are robust and healthy; the United States has far more unlicensed spectrum allocated than China or any other country, which is one factor in WiFi's status as an American success story.

However, the "arteries" of the U.S. wireless ecosystem—the licensed wide-area coverage that provides mobile connectivity broadly across the vast continent—are already near capacity, with no further expansions currently in the spectrum pipeline. The United States has gone from leading the world on this metric to drastically trailing China and a dozen peer countries, and this deficit is expected to grow substantially over the next decade.

The existing disparity between U.S. licensed mid-band spectrum allocations as compared to the rest of the world has become a major national security challenge, as it has created a platform for China to shape the near-term and future technology environment to its strategic advantage. China is ensuring that its mid-band arteries have ample capacity, while the U.S. 5G and next-generation mid-band wireless ecosystem is limited today and soon to reach its limits. This places a structural constraint on the United States' ability to lead in these technology developments. This problem also broadens the threat landscape across the global network technology supply chain, further emphasizing the imperative of ensuring sufficient licensed spectrum allocations to support U.S. innovations in wireless.

Addressing the Risks of the U.S. Commercial Spectrum Shortage

The United States should act urgently to optimize spectrum use so it can lead in all key areas of the wireless environment. This optimization process should be organized to benefit all parties, encouraging

transparency and mutual benefit and advancing U.S. interests rather than creating a zero-sum game with distinct losers and winners. In a zero-sum approach, the real loser is U.S. national security.

This effort should begin with restoring the Federal Communications Commission's statutory authority to auction spectrum. The ongoing lapse in this authority severely damages U.S. leadership and security with each passing day. Urgent action is needed to restore auction authority so that the studies of the bands identified in the NTIA's National Spectrum Strategy Implementation Plan lead to actual increases in spectrum capacity and auctions for essential licensed mid-band spectrum.

With this authority in place, stakeholders must work collaboratively and urgently to make spectrum allocation optimization a reality, particularly in the bands identified for study in the National Spectrum Strategy Implementation Plan. Again, this process should not be seen as a zero-sum game; done properly, it will create mutual benefits. Federal agencies, including the Department of Defense, can maintain and, in many cases, upgrade or otherwise advance their vital operations, while commercial providers can build out innovative 5G networks nationwide, driving U.S. technological leadership globally.

Government and industry should collaborate on initiatives to maximize spectrum use in any given band. Most immediately, this should include advancing currently viable spectrum-sharing regimes; when fully clearing a spectrum band for new uses is not practical, coordinated sharing through proven methods can offer a solution. Government and industry should work together to promote "static" sharing, where parties benefit from predictable spectrum access by coordinating use over geography, time, or frequency. These sharing methods provide coordinated access and certainty, with technological advancements increasing their precision. As Part 2 of this paper will explore in greater depth, U.S. defense systems must possess sharing capabilities in the lower 3 gigahertz (GHz) band (3.1–3.45 GHz) that enable commercial 5G through these static coordination mechanisms, as the United States and its allies operate defense systems in the band abroad in countries with existing 5G deployments today. The United States should focus on these proven models of sharing to support its national interest in maintaining global 5G leadership.

In parallel, over the long term, the U.S. government and industry should pursue breakthroughs in "dynamic" spectrum sharing—where each party's use of frequencies changes dynamically according to near-real-time needs—to overcome existing practical impediments to real-world implementation. Such breakthroughs will likely take years to become practically and economically viable at scale. U.S. global leadership and collaboration with allies will be required to address the need for global harmonization and scale sufficient to support diverse and competitive trusted suppliers in such a sharing environment. Without strategic leadership, U.S.-only sharing frameworks could slow deployment compared to other countries that adopt globally harmonized, standardized frameworks, and the custom sharing solutions would be too circumstance-specific to gain traction in the global market.

Conclusion

U.S. spectrum leadership is directly relevant to a secure supply chain and application ecosystem, and thus to the United States' core national security interests. The United States must not abandon globally harmonized bands and allow China to dominate the supply chain. Instead, immediate steps should be taken to maintain U.S. leadership in spectrum policy and secure the technological future.

The 7/8 GHz band, which is being studied around the world for 5G use in anticipation of the World Radiocommunication Conference in 2027 (WRC-27), represents a key opportunity for the United States to champion future harmonized capacity that can bolster its domestic wireless capabilities and support economies of scale for its trusted vendors.

Reestablishing U.S. leadership in global spectrum harmonization requires recognizing that spectrum policy is not a battle between commercial interests and national security. This binary frame is a false and dangerous dichotomy in the twenty-first century, where U.S. national security depends as much on economic strength and technological innovation as on traditional sources of power.

Critically, the risks of autocratic leadership in essential wireless supply chains extend to federal and military uses of commercial systems as well. As Deputy National Security Advisor Anne Neuberger has highlighted, the security considerations present in commercial settings are also central to future battlefields. The technology ecosystem in which U.S. warfighters will wage the battles of the future will be shaped by commercial spectrum availability for current and future generations of wireless. For operational warfighting purposes, it is crucial that future technologies, standards, hardware, software, and applications—including AI, cyber operations, and battlefield communications—are developed by U.S. and allied companies with sufficient spectrum harmonization and scale to lead the world.

Part 2 of this paper will explore these issues in greater depth, focusing specifically on the importance of agile spectrum management capabilities in the context of electronic warfare. ■

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