PRESIDENT'S NATIONAL SECURITY TELECOMMUNICATIONS ADVISORY COMMITTEE

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September [XX], 2023
**The Honorable Joseph R. Biden**
The White House
1600 Pennsylvania Avenue, N.W.
Washington, D.C. 20500

Dear Mr. President:

In your tasking dated June 15, 2023, you requested that the National Security Telecommunications Advisory Committee (NSTAC) share insights to improve U.S. competitiveness and maintain leadership in next-generation wireless telecommunications.[1] In this letter, the NSTAC recommends expanding upon the 2019 *NSTAC Report to the President on Advancing Resiliency and Fostering Innovation in the Information and Communications Technology Ecosystem*[2] and makes the following recommendations:

- Develop and implement a spectrum strategy to support continued leadership of the U.S. wireless industry and ensure there is sufficient spectrum to deploy next-generation mobile networks as well as next-generation Wi-Fi and satellite technologies while taking into consideration national security capabilities, systems, and platforms.

[1] The administration's tasking reads, "The National Security Telecommunications Advisory Committee (NSTAC) will describe how new and emerging approaches to fifth generation (5G) and sixth generation (6G) telecommunications, such as Open Radio Access Networks (Open RAN), present an opportunity for the United States to leverage its own strengths in software development, hyperscale cloud computing, and research and development to create a more sustainable and secure wireless ecosystem that will present countless opportunities for novel applications and services at both the enterprise and consumer level."
[2] President's NSTAC, *Report to the President on Advancing Resiliency and Fostering Innovation in the Information and Communications Technology Ecosystem, 2019*, The President's NSTAC Publications | CISA.

- Develop and implement a U.S. strategy for fostering innovation in wireless communications, including support for the development of Open Radio Access Networks (Open RAN)[3] that welcomes new entrants to the wireless supply chain while ensuring the existing pool of trusted suppliers can continue to innovate.
- Reinforce and bolster the current industry-led standards model.
- Remove barriers to deployment of new wireless technologies.
- Partner with like-minded governments to provide funding for trusted suppliers and to support communications ecosystem policies consistent with those of the United States.

## Background

The global wireless industry has grown exponentially since its inception in the 1980s, moving from analog radio technology through various generations of digital technology to the fifth generation (5G) world that exists today. According to a report by Compass Lexecon that was commissioned by the CTIA, U.S. wireless carriers have invested more than $265 billion over the last decade on infrastructure deployment, and U.S. spectrum auctions have raised $155 billion for the U.S. Treasury.[4] The same report highlights that the U.S. wireless industry has contributed $5.4 trillion in GDP to the U.S. economy. In addition, unlicensed spectrum contributed $995.8 billion in economic value to the U.S. economy in 2021 alone[5] and is expected to contribute $1.58 trillion by 2025.[6]

Furthermore, satellite operations may play a vital role in the future of wireless networks. The standards-setting body 3rd Generation Partnership Project (3GPP) recently published Release-17, which supports 5G New Radio for non-terrestrial networks. Not only may satellite operations provide the coverage necessary for ubiquitous 5G, but they are also inherently resilient in the face of natural disasters. Satellite operations may ensure more widespread availability of 5G and future-generation networks, cost-effectively reaching remote underserved locations. In 2022, the satellite industry generated $281 billion in revenue, and U.S. firms built approximately 87% of all commercially procured satellites launched in 2022.[7]

Consumers throughout the world—as well as organizations relying upon Internet-of-Things-connected devices and device-to-device communications—have benefited from robust competition among mobile network operators, particularly in the United States. Prices for service have come down markedly over the past few decades even while speeds, availability, and reliability have increased. Wireless communications, the foundation for the global digital economy, is essential to the well-being of people everywhere. The smartphone era exploded with the launch of the first iPhone in 2007 and drove exponential mobile broadband adoption with

[3] Open RAN is described in the Appendix to this letter.
[4] CTIA, *The Importance of Licensed Spectrum and Wireless Telecommunications to the American Economy*, December 2022, https://www.ctia.org/news/the-importance-of-licensed-spectrum-and-wireless-telecommunications-to-the-american-economy.
[5] WifiForward, *New Resources from WifiForward Provide Guide to the Future of Connectivity*, March 2021, http://wififorward.org/news/new-resources-from-wififorward-provide-guide-to-the-future-of-connectivity/.
[6] NCTA—The Internet & Television Association, *The Future of Commercial Spectrum*, https://www.ncta.com/positions/spectrum-wifi.
[7] Satellite Industry Association, *2023 State of the Satellite Industry Report*, June 2023, https://sia.org/news-resources/state-of-the-satellite-industry-report/.

4G/LTE, 5G, and Wi-Fi. Today, consumers are dependent on their mobile phones for news, social media, banking, education, entertainment, and live video communication. These uses are supported by the availability of licensed spectrum made available to U.S. carriers and by unlicensed spectrum, Bluetooth, and other similar protocols.[8] Existing 5G and future sixth generation (6G) networks with higher bandwidth and lower latency will enable these technologies and support many consumer, business, and government services. Advances in technologies, licensed and unlicensed, will utilize wider bandwidths and offer the ability to link bandwidths of different sizes and therefore provide the higher capacity and faster speeds needed to support current and projected wireless uses. Numerous wireless innovations, such as "smart home," "smart community," and precision agriculture technologies, have all been made possible through commercial spectrum use, which helps develop many of the technologies needed to keep America competitive.

During the last two decades, consolidation has occurred in the wireless supply chain, with some participants failing (most prominently Canada's Nortel) and others merging (Lucent, Motorola, Siemens, Alcatel, and more). Today, for the first time, Chinese vendors have become global market-share leaders for wireless infrastructure, helped by many years of Chinese government policies and subsidies, including through the Belt and Road initiative. In short, the market has grown significantly, while the number of trusted suppliers, including manufacturers of RAN equipment, has not. In fact, even with consolidation, trusted suppliers struggle to compete given the sheer scale of required research and development investment as well as the price supports provided by the Chinese government. Or, to put it another way, the level of investment and the level of innovation required to sustain leadership has only increased, while the combined size and financial health of trusted market participants has declined. This creates a need for the United States and allied countries to work together to confront China's market-distorting practices and offer alternatives to China's Belt and Road initiative to ensure that trusted suppliers can effectively compete with untrusted suppliers in the global marketplace.

## Recommendations

The United States must maintain its leadership position in wireless communications technology, starting with the Federal Communications Commission (FCC) identifying more mid-band spectrum for commercial use and Congress restoring the FCC's auction authority. It is imperative that the United States maintain its competitiveness with global rivals.

The United States response must be strategic and build upon policies that have made this country the most innovative nation in the world. First, the United States must plan to meet future commercial spectrum requirements while maintaining its leadership advantage in advanced defense and aerospace technologies. The National Telecommunications and Information Administration (NTIA) working with the U.S. Department of Defense and the FCC, through the

[8] Stefano Porto Bonacci & Rupert Wood, *Wireless Network Data Traffic: Worldwide Trends and Forecasts 2021-2026*, Analysys Mason, at 11, (observing that, globally, "Wi-Fi continues to account for the largest part of wireless network data traffic").

development of the National Spectrum Strategy, should consider making other bands available for commercial uses that can coexist with critical federal operations.[9]

Second, regarding the infrastructure-equipment supply chain, the United States and allied response of banning and replacing Chinese suppliers in our networks is not enough; the United States must actively promote the development of Open RAN as one way to potentially expand supplier diversity. These efforts should utilize established funding programs to support emerging innovators without impairing existing trusted suppliers that continue to provide vital services to U.S. wireless-network operators.

Third, consistent with the 2022 *NSTAC Letter to the President on Standards*[10] which outlines several recommendations on how to enhance U.S. competitiveness in international communications technology standards, U.S. policy should avoid politicizing the global standards process and help preserve the stability and integrity of the industry-led system and promote global interoperability of communications technology. Fragmentation of the global standards process will have long-term detrimental effects and only entrench regional and national divisions.

The U.S. government must adopt policies that enhance U.S. leadership in wireless communications technology. This involves a multi-pronged strategy:

- Develop a robust spectrum pipeline to support continued expansion of and investment in wireless networks. Wide, contiguous blocks of spectrum are required.[11]
- Develop a strategy for the 2023 World Radiocommunication Conference, in partnership with all relevant industry participants, to meet future commercial spectrum requirements balanced with the impact on national security and defense systems.
- Develop and implement a strategy to support innovation in the wireless supply chain ecosystem and the continued development of Open RAN. This strategy must focus on the security of Open RAN networks and provide incentives for operators to explore brownfield deployments.
- Support domestic and international efforts to promote trusted vendors that may not currently provide Open RAN equipment to support nearer-term deployment of wireless technologies.
- Create the right conditions for strong domestic investment for innovators and manufacturers of critical technology.
- Present a more strategic and cohesive U.S. position within international standards-setting bodies that discourages politicization of the standards process by defending and promoting global industry-led standards development, such as 3GPP and IEEE, and by

[9] The National Spectrum Consortium launched the Partnering to Advance Trusted and Holistic Spectrum Solutions Task Group in 2021 to collaborate with the Department of Defense to explore sharing solutions to make more mid-band spectrum available for commercial 5G, specifically in the 3.1-3.45 GHz band.
[10] President's NSTAC, *NSTAC Letter to the President on Standards*, 2022, The President's NSTAC Publications | CISA.
[11] It is important to note that for these strategies to be implemented, the Federal Communications Commission must have its auction authority reauthorized.

coordinating with partner countries in government-led standards bodies such as the International Telecommunication Union (ITU).
- Incentivize U.S. companies to participate more robustly in international standards bodies and remove barriers to standards participation such as ongoing challenges to hosting meetings in the United States posed by U.S. visa processing delays.
- Increase investments in foundational technology that can be commercialized and taken into international standards bodies to drive essential patents, especially in the context of 6G.

The following addresses this strategy in more detail.

**Develop a Robust Spectrum Pipeline**

Spectrum is critical to the wireless industry. There can be no growth in the U.S. wireless marketplace without additional spectrum made available for commercial wireless use. The additional dependencies on the wireless networks noted above will require more bandwidth configured as large contiguous blocks of spectrum. This is particularly true as new applications require broader channels to carry more data. Studies show that the demand for data capacity in North America has quadrupled from 2015 to 2022, and analysts predict that consumers will use five times more data per year by 2027. Wireless network growth will aid U.S. competitiveness in several ways. Among other things, it will drive network build out and require specialized labor to do so. Wireless network growth will also create opportunities for additional application development and promote the technology and software that underlies those applications (i.e., it will expand the wireless ecosystem). Deployment and application development expertise can then be exported to other countries. New spectrum also drives additional deployments of RAN equipment as carriers add to their networks, which in turn drives Open RAN deployments, especially as the technology matures.

It is necessary to identify spectrum that the FCC can make available in the future that can be designated for commercial wireless network use. In the past, Congress has directed government agencies make available spectrum that can be repurposed or shared with commercial networks and that the administration should direct federal agencies to identify that spectrum. Given the lengthy process to identify and allocate additional spectrum for commercial use—recognizing that developing a pathway will place the industry on a clear trajectory allowing it to make investments in the next generation of wireless technologies—the administration and Congress must act now. The administration must also work with Congress to restore the FCC's auction authority.

Moreover, this may have a direct impact on the success of Open RAN. Today, operators can more easily deploy Open RAN equipment in greenfield networks, which newly allocated spectrum will help create. Operators in the United States have already made their investments in 5G based on currently identified spectrum bands. Without access to additional spectrum for commercial use, future investments will be limited to refreshing existing infrastructure, and the potential for wireless innovation will be more challenging. The U.S. government must begin to identify spectrum to support the U.S. wireless ecosystem.

**Support Innovation and Open RAN**

As discussed above, Open RAN may expand the supplier ecosystem in the RAN, an issue first addressed in the 5G case study included in the 2019 *NSTAC Report to the President on Advancing Resiliency and Fostering Innovation it the ICT Ecosystem*.[12] Presently, operators can only buy from a small group of trusted suppliers who provide vertically integrated full-stack solutions (radio, hardware, and software). If successful, an open architecture would enable expansion of the supply chain by lowering barriers to entry for new players in the marketplace. By not requiring them to build vertically integrated full-stack solutions, suppliers can specialize in specific parts of the RAN rather than focus on trying to sell a much more complex and fully integrated stack. Additionally, by allowing newer suppliers to focus on various aspects of the network, operators can choose best-of-breed components. However, Open RAN remains challenged by several factors.

First, wireless network operators have made significant investments in spectrum and network infrastructure using incumbent tier-one vendors who provide equipment and integration services, thus simplifying operators' deployments and operations. Network operators must achieve a return on those investments and be convinced of the value of moving to the Open RAN model; that is, Open RAN must show improvements in performance, reduced operating costs, and the ability to offer new monetizable services to the enterprise, such as industrial automation. Open RAN must show it can be integrated with the legacy brownfield network deployments that overwhelmingly serve the U.S. market. Existing funding vehicles such as the Public Wireless Supply Chain Innovation Fund (PWSCIF) should be used to explore any innovation that can be inserted in today's brownfield networks to improve network performance on existing spectrum. This innovation can be driven in parallel while the issues mentioned above are resolved to address the urgent need for new spectrum.

Second, while a truly Open RAN network infrastructure may increase both competition (to lower costs) and vendor diversity (to create a healthier supply chain), it will also require a new level of integration that is particularly challenging in brownfield environments and not necessary when buying a vertically integrated solution. More specifically, various suppliers may have interoperability issues between their equipment, something highlighted extensively in responses to the NTIA Notice of Inquiry earlier this year regarding the implementation of the PWSCIF.

Industry is addressing these issues with operators developing their own strategies around Open RAN, including working with incumbent vendors to have those vendors support Open RAN by opening interfaces that will enable operators to integrate a new supplier into their RAN. While this transition will take time and be based on each individual operator's business decisions, this migration: (1) strikes an appropriate balance between promoting Open RAN and not undermining trusted suppliers by giving them time to shift to the new architecture; (2) expands the overall universe of suppliers; and (3) ensures that the technology can serve network operators at the scale and reliability they require.

[12] President's NSTAC, *NSTAC Report to the President on Advancing Resiliency and Fostering Innovation in the Information and Communications Technology Ecosystem, 2019*, The President's NSTAC Publications | CISA. See Appendix A.

The U.S. government can take important steps to accelerate the development of Open RAN by providing support for field trials/proof of concepts, supporting the establishment of Open RAN integration, and engaging in greater collaboration with like-minded countries.

- **Develop Field Trials, Proof of Concepts, or Pilots**. In accordance with their network development plans, mobile network operators will develop Open RAN proof-of-concept implementations and pilots to gain experience and understanding of Open RAN operation and capabilities to inform future deployment. The U.S. government could support these efforts through a variety of ways. For example, the United States could provide funding for such trials through a future PWSCIF Notice of Funding Opportunity. The pilots would allow operators to get real world experience with Open RAN and could serve as a complement to the integration-center concepts discussed below. Interested operators could consider starting field trials by the end of the year contingent upon funding and available resources. Operators will then decide on possible commercial deployment of Open RAN based on business considerations, including cost, technical viability, performance, reliability, security, supplier capabilities, and overall network-deployment considerations.

- **Establish Open RAN Integration/Testing Centers**. The challenges of deploying multi-vendor networks at scale are significant, especially for operators that have a significant embedded base of vertically integrated RAN components. The current Open RAN standards for greenfield deployments are mature, as shown by one carrier in the United States, but are not fully implemented by all suppliers. Work between individual vendors, or among multiple vendors, is needed and has the greatest likelihood for success if shepherded by a neutral party, such as a carrier. The government can help industry address this challenge by funding the establishment of integration centers to support ongoing integration between vendors. The establishment of integration centers was a key theme raised in comments to NTIA regarding the PWSCIF. Participation in centers would be voluntary and open to any trusted vendor—incumbent or new entrant. The centers can also explore how to leverage experience from operators and vendors, which would be beneficial to the entire ecosystem. The centers can also assess needs and opportunities for security-validation and certification efforts. The goal of the integration centers would be to work through issues to ensure key interfaces in the RAN are interoperable, which is critical to driving deployment of Open RAN-based wireless networks. Integration centers do not need to be entirely new test labs but could build upon existing facilities. In fact, building these centers upon existing facilities has the greatest potential of generating short-term gains to brownfield networks as the spectrum policy issues are resolved.

- **Facilitate Information Sharing and Lessons Learned Between Like-Minded Countries**. Establishing periodic formal or informal meetings between the United States and other countries would be helpful so that governments and operators can discuss their experiences with Open RAN. This might include sharing information related to interoperability, performance, security, load testing costs, and other factors relevant to the global deployment of Open RAN.

**Support Trusted Vendors Domestically and Internationally**
In addition to promoting Open RAN, and based on the current limitations to its deployment, the United States must support existing trusted vendors whose equipment is the backbone of current 5G networks. Existing networks that feature full-stack solutions will continue to be built out and will require maintenance for years to come. Promoting the trusted vendors that manufacture the equipment for those networks will help ensure their continued utility. Favorable trade policies can help reduce economic barriers to shipment of trusted equipment; and tax benefits can be extended to encourage those trusted vendors to establish production, distribution, or other facilities in the United States, thus promoting the twin goals of providing economic incentives for trusted vendors to locate operations in the United States and generating employment opportunities for Americans.

Strengthening the ability of trusted vendors to serve the U.S. market will help them compete internationally against untrusted vendors, creating a virtuous cycle of broader adoption, greater availability, and lower costs. To do that, the U.S. government generally, and the State Department specifically, should more broadly engage with our allies to promote internationally the same programs as noted above and others that the United States adopts domestically. In June 2023, Secretary of State Blinken met with the president and CEO of one of our trusted vendors and announced a U.S.-Finland joint statement on 6G development and deployment. That statement stressed the two countries' cooperative approach to research and development, standards, workforce expansion, and policy frameworks that support an advanced communications ecosystem aligned with democratic values. Implementation of the goals identified in the framework will both support trusted vendors and more broadly help promote U.S. interests as the foundation for worldwide 5G, 6G, and future wireless networks.

**Create the Right Conditions for Investment**
Although making spectrum available is necessary to promote the deployment of next-generation wireless networks and U.S. competitiveness in the wireless ecosystem, current U.S. laws also must be revised to make it easier for providers to install and operate network infrastructure. This may mean limiting the ability of state and local governments to impede the permitting process and re-evaluating laws that may require wireless providers to analyze the impact of siting on what may unnecessarily be considered environmentally and historically sensitive locations. In addition, the federal government is one of the largest property holders in the country. While there has been some progress on making siting on federal properties more streamlined, more work is necessary. Indeed, the areas where communications capabilities are most necessary—in remote locations on and near military bases—are exactly the areas where the federal government controls the siting process. The United States should encourage coordination across agencies to expedite permitting review and urge agencies to leverage existing permitting processes and eliminate unnecessary categorical exclusions.

**Bolster U.S. Leadership in Standards Development**
Finally, the U.S. government can take steps to bolster U.S. leadership in standards in response to the competitive and national security challenge of China's growing participation in international standards development. In fact, international standards bodies, marked by extensive Chinese participation, could target known national-security spectrum of the United States and its allies, which is particularly troublesome. The U.S. standards strategy must ensure industry and the

United States and its allies work together to balance the spectrum goals for the overall wireless (terrestrial and space) ecosystem. Global, industry-led, voluntary consensus-standards development has served the United States well, leading to the success of interoperable U.S. technology being adopted around the world. The United States must not undermine that process because of the growing competition with China but recognize China's growing influence and augment and revitalize the existing process. The 2022 *NSTAC Letter to the President on Standards*, which was based upon extensive interviews with members of federal departments and agencies, standards bodies, industry, and academia makes several key findings and recommendations along those lines.

First, the United States must defend against the politicization of the standards process by justifying and promoting global industry-led standards development. The administration recognizes the vital role the voluntary, industry-led standards process plays in ensuring U.S. technology leadership and competitiveness, promoting international interoperability, and addressing security concerns,[13] and the administration's support for that model must be unequivocal. Moreover, in government-led standards bodies such as the ITU, the United States must maintain its leadership in the ITU Radiocommunication Sector and reform the ITU Telecommunication Standardization Sector. The United States must also coordinate with partner countries to achieve the right outcomes.

Second, the United States needs to make strategic investments that bolster U.S. participation in standards both by companies and government officials because of the importance of standards development and China's increased participation in standards bodies. More specifically, the U.S. government can: (1) streamline visa issuance to establish the United States as a venue of choice for hosting standards meetings; (2) invest in developing a more standards-savvy U.S. workforce to ensure a robust bench of standards subject-matter experts; (3) collaborate with industry to ensure robust U.S. standards participation by leveraging the U.S. government's convening capabilities;[14] and (4) seek ways to support standards participation by smaller players with cutting-edge technologies that warrant standardization to support U.S. innovation leadership.

## Conclusion

Learnings from 5G undoubtedly will drive the design of 6G. While Open RAN may be an important design element of 6G, 6G will increasingly incorporate cloud computing and software-driven capabilities to enable more agile and dynamic configuration, upgrade, and security.

As the NSTAC discussed in its 2020 *NSTAC Report to the President on Software-Defined Networking*,[15] the industry has spent several decades driving software-defined networking and software distribution, and now most wireless-network functions are virtualized. This sets the stage for fully programmable software-based wireless networks that run efficiently on general-purpose silicon. These skills—software development, hardware manufacturing, and systems

[13] The Administration recently released a U.S. standards strategy addressing many of these issues, and there is an opportunity for industry to collaborate with the Department of Commerce, which has been tasked with implementing the strategy, and bolster U.S. participation in standards.
[14] Ibid.
[15] President's NSTAC, *NSTAC Report to the President on Software-Defined Networking*, 2020, The President's NSTAC Publications | CISA.

management at-scale—are existing strengths among many large U.S. companies that are prime candidates to lead future wireless innovation once networks are open and software-based. After networks become open and fully programmable, artificial intelligence (AI)/machine learning has the potential to drive further benefits, from AI-generated programming code to better network security. The nation must seize this opportunity.

On behalf of the NSTAC, I thank you for the opportunity to provide our industry insights and recommendations related to next-generation wireless communications. This is an area that is vital to our continued leadership in wireless communications, and we appreciate your administration's consideration of our recommendations.

Signature

# Appendix

**What is Open RAN?**

In a traditional RAN system, the radio, hardware, and software are proprietary. This means that nearly all the equipment comes from one supplier and that operators are unable to, for example, deploy a network using radios from one vendor with hardware and software from another vendor. Mixing and matching cell sites from different providers typically leads to a performance reduction, so network operators deploy networks using a single vendor in a geographic region even while supporting multiple RAN vendors.

Open RAN is a shift in mobile network architecture that allows networks to be built using subcomponents from a variety of vendors. The key concept of Open RAN is "opening" the protocols and interfaces between the various subcomponents (radios, hardware, and software) in the RAN, which the industry refers to as a disaggregated RAN. The benefits of this approach include increased network agility, flexibility, and innovation as well as cost savings. The RAN has three primary elements:

- The Radio Unit (RU) is where the radio frequency signals are transmitted, and once received, amplified and digitized. The RU is located near or integrated into the antenna.
- The Distributed Unit (DU) is where the real-time baseband processing functions reside. The DU can be centralized or located near the cell site.
- The Centralized Unit (CU) is where the less time-sensitive packet processing functions typically reside.
- The interfaces between the RU, DU, and CU are the focus of Open RAN. By opening and standardizing these interfaces (among others in the network) and incentivizing their implementation, networks can be deployed with a more modular design without being dependent upon a single vendor. Making these changes can also allow the DU and CU to be run as virtualized software functions on vendor-neutral hardware.