Before the
DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Washington, DC 20554

In the Matter of	)	
	)	
Development of a National Spectrum Strategy Implementation	)	Docket Number: 230308–0068
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COMMENTS OF UNITED STATES CELLULAR CORPORATION

United States Cellular Corporation ("UScellular")[1] submits these comments in response to National Telecommunications and Information Administration's ("NTIA") request for comment on implementation of a National Spectrum Strategy ("NSS").[2] UScellular commends NTIA for its leadership in developing an NSS. We look forward to working with NTIA and share its view on the importance of spectrum not just to the wireless community, but to America's economy, national security, global competitiveness, research and development, and workforce development.

I. Introduction

Just last week we celebrated the 50th anniversary of the first cellular phone call. Since Martin Cooper's call, wireless technology has become foundational to our national security and economic prosperity. But the benefits of wireless have not been delivered equally. UScellular's mission is to connect our customers to what matters most to them, and we do this primarily in

[1] United States Cellular Corporation is a mobile communications and broadband provider, offering to more than 5 million customers in 21 states. We built a state-of-the-art network that is tailored to the communities we serve across rural, suburban and city-center spaces. We make sure you stay connected to the people matter, no matter where they are. It's what we do. It's who we are.

[2] NTIA, *Development of a National Spectrum Strategy Implementation*, Request for Comment (March 16, 2023), Docket Number: 230308–0068, https://www.regulations.gov/document/NTIA-2023-0003-0001

rural and underserved markets. Connecting the unconnected is in our DNA as a company. Our recommendations in these comments are informed by our continued focus on bringing all of the promises of wireless technology to the traditionally unserved and underserved.

II. Spectrum Pipeline to ensure United States leadership in spectrum-based technologies

a. Whole Ecosystem Approach

Creating an NSS and building the spectrum pipeline will take a whole ecosystem approach. Success in wireless technology will not only be linked to spectrum. We will need to look at a whole-network approach, and in particular new research and development approaches. Most importantly, perhaps, is ensuring the technology is secure and reliable, and not overly complex, which would slow its adoption and deployment.

With so much at stake, NTIA and its federal partners needs to build a spectrum pipeline that allows the United States to lead globally in next generation technologies. We want to avoid short-term gains that could lead to longer term 5G and 6G failures. For example, this proceeding should yield much more than 1500 MHz of spectrum for mobile commercial use with larger channel sizes. In particular, UScellular recommends that NTIA study the below listed bands:

- Low-Mid (1-5 GHz)
- Upper-Mid (7.125 – 15.35 GHz)
- High (25.25-27.5 GHz); Sub-Terahertz (90 GHz-300GHz)

UScellular cautions against isolated decisions that could lead to situations similar to C-band or 3.45 GHz, which ended up delaying the use of the spectrum in a number of locations, requiring a protracted negotiation process between spectrum licensees and various federal agencies before its use, and increased the cost and inefficiency of deployment for the spectrum licensees. We trust that NTIA will review the evidence in the record to develop a strategy that

will keep these inefficiencies from occurring in the near term and allow the United States to lead with respect to future deployments.

We understand that NTIA would like to complete this proceeding and identify the spectrum pipeline by the end of 2023. Success on this timeline will require NTIA to consider the entire ecosystem that generates, supports, and deploys spectrum to ensure that the whole value chain is ready for efficient implementation. Once the strategy is finalized, NTIA should target 36 to 48 months to generate, complete and issue spectrum licenses. This will allow for actual deployment of spectrum in 48 or more months.

As noted at the outset, connecting the unconnected is in our DNA. And one of the biggest challenges in deploying mobile technology to this population are buildout obligations and when licensees are required to complete them. Appropriate buildout obligations are critically important to a sustainable spectrum strategy so licensees can allocate resources to ensure that those in rural areas also have access to spectrum in the short-term. Just like any good spectrum portfolio, needing low-, mid-, and high-band spectrum, buildout obligations should reflect the types of spectrum and geographic realities. For example, higher frequency spectrum should incorporate more relaxed buildout requirements due to its propagation characteristics and should not be restricted to legacy percent population or percent geography covered.

Beyond spectrum, American leadership in wireless technology depends on a number of other policy, regulatory, and economic factors. The NSS also must consider infrastructure challenges that continue to plague wireless deployment, including inadequate research and development innovation and funding, the need for healthy industry partners and suppliers, the benefits of friend-shoring of research and manufacturing, and other related issues.

A whole ecosystem approach is required for both short-term success and longer-term leadership in future technology deployment.

b. Not all spectrum is created equal

The NSS will identify new spectrum allocations, and UScellular agrees with those that spoke at NTIA's listening sessions that 1500 MHz represents a good start. But much more will be required to keep pace with other nations and with our own domestic demand. In your strategy deliberations UScellular recommends exclusive, licensed, full power use to realize the maximum public good. Dedicated licensed spectrum has proven to be the best and highest use of our nation's spectrum resources, contributing nearly $1 trillion annually to our economy. Dedicated licensed spectrum benefits from high spectral efficiency, and it enables the delivery of the deterministic and consistent experience needed for the development and adoption of future use cases.

In addition, power matters, especially when bringing wireless to the unserved and underserved, and when enabling productivity-enhancing applications throughout rural America. This is an important point, especially for UScellular — the more rural the user, the more critical it is to have full power. Anything less degrades the customer experience and creates prohibitive economics for universal connectivity. Power limitations only serve to deepen the digital divide.

One measure reflecting the differentiated value of dedicated licensed spectrum is the value that markets place on it. For example, the recent C-band auction raised just under $1 per MHz-pop sold, while the CBRS auction raised about one quarter of that amount. Unlicensed spectrum users, by contrast, do not contribute to the United States Treasury for the spectrum assets they benefit from.

Developing innovative technologies and delivering the promise of wireless technology throughout the United States requires massive investment. Dedicated licensed spectrum provides the long-term certainty needed for markets to invest tens of billions annually developing scale needed to provide service in *all* markets. Dedicated licensed spectrum provides companies, ranging from wireless carriers like us, to auto and airplane manufacturers with decade-long product development cycles, with the certainty to commit their business models to nascent technologies.

Unleashing more exclusively licensed spectrum will require NTIA to develop an incentive system to encourage federal users to release spectrum. UScellular recommends that NTIA consider moving or consolidating federal spectrum. Much like the successful incentive auction, NTIA should explore financial incentives and other possible budget considerations. And last, but certainly not least, NTIA needs an innovative approach to research and development that includes various stakeholders from across the whole ecosystem, including academia, government, and private industry. UScellular appreciates that NTIA's listening sessions to date have included a number of these stakeholders, and we look forward to their continued engagement.

While exclusive license use is ideal for the reasons stated above, there are little greenfield bands left to be allocated that won't require sharing, reallocation, and/or reimbursement. Shared spectrum therefore has a place in wireless, and UScellular supports static, well-defined, full power, shared spectrum licensing as a complement to exclusively licensed spectrum.

Dynamic sharing schemes, however, have been operationally challenging to date. Dynamic sharing schemes create complexity that limits adoption and investment, and potentially leaves valuable spectrum underutilized in stark contrast to its purported benefit. This is not a

theoretical argument, but a very real and practical issue especially in unserved and underserved areas of our country. A cell site equipped with CBRS will provide a usable connection to approximately a 1.5 km radius. In contrast, a similarly designed site using C-band will provide customer benefit up to a distance of 9 km. That's six times the distance, and over 40 times the area covered by using full power spectrum. There can be no question that additional dynamic shared spectrum, with the attendant power compromises, will not deliver the NSS benefits that our country demands.

Unlicensed spectrum also has a place in wireless, for best effort services with lower requirements for latency, speed and full mobility. These needs are well satisfied through existing spectrum allocations for unlicensed use. And, notably, many advocates of unlicensed spectrum have pockets deep enough to purchase licensed spectrum if needed to deliver their services.

To be clear, dedicated licensed spectrum enables the greatest benefits for the most people. Universal connectivity should be the goal, with special focus on leveraging fixed wireless solutions to bridge the digital divide.

III. Global Competitiveness and Secure Networks

A National Spectrum Strategy must be both ambitious and deliverable for the United States to catch up to other nation's spectrum and technology plans. As noted often in NTIA's Listening Sessions, the United States lags far behind in allocating licensed mid-band spectrum for mobile use, and several experts expect the United States to fall behind in licensed spectrum in the low- and high-bands within the next few years.[3] Losing the leadership position in wireless is unacceptable. Furthermore, it is avoidable through an aggressive spectrum pipeline geared

[3] Janette Stewart, Chris Nickerson, & Juliette Welham, Comparison of total mobile spectrum in different markets, Analysis Mason, at 10-11 (Sept. 2022), https://api.ctia.org/wp-content/uploads/2022/09/Comparison-of-totalmobile-spectrum-28-09-22.pdf ("Analysis Mason Report").

towards the proven highest benefit uses, infrastructure initiatives that encourage investment, and a national approach to connectivity and wireless research and development.

Ericsson forecasts that North American average smartphone use will be the highest of any region across the globe, but the United States is hundreds of megahertz behind rival nations in mid-band spectrum for licensed commercial use.[4] In just five years, the United States will lag behind China in mid-band spectrum allocations with China having 1660 MHz and the United States having just 450 MHz.[5]

The United States must maintain its wireless technology leadership. The United States has historically been the leader in the deployment of wireless services and must lead in the development and deployment of 6G. To have a leadership position in the evolution of wireless systems, the United States must be a leader in allocating new, high-power, mid-band spectrum for 6G. The Next Generation Mobile Network Alliance (NGMN Alliance) recommends supporting capacity with "new allocations of high-power, exclusive use. …. [t]he allocation of new IMT spectrum has been a more cost-effective means of extending capacity and would also be preferred from a sustainability perspective as studies have highlighted that lower site densities reduce overall power consumption."[6] The allocation of licensed spectrum in the 3 GHz – 15 GHz mid-band frequencies is critical to United States leadership.

Under the Spectrum Coordination Initiative, NTIA and the Federal Communications Commission ("FCC") are collaborating to develop and implement a long-term strategic plan. Spectrum is a public good, owned by taxpayers. Wireless companies have deployed this

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[4] According to the Analysis Mason Report, the U.S. currently ranks 13th out of 15 countries in the amount of spectrum allocated to commercial wireless in the lower mid-band range with approximately 270 megahertz available between 3 GHz and 8.4 GHz, while countries such as Japan and China have over 650 megahertz available on average. Analysis Mason Report at 10.

[5] Analysis Mason Report at 11.

[6] *See* https://www.ngmn.org/wp-content/uploads/NGMN_6G_Requirements_and_Design_Considerations.pdf

spectrum in a way that maximizes the public good and, together with the FCC and NTIA, are best positioned to unleash spectrum's potential for the benefit of all Americans. With that in mind, UScellular recommends that NTIA and the FCC, through its Spectrum Coordination Initiative, build the first drafts of the NSS.

The FCC and NTIA are the only agencies with technological, regulatory, engineering, and use-case expertise to make decisions in the near to mid-term. According to a new report by Compass Lexecon, commissioned by CTIA, the "U.S. wireless industry, relying on exclusive use, licensed spectrum, contributed $825 billion in GDP to America's economy and enabled approximately 4.5 million jobs in 2020 alone."[7] In addition, over the past decade the wireless industry contributed nearly $5.4 trillion in GDP to the American economy.[8] Examples of successful auctions include the Broadcast Incentive Auction, which freed up 84 MHz of spectrum and raised approximately $20 billion; the 700 MHz auction in 2008 which allocated 62 megahertz of spectrum and raised approximately $19 billion; and, the AWS-3 auction which freed up 65 megahertz of spectrum and raised approximately $51 billion.

With the passage of the Infrastructure Investment and Jobs Act and through its Commerce Spectrum Management Advisory Committee, NTIA has seen an influx of spectrum and infrastructure experts, making it a primary agency to determine how best to unleash the greatest potential for our wireless future. This is particularly true with respect to the nuanced challenges of connecting the unconnected and under-connected. In addition, NTIA represents the nation in global spectrum negotiations. Spectrum policy is increasingly becoming a global priority, and NTIA is well positioned to make decisions for the US and its allies. Once spectrum

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[7] The Importance of Licensed Spectrum and Wireless Telecommunications to the American Economy, Aren Megerdichian, Ph.D. Compass Lexecon, December 7, 2022, at https://www.ctia.org/news/u-s-wireless-industry-powered-by-licensed-spectrum-contributes-825-billion-to-americas ("CTIA report").

[8] See CTIA Report.

bands and technologies are explored, identified, and potentially ready for auction, the FCC and NTIA should engage the agencies who have interests in the spectrum to work out ahead of any auction certain specifics like interference, relocation, incentives for reallocation and reimbursement.

In addition to the relevant agencies, non-political, consensus-based standards bodies are critical to establishing spectrum efficiency and allocations. UScellular participates in 3GPP, GSMA, NGMN, ATIS, NextG Alliance, National Spectrum Consortium, among others. These standards bodies are largely successful because they have remained non-political and focus on the highest and best use of spectrum.

The United States must avoid losing the global leadership position in wireless and doing so requires the creation of an aggressive spectrum pipeline geared towards proven, highest benefit uses.

IV. Technology development

Open RAN is possibly the most talked about technology that could theoretically improve security and efficiency of wireless networks. As with dynamic sharing schemes, UScellular supports the concepts and goals of Open RAN and their continued evaluation. Open RAN has the potential to create opportunities to develop a more diverse vendor market, encourage innovative 5G and next generation equipment solutions including open, standards-based, interoperable equipment, help to relieve the wireless technology supply chain delays, enhance 5G and next generation competitiveness, and promote a secure communications ecosystem. For these reasons, UScellular believes that Open RAN is a promising solution for future mobile broadband networks. Unfortunately, Open RAN lacks the maturity that is needed for commercial

deployment and as a replacement for currently operating large-scale, 5G networks that support macro, small-cell and centralized RAN architectures.

UScellular has been actively participating in Open RAN exploratory efforts. UScellular also is uniquely situated to provide feedback on efforts to develop an open, interoperable, competitive radio access network. In July 2021, UScellular released a Request for Information ("RFI") to eight RAN vendors including both incumbent UScellular vendors as well as several new entrants to the equipment vendor market. The RFI solicited information from these vendors regarding their readiness to initiate lab trials of Open RAN technology.

Based on responses to our RFI and subsequent technical discussions, UScellular learned that Open RAN technology has not matured enough for large-scale deployments. In particular, UScellular discovered that all eight RAN providers lacked readiness for trial activity and therefore heard mixed support for open interfaces from RAN vendors. UScellular identified the below challenges.

- Open RAN technology has mostly only been deployed by greenfield or new operators and large-scale deployments by brownfield or incumbent operators have not materialized.
- System integration is complex and costly to implement because there are multiple vendors that would need to integrate, and many aren't ready for full integration. Importantly, not one RFI participant was ready or equipped to lead this type of integration.
- Interoperability with existing RAN infrastructure requires bi-lateral agreements, customized integration, and significant testing prior to deployment.
- Open RAN expands the cybersecurity threat surface area, and the involvement of multiple infrastructure component suppliers creates added concerns around interoperability, accountability, and the complexity of the security infrastructure.
- Open RAN performance is not comparable with existing RAN architecture including lack of parity with power efficiency, network performance, and feature support. Performance is a primary consideration for UScellular as its existing RAN networks have a proven history of reliable voice and data communications including emergency services such as 911.
- Open RAN would likely increase the cost of vendor and infrastructure deployment, counter to one of the desired goals of ORAN. At best, unit cost savings are unclear

and worse, likely to be offset by higher costs for system integration and security infrastructure implementation.

Nevertheless, we are pleased to see NTIA continue to explore how best to spur development of Open RAN or other technologies. UScellular encourages NTIA to use the Fund to explore opportunities for trusted and established RAN vendors from allied nations including Ericsson, Nokia, and Samsung to participate, with the objective to develop a fully interoperable and open RAN ecosystem. While the Fund represents an opportunity to increase competition in the vendor ecosystem, UScellular encourages NTIA to invest in proven RAN vendors from allied nations. In addition, to take a phrase from Commerce Secretary Gina Raimondo, NTIA should "re-shore or friend-shore" equipment and technology from vendors residing in United States allied countries.[9] This will help to secure our supply chain and create a more diverse and competitive equipment market.

NTIA should support increased testbed deployments of 5G Open RAN networks with the goal of expediting the development of solutions for issues that predominantly hinder Open RAN, including interoperability and system integration and features like 911 compatibility and critical security infrastructure and other systems.

Finally, NTIA should spur deployment of additional independent testing and certification lab facilities such as the O-RAN Alliance Open and Testing and Integration Centers where an independent third party can perform end to end testing, conformance, and certification. UScellular is a founding member of CTIA's 5G security test bed. This test bed has convened the world's leading telecom and technology organizations to assess and address the current and

[9] Gina Raimondo, Remarks by U.S. Secretary of Commerce Gina Raimondo on the U.S. Competitiveness and the China Challenge, Nov. 30, 2022, http://www. commerce.gov/news/speeches/2022/11/remarks-us-secretarycommerce-gina-raimondo-us-competitiveness-and-china (last visited Jan. 27, 2023).

future of cybersecurity. Similarly, UScellular recommends that NTIA explore the possibility of additional joint partnership opportunities bringing together wireless suppliers, mobile operators, federal agencies and/or academia to accelerate the needed maturity of Open RAN technology.

UScellular recommends a national approach to connectivity and wireless research and development as a key component to the United States' leadership in wireless.

V. Conclusion

The United States has historically been the leader in the deployment of wireless services and must lead in the development and deployment of 6G. Losing that leadership position is unacceptable. And it is avoidable through an aggressive spectrum pipeline geared towards the proven highest benefit uses, infrastructure initiatives that encourage investment, and a national approach to connectivity and wireless research and development. When focusing on spectrum, the key to success is three-fold: (1) a significant amount of additional spectrum must be made available for commercial use; (2) that spectrum must be primarily exclusive use, licensed, and full power to realize the maximum public good, particularly in rural America; and (3) a national approach to wireless research and development must be used to further explore the benefits of dynamic sharing schemes and Open RAN, which to date remain theoretical.

The time is ripe to build our digital future, with universal connectivity ensuring America's economic prosperity, global competitiveness, and national security.

Respectfully submitted,

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