PUBLIC KNOWLEDGE

BACK TO THE SPECTRUM FUTURE:

The 20th Anniversary of the Spectrum Policy Task Force

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This paper is the culmination of a year-long research effort which included Public Knowledge's event, "Back to the Spectrum Future: The 20th Anniversary of the Spectrum Policy Task Force," in June of 2022. Thank you to our speakers and panelists.

Following that event, we interviewed 15 spectrum experts representing a diverse range of spectrum stakeholders—public interest advocates, tribal representatives, civil servants, former members of the Spectrum Policy Task Force, and commercial policy professionals. These interviews helped inform the ideas and themes developed throughout this paper. Thank you to all of our interviewees including Michael Calabrese, Greg Guice, Jaime Hjort, Grace Koh, Paul Koldsky, Blair Levin, Matthew Rantanen, Peter Tenhula, Alisa Valentin, and many others.

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EXECUTIVE SUMMARY

What does a 20-year-old policy task force and the future of spectrum policy have to do with a fictional time traveling DeLorean powered by a yet-to-be-invented flux capacitor? On the surface, not much. But Doc Brown and Marty McFly's adventures through time can serve as an allegory for the future of spectrum policy. Just like Doc Brown's invention of the flux capacitor transformed what was possible in time, wireless innovations today can transform our society and the future ahead. Just like Marty McFly's trip to the past gave him a whole new perspective on his parents and provided an opportunity to transform his future, taking a look at the Spectrum Policy Task Force (SPTF) and its report from 20 years ago can provide key insights into today's spectrum policy landscape and serve as a framework to transform our wireless future.

"Back to the Future" demonstrates that even the smallest choices we make today—or in the past—can shape the future. This is both a warning and an opportunity. Part II of this paper explores this theme by taking a look at the future of technology and its symbiotic relationship with spectrum policy. The spectrum policy choices we make today will determine the future of wireless technology and its impact on society, for better or for worse. Do we want to live in a society where everyone has access to reliable telecommunication services at affordable rates? Or do we want to live in a society with an ever-widening digital divide, where only a privileged few reap the benefits of new technologies? Unlike Doc Brown and Marty McFly, we do not have a time traveling DeLorean to help us fix the timeline if we get today's spectrum policy decisions wrong. Which is why we need a framework rooted in core public interest principles to help guide policymakers towards a wireless future that serves and includes *all* Americans.

In "Back to the Future," moving forward often requires a trip to the past. Part III of this paper does just this by exploring the SPTF's recommendations from 20 years ago and reframing them into two key issue areas for the future: spectrum efficiency and spectrum access

models/technical measures. Spectrum efficiency is a core goal of our telecommunications regulators, yet the definition of spectrum efficiency varies greatly amongst spectrum policy stakeholders. The SPTF developed several definitions of efficiency within the spectrum policy landscape 20 years ago, but none of these were widely adopted. Instead, spectrum policy stakeholders easily manipulate the definition of spectrum efficiency to meet the political pressures of the day. By refocusing spectrum policies on efficiency metrics that serve the public interest such as economic impact, consumer impact, and technical usage, policymakers can provide consistency and transparency while maximizing the public benefits of wireless technologies.

The SPTF also proposed moving away from the traditional command-and-control regime to more flexible approaches to spectrum access. The SPTF recommended balancing the majority of spectrum access between two models—a commons model and flexible-use license approach designed to maximize spectrum access through secondary markets. Today, the commons model has achieved significant success in the form of unlicensed spectrum access. But, outdated technical measures artificially create spectrum scarcity and prevent exclusively licensed spectrum from achieving the flexibility envisioned by the SPTF. As long as spectrum policies are designed to keep spectrum scarce, the public will suffer from the negative impacts of limited spectrum access. Re-evaluating our spectrum policies in light of new interference mitigating and spectrum reuse technologies is essential to creating a thriving, competitive wireless ecosystem.

Marty McFly and Doc Brown often use the hindsight they have from living in the present or experiencing the future to make better choices throughout their adventures. Re-examining the SPTF's recommendations in light of what did and did not work also gives us the opportunity to apply hindsight to spectrum policy for the future. Part IV of this paper explores two key issues

that the SPTF failed to address: the stakeholder dynamic and spectrum policy's role in diversity, equity, and inclusion. Policymakers must consider these aspects of spectrum policy if they hope to create a wireless future that benefits everyone.

Many of the SPTF's most innovative recommendations were never adopted. Why? Because of the complicated stakeholder dynamic in spectrum policy. Spectrum policy is often approached as a zero-sum game by many stakeholders even though that need not be the case. Breaking down the stakeholder dynamic into three distinct subgroups—the government, the industry, and the public—provides a map for navigating the spectrum policy stakeholder dynamic while also shining a light on the zero-sum game fallacy. This is essential to moving spectrum policies that embody public interest principles forward.

Additionally, providing reliable and affordable access to wireless technologies for all Americans requires that all aspects of telecommunications policy—including spectrum policy—address diversity, equity, and inclusion (DEI). The SPTF considered DEI outside of its scope because the report focused on the technical aspects of spectrum policy. But even technical decisions have a significant impact on who does and does not get access to a technology. Preventing an inequality is always easier and more effective than trying to remedy it afterwards. This is why policymakers must ask how spectrum policies will impact DEI and adopt policies that have a beneficial, or at least, net neutral impact on DEI.

As Doc Brown tells Marty in the final movie, the future is what you make it. We have an opportunity to create a wireless future that benefits all Americans no matter where they live—one in which everyone has access to affordable reliable telecommunications services. A future where spectrum is used effectively to meet the needs of all users; where there is ample spectrum available for innovative technologies that improve our safety and increase our access to

education, economic, and cultural opportunities; that allows society to decide what technologies succeed; and where all stakeholders work together to meet the public's telecommunications needs. Let's make this our future by adopting a spectrum policy framework that is driven by a vision of the future that benefits all of us.

I. INTRODUCTION

In June 2002, FCC Chairman Michael Powell established the Spectrum Policy Task Force. Chairman Powell was determined to develop a spectrum policy playbook to provide consumers with what they want—access to interference-free spectrum when they need it—by creating a policy environment that would allow innovative technologies to prosper without the hindrance of outdated and inflexible regulations.[1] In the words of Chairman Powell, "The Commission is chartered to serve the public interest. The public has made their desire for interference-free spectrum-based services quite clear. The challenge now rests with us to deliver."[2]

After seeking public comment and holding several workshops, in November 2002, the Spectrum Policy Task Force issued its final report—the Spectrum Policy Task Force Report (SPTF).[3] This report profoundly impacted U.S. (and global) spectrum policy. It essentially formed the general basis for U.S. spectrum policy over the last 20 years. The SPTF's chief contributions included significantly limiting command-and-control spectrum allocations in favor of two separate access models designed to meet different needs: (1) a flexible exclusive-use model that bore a close resemblance to a property school approach and (2) an unlicensed

[1] F.C.C., Press Statement of Chairman Michael K. Powell On Spectrum Policy Task Force (Nov. 7, 2002), https://www.fcc.gov/document/press-statement-chairman-michael-k-powell-spectrum-policy-task-force.
[2] *Id.*
[3] F.C.C., Spectrum Policy Task Force Report, ET Docket No. 02-135 (Nov. 2002), https://docs.fcc.gov/public/attachments/DOC-228542A1.pdf [hereinafter SPTF Report].

commons model. The SPTF believed that these models would expand the liquidity of spectrum, making spectrum more accessible and encouraging wireless innovation.

The SPTF made a number of specific recommendations—some were adopted, a few were modified, and several were ultimately rejected. Unsurprisingly, the political strength of the interests involved frequently determined the proposals' outcomes. Nevertheless, a surprising number of fairly radical policies were adopted over the objections of incumbent interests. Twenty years later, these changes have significantly altered the spectrum policy landscape.

Some changes have substantially improved spectrum management. The past 20 years have seen the rise of greater spectrum access and flexibility—especially in unlicensed and shared spectrum. This shift has also increased innovation and certain types of competition, particularly amongst new services and technologies. But some changes have exacerbated problems or created new ones. Concentration in the mobile services industry is at an all-time high. And even though command-and-control models are mostly gone, optimizing spectrum for specific technologies (e.g., LTE, Wi-Fi) has created a new form of de facto command-and-control via technical standards. Rural deployment remains deficient and digital inequities continue to grow with increasingly negative consequences for those on the wrong side of the digital divide. In addition, new issues have emerged that the SPTF did not anticipate.

The SPTF's impact on U.S. spectrum management policy over the last 20 years can serve as a framework for thinking about the next 20 years of spectrum policy. This paper digs into some of the SPTF's key recommendations and asks what worked, what did not work, and why? Most importantly, this paper takes those findings and proposes a framework for making spectrum policies that will move us towards a desirable future that provides affordable and reliable

telecommunication services to all Americans by ensuring that there is ample access to spectrum for all of society's wireless needs.

II. THINGS ARE HEAVY IN THE FUTURE: SPECTRUM POLICY & ADVANCING TECHNOLOGY

Any productive conversation about the future of spectrum policy must also include a conversation about the future of technology. What is this country going to look like in 20 years? Are we going to have radio? What are the future uses of spectrum? This section addresses these questions and goes one step further—asking also, what do we want the world to look like in 20 years? And, how can spectrum policy help us get there?

A. The Future Isn't Written: The Symbiotic Relationship Between Spectrum Policy and Technology

Despite the advent of data-driven algorithms that can help predict future trends and consumer behavior, predicting the future of technology is still more of an art than a science. H.G. Wells, the father of modern science fiction, was one of the first to use literature to predict the future of technology. Even though Wells anticipated much of the future—televisions, VCRs, and powered commercial and combat aircraft—Wells' vision still fell short, only extrapolating on the machinery of his time.[4] Wells did not foresee that the "most powerful physical technologies of the twentieth century are based on manipulation of the invisible worlds of subatomic particles and the electromagnetic spectrum."[5]

Although today's technology predictions are full of the wireless advancements H.G. Wells missed, the reality of how spectrum policy can limit the advancement of these

[4] Stephen J. DeCanio, *The Future Through Yesterday: Long-Term Forecasting in the Novels of H.G. Wells and Jules Verne*, 38 Centennial Rev. 75, 81 (Winter 1994), https://www.jstor.org/stable/23739681?read-now=1&seq=3#page_scan_tab_contents.
[5] *Id.*

technologies is often overlooked. The IEEE Computer Society's 2022 technology predictions[6] included numerous technologies that will require some form of wireless data transmission, including:

1. Data-centric artificial intelligence (AI) enabled by improved data acquisition through Internet of Things (IoT) and 5G;[7]
2. Remote medicine tools will allow physicians to perform procedures and tests remotely;[8]
3. Advanced wearables that capture and analyze biological data to help improve fitness, health, and well-being—including wearables that can be embedded in the human body as micro-chips or smart tattoos;[9]
4. Safe, reliable, and resilient autonomous systems—vehicles, mobile robots, etc;[10]
5. An industrial metaverse and Digital Twins (exact virtual representations of a real-world system or object) in manufacturing that integrate IoT, 5G, AI, and Extended Reality (XR) to create a blended reality and simulation experience;[11]
6. Commoditized space technology;[12] and
7. Virtual and augmented reality technology that is fully immersive with enhanced sensory (smell, touch, taste) experiences.[13]

Even though these technologies are sure to depend on spectrum access for their wireless components, the detailed lists of enablers and inhibitors that accompany each prediction make no mention of spectrum access. Whether or not a wireless technology is technically feasible will not matter if *spectrum policies and regulations prevent it from accessing the spectrum it needs to function*.

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[6] Rosa Badia, et al., 2022 Technology Predictions, IEEE Computer Society (2022).
[7] *Id.* at 8.
[8] *Id.* at 9.
[9] *Id.* at 10.
[10] *Id.* at 15.
[11] *Id.* at 16.
[12] *Id.* at 19.
[13] *Id.* at 22.

The recent past demonstrates the symbiotic relationship between technological advancement and spectrum policy. Take a look at Uber; Advanced 4G wireless technology made ridesharing possible.[14] In turn, the success of Uber and other mobile-dependent apps have fueled demand to allocate more spectrum to mobile wireless. While at the same time, Uber has and continues to invest in wireless technologies that improve data usage and GPS accuracy.[15] The popularity of Uber has also driven others to develop new technologies that enhance wireless coverage such as cell boosters for vehicles.[16] These advanced technological developments change what is possible in spectrum policy by providing new ways to share and maximize spectrum use.

Essentially, the future of spectrum policy and the future of technology go hand-in-hand. The spectrum policies that are enacted today will impact what technologies are developed and how quickly they are adopted. Vice versa, future technological advances will impact what policies are possible.

B. Fixing the Timeline: Backcasting Spectrum Policy from Public Interest Principles

The symbiosis of spectrum policy and future technologies makes it possible for us to do more than predict and prepare for the future. It also empowers us to envision the technological future we want and create policies that will help us get there.

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[14] Clare Duffy, *The Big Differences Between 4G and 5G*, CNN (Jan. 17, 2020), https://www.cnn.com/2020/01/17/tech/5g-technical-explainer/index.html.
[15] *See, e.g.*, Andrew J. Hawkins, *How Uber Moves the 'Blue Dot' to Improve GPS Accuracy in Big Cities*, The Verge (Apr. 19, 2018), https://www.theverge.com/2018/4/19/17252680/uber-gps-blind-spot-shadow-maps.
[16] *How Uber & Lyft Drivers Improve Connection & Internet Speeds*, Wilson Amplifiers (Feb. 18, 2021), https://www.wilsonamplifiers.com/blog/earning-more-how-uber-lyft-drivers-improve-connection-internet-speeds-with-signal-boosters/.

This approach, known as "backcasting," is ideal for "long-term complex issues, involving many aspects of society as well as technological innovations and change."[17] Backcasting from principles is particularly useful. Instead of predicting a detailed world-to-come, this type of backcasting identifies a set of principles that define a desirable future. These principles are then used to guide policy decisions, helping move society towards a desirable future aligned with our values. Backcasting from principles is not about predicting specific technologies, but rather about world building. What kind of an impact do we want technology to have? There is a difference between saying we want spectrum to enable non-commercial uses like education and health care and trying to predict specific spectrum-fueled educational or health care technologies. The later is impossible, but the former invites us to imagine the conditions that make the world we want possible.

Most technology predictions simply extrapolate on what already exists, failing to predict the inevitable major departures from our current technological reality. In a backcasting from principles model, even if such predictions miss the mark, they still have a value. After all, "accuracy is not everything…. Projections of social and technological development, even the very act of speculating on the shape of the distant future, implicitly involve articulation of a moral vision."[18] Instead of focusing on the accuracy of technology predictions, backcasting from principles allows us to use the visions these predictions reveal to determine what principles are necessary for a desirable future. This model is particularly suited to spectrum policy because it works for *many* desirable futures—not just one.

[17] Karl H Dreborg, Essence of Backcasting, 28 Futures 813, 814 (1996).
[18] DeCanio, *supra* note 4 at 79.

Predictions that focus on the potential positive and negative impacts of technology provide the most insight into what a desirable future *must* and *must not* look like. In 2019, the Pew Research Center released a study it had conducted on the next 50 years of life online. While the participants did make predictions about specific technological advances, "most of their responses were tied to hopes and concerns over human evolution in light of technological change."[19] Researchers identified several themes, including:

- **Internet of Everything**: "In 50 years, internet use will be nearly as pervasive and necessary as oxygen. Seamless connectivity will be the norm, and it may be impossible to unplug."[20]
- **Living longer and feeling better**: "Internet-enabled technology will help people live longer and healthier lives. Scientific advances will continue to blur the line between human and machine."[21]
- **Individualized experiences**: "Digital life will be tailored to each user."[22]
- **Collaboration and community**: "A fully networked world will enhance opportunities for global collaboration, cooperation and community development, unhindered by distance, language or time."[23]
- **Widening divides**: "The divide between haves and have-nots will grow as a privileged few hoard the economic, health and educational benefits of digital expansion."[24]
- **Internet-enabled oppression**: "A powerful elite will control the internet and use it to monitor and manipulate, while providing entertainment that keeps the masses distracted and complacent."[25]

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[19] Kathleen Stansberry, Janna Anderson & Lee Rainie, *Experts Optiistic About the Next 50 Years of Digital Life*, Pew Research Center (rel. Oct. 28, 2019), PDF available at https://www.pewresearch.org/internet/2019/10/28/themes-about-the-next-50-years-of-life-online/.
[20] *Id.* at 10.
[21] *Id.* at 12.
[22] *Id.* at 13.
[23] *Id.* at 13.
[24] *Id.* at 15.
[25] *Id.* at 15.

- **The end of privacy**: "Personal privacy will be an archaic, outdated concept, as humans willingly trade discretion for improved healthcare, entertainment opportunities and promises of security."[26]

These themes help identify both desirable and undesirable outcomes for the future of technology. On the desirable side: ubiquitous internet access enables global collaboration and communication, ushering in a time of unprecedented peace and prosperity; and automated technology powered by AI improves our health, allows us more leisure time, and adapts to our individualized needs. On the undesirable side: privileged elites hoard the wealth and benefits of technology, oppressing the masses as an ever-widening digital divide makes it impossible for the have-nots to ever catch up; and only the rich can afford privacy, leaving everyone else to trade their discretion, data, and digital rights to continue participating in what has become a completely digital society.

Obviously, these potential futures are influenced by more than just spectrum *regulation*, but they are tied up in the important role of spectrum *policy*. All of these futures, good and bad, are only made possible by technologies that use spectrum. Spectrum policy will therefore shape their evolution. The ubiquity, affordability, and even the basic capabilities of these technologies will be shaped—at least in part—by the rules governing access to, and use of, spectrum. So, how should we translate these potential futures into a set of principles to govern spectrum policy? By starting with the public interest principles already embedded in our telecommunications system.

The public interest underpins the spectrum management authority of the two regulatory agencies that oversee spectrum in the United States—the Federal Communications Commission (FCC or Commission) and the National Telecommunications and Information Administration (NTIA). The public interest purpose of the FCC is evident throughout the Communications Act

[26] *Id.* at 16.

of 1934 (the Act)[27] and is the "primary criterion for apportioning spectrum in the United States to non-federal users.[28] Section 309(a) requires the Commission to determine whether a spectrum license application will serve "the public interest, convenience and necessity" and limits the Commission's authority to grant a license unless it finds that it will.

Although Title III does not provide a clear definition of what will serve the public interest, other parts of the the Act provide objectives that help define the public interest. For example, Section 1 of the Act provides the Commission's purpose, which also underlies the Commission's spectrum management objectives. It states that the FCC is:

> to make available, so far as possible, to all the people of the United States, without discrimination on the basis of race, color, religion, national origin, or sex, a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges, for the purpose of the national defense, for the purpose of promoting safety of life and property through the use of wire and radio communications…[29]

These provisions provide a definition of what serves the public interest—reliable, affordable, telecommunications services for all; securing our national defense; and promoting public safety.

Similar to the FCC, NTIA's spectrum authority is also underpinned by a need to serve the public interest. Section 901(c)(4) of the NTIA Organization Act requires NTIA to foster "full and efficient use of telecommunications resources, including effective use of the radio spectrum by the Federal Government, in a manner which encourages the most beneficial uses thereof in the public interest."[30]

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[27] *See, e.g.*, 47 U.S.C. § 303.
[28] U.S. Dept. of Commerce, Spectrum Policy for the 21st Century—the President's Spectrum Policy Initiative: Report 1 at 9 (June 2004), https://www.ntia.doc.gov/files/ntia/publications/spct_pol_part_1_rl.pdf.
[29] 47 U.S.C. § 151.
[30] 47 U.S.C. § 901(c)(4).

We can translate the public interest goals that underpin these regulatory agencies into principles that can guide spectrum policy. This approach is similar to that taken by the SPTF 20 years ago when it also tried to envision a spectrum plan for the future. As the SPTF recognized, "the overarching goal of effective spectrum policy is to maximize the potential public benefits to be derived through spectrum-based services and devices."[31]

Backcasting from principles goes one step further and defines what it means to maximize the public benefit by asking us to fill in the blank:

> ***In a desirable future that maximizes the public benefits of our telecommunications system_____.***
>
> - …all Americans regardless of race, color, religion, national origin, or sex are able to access affordable and reliable telecommuncations services.
> - …spectrum is used effectively to meet the needs of all spectrum users—both federal and non-federal.
> - …there is ample spectrum available for developing innovative technologies that will help improve safety and health; maintain a strong national defense system; increase access to education, economic, and cultural opportunities; and provide other public benefits to society.
> - …society decides what technologies succeed—not regulatory regimes that protect entrenched incumbents at the expense of new entrants.
> - …all stakeholders work together to meet the public's telecommunications needs.

A value-based framework for making policy decisions affords policymakers the flexibility necessary to adapt spectrum policies, even technical ones, to meet the needs of a technological future we cannot truly predict. Instead of enacting spectrum policies based on foolhardy attempts to predict the fine details of what technology will look like in 20 years or more, policymakers should enact spectrum policies based on these core principles to help create

[31] SPTF Report, *supra* note 3 at 11-12.

the conditions of a wireless future that benefits everyone, not just a privileged few, while avoiding the technology-fueled dystopias so many fear.

III. SEE YOU IN THE PAST: REEXAMINING THE SPECTRUM POLICY TASK FORCE'S RECOMMENDATIONS

Many of the SPTF's recommendations from twenty years ago are still relevant today. By re-evaluating them in the context of two key issues for the future—efficiency and spectrum access models—we can reframe these issues in light of the public interest principles that will help us shape a wireless future that benefits all Americans while increasing access to spectrum to meet the public's wireless needs.

A. Promoting Spectrum Efficiency

Efficiency is a term that is often lobbed around in spectrum policy discussions as a valued goal and tool for measuring the effectiveness of spectrum regulations. It is even embedded in NTIA's statutorily mandated purpose[32] and the FCC is directed to promote "efficient and intensive use" of spectrum in Title III of the Act.[33] In theory, making spectrum decisions that maximize efficiency is ideal, but in practice, the metric by which efficiency is determined can vary greatly. This section re-evaluates the Spectrum Policy Task Force's take on efficiency.

The Spectrum Policy Task Force's Approach To Evaluating Efficiency in the Context of Spectrum Management

The Spectrum Policy Task Force identified three different definitions of the term efficiency in the context of spectrum management:

1. **Spectrum Efficiency**, which "occurs when the maximum amount of information is transmitted within the least amount of spectrum;"[34]

[32] 47 U.S.C. § 901(c)(4).
[33] 47 U.S.C. § 309(j)(3)(D).
[34] SPTF Report, *supra* note 3 at 21.

2. **Technical Efficiency**, which "occurs when inputs, such as spectrum, equipment, capital, and labor, are deployed in a manner that generates the most output for the least cost;"[35] and

3. **Economic Efficiency**, which "occurs when all inputs are deployed in a manner that generates the most value for consumers."[36]

In its report, the SPTF lumped spectrum efficiency and technical efficiency together and determined that "spectrum and technical efficiency are components of economic efficiency, but that measuring spectrum and technical efficiency does not necessarily provide any meaningful information with respect to economic efficiency."[37] It also concluded that developing a particular metric for evaluating spectrum or technical efficiency "would, inherent in its assumptions, provide advantages to one service or another."[38]

Based on these conclusions, the Spectrum Task Force focused on promoting economic efficiency. The SPTF argued that increasing the flexibility of use cases for a spectrum license and encouraging the transferability of a licensee's spectrum access would best promote economic efficiency.[39] By allowing licensees to transfer or sublease their allocated spectrum with few to no restrictions, the SPTF believed that spectrum users would negotiate amongst themselves for spectrum access which would determine the highest and best-use of given frequency.[40]

Efficiency in the Current Spectrum Policy Landscape

The Commission has only recently taken steps to reconsider the role spectrum and technical efficiency (as defined by the SPTF) have on the whole spectrum ecosystem. The Commission's recent Notice of Inquiry (NOI) on receiver standards considers the impact

[35] *Id.*
[36] *Id.*
[37] *Id.*
[38] *Id.*
[39] *Id.*
[40] *Id.* at 16.

receivers have on spectrum and technical efficiency, recognizing that "as spectrum use…becomes more intensive, Commission spectrum management policies must consider potential efficiencies across all aspects of wireless systems, not just transmitters but receivers as well."[41]

This is more than a shift in the Commission's thinking. It is an opportunity to revisit the efficiency questions the Spectrum Policy Task Force grappled with 20 years ago in light of the current spectrum landscape. How has the SPTF's view of efficiency held up over time and do we need to adjust our approach to efficiency for the future? Exploring this question revealed two themes: (1) focusing on economic value as an efficiency metric has negatively skewed the way efficiency is approached in current spectrum management practices; and (2) policymakers should not use a universal metric for efficiency in the context of spectrum management.

The Negative Impact of Economic Efficiency

Twenty years later, economic efficiency underpins most spectrum management decisions. Unfortunately, the current definition of economic efficiency has shifted significantly. Today, economic efficiency is less about generating the most value for consumers and more about generating the most value for the government and service providers. Unsurprisingly, the focus on maximizing the revenues generated from spectrum use has negatively impacted the general public and our national telecommunications system as a whole.

The Coase theorem on economic efficiency heavily underpinned the SPTF's approach to economic efficiency. In 1959, economist Ronald Coase argued for a market-based approach to assigning property rights in spectrum at auction as an alternative to the government's inefficient

[41] F.C.C., Notice of Inquiry, *In the Matter of Promoting Efficient Use of Spectrum through Improved Receiver Interference Immunity Performance*, ET Docket No. 22-137, at ¶ 1 (rel. April 21, 2022), https://www.fcc.gov/ecfs/search/search-filings/filing/10421179984230.

command-and-control approach.[42] Coase's proposal was based on the theory that those who will pay the most for rights to a given frequency will also extract the highest and best value of that frequency—even if that means re-selling their spectrum rights to another party at a later date. In ideal economic conditions, Coase argued that this approach would achieve Pareto efficiency in the world of radio—an optimal state where no action or allocation would make one spectrum user better off without making another worse off.[43]

Auction proponents often use this theory to argue that the price paid at auction *is* a proxy for the public interest. But, even Coase acknowledged that there were public concerns—like pollution and monopolistic practices—that required a regulatory solution, rather than a market one.[44] Additionally, Coase's theory depends on maintaining an artificial scarcity of licenses. Innovations that permit unlicensed spectrum access and other forms of cooperative sharing did not exist when Coase was developing his views on spectrum management. While no one can doubt that these spectrum access regimes create enormous value—both economically and to society at large—they run contrary to the argument that auctions and secondary markets are the only means of putting spectrum to its "highest, best use."

Unfortunately, rather than achieving Coase's dream of Pareto efficiency, spectrum auctions are used as a tool to maximize the government's revenue, often at the expense of the public and our national telecommunication's system. To date, federal spectrum auctions have raised hundreds of billions of dollars for the U.S. Treasury. Even though the FCC is statutorily forbidden from considering revenue when making auction decisions,[45] at such high numbers, the

[42] Ronald Coase, The Federal Communications Commission, 2 J. of L. and Econ. 1 (Oct. 1959).
[43] *See id.* at 27.
[44] *See id.* at 17, 29.
[45] 47 U.S.C. § 309(j)(7)(A).

importance of revenue has seeped into auction considerations. Chairman Ajit Pai based his decision to auction the C-Band on four principles including the need to "generate revenue for the federal government."[46] While this principle never made its way into the agency's final Report and Order, it was included in other commission documents announcing the C-Band auction.[47]

The issue with a revenue maximizing approach to economic efficiency is that it is often at odds with other forms of efficiency—including the SPTF's consumer value focused definition of economic efficiency. For example, an incumbent may value a license higher than a new entrant, "simply because of the greater market power the incumbent would enjoy without the new entrant."[48] Similarly, when there are competing technology standards, supporters of one standard may value a license more "if it creates a hole in the footprint of a competing standard."[49] For example, prior to the C-Block auction, the Global System for Mobile (GSM) communications did not have coverage in Chicago, but the Code Division Multiple Access (CDMA) standard did. By the time the auction closed in 1996, a GSM bidder had won the C-Block license for Chicago—but only "after a long fight with the largest CDMA bidder."[50] While this type of behavior may generate more economic revenue, it does so at the expense of the end consumer who ultimately pays for the increased spectrum costs and suffers from the anti-competitive result such barriers to entry create.

This is why Congress forbid the FCC from considering revenue from its auction decisions. It is also why it is important to ensure that the metrics we use to determine spectrum

[46] Letter from Aji Pai to the Honorable Roger Wicker, Chairman of the Committee on Commerce, Science, and Transportation (Nov. 18, 2019).
[47] *See* F.C.C., The C-Band: Repurposing Mid-Band Spectrum for 5G at 1 (February 6, 2020), https://docs.fcc.gov/public/attachments/DOC-362335A1.pdf ("...and it would generate significant revenue for the U.S. Treasury.").
[48] Peter Cramton, Handbook of Spectrum Auction Design, 57 (Oct. 2017)
[49] *Id.*
[50] *Id.*

efficiency serve the public interest and move us towards a future that makes good on the FCC's goal of providing affordable and reliable communications services to all rather than the revenue an auction can raise.

How is Efficiency Defined Today?

At least one aspect of the efficiency question is still the same today: there is no one-size fits all definition of efficiency. Rather, efficiency is in the eye of the beholder. Nearly every interviewee for this paper had markedly different approaches, preferences, and metrics for measuring efficiency in the context of spectrum management.

The one consistent line on efficiency throughout all of the interviews was that using a universal efficiency metric to make spectrum policy decisions is a bad idea. If we use a single metric to evaluate efficiency, some spectrum policies will perform really well at that metric, and others will not—which will create a unitary spectrum ecosystem. For example, if we define efficiency based solely on technical usage (how much data is being transferred across a frequency) unlicensed will always outperform licensed. While unlicensed plays a critical role in our wireless ecosystem, there are other important services that require the reliability of an exclusive license. Ensuring that many different use cases can access spectrum requires a multi-faceted approach to efficiency.

Ultimately, when it comes to defining efficiency, the SPTF's three definitions are no longer sufficient for viewing efficiency in the context of spectrum management. Today's spectrum stakeholders use spectrum efficiency to mean efficiency in the context of spectrum management and use other terms to discuss the various metrics by which that efficiency can be measured. The various spectrum efficiency metrics that stakeholders use fit into the following four categories:

1. **Economic Value**. Under an economic value metric, spectrum efficiency is determined by looking at the monetary value a particular spectrum use generates either for the government or the service provider.

2. **Economic Impact**. Under an economic impact metric, spectrum efficiency is determined by looking at the value-add a particular use has on the overall economy.

3. **Consumer Impact**. Under a consumer impact metric, spectrum efficiency is determined by looking at how many consumers are served by a spectrum use and how much consumers are paying for a spectrum service.

4. **Technical Usage**. Under a technical usage metric, spectrum efficiency is determined by looking at how often and how much data is being transferred across particular spectrum frequencies.

Each of these metrics, if prioritized above the others, can lead to widely different spectrum policies with extremely different results. Such outcome disparities make transparency about the definition of efficiency and the metrics by which efficiency is measured incredibly important. Without such transparency, spectrum policy advocates can manipulate the value of efficiency that underpins our spectrum regulations to suit their own purposes, making it difficult, if not impossible, for policymakers to make informed spectrum management decisions.

Rethinking Spectrum Efficiency for the Future

Given the disparities between how different stakeholders define and try to optimize spectrum efficiency, the easiest thing to do might be to stop focusing on spectrum efficiency altogether. Unfortunately, this is not possible. The Act directs the Commission to distribute licenses so "as to provide a fair, efficient, and equitable distribution of radio service…."[51] And, NTIA is tasked with "promot[ing] efficient and cost-effective use of the spectrum" it assigns.[52]

[51] 47 U.S.C. §307(b).
[52] 47 U.S.C. §903(d)(1).

The value of efficiency is baked into the statutory mandates of our spectrum regulators, making it an essential factor in spectrum management.

Fortunately, neither regulatory agency is restricted to a statutory definition of efficiency. This affords the Commission and the NTIA flexibility to refine the metrics based on the public interest principles that will help us achieve a desirable future. Of the metrics stakeholders use today, only "economic value" fails to serve the public interest by giving more weight to the revenues generated by spectrum for the government and corporate interests than the value consumers receive from those spectrum uses.[53]

The remaining metrics all play a role in promoting the public interest. For example:

- **Economic Impact** takes a holistic view of the economic value a particular spectrum use creates for society, not just the amount of money generated for the government and service providers. It includes the impact of a particular spectrum use on personal wages, job opportunities, and the overall economy.
- **Consumer Impact** focuses on how many end users are served by a particular spectrum use and how much end users have to pay for that service. Making sure *all* Americans receive affordable telecommunication services is a core public interest principle that this metric seeks to achieve.
- **Technical Usage** values spectrum uses and access models that maximize data transmissions over spectrum. This serves the public interest by valuing spectrum services that actually use their spectrum allocations to their fullest potential and devaluing services that leave spectrum fallow, refusing to build out service to less profitable regions while also preventing competitors and new entrants from gaining access to spectrum.

Each of these efficiency metrics has the potential to provide significant benefits to the public. Instead of focusing on one over another, our spectrum regulators should treat these metrics as factors that they must balance to maximize the public benefits of a particular spectrum

[53] This was discussed in more detail earlier in this section.

decision. Deliberately and transparently discussing specific efficiency metrics and how they benefit the public will help us continue moving towards a desirable future.

B. Re-evaluating Spectrum Access Models & Technical Measures

The SPTF tried to move spectrum regulation away from a command-and-control approach dictated by regulators to unlicensed and flexible-use licensed access models that would allow society to determine which wireless technologies succeed. Unfortunately, out-dated technical regulations often limit the potential of these and shared-use spectrum access regimes that would help eliminate spectrum scarcity. By re-evaluating technical regulations that limit flexibility and access to spectrum in light of new technologies, our policymakers can serve the public interest by creating a thriving, competitive, and innovative wireless ecosystem.

The Spectrum Policy Task Force: Thinking Beyond Command-and-Control

When the FCC first started allocating spectrum for commercial use, it did so using a command-and-control model. Under this model, governments and regulatory bodies operate as a "wise man" by allocating spectrum for particular uses or services, limiting which geographic regions such services operate in, and establishing the services' technical rules.[54] Essentially, command-and-control models assume that the government is the best arbitrator of spectrum on behalf of the public.

By the time the SPTF was formed, it was clear that the command-and-control spectrum model was not putting spectrum to its best and highest use. The SPTF Report explained that "in many bands, spectrum access is a more significant problem than physical scarcity of spectrum, in large part due to legacy command-and-control regulations that limit the ability of potential

[54] Philip J. Weiser & Dale Hatfield, *Spectrum Policy Reform and the Next Frontier of Property Rights*, 15 Geo. Mason L. Rev. 549, 559(Spring 20008).

spectrum users to obtain such access."[55] Not only had command-and-control artificially limited spectrum and kept out new entrants, it had also created a series of disjointed allocations that did not always play nice with their neighbors. As one interviewee explained, the biggest complaint they heard while working on the SPTF was the "adhocery" created by command-and-control spectrum allocations.

In 2002, it was obvious that making spectrum ready for the future meant moving beyond command-and-control. This is why looking for new ways to allocate spectrum was one of the SPTF's primary goals. FCC Chairman Powell also hoped new models would remove policymakers from the minutiae of technical regulations and allow the market to dictate which spectrum technologies and services thrived. As one interviewee explained, "The 'P' for 'policy' in the Spectrum Policy Task Force was important. If the policies were correct, then policymakers would only have to look at the big picture issues, instead of spending two years fighting about Out-of-Band Emissions (OOBE)."

The SPTF ultimately found that when it comes to spectrum access, "one size does not fit all."[56] Instead, the SPTF proposed a balanced approach between three access models:

1. **Exclusive But Flexible Use**, which "should be applied primarily but not exclusively in bands where scarcity is relatively high and transaction costs associated with market-based negotiation of access rights are relatively low;"
2. **Unlicensed Use** (referred to by the SPTF as a "commons" model) which "should be applied primarily but not exclusively in bands where scarcity is relatively low and transaction costs are relatively high;" and
3. **Limited Command-and-Control**, which "should be reserved only for situations where prescribing spectrum use by regulation is necessary to accomplish important public interest objectives or to conform to treaty obligations."[57]

[55] SPTF Report, *supra* note 3 at 3.
[56] *Id.* at 4.
[57] *Id.* at 4.

The SPTF argued that the Commission should transition most of the spectrum that was subject to command-and-control at the time to flexible exclusive-use and commons (unlicensed) models to "the greatest extent possible."[58]

Spectrum Access Models Today

Twenty years later, below the surface, spectrum access models still function much like they did when the SPTF was envisioning new models for the future. There are, however, a few things that have changed. First, command-and-control is now achieved through technical specifications, indirectly rather than directly dictating which technologies can operate under a particular license. Second, the FCC has expanded access to spectrum outside of traditional exclusive-use licenses in limited bands—including shared access in the Citizens Broadband Radio Service (CBRS) band and unlicensed access in the 6 GHz and 5.9 GHz bands. Despite the success of these models, alternative spectrum access models continue to face significant opposition and are often altered to reduce or eliminate their more innovative aspects in later proceedings.[59]

Even though direct command-and-control is no longer the regime of the day, neither is flexibility. Today, auction rules (which ensure only certain types of businesses can afford to acquire licenses) and technical specifications (issued under the guise of preventing harmful interference) significantly limit the types of technology that can operate in a particular band.[60] These technical restrictions, in particular, "often favor incumbents and tend to err on the side of caution/conservatism as far as the technical abilities of newcomers."[61]

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[58] *Id.* at 10.

[59] The stakeholder dynamic plays a significant role in what types of access models succeed, and which ones do not. While addressed in limited form here, this paper covers the impact of the stakeholder dynamic in more detail in Section V(A) of this paper.

[60] *See* John Leibovitz & Ruth Milkman, *Taking Stock of Spectrum Sharing*, 7 (Sept. 2021).

[61] *Id.*

In licensed bands, this de facto command-and-control under the guise of flexibility generally begins with the hype around a particular technology, like 5G. For example, contrary to the proceeding's title, opening up the C-Band was not about "expanding flexible use of the 3.7 to 4.2 GHz band."[62] No, it was necessary to "fuel the deployment of 5G."[63] In fact, then FCC Chairman Ajit Pai repeatedly referred to the C-Band as "5G spectrum."[64] Moreover, even though the C-Band technically allowed flexibility for a variety of services, including IoT-type fixed and mobile services, and fixed, point-to-point links,[65] the auction results tell a different story. Of the 21 bidders, 17 were wireless carriers and the remaining four appear to be private investors speculating on spectrum.[66] The big three—Verizon, AT&T, and T-Mobile—spent a combined $78.2 billion, accounting for 96.78% of the total $80.8 billion raised.[67] Essentially, just as the hype demanded, the C-Band went to 5G.

Not only is there no real technological flexibility in the C-Band, the concentration of licenses amongst the big carriers has limited some of the most innovative and flexible uses of 5G itself, such as small private networks that support niche 5G use cases like smart city infrastructure and Industrial IoT applications.[68] While, in theory, municipalities, businesses, and other entities that want to build private 5G networks could sub-lease spectrum from C-Band

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[62] Report & Order, *In the Matter of Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, GN Docket No. 18-122 (Rel. March 3, 2020) [hereinafter C-Band R&O].
[63] Margueritte Reardon, *FCC to Auction C-band Spectrum for 5G*, CNET (Nov. 18, 2019), https://www.cnet.com/tech/mobile/fcc-to-auction-c-band-spectrum-for-5g/.
[64] *E.g.* Letter from Aji Pai to the Honorable Roger Wicker, Chairman of the Committee on Commerce, Science, and Transportation (Nov. 18, 2019).
[65] C-Band R&O, *supra* note 62 at ¶84, 86.
[66] Adam Simmons, *C-band Auction Results: Verizon, AT&T, T-Mobile, U.S. Cellular, and Grain,* Dgtl Infra (Feb. 24, 2021), https://dgtlinfra.com/c-band-auction-results-verizon-att-tmobile/ (the table analyzing auction spend classifies winning bidders as "Wireless Carrier" or "Private Equity").
[67] *Id*; *see also* Sascha Segan, *Strike Up the C-Band: Opening New Lanes on the 5G Highway*, PC Mag (Feb. 26, 2021), https://www.pcmag.com/opinions/strike-up-the-c-band.
[68] Herald Remmert, *5G Applications and Use Cases*, Digi (Nov. 25, 2019), https://www.digi.com/blog/post/5g-applications-and-use-cases.

auction winners, the big carriers are not usually known for their willingness to share spectrum even when doing so financially benefits them.

Even though unlicensed spectrum does not require users to purchase expensive licenses, they still risk becoming de facto command-and-control bands due to technical specifications and the cost barriers of spectrum coordination mechanisms. There is a reason that unlicensed spectrum is often considered synonymous with Wi-Fi even though it is not the only thriving unlicensed technology. Expanding Wi-Fi sells the public and policymakers on opening up spectrum for unlicensed even though many additional unlicensed technologies function better than Wi-Fi for certain use cases—like Bluetooth for personal wearables and indoor location services,[69] ZigBee for IoT and smart home devices,[70] and MulteFire for private LTE networks.[71] At its most ideal, unlicensed spectrum creates a sandbox for innovation *because of its flexibility*.

Unfortunately, unlicensed spectrum bands are increasingly bogged down by technical specifications and cumbersome coordination requirements that limit opportunities for innovation. For example, even though the 6 GHz band rule is largely a win for unlicensed opportunities, there are some aspects of the band rules that limit its full potential. The Commission authorized standard power unlicensed use throughout the band with the use of an Automated Frequency Coordinator, but prohibited unlicensed mobile operations because they might add complexity to the AFC system.[72] Despite this prohibition, the Commission authorized transportable devices, so

[69] Learn about Bluetooth: Bluetooth Technology Overview, Bluetooth (last accessed Jan. 13, 2023), https://www.bluetooth.com/learn-about-bluetooth/tech-overview/.
[70] Maggie Tillman, *What Is Zigbee and Why Is It Important for Your Smart Home?*, Pocket-lint (Aug. 9, 2022), https://www.pocket-lint.com/smart-home/news/home-security/129857-what-is-zigbee-and-why-is-it-important-for-your-smart-home.
[71] About MulteFire and Uni5G Technology, MFA (last accessed Jan. 13, 2023), https://www.mfa-tech.org/technology/.
[72] *See* F.C.C., Report and Order and Further Notice of Proposed Rulemaking, *In the Matter of Unlicensed Use of the 6 GHz Band, Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, ET Docket No. 18-295, GN Docket No. 17-183, at ¶ 209 (rel. April 24, 2020).

long as they are not used while in motion, and mobile operations for aircraft operating above 10,000 feet.[73] In neither case did the Commission discuss the complexity these exceptions might add to the AFC system—making the decision to exclude mobile devices seem somewhat arbitrary and unnecessarily cumbersome. Are there really decent mechanisms to prevent an end user from using a transportable device in transit?

Even when the Commission does manage to adopt a significantly innovative approach to spectrum management, there is significant opposition by spectrum stakeholders that are entrenched and protected by old models. This often results in dumbing down the innovative aspects of the band. Take the Citizens Broadband Radio Service (CBRS) band for example. The Commission originally adopted rules that based the geographic footprint of Priority Access Licenses (PALs) on census tracts.[74] This smaller-sized license would have increased competition for these licenses by making it possible for smaller internet service providers, private entities, and community institutions to participate. Instead, after the change of administration, the Pai Commission increased the size of the PAL licenses to a county-basis.[75] This and other rule changes ultimately "prevented experiential learning from some of the more innovative aspects of the CBRS regime and limited access to the Priority Access License tier in major markets to large network service providers."[76]

Claiming that spectrum allocations are flexible when every aspect of a band plan is set up to encourage a singular use is disingenuous at best, and deliberately manipulative at worst.

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[73] *Id.* at ¶ 211.

[74] F.C.C., Report and Order and Second Further Notice of Proposed Rulemaking, *In the Matter of Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, GN Docket No. 12-354 at ¶ 96 (rel. April 21, 2015), https://www.fcc.gov/ecfs/document/60001029681/1.

[75] F.C.C., Report and Order, *In the Matter of Amendment of Promoting Investment in the 3550-3700 MHz Band*, GN Docket No. 17-258 at ¶ 19 (rel. Oct. 24, 2018), https://www.fcc.gov/ecfs/document/10242030623468/3.

[76] Leibovitz & Milkman, *supra* note 60 at 3.

Americans will not receive the benefit of flexible spectrum access models if those models are flexible in name only.

Moving Forward: Eliminating Spectrum Scarcity

Today, spectrum policy debates are rooted in a belief that spectrum is a scarce resource. Presented as an undisputed fact, concern about spectrum scarcity underpins the urgency to allocate more and more spectrum for licensed exclusive-use. Creating a spectrum pipeline is always necessary to help the U.S. "win the race" to the next generation of cellular coverage—today, the race to 5G; tomorrow, the race to 6G; and so on. The belief that spectrum is a limited resource also underpins the argument that the government must maintain a strong regulatory grip on who *can* and who *cannot* access spectrum. The lack of spectrum is used to justify gatekeeping policies that exacerbate spectrum scarcity.

Unfortunately, limiting spectrum access also significantly limits the public benefits of our nation's telecommunication systems. Constraining spectrum access increases consumer costs by decreasing competition. Without access to spectrum, small companies and new entrants cannot provide wireless service, which reduces wireless competition, driving up prices and limiting consumer choices. Spectrum scarcity also limits innovation by making it prohibitively expensive for untried and unproven technologies to get access to spectrum. Ultimately, the future of a healthy wireless ecosystem lies in more widespread, equitable, and local access to spectrum.

But, why is spectrum considered scarce? It is not consumable. A particular frequency does not disappear after a radio signal is transmitted. Although there are physical characteristics that make some frequencies more usable for certain applications then others, generally what is considered usable spectrum continues to shift with technological advancements. As several interviewees pointed out, many of the spectrum bands that are now considered prime mid-band spectrum were junk bands only a few years ago.

The reality is that spectrum is only scarce because regulatory policies make it scarce—not because it is inherently a limited resource.[77] This distinction is meaningful because it allows us to ask if the regulatory policies that impact the availability of spectrum are really necessary today. Has technology evolved in ways that make it possible to adopt policies that reduce or eliminate spectrum scarcity? As this section discusses, the answer is yes, particularly in key areas that improve interference protection and allow for greater spectrum reuse.

Minimizing Interference

In the early days of radio, strong regulatory policies that restricted spectrum use were necessary because of interference.[78] When radio signals are sent out using the same or adjacent frequencies, they can cause interference and disrupt the use of a spectrum based service such as television, radio, or mobile wireless.[79] Interference "became especially acute with the rapid growth of broadcasting in the late 1920s."[80] This prompted Congress to act, eventually passing the Communications Act in 1934 which created the FCC and "gave us the basic structure of the communications laws we have today."[81] At the time, parceling out spectrum to exclusive uses was necessary to prevent competing services from essentially canceling one another out.

Technological advancements have not just expanded which bands are considered prime spectrum, they have also significantly decreased the risk of interference between competing radio signals. Unfortunately, just as the SPTF found in 2002, the Commission's regulations still

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[77] *See id.* at 21.

[78] Interference protection may be the dominant issue that is artificially causing spectrum scarcity. But, it is not the *only* issue. For example, the ad-hoc approach to spectrum allocation for federal users before the FCC and NTIA were established has significantly impacted the availability of spectrum. This paper focuses on the interference aspect because of the technology advancements that make new interference related policies possible.

[79] *Interference with Radio, TV, and Cordless Telephone Signals*, FCC.gov, (last accessed Jan. 18, 2023), https://www.fcc.gov/consumers/guides/interference-radio-tv-and-telephone-signals.

[80] Doug Brake, *Coase and Wi-Fi: The Law and Economics of Unlicensed Spectrum*, ITIF, 2 (Jan. 2015).

[81] *Id.*

"do not reflect and capitalize upon the significant advancements made in spectrum-based technologies" today.[82] For example, MIMO (multiple-input multiple-output) technology uses multiple antennas to significantly improve the capacity of a spectrum channel.[83] Multiple antennas enable the transmitter and a receiver in a MIMO system to send and receive multiple versions of the same signal.[84] This signal diversity helps stabilize a link, improve performance, and reduce error rates. It is even possible to use this system to "cancel-out" interference.[85] Yet, even though this technology has been around for more than 15 years, the FCC still uses single-antenna interference metrics for MIMO systems.

Interference protection is perhaps the most overlooked area in which technological advancements have changed what is possible in policy. This makes it a prime area for re-evaluating future access models and opportunities to increase access to spectrum. By updating its interference metrics based on the latest technologies, the FCC can update one of the key areas of spectrum policy that is limiting the availability of spectrum today.

Maximizing Spectrum Reuse

Interference protection is not the only area that has experienced technological advances that can change what is possible in spectrum policy. The rise of Dynamic Spectrum Access (DSA) now makes spectrum reuse more possible than ever. DSA is an approach to spectrum management that enables multiple spectrum uses to coexist in the same frequency by using technologies and techniques that make it possible for a spectrum service to dynamically change

[82] SPTF Report, *supra* note 3 at 15.
[83] *MIMO*, Wikipedia (last accessed Jan. 24, 2023), https://en.wikipedia.org/wiki/MIMO.
[84] *Id.*
[85] *See* Milembolo Miantezila Jr. et al., *Interference Cancellation Based Spectrum Sharing for Massive MIMO Communication Systems*, 11 Sensors 3584 (2021), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8196734/.

its operating parameters in real-time.[86] This approach to spectrum management works to maximize technical spectrum efficiency through re-use of frequencies within a wireless system or amongst multiple wireless uses.

Some of the technologies that have made dynamic spectrum access possible are:

- **Dynamic Spectrum Sharing (DSS).** This antenna technology enables the use of 4G LTE and 5G in the same frequency band, using the same antenna. Instead of splitting spectrum between two different standards, this technology allows a mobile wireless carrier to use its whole spectrum allocation for both standards—significantly improving the transition from one standard, like LTE, to a new standard, like 5G. As T-Mobile's parent company Deutsch Telekom explained in a blog post, "DSS is an important stepping stone on our path to nationwide 5G. The software-based technology allows us to bypass the process of re-farming spectrum in the near term, which ultimately means a smoother transition and expedited 5G adoption."[87]

- **Sensing Technology.** In an earlier stage of development, this technology was known as "cognitive radio."[88] It allows a wireless device to sense whether or not a particular frequency is already in use by another device. Sensing technology is what makes Wi-Fi's listen-before-talk protocol possible. There are several sensing models: (1) energy detection "measures the energy of the signal and matches it to a given threshold[.] If the signal energy is higher than the predefined threshold, then it is assumed that the [Primary User] is present[.] Otherwise, the channel is considered as idle;" (2) matched filter detection "compares the received signal with the pilot signal obtained from a similar transmitter;" and (3) machine learning-based sensing methods.[89]

- **Automatic Frequency Coordination Databases (AFCs).** These automated databases are the next evolutionary step from manual databases that regulators have used to coordinate spectrum access between multiple licensees or uses. This

[86] *See Dynamic Spectrum Management*, Wikipedia (last accessed Jan. 24, 2023), https://en.wikipedia.org/wiki/Dynamic_spectrum_management.
[87] Leonard Dahmen, *Intelligent 5G Network: How Does Dynamic Spectrum Sharing Work?*, Telekom (last accessed Jan. 18, 2023), https://www.telekom.com/en/company/details/intelligent-5g-network-how-does-dynamic-spectrum-sharing-work-611104 (referring to 5G rollout in Germany).
[88] *See Cognitive Radio*, Wikipedia (last accessed Jan. 18, 2023), https://en.wikipedia.org/wiki/Cognitive_radio#History (for a fuller review of cognitive radio and spectrum sensing technology).
[89] Muddasir Rahim et al., *Self-Organized Efficient Spectrum Management Through Parallel Sensing in Cognitive Radio Network*, Wireless Commc'ns & Mobile Comp. (2021), https://www.hindawi.com/journals/wcmc/2021/5552012/.

> approach "speeds access to spectrum, lowers costs, promotes more intensive use, better protects incumbent licensees, ensures consistent outcomes, and accounts quickly for changes in use of the band or even changes in [a spectrum regulators] rules."[90] By using sensing technology to incorporate GIS and dynamic data, AFCs can "support far more sophisticated propagation and interference modeling," making it possible to coordinate between the conflicting rules of adjacent nations to make spectrum dead zones productive.[91] CBRS uses an AFC to coordinate the multi-tiered licensees operating with the band.[92]

These technologies make it possible to adopt spectrum management policies that allow multiple users to use the same spectrum frequencies without causing harmful interference to each other. The default rules should promote an abundance of spectrum through reuse, particularly in the higher bands where propagation is highly directed and contained.

Spectrum reuse is essential to moving us towards a future that embodies the public interest principles outlined in Section II. Increasing access to spectrum eliminates a key barrier to a thriving, competitive wireless ecosystem. This helps connect more people to wireless services, lowers the costs of those services, advances wireless innovation, and spurs digital inclusion.[93] Re-evaluating and updating spectrum access models and regulatory policies to encourage dynamic spectrum access is essential to building a road to that future.

IV. WHERE WE'RE GOING WE NEED ROADS: KEY SPECTRUM POLICY ISSUES FOR THE FUTURE

In some ways, the SPTF Report was ahead of its time, but in other ways it was very much a product of its time. Today, with the benefit of hindsight, this section explores what we can

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[90] Dynamic Spectrum Alliance, Automated Frequency Coordination: An Established Tool for Modern Spectrum Management, 11 (Mar. 2019), https://dynamicspectrumalliance.org/wp-content/uploads/2019/03/DSA_DB-Report_Final_03122019.pdf.
[91] *Id.*
[92] F.C.C., Public Notice, *Wireless Telecommunications Bureau and Office of Engineering and Technology Approve Five Spectrum Access System Administrators to Begin Initial Commercial Deployments in the 3.5 GHz Band*, GN Docket No. 15-319 (rel. September 16, 2019), https://docs.fcc.gov/public/attachments/DA-19-915A1.pdf.
[93] *See Our Goals*, Dynamic Spectrum Alliance (last accessed Jan. 18, 2023), https://www.dynamicspectrumalliance.org/.

learn from the SPTF's blind spots: the spectrum stakeholder dynamic and the impact of spectrum policy on diversity, equity, and inclusion (DEI). Successfully adopting a value-based framework for making spectrum policy decisions that are rooted in public interest principles will require addressing these key issues.

A. Nobody Calls Me Chicken: Reframing the Spectrum Stakeholder Dynamic

The stakeholders that play a role in spectrum policy represent a wide variety of constituencies each with a unique perspective, agenda, and relationship to spectrum. This section evaluates the role stakeholders play in spectrum policy and how the current dynamic between these varied voices has hindered the adoption of forward-looking spectrum policies. It makes the case that any spectrum policy agenda that hopes to succeed must also factor in and reframe the spectrum stakeholder dynamic—debunking the current zero-sum game approach to spectrum policy.

The Spectrum Policy Task Force's Failure to Consider the Stakeholder Dynamic

The Spectrum Policy Task Force Report did not consider the impact stakeholders have on spectrum policy. The consequences of not anticipating the spectrum stakeholder dynamic were almost immediately apparent. In the comments following its release, stakeholders were only supportive of the SPTF's recommendations that did not impact their own status quo. For example, not only did AT&T argue against incorporating unlicensed underlays or opportunistic uses in any currently licensed bands, it also argued against granting current exclusive licensees more flexible uses.[94] Public Safety advocates argued that allowing public safety users more flexibility with their spectrum licenses would "only create shortages and endanger citizens."[95]

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[94] AT&T, Comments, *In the Matter of Commission Seeks Public Comment on Spectrum Policy Task Force Report*, ET Docket No. 02-135, 13 (Jan. 27, 2003).

[95] Public Safety Wireless Network Program, Response to the Commission's Request for Comments on Spectrum Policy Task Force Report, *In the Matter of Spectum Policy Task Force Seeks Public Comment on Issues Related to*

Even public interest groups, like Public Knowledge, were suspicious of the proposed flexible use model—viewing it as a back door to establishing private property rights in spectrum frequencies.[96]

Unfortunately, the stakeholder dynamic prevented many of the SPTF's most innovative policies from being enacted. For example, in 2004 the Commission unsuccessfully proposed a rule that would have adopted the SPTF's recommendation of using an "inteference temperature" model to improve interference avoidance.[97] This model would have shifted the Commission's approach of assessing interference based solely on the operations of transmitters, to an approach based on more accurate real-time measurements that "take into account the cumulative summation of all the undesired RF energy available to be captured by a particular receiving antenna for delivery to the receiver."[98] Incumbent stakeholders, viewing this approach as an attempt at creating a mandatory unlicensed underlay,[99] opposed the proposal so vehemently that the Commission eventually terminated the proceeding in 2007.[100] The Commission still uses the same outdated interference model that it used 20+ years ago.

Commission's Spectrum Policies, ET. Docket No. 02-135, at 10 (Jan. 27, 2003), https://www.fcc.gov/ecfs/document/5508556576/1.

[96] New America Foundation et al., Comments, *In the Matter of Commission Seeks Public Comment on Spectrum Policy Task Force Report*, ET Docket No. 02-135, 17 (Jan. 27, 2003).

[97] F.C.C., Notice of Inquiry and Notice of Proposed Rulemaking, *In the Matter of Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands*, ET Docket No. 03-237 (rel. Nov. 28, 2003), https://www.fcc.gov/ecfs/document/5510444151/1.

[98] SPTF Report, *supra* note 3, at 27.

[99] *See e.g.* Comments of the Cellular Telecommunications & Internet Association, *In the Matter of Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands*, ET Docket No. 03-237, at 6-11 (April 5, 2004).

[100] F.C.C., Order, In the Matter of Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands, ET Docket No. 03-237 (rel. May 4, 2007).

Essentially, the SPTF failed to factor in the political element of spectrum policy. By not considering the dynamic between spectrum policy stakeholders, the SPTF limited the success of its recommendations.

The Current Stakeholder Dynamic

Today, the increasing demand on our airwaves has placed an ever growing importance on navigating stakeholder dynamics to effectuate successful spectrum policy.[101] As a recent report from the Aspen Institute observes, "policy disputes among a wide range of stakeholders—licensed incumbents, unlicensed upstarts, and government agencies—have become amplified as intensity of spectrum use has increased."[102]

Understanding the stakeholder dynamic first requires stepping back to look at each of the various stakeholders that play a role in spectrum policy. All of the stakeholders that interviewees identified fit into three main categories: (1) the government—including agencies, Congress, and the Congressional Budget Office; (2) industry and public safety entitites—embodying the incumbents vs. new entrants dynamic; and (3) the general public—including end users and community institutions like schools and libraries.

The Government: Financial Beneficiary, Expert Regulator & Spectrum User

The United States government is perhaps the most influential stakeholder group when it comes to spectrum policy because it encompasses so many different stakeholder roles. This section takes a detailed look at all of the roles the government plays within the spectrum policy stakeholder dynamic—financial beneficiary, expert regulator, and spectrum user. The tension

[101] *See* Aspen Institute, Toward a National Spectrum Strategy, 3 (Sept. 2022), http://www.aspeninstitute.org/aspendigital/spectrum [hereinafter Aspen Report].
[102] *Id.*

between these disparate roles has significantly impacted spectrum policy and understanding that tension is essential to crafting successful spectrum policies.

Congress & the Congressional Budget Office: The Problem with Spectrum Pay Fors

In its originating statute in 1934, Congress authorized the FCC as the agency that would oversee access to and use of commercial spectrum.[103] It was not until much later, 1993, that Congress authorized the FCC to use auctions as an additional means to grant entities access to spectrum.[104] The original goal was not to raise revenue, but rather to use competitive bidding to distribute licenses in a manner that promoted the public interest.[105] In fact, this goal was important enough that in its grant of auction authority, Congress expressly forbade the Commission from considering revenue implications.[106] Instead, the FCC was tasked with using auctions to promote efficient and intensive spectrum use to benefit the public and disseminate licenses to a wide variety of applicants, including small businesses, rural telecom providers, and women and minority-owned companies.[107]

Four years after Congress authorized spectrum auctions, the FCC Report to Congress on Spectrum Auctions proclaimed victory. Not only had the FCC awarded 4,300 licenses at auction, 53% of which were granted to small businesses,[108] but spectrum auctions had already raised a

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[103] 47 U.S.C. § 301 ("It is the purpose of this chapter, among other things, to maintain the control of the United States over all the channels of radio transmission; and to provide for the use of such channels, but not the ownership thereof, by persons for limited periods of time, under licenses granted by Federal authority, and no such license shall be construed to create any right, beyond the terms, conditions, and periods of the license.").
[104] Jill C. Gallagher & Patricia Moloney Figliola, *FCC Spectrum Auction Authority: Background and Proposals for Extension*, Congressional Research Service, 2 (updated Dec. 30, 2022), https://crsreports.congress.gov/product/pdf/R/R47258.
[105] *See* 47 U.S.C. § 309(j).
[106] 47 U.S.C. § 309(j)(7)(A).
[107] F.C.C., The FCC Report to Congress on Spectrum Auctions, 2 (rel. Oct. 9, 1997), https://www.fcc.gov/sites/default/files/wireless/auctions/data/papersAndStudies/fc970353.pdf.
[108] *Id.* ("although the larger licensees tend[ed] to control geographic areas with greater populations…").

total of $23 billion for the Treasury's coffers.[109] The results were in—spectrum auctions were and still are cash cows.[110] Unfortunately, even though the FCC cannot factor these revenues into its auction decisions, Congress can.

Today, Congress uses spectrum auctions to offset the cost of new legislation. This practice is often referred to as "spectrum pay-fors" and plays out through the Congressional Budget Office's (CBO) bill scoring process.[111] The CBO is required by law to estimate the costs of nearly every bill approved by a full House or Senate committee.[112] While these estimates are only advisory, they significantly impact the politics of what legislation gets passed into law.[113] A bill with a net zero or net positive impact on the federal budget is much easier to pass than a bill that will increase the federal deficit.

The CBO's budget scoring process impacts spectrum policy in two distinct ways:

1. **It disincentivizes Congress from granting the FCC permanent auction authority.**
2. **It encourages Congress to make spectrum policy decisions that maximize revenue over serving the public interest.**

First, it is highly unlikely that Congress will ever grant the FCC permanent auction authority, even though doing so would allow the FCC to focus on developing a cohesive long-term communications plan for our nation. The CBO's budget scoring process is at the heart of this issue. For the purpose of bill scoring, the CBO only looks at expenses and revenues on a

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[109] *Id.*

[110] *See* Thomas Winslow Hazlett, The Political Spectrum: The Tumultuous Liberation of Wireless Technology from Hoover to the Smartphone, 245-247 (May 23, 2017).

[111] The CBO is a strictly non-partisan agency that exists solely to estimate the economic impact of legislation. Amber Phillips, *What Is the CBO, and How Could Its Score Derail Democrats' Social Safety Net Bill?*, the Washington Post (Nov. 19, 2021), https://www.washingtonpost.com/politics/2021/11/05/what-is-cbo-how-could-its-score-derail-democrats-spending-bills/

[112] Congressional Budget Office, *An Introduction to the Congressional Budget Office*, 2 (Jan. 2021).

[113] *See* Phillips, *supra* note 111 (explaining how CBO scores have derailed legislation).

maximum 10-year basis.[114] This means that Congress will not receive budgetary credit for extending the FCC's auction authority beyond a 10-year period, which is why it is highly unlikely the FCC will ever receive permanent auction authority.

Regrettably, limiting the FCC's auction authority to a specific time frame does not promote a balanced approach to spectrum policy. Rather, it treats spectrum as an ATM that Congress can pull from to accommodate the politics of the day.[115] Instead of focusing on a long-term plan for our nation's diverse spectrum needs, our spectrum regulators are forced to focus on short-term auctions that may actually impede our future spectrum needs.[116] Limiting the timeframe of one of the FCC's key tools for opening up spectrum access makes it challenging to pull together a cohesive vision of spectrum policy. Long-term strategies require long-term tools.

Second, by tying an initiative that will cost money to legislation that authorizes a specific spectrum auction, legislators can create a net neutral or net positive CBO score. This encourages Congress to specify what should and should not be auctioned instead of allowing the FCC to decide. When the FCC decides to auction spectrum that Congress has not specifically directed it to, Congress loses the opportunity to tie that particular spectrum auction to legislation, a higher CBO score, which can in turn be used to pay for a program that Congress needs to raise revenue to cover. This results in a perverse incentive for Congress to tie up the Commission's auction

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[114] *See* CBO FAQ, *What is a budget resolution? What role does CBO play when the Congress considers a budget resolution?*, CBO.gov (last accessed Jan. 24, 2023), https://www.cbo.gov/faqs.

[115] Chris Lewis, Testimony on Strengthening our National Spectrum Strategy, Before Senate Subcommittee on Communications, Media and Broadband of the Committee on Commerce, Science and Transportation, (August 2, 2022), https://publicknowledge.org/policy/chris-lewis-senate-commerce-subcommittee-testimony-on-future-of-spectrum/.

[116] *See* Harold Feld, *Spectrum Is More than a National Piggy Bank*, Forbes (Sept. 14, 2022), https://www.forbes.com/sites/forbestechcouncil/2022/09/14/spectrum-is-more-than-a-national-piggy-bank/?sh=63fed39736f8

authority and get ahead of the FCC by passing legislation that directs the Commission to perform specific auctions, instead of relying on its expertise to craft an auction.

The current games in Congress over renewing the FCC's auction authority are evidence of this unfortunate dynamic. The FCC's auction authority was set to expire on September 30, 2022. Instead of passing the typical 10-year blanket renewal, the current Congress has treated the FCC's auction authority as a political bargaining chip. To date, Congress has only managed to pass a series of stop-gap measures that have periodically extended the FCC's auction authority a few months—most recently until March 9, 2023.[117] For the first of these short extensions, the CBO added an extra $2.5 billion dollars to this year's revenue,[118] "leaving Congress to claim even more money in 18 months when Congress extends it again."[119] For the first time since 1993, the FCC's auction authority is at risk of lapsing because Congress is battling with itself over what and how spectrum should be allocated.

The problem with this dynamic is that allowing Congress to dictate how and what spectrum the FCC should auction off is not the best way to allocate spectrum resources to meet the public's needs. For example, when Congress dictates that the FCC perform a specific spectrum auction, it typically forecloses the FCC's ability to take a balanced approach to spectrum access, making exclusive licensing the only option.[120] While exclusive licensing may raise the most money, it is not always the best way to ensure that the telecommunication needs of the public are met.

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[117] Ahmad Hathout, *Omnibus Bill Includes FCC Spectrum Auction Extension, TikTok Ban on Government Devices*, Broadband Breakfast (Dec. 20, 2022), https://broadbandbreakfast.com/2022/12/omnibus-bill-includes-fcc-spectrum-auction-extension-tiktok-ban-on-government-devices/.

[118] CBO, H.R. 7624, the Spectrum Innovation Act of 2022 (July 27, 2022), https://www.cbo.gov/publication/58346.

[119] Harold Feld, *Spectrum is More than a National Piggy Bank*, Forbes (Sept. 14, 2022), https://www.forbes.com/sites/forbestechcouncil/2022/09/14/spectrum-is-more-than-a-national-piggy-bank/?sh=63fed39736f8.

[120] *See* Spectrum Innovation Act of 2022, H.R. 7624 (117th Congress).

Unfortunately, members of Congress often overlook the significant impact spectrum policy has on wireless services and technologies, and there are very few congressional staffers left that do.[121] The "brain drain" on the Hill has only gotten worse in recent years—limited pay, poor benefits, the Jan. 6 riot that threatened the lives of staffers, and the ongoing pandemic have all played a role in exacerbating Congress' already abysmal retention rates.[122] This has left Congress even more susceptible than in years past to incumbent wireless industry lobbyists who significantly outgun new entrants and the few civil society groups that represent the public interest on spectrum policy.

In contrast to Congress, when the FCC decides to auction spectrum using its general auction authority, it tends to use creative models that provide diverse access options—like the multi-tiered shared access model of the CBRS band. Since the FCC finalized rules for the CBRS band in 2019, companies have deployed over 240,000 base stations and nearly 500 certified client devices.[123] Over 4,300 technicians have received the FCC's mandatory installer certification to deploy CBRS networks.[124] CBRS has become popular for deployment of private 5G networks, with networks deployed for purposes such as manufacturing safety, warehouse

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[121] Emily Birnbaum & John Hendel, *Big Tech Sweeps Up Hill Staffers—Just When Congress Needs Them the Most*, Politico (Oct. 12, 2021), https://www.politico.com/news/2021/10/12/hill-staffers-tech-lobbying-515742.

[122] *Id.*; Katherine Tully-McManus, *Congress Wakes Up to Its Staff Retention Problems After Covid, Bomb Threats and Riots*, Politico (Sept. 10, 2021), https://www.politico.com/news/2021/09/10/congress-staff-retention-problems-510879.

[123] OnGo Alliance, Press Release, *OnGo Alliance Marks Important Milestones for CBRS Networks, Illustrating Substantial Momentum for Private, Fixed and Neutral Networks*, (Sept. 28, 2022), https://ongoalliance.org/news/ongo-alliance-marks-important-milestones-for-cbrs-networks-illustrating-substantial-momentum-for-private-fixed-and-neutral-networks/.

[124] Vernita D. Harris, *A Spectrum Sharing Success Story: Citizens Broadband Radio Service, Electromagnetic Spectrum Enterprise Policy & Programs*, Department of Defense, LinkedIn Blog (Nov. 14, 2022), https://www.linkedin.com/pulse/spectrum-sharing-successstory-citizens-broadband-radio-harris/.

inventory management, and broadband access.[125] The CBRS framework has also become sufficiently successful to draw the attention of regulators in the UK and Europe.[126]

Models like this increase spectrum access for new entrants, small companies, and community institutions that fill in the service gaps left by the major wireless carriers—moving us closer to a future where all Americans can access the digital services they need to function and thrive in the modern world. Generally, when the FCC is allowed to decide what to auction and how to auction it, the results tend to serve the American public better.

Given the dynamics at play, moving Congress away from using spectrum auctions as a piggy bank is not an easy task. Unfortunately, until this dynamic shifts, it will continue to have detrimental impacts on spectrum policy that may jeopardize America's future as a leader on wireless innovation and exacerbate digital inequities.

Interagency Conflict: Spectrum Users vs. Spectrum Regulators

Most discussions of interagency conflict center around the commercial vs. federal use distinction. But, this does not provide a complete picture. The spectrum regulator vs. spectrum user dichotomy is also essential to understanding the government's internal stakeholder dynamic.

On the regulatory side, spectrum management is split primarily between two agencies: (1) the FCC, which handles non-federal spectrum use (often described as commercial use), and (2) the National Telecommunications and Information Administration (NTIA), which handles federal spectrum use.[127] On the spectrum user side, the list of agencies is long. Here is just a

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[125] *See* Letter of 25 Public Interest Organizations to Senate Energy and Commerce Leadership on FCC Spectrum Auction Authority Re-Authorization (November 15, 2022), https://publicknowledge.org/policy/group-letter-urging-congress-to-renew-fcc-auction-authority/.

[126] *See e.g.*, Ofcom, *Shared Access Licenses*, https://www.ofcom.org.uk/consultations-andstatements/category-1/enabling-opportunities-for-innovation.

[127] There are other agencies that provide inputs on spectrum management, outside the scope of this paper that play an, role in spectrum management, like the Department of State, which is involved in all aspects of international spectrum management. U.S. Dept. of Commerce, *Spectrum Policy for the 21st Century—the President's Spectrum*

sampling: the Department of Defense (DoD);[128] the Federal Aviation Administration (FAA),[129] the Department of Agriculture (DOA);[130] the Department of Energy (DOE); the Department of Interior (DOI);[131] the Department of Homeland Security (DHS);[132] the National Aeronautics and Space Administration (NASA);[133] the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA);[134] and the National Science Foundation (NSF).[135]

NTIA has two interagency advisory committees that provide policy advice and help it manage all of the different spectrum interests it represents: (1) the Interdepartment Radio Advisory Committee (IRAC) and (2) the Policy and Plans Steering Group (PPSG).[136] These two groups help the NTIA manage the spectrum needs of all of the diverse agencies it represents.

IRAC is composed of spectrum-user agencies and an FCC liaison. Although IRAC primarily serves as a subordinate advisory group today, it originally exercised the president's authority to assign spectrum frequencies to federal users. In fact, the first IRAC meeting was

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Policy Initiative: Report 1, at 14 (June 2004), https://www.ntia.doc.gov/files/ntia/publications/spct_pol_part_1_rl.pdf.

[128] DoD "is the largest user of spectrum, and the diversity and breadth of its spectrum use is unlike any other federal government or commercial user." DoD uses "narrowband, wideband, broadband communications systems that are fixed, mobile, portable, satellite, vehicle, and ship-based." Aspen Report, *supra* note 101 at 12.

[129] The FAA "uses spectrum for safety services such as aeronautical radionavigation, precision-landing systems for all weather operations, surveillance, and air-to-ground communications." U.S. Dept. of Commerce, *Spectrum Policy for the 21st Century—the President's Spectrum Policy Initiative: Report 1* at 1 (June 2004), https://www.ntia.doc.gov/files/ntia/publications/spct_pol_part_1_rl.pdf

[130] The DoA's "Forest Service rangers use the spectrum every time they use their transportable radios for control of crowds or forest fires." *Id.*

[131] The DOE and DOI use spectrum "to transmit and receive control data to operate and protect federal dams and power grids." *Id.*

[132] DHS' spectrum uses include "the protection of the United States and for communications in disaster areas." *Id.*

[133] NASA uses spectrum "in virtually every aspect of satellite technology – launch, command, data collection, and landing." *Id.*

[134] NOAA uses spectrum "to provide accurate and timely weather and water information, including forecasts and severe weather warnings." *Id.*

[135] NSF "supports research in radio astronomy and other scientific disciplines that requires that the nation's scientists have access to specific." *Id.*

[136] The NTIA is also advised by the Commerce Spectrum Management Advisory Committee (CSMAC). While IRAC and PPSG are interagency advisory groups, CSMAC is an advisory committee composed of a broad range of spectrum policy experts that represent various *non-governmental* stakeholder groups, which is why it is not included here.

held on June 1, 1922—more than 50 years before NTIA was formed.[137] Instead of promoting a cohesive *national* approach to spectrum policy, IRAC promoted a *decentralized* approach to spectrum policy, resisting numerous attempts to centralize control of federal frequency allocation.[138] By the time the Spectrum Policy Task Force was formed, IRAC had become what several interviewees called "alphabet soup"—a fairly dysfunctional advisory committee that, as a 2004 Government Accountability Office (GAO) report concluded, lacked expertise and was composed of agency personnel too junior to advise on contentious spectrum policy issues.[139]

Instead of taking meaningful steps to fix IRAC, the NTIA formed a new group—the Policy and Plans Steering Group (PPSG)—under the direction of a Presidential Memorandum in 2005.[140] This interagency organization is composed of "Assistant Secretaries, or equivalent, with spectrum management oversight in agencies that are major stakeholders in the spectrum issues under consideration."[141] Although the PPSG played a critical role in meeting President Obama's

[137] IRAC started as the Interdepartment Advisory Committee on Governmental Radio Broadcasting but in March 1923 was renamed to its current moniker the Interdepartment Radio Advisory Committee. Ronald Coase, *The Interdepartment Radio Advisory Committee*, 5 J. Law & Econ. at 17 (Oct 1962), https://chicagounbound.uchicago.edu/jle/vol5/iss1/3.

[138] Ronald Coase detailed the history of IRAC's ability to resist a more cohesive approach to federal spectrum management up until the appointment of the Director of Telecommunications Management in February of 1962 in *The Interdepartment Radio Advisory Committee*, 5 J. Law & Econ. at 17-24 (Oct 1962), https://chicagounbound.uchicago.edu/jle/vol5/iss1/3.

[139] *See* Gov't Acct. Off., Interdepartment Radio Advisory Committee, IRAC Representatives Effectively Coordinate Federal Spectrum but Lack Seniority to Advise on Contentious Policy Issues (Sept. 2004), https://www.gao.gov/assets/gao-04-1028.pdf.

[140] Press Release, *NTIA and Federal Agencies Begin to Implement Spectrum Policy for the 21st Century*, NTIA (Jan. 24, 2005), https://www.ntia.doc.gov/legacy/ntiahome/gallery/ppsg01242005.htm; *see also* The White House, *Presidential Determination: Memorandum for the Heads of Executive Departments and Agencie*s (Nov. 30, 2004), https://georgewbush-whitehouse.archives.gov/news/releases/2004/11/20041130-8.html.

[141] Gov't Acct. Off., Report, Spectrum Management: NTIA Planning and Process Need Strengthening to Promote the Efficient Use of Spectrum by Federal Agencies, n. 41 (April 2011), https://www.gao.gov/assets/gao-11-352.pdf.

goal of opening up 500 MHz of federal spectrum for commercial use,[142] there is very little on its current activity and involvement in federal spectrum policy.[143]

The general consensus amongst interviewees is that while these advisory groups play a critical role in spectrum policy, they are not currently functional. This makes sense—given that the interagency dynamic as a whole is not currently functional.[144] In August 2022, the GAO testified that it had found gaps in the collaboration mechanisms between the NTIA, the FCC, and federal spectrum users.[145] The consequences of this poor collaboration are tangible. For example, the GAO found that "disputes among the agencies and the inability to reach agreement on U.S. technical contributions challenged the U.S.'s ability to present an agreed-upon basis for decisions or a unified position."[146]

Another example is the squabble between the Federal Aviation Administration (FAA) and the FCC over altimeter interference in 2021.[147] The FAA authorized altimeters that were not operating within their technical requirements, making them more susceptible to interference. Instead of following the FCC's process to address the issue, the FAA delayed action and at the last minute took to the media "claiming that planes would fall from the sky if the spectrum known as the C-Band was turned on to support the 5G services provided by some wireless

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[142] *See* Dep't of Commerce, Second Interim Progress Report on the Ten-Year Plan and Timetable (Oct. 2011) (detailing the PPSG's significant involvement in evaluating the 1755-1850 MHz band for reallocation).

[143] There are occasional references to PPSG's continued existence in current NTIA materials, but I could not find any publicly available information regarding its current activities. NTIA, *NTIA At-A-Glance* at 3 (updated March 2021), https://www.ntia.doc.gov/files/ntia/publications/ntia_at_a_glance_march_2022.pdf (educational .pdf including PPSG among the groups that give NTIA's Office of Spectrum Management advice).

[144] *See e.g.,* Aspen Institute Report, *supra* note 101 at 25 ("Over the last several years, there has been bipartisan recognition that the system by which the federal government addresses spectrum issues has deteriorated.").

[145] Gov't Acct. Off., Testimony on Spectrum Management, Before Senate Subcommittee on Communications, Media and Broadband of the Committee on Commerce, Science and Transportation (Aug. 2, 2022), https://www.gao.gov/assets/gao-22-106170.pdf.

[146] *Id*. at 5.

[147] *See* Joel Thayer & Greg Guice, The Interagency Process and Its Importance in Securing the Future of 5G, 20-24 (March 2022), https://publicknowledge.org/policy/the-interagency-process-and-its-importance-in-securing-the-future-of-5g/.

providers."[148] Ultimately, this squabble has delayed 5G rollout around airports, negatively impacting the communities in the surrounding areas.

Unsurprisingly, the root cause of the spectrum policy breakdown between agencies is complex. Interviewees pointed to several critical influences that have led to increasing interagency conflict. Three themes emerged:

1. **Degrading Trust Between NTIA and the Agencies It Represents.**

   In 2010, President Obama issued a Memorandum directing NTIA to collaborate with the FCC and find 500 MHz of spectrum to reallocate to commercial use.[149] This resulted in the FCC's auction of the AWS-3 band, which raised an at-the-time record of more than $40 billion.[150] While opening up federal spectrum was necessary, tasking the NTIA with finding fallow federal spectrum had the unfortunate consequence of sowing distrust between NTIA and the federal agencies it represents on spectrum issues. Instead of advocating for the spectrum needs of these agencies, it was tasked with *taking away* spectrum, an incredibly valuable resource. As one interviewee explained, "During that time, NTIA's authority eroded because the other agencies started beefing up on their spectrum expertise to be able to push back. One of the side effects of opening up federal spectrum for commercial use—a very good policy—is that the authority of NTIA was picked away."

2. **Imbalance of Power Between Agency Heads.**

   The FCC was established as an independent agency by the Communications Act of 1934, which authorized the FCC to allocate spectrum frequencies for all non-federal uses.[151] While Commissioners are appointed by the president and confirmed by the Senate, once appointed FCC Commissioners serve independently of the president and cannot be fired at will. In contrast, NTIA was established in 1978 after President Carter delegated the president's authority to allocate spectrum to federal users to the Secretary of Commerce. The Secretary of Commerce immediately passed that authority on, making the Assistant

[148] *Id.* at 21.
[149] The White House, Presidential Memorandum: Unleashing the Wireless Broadband Revolution (June 28, 2010), https://obamawhitehouse.archives.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution.
[150] Leibovitz & Milkman, *supra* note 60 at 11.
[151] 47 U.S.C. § 301 (The authority to allocate frequencies for federal uses was reserved for the president under Section 305.).

Secretary of Commerce NTIA's administrator.[152] Although NTIA's administrator is appointed by the president and confirmed by the Senate, as an Assistant Secretary, NTIA's administrator is subordinate to the Secretary of Commerce—technically as an Assistant Secretary, NTIA's administrator is also a level below the Department of Commerce's Under Secretaries.[153]

Essentially, the FCC is run by independent Commissioners whereas NTIA is run by a Level IV executive agent that serves at the pleasure of the president. Not only does this create a power imbalance between NTIA and the FCC, but it also creates an imbalance between NTIA and the other federal agencies that it represents—many of whom are headed by cabinet-level officials. Even though NTIA is technically the authority on federal spectrum issues, the NTIA administrator and NTIA staff often lack the clearance necessary to know how agencies like the Department of Defense are even using their allocated spectrum. This power imbalance makes it practically impossible for NTIA to functionally fulfill its role.

3. Lack of Direction from the White House.

Despite the distrust sowed by the Obama administration's directive to open up federal spectrum, the Obama administration's strong White House leadership on spectrum policy was critical to the success of the AWS-3 and CBRS auction.[154] Unfortunately, the immediate successor to President Obama, Donald Trump, provided little to no direction on spectrum policy. Despite frequent promises that a spectrum plan was forthcoming, the Trump administration never issued a national spectrum strategy.[155] While steps are being made by the Biden administration to develop a national spectrum plan, as evidenced by

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[152] The Secretary of Commerce immediately created NTIA, assigned the scope of authority to the Assistant Secretary, and made the Assistant Secretary the Administrator of NTIA. The NTIA Organization Act of 1992 finally codified this organizational structure and the public purpose behind NTIA's spectrum management authority.

[153] Under Secretaries are Level III positions on the Executive Pay Schedule, whereas Assistant Secretaries are Level IV. *Compare* 5 U.S.C. § 5314 with 5 U.S.C. § 5314. *See also* Organizational Chart for the U.S. Department of Commerce (2020-2022), https://www.commerce.gov/sites/default/files/2021-01/FY20-22DOCAPPROrgChart.pdf

[154] Leibovitz & Milkman, *supra* note 60 at 12 ("...when Federal spectrum interests are involved, White House leadership truly matters. The Federal agencies involved in the AWS-3 process were motivated by two separate Presidential memoranda directing them to bring spectrum to market through a collaborative process that involved spectrum sharing as part of the solution.").

[155] President Trump issued a Presidential Memorandum on October 25, 2018 directing NTIA in consultation with OMB, OSTP, FCC, and other relevant Federal entities to submit a long-term National Spectrum Strategy within 270 days. On September 10, 2019, 320 days later, Doug Kinkoph, the newly appointed head of NTIA's Office of Spectrum Management gave an address mentioning a drafted document that "will provide an outline of the elements that will drive our national spectrum policy firmly into the future." No such plan was ever released. The White House, Presidential Memorandum on Developing a Sustainable Spectrum Strategy for America's Future (Oct. 25, 2018), https://trumpwhitehouse.archives.gov/presidential-actions/presidential-memorandum-developing-sustainable-spectrum-strategy-americas-future/; NTIA, *Remarks of Associate Administrator Cooper at the 2019 NTIA Spectrum Policy Symposium* (Sept. 10, 2019), https://www.ntia.doc.gov/speechtestimony/2019/remarks-associate-administrator-cooper-2019-ntia-spectrum-policy-symposium.

the recent issuance of notice seeking comment,[156] that process is only now beginning because the Biden administration waited a full year to appoint the NTIA's administrator,[157] and nearly two years after being sworn in still has not secured a full slate of commissioners at the FCC.[158] These gaps in leadership have allowed the distrust between federal agencies on spectrum to fester unchecked. Given this environment, the dispute between the FCC and the FAA over 5G's interference with altimeters was practically inevitable.

As no single issue led to this dysfunctional dynamic, fixing it will require more than updating the Memorandum of Understanding between the FCC and NTIA. This is where public interest principles can help. By committing to a policy approach that uses specific public interest principles rooted in the public interest goals of our regulatory agencies, the various facets of the government can begin to find common ground and develop a transparent framework for balancing all of the government's disparate spectrum interests.

Industry & Public Safety: Incumbents vs. New Entrants

Commercial and public safety spectrum users also play a major role in spectrum policy. The commercial and public safety applications for spectrum are incredibly diverse. Mobile and fixed wireless, wireline broadband, broadcast radio and television, satellite TV, cable, Wi-Fi, Bluetooth, and First Net are just a few of the different commercial and public safety technologies, networks, and applications that rely on spectrum access. Even though commercial and public safety stakeholders play distinct roles in our telecommunications system, the stakeholder dynamic amongst these spectrum users is practically the same—incumbents vs. new entrants.

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[156] Christopher Cole, *Feds Need Input on Spectrum Use, Key NTIA Official Says*, Law360 (Oct. 19, 2022).
[157] Shiva Stella, *Public Knowledge Applauds Senate Confirmation of Alan Davidson as NTIA Administrator*, Public Knowledge (Jan. 11, 2022), https://publicknowledge.org/public-knowledge-applauds-senate-confirmation-of-alan-davidson-as-ntia-administrator/.
[158] Nilay Patel, *The Mystery of Biden's Deadlocked FCC*, The Verge (Nov 3, 2022), https://www.theverge.com/23437518/biden-fcc-gigi-sohn-fox-news-comcast-senate-democrats-midterms-election

Incumbents represent the old guard: protective of their spectrum access, resistant to change, and powerful enough to impede the development of innovative new technologies and business models that would threaten their profits or create potential interference. New entrants represent the new and novel: eager to succeed and willing to take on the risk of unproven technologies. Unfortunately, incumbents are incentivized to impede new entrants, which "can undermine socially beneficial transactions."[159] Add to this, the fact that while an entity may be an incumbent in one segment of the telecommunications market, it may also be a new entrant in another, leading those entities to sometimes have internally conflicted policy positions.

These dynamics are by no means unique to telecommunications; they play out in nearly every industry. But, because access to spectrum is essential to all wireless technologies, the contentious dynamic between incumbents and new entrants is particularly apparent in spectrum policy. The fear that harmful interference from new uses may impede an incumbent's business adds another point of conflict between new entrants and incumbents. This not-in-my-back-yard attitude is particularly rampant amongst public safety incumbents. Since 2009 the FCC has tried to modify the 4.9 GHz band in order to increase its utilization.[160] Repeatedly, public safety incumbants have pushed back on these efforts, fearful that allowing commercial uses in the band could interrupt law enforcement, fire and emergency medical officials ability to protect the public during times of crisis.[161]

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[159] Philip J. Weister & Dale Hatfield, *Spectrum Policy Reform and the Next Frontier of Property Rights*, 15 Geo. Mason L. Rev. 549, 605 (Spring 2008).

[160] The FCC released its first Report and Order and Further Notice of Proposed Rulemaking on increasing the utilization of the 4.9 GHz band in April 2009. F.C.C., Report and Order and Further Notice of Proposed Rulemaking, *In the Matter of Amendment of Part 90 of the Commission's Rules*, WP Docket No. 07-100, 24 FCC Rcd 4298, 4304, ¶ 10 (rel. April 9, 2009). Currently, the FCC's Order on Reconsideration and Eighth Further Notice of Proposed Rulemaking from 2021 is still pending. F.C.C., Order on Reconsideration and Eighth Further Notice of Proposed Rulemaking, In the Matter of the Amendment of Part 90 of the Commission's Rules, WPDocket No 07-100 (rel. Oct. 1, 2021).

[161] *See e.g.*, Comments of the National Public Safety Telecommunications Council to the FCC's Further Notice of Proposed Rulemaking, *In the Matter of Amendment of Part 90 of the Commission's Rules*, at 17-19 (Nov. 29, 2021),

The obstructive behavior of wireless incumbents is often described as a series of "market failures."[162] These include:

- **Strategically Holding Out.** When multiple incumbents must be cleared or shifted to repurpose or open up spectrum, incumbents that can block the process may do so in hopes of getting better benefits or more financial gains.[163] This can be particularly problematic when Congress has mandated clearing spectrum for re-auction by a specific date. In such instances, the negotiating power of the regulatory agencies tasked with repurposing spectrum is significantly reduced. This market failure played a role leading up to the Broadcast Incentive Auction. The FCC has no legal obligation to compensate licensees when it reassigns or alters a licensee's spectrum allocation. Despite this, broadcasters were able to assert enough political pressure to receive compensation for voluntarily giving up spectrum licenses they originally received for free. The Broadcast Incentive Auction generated $19.8 billion in revenue, more than $10 billion of which was handed over to broadcasters.[164]

- **Spectrum Speculating.** The inability to substitute spectrum for another resource makes it essential to any wireless communication technology. This drives the value of spectrum and also incentivizes speculators to secure licenses in hopes of sub-leasing or re-assigning their rights to others at a significant profit in the future. This can artificially drive up the cost of spectrum access and make the spectrum scarcity problem worse. Unfortunately, spectrum speculating is alive and well. Not only do incumbents sometimes engage in this behavior, so do investment entities that exist solely for speculating on the future of telecommunications. For example, Grain Management, a private investment group, was the fifth largest bidder in the C-Band auction.[165]

- **The Principal-Agent Problem.** The interests of an incumbent's employees are not always aligned with the larger company.[166] Even if new technologies or policy

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https://www.fcc.gov/ecfs/search/search-filings/filing/112972063242; Public Safety Wireless Network Program, Response to the Commission's Request for Comments on Spectrum Policy Task Force Report, *In the Matter of Spectum Policy Task Force Seeks Public Comment on Issues Related to Commission's Spectrum Policies*, ET. Docket No. 02-135, at 10 (Jan. 27, 2003), https://www.fcc.gov/ecfs/document/5508556576/1.

[162] *See id; see also* Evan Kwerel & John Williams, *A Proposal for a Rapid Transition to Market Allocation of Spectrum*, OPP Working Paper #38, at 10-11 (Nov. 2002), https://www.fcc.gov/reports-research/working-papers/proposal-rapid-transition-market-allocation-spectrum.

[163] Kwerel & Williams, *supra* note 162 at 10.

[164] *A Groundbreaking Auction to Realign Use of the Public's Airwaves*, F.C.C. (May 9, 2017), https://www.fcc.gov/about-fcc/fcc-initiatives/incentive-auctions.

[165] Simmons, *supra* note 66.

[166] Kwerel & Williams, *supra* note 162 at 11.

changes would mean more profits for the company or significantly benefit customers, the employees in charge of a company's spectrum policies might actively work against such changes. New technology could threaten an employee's job or damage the trajectory of their career if they do not have expertise in the new technology. Upgrading to more efficient technology or significantly changing the company's business model could make an employee's role obsolete. This market-failure is particularly problematic, "[s]ince senior management typically delegates responsibility for spectrum policy issues to the managers responsible for spectrum-based communications systems[.]"[167]

- **Stonewalling Disruptive Technologies.** Not only will incumbents often refuse to embrace new technologies within their own services and networks, but they will also often try to prevent the introduction of new technology in the marketplace altogether.[168] Instead of adapting with the changing times, incumbents will often seek to prevent the development of technologies that could undermine their business. The 5.9 GHz band proceeding provides a good example of this market failure.[169] After more than 20 years, Dedicated Short Range Communications (DSRC) incumbents had not managed to meaningfully develop or deploy their services in the 5.9 GHz band.[170] Instead of embracing the new Cellular Vehicle-to-Everything (C-V2X) standard, DSRC incumbents sought to prevent its adoption.[171]

These market failures are alive and well in today's spectrum stakeholder dynamic and evident in nearly every FCC proceeding that explores adding new uses to a band. Without firm public interest principles to guide our policymakers, the regulatory landscape is incredibly susceptible to the machinations of incumbents who can turn the regulatory process itself into just another barrier to entry.

[167] *Id.*
[168] Weister & Hatfield, *supra* note 159 at 605-606.
[169] *See* F.C.C., Report and Order, *In the Matter of Use of the 5.850-5.925 GHz Band*, ET Docket No. 19-138 (rel. Nov. 20, 2022).
[170] *Id.* at ¶ 6-8.
[171] *See* Intelligent Transp. Soc'y of Am. v. FCC, 45 F.4th 406 (D.C. Cir. 2022) (DSRC incumbents unsuccessfully appealed the FCC's decision to reallocate part of the 5.9 GHz band to the D.C. Circuit).

The Public: End Users and Community Institutions

The public is often overlooked in the spectrum stakeholder dynamic. Even though our spectrum regulators have a public interest mandate, the public is not always considered a stakeholder of spectrum policies due to their technical nature. This is unfortunate and problematic. The public plays a critical role in the spectrum stakeholder dynamic. Without the public's input and perspective, it is practically impossible for our regulators to achieve their public interest missions. By adopting a backcasting approach to policy decisions using public interest principles, policymakers can better protect the public's critical seat at the spectrum policy table.

The few public interest organizations that work on spectrum policy, including Public Knowledge, face significant challenges representing the public on spectrum issues. As is the case for most public advocacy issues, public interest groups are materially out-resourced by other stakeholders. In 2022, the three largest wireless carriers spent a combined $24.91 million on lobbying.[172] In contrast, Public Knowledge spent $110,000.[173] Additionally, public interest groups, like Public Knowledge, also face the challenge of representing an amorphous and incredibly diverse constituancy. The public is not one single entity but rather a collective of diverse populations and community institutions that have distinct needs. Representing this collective interest requires careful consideration of the varying needs of these different

[172] According to Opensecrets.org Verizon spent $8.63 million, AT&T spent $9.45 million, and T-Mobile spent $6.831 million on lobbying services. Client Profile: Verizon, Opensecrets.org,https://www.opensecrets.org/federal-lobbying/clients/summary?id=D000000079; Client Profile: AT&T Inc., Opensecrets.org, https://www.opensecrets.org/federal-lobbying/clients/summary?id=D000000076; Client Profile: T-Mobile USA, Opensecrets.org, https://www.opensecrets.org/federal-lobbying/clients/summary?id=D000022272

[173] This number reflects Public Knowledge's total spend on lobbying which includes lobbying on many issues outside of the telecom industry. Client Profile: Public Knowledge, Opensecrets.org, https://www.opensecrets.org/federal-lobbying/clients/summary?cycle=2022&id=D000096570.

populations. A one-size-fits-all approach to representing the public in policy discussions does not always work.

Adequately representing the public in policy discussions is challenging enough without the added difficulty of justifying why the public is a stakeholder. Often spectrum policy is considered too technical to be of consequence to the general public. However, even technical decisions can significantly impact the public. For example, if the Commission had required low-power indoor unlicensed devices in the 6 GHz band to use an AFC, it would have significantly increased the costs of and prolonged the rollout of devices designed to take advantage of the new 1200 megahertz of unlicensed spectrum[174]—at a time when Americans were relying on wi-fi more than ever to stay connected during the COVID-19 pandemic. Technical decisions can significantly impact affordability, reliability, and who does and does not receive access to a technology or service.

When the public is ignored or not present, the consequences of technical rules are often overlooked in spectrum policy. This can result in policies that move us away from a desirable future, towards one of the dystopian universes feared by futurists. This is why policymakers must ensure that the public has a seat at the table to advocate for policies that embody core public interest principles.

Reframing the Dynamic: The Zero-Sum Game Fallacy

Since the early days of spectrum, stakeholders have treated access to our airwaves as a zero sum game. Initially this made sense—early radio technology could not handle multiple signals within the same frequency. Unfortunately, the zero-sum game approach to spectrum

[174] *See* Open Technology Institute at New America et all, Comments, *In the Matter of Unlicensed Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, ET Docket No. 18-295, GN Docket No. 17-183, at 17 (Feb. 15, 2019).

policy still dominates the stakeholder dynamic today even though it no longer makes sense and hinders innovation in the wireless industry. Adopting concrete public interest principles to guide policymakers will help us finally move beyond an out-dated zero-sum game approach to spectrum policy.

In the early days of spectrum technology, spectrum access technically was a zero-sum game. Radio technology was rudimentary and highly susceptible to interference. Competing radio signals would cancel one another out if they overlapped, making it impossible for multiple users to operate in the same frequencies within the same geographic area. This was more than just an inconvenience, it had harmful consequences. Before spectrum was regulated, novice radio operators often interfered with official military communications and even exacerbated the Titanic's disastrous end.[175] Amateur radio operators impeded the Titanic's distress signals by congesting the airwaves and maliciously transmitting false information claiming that the ship and its passengers were safe.[176] Only four months after the Titanic sank, Congress passed the Radio Act of 1912 marking the government's foray into restricting our nation's spectrum frequencies.[177]

Radio technology has come a long way since the days of the Titanic. Today, interference mitigating and spectrum reuse technologies like those outlined in Section III make it possible for multiple wireless uses to co-exist on the same frequencies. Despite these technological advances, the zero-sum game approach to spectrum policy still dominates the spectrum stakeholder dynamic even though it no longer makes sense. Take a look at the discourse around opening up

[175] Bill Kovarik, *Radio and the Titanic*, Revolutions in Communication (last accessed Jan. 24, 2023), https://revolutionsincommunication.com/features/radio-and-the-titanic/.
[176] *Id.*
[177] *Id.*; An Act to Regulate Radio Communication (Radio Act of 1912), 37 Stat. 302 (May 20, 1912).

the 7 GHz band.[178] This band is currently occupied by federal fixed point-to-point links that are difficult and expensive to move.[179] Instead of trying to find a way to share this band, wireless incumbents who are represented by groups like CTIA would rather clear the band for exclusively licensed spectrum.[180]

This approach is not only technologically unnecessary, it is also short sighted. Wireless incumbents rely on and benefit from unlicensed technologies. Today's wireless carriers use unlicensed technologies throughout their network to improve performance, off load data, and manage backhaul. Additionally, when consumers use their cell phones they often give credit to their service providers even when they are using wi-fi or GPS instead of their cellular network. The reality is that often "different radio technologies can enable new capabilities where the sum is greater than the parts. For example, navigation apps typically use a GPS receiver, a cellular connection, and a Wi-Fi connection (to augment GPS triangulation)."[181] Realizing the benefits of these innovative radio technology mashups requires a diverse spectrum access environment that encourages a thriving competitive wireless ecosystem.

Not only is a balanced approach to spectrum access—including licensed, shared, and unlicensed access regimes—possible, it is also essential to maintaining our nation's global leadership in wireless innovation. Technologically speaking, restricting *all* spectrum access to exclusive uses is no longer necessary. Practically speaking all spectrum users, *including*

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[178] *See e.g.*, WiFi Forward, *Let's Not Gamble on Spectrum Availability for Lucky Wi-Fi 7*, Medium (June 3, 2022), https://medium.com/@WifiForward/lets-not-gamble-on-spectrum-availability-for-lucky-wi-fi-7-wififorward-7833a61994eb; Sue Marek, *CTIA Wants More Mid-Band Spectrum Available for 5G*, Fierce Wireless (Sept. 29, 2022), https://www.fiercewireless.com/5g/ctia-wants-more-mid-band-spectrum-available-5g.

[179] Michael Calabrese, *NTIA Studying Sharing in 7.125-8.4 GHz Band; Controversy Expected*, New America (Oct. 2, 2019), https://www.newamerica.org/oti/in-the-news/ntia-studying-sharing-7125-84-ghz-band-controversy-expected/.

[180] Press Release, *Three Mid-band Spectrum Bands Offer Greatest Potential to Meet 5G Demand in the US, Study Finds*, CTIA (Sept. 28, 2022), https://www.ctia.org/news/three-mid-band-spectrum-bands-offer-greatest-potential-to-meet-5g-demand-in-the-us-study-finds.

[181] Aspen Report, *supra* note 101 at 21.

incumbents, benefit from the innovative advancements of a thriving competitive wireless ecosystem. So why is the zero-sum game still dominating spectrum policy debates? The answer lies within the stakeholder dynamic itself. The tension between the government's disparate roles as financial beneficiary, spectrum regulator, and spectrum user make our regulators susceptible to the machinations of incumbents who would rather maintain their dominant status quo than adapt to new market conditions or risk potential interference from new spectrum use cases.

Adopting concrete public interest principles to use as a guide for spectrum policy decisions can help shift this dynamic and combat the zero-sum game approach to spectrum policy. If policymakers use guiding principles that are rooted in the public interest to determine what spectrum policies to adopt, spectrum stakeholders will have to adapt their approach to spectrum policy and realign their interests with those of the public. This approach will also require figuring out how to fix the federal dynamic so that our spectrum regulators can operate more effectively. This will take time, but ultimately any successful spectrum policy playbook has to consider the spectrum stakeholder dynamic and work towards shifting the zero-sum game approach to spectrum policy.

B. This Car Has a Blind Spot: Spectrum Policy's Impact on Diversity, Equity, and Inclusion

The Communications Act begins with the pledge to provide equal access to communications services "to all Americans."[182] As with other areas of policy, despite this explicit mandate for inclusion, the FCC did not initially consider the needs of people of color, women, or Native Americans.[183] In the context of broadcast regulation, who is included began to

[182] Communications Act of 1934, as amended, Section 1 (codified at 47 U.S.C. § 151).

[183] *See e.g.,* Jeffrey Layne Blevins & Karla Martinez, *A Political-Economic History of FCC Policy on Minority Broadcast Ownership*, 13 Commc'n Rev 216-238 (2010).

expand in the 1960s and early 1970s. The historic lawsuits by the United Church of Christ,[184] and the general rise and expansion of the Fairness Doctrine following the Supreme Court's decision in *Red Lion*,[185] forced the FCC to re-evaluate its policies on broadcast guidelines. The FCC therefore implemented policies to enhance minority-oriented programming, increase the employment of minorities in the broadcast industry, and expand broadcast station ownership by women and minorities.[186]

When Congress moved license distribution to auctions in 1993, it considered whether or not to maintain these expressly inclusive policies. At the time, auction theory was considered "color blind." Granting a license to whoever could pay the most money would ostensibly place licenses in the hands of those who valued them the most, ultimately producing the most "efficient" result. That said, Congress still charged the FCC with an independent obligation as part of this auction authority with promoting diversity in ownership through auction design.[187] As history has made abundantly clear, despite that direction, systemic racism has created market mechanisms that inherently favor white ownership—making even facially neutral policies biased in practice. Additionally, the history of deployment of telecommunications services demonstrates that without legal compulsion, traditionally marginalized communities remain marginalized even without explicit racial animus.

Congress tried to avoid this result by explicitly instructing the FCC to adopt auction policies that would continue the FCC's inclusion efforts without reliance on comparative

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[184] Office of Communications of United Church of Christ v. FCC, 359 F.2d 994 (D.C. Cir. 1966) [hereinafter UCC I].
[185] Red Lion Broadcasting co., Inc. v. FCC, 395 U.S. 367 (1969).
[186] These policies were made mandatory in 1988, and the Supreme Court approved application of these policies in 1990. Metro Broadcasting v. FCC, 497 U.S. 547 (1990).
[187] 47 U.S.C. § 309(j)(4).

hearings.[188] Section 309(j)(3)(B) requires the FCC to design auctions that "disseminate licenses among a wide variety of applicants, including . . . businesses owned by members of minority groups,[189] and women." Section 309(j)(4)(C)[190] requires the FCC to consider how to assign "license areas and frequencies" to promote both license acquisition and generally ensure "economic opportunity" to minority-owned and women-owned businesses. And, Section 309(j)(4)(D)[191] instructs the FCC to ensure that minority-owned and women-owned businesses "are given the opportunity to participate in the provision of spectrum-based services," and expressly instructs the FCC to consider bidding preferences to achieve these outcomes.

The FCC's initial efforts to formulate policies to effectuate these inclusion directives ended almost immediately with the Supreme Court's decision in *Aderand Constructors, Inc. v. Pena*.[192] There, the Supreme Court explicitly reversed *Metro Broadcasting,* finding that any race-conscious measures not expressly designed to remedy past acts of discrimination were unconstitutional. But while *Aderand* prohibited explicit racial preferences, it did not eliminate the FCC's obligation to ensure all Americans have equal access to wireless technologies and their benefits. The FCC still must consider the effects of its policies on that goal.[193] Additionally, the FCC shares obligations with the Federal government under the Federal "Trust Relationship" with Tribes to ensure that people living on Tribal lands have access to communications services and the benefits these services provide.[194]

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[188] Omnibus Reconciliation Act of 1993, P.L. 103-66, Section 6002.
[189] 47 U.S.C. § 309(j)(3)(B). The term "minority groups" is defined in Section 309(i)(3)(A) to "include[] Blacks, Hispanics, American Indians, Alaska Natives, Asians, and Pacific Islanders."
[190] 47 U.S.C. § 309(j)(4)(C).
[191] 47 U.S.C. § 309(j)(4)(D).
[192] Adarand Constructors, Inc. v. Peña, 515 U.S. 200 (1995).
[193] *See* Prometheus Radio Project v. FCC, 373 F.3d 372 (3rd Cir. 2004).
[194] *See* F.C.C., Notice of Proposed Rulemaking, *In the Matter of Improving Communications Services for Native Nations by Promoting Greater Utilization of Spectrum Over Tribal Lands*, 26 FCCRcd 2623 (2011) [hereinafter Tribal Spectrum NPRM].

The Spectrum Policy Task Force's Failure to Consider Diversity, Equity, and Inclusion

Despite the FCC's inclusive mandates, the SPTF did not consider the use of spectrum policy to promote diversity, equity, and inclusion (DEI). In fairness to the SPTF, they are not unique in this failing. Almost 10 years later, the FCC's National Broadband Plan[195] did not mention DEI as part of its consideration of spectrum policy. To the extent the Federal government considered the implications of spectrum policy on DEI, it did so exclusively in the context of Tribal governments[196]—frequently conflating the unique circumstances of Tribes with the broader concerns of rural service generally.

Several factors account for this traditional failure amongst policymakers. First, broadcast policy long recognized the importance of controlling broadcast licenses to the representation of non-whites and women, to the way in which news and issues of importance were covered in communities, and to the availability of employment opportunities. Indeed, civil rights advocate Rev. C. Everett Parker of the United Church of Christ launched the landmark license challenge to WLBT in Jackson, MS precisely because the racist views of the licensee translated directly into racist news coverage and racist programming.[197] But the connection was not as clear or well established in common carrier telephone service, which historically was the focus of wireless spectrum policy. Although evidence demonstrated underinvestment and poor maintenance by phone companies in traditionally red-lined communities (and even worse service to Tribal

[195] F.C.C., Connecting America: The National Broadband Plan, (March 17, 2010), https://www.fcc.gov/general/national-broadband-plan.
[196] *See* Tribal Spectrum NPRM, *supra* note 194; *See also* F.C.C., Report & Order, *In the Matter of Transforming the 2.5 GHz Band*, 34 FCCRcd 5446 at ¶¶ 47-48.
[197] *See* Office of Communications of the United Church of Christ v. FCC, 425 F.2d 543 (D.C. Cir. 1969); UCC I, *supra* note 184.

lands),[198] the traditional redress for this was behavioral remedies requiring phone companies to deploy throughout the area of license through carrier of last resort-type obligations and sometimes fining phone companies for poor service quality and outages.

Additionally, most policymakers and advocates felt that purely technical decisions on wireless policy did not impact DEI or other "social" issues. Just as economists believed that market mechanisms were race-blind, policymakers and technologists had a similar belief with regard to the specifics of technical spectrum rules. This belief was further justified by the reality of mobile tower deployment. Unlike telephone or cable service, which required explicit investment in red-lined communities to bring wires to homes, the dominant thought was that wireless did not require any such investment because a single cell tower could cover a large enough footprint to provide service to both traditionally white neighborhoods and non-white neighborhoods. A wireless carrier that wanted to serve wealthier and whiter communities in urban and suburban areas would naturally end up providing similar quality of service to the non-white neighborhoods simply as a function of the technology.

It was this sort of blind spot in the thinking of the policymakers (in this case, the FCC) and technologists that failed to see, for example, that a license area that included marginalized communities, such as Tribal lands or low-income communities, when coupled with a network buildout requirement that could be satisfied by serving less than all of the population in that area, could (and likely would) mean that those marginalized communities were the very communities

[198] *See* NTIA, *Falling Through the Net: A Survey of the 'Have Nots' in Rural and Urban America*, (1995), https://ntia.gov/page/falling-through-net-survey-have-nots-rural-and-urban-america; Falling Through the Net II: New Data on the Digital Divide (1998), https://ntia.gov/page/falling-through-net-ii-new-data-digital-divide; Tribal Spectrum NPRM, *supra* note 194.

left unconnected.[199] Additionally, problems like discriminatory pricing were considered by policymakers and technologists as within the realm of a more generalized consumer protection consideration, not technical spectrum policy. And to the extent Tribal lands remained excluded from coverage, the issue was considered to be no different from the general economic problem of supporting adequate deployment in rural areas.

To the extent advocates and policymakers considered spectrum policy relevant to DEI, it focused solely on ownership of licenses, as it had in media ownership. Here, at least, the argument that ownership influenced decisions on deployment had intuitive appeal and supportive evidence. Even if cell towers covered red-lined and non-redlined neighborhoods, decisions on when and where towers were deployed, to whom services were marketed, and at what price, were still subject to the discretion of the licensee and therefore susceptible to discriminatory impacts, reinforcing exclusion and inequality along race-based lines from an earlier source of discrimination. The FCC (and most advocacy) therefore focused on bidding credits for minority owned bidders or Tribal land bidding credits.[200] After the *Aderand* decision, the FCC used the more neutral "small business entity" (SBE), reasoning that minority new entrants would overlap with small businesses. By targeting the permissible category of small businesses, the FCC hoped to enhance ownership by minority and women owned businesses.[201]

In short, despite clear statutory language to consider spectrum policy related factors such as "license area and frequency" as tools of inclusion, the general attitude of technologists was,

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[199] Construction/Coverage Requirments, F.C.C. (last accessed Jan. 24, 2023), https://www.fcc.gov/wireless/support/knowledge-base/universal-licensing-system-uls-resources/constructioncoverage

[200] Tribal Lands Bidding Credits, F.C.C. (last accessed Jan. 24, 2023), https://www.fcc.gov/tribal-lands-bidding-credits#:~:text=The%20FCC%27s%20Tribal%20Lands%20Bidding,to%20or%20below%2085%20percent.

[201] *See* F.C.C., Notice of Proposed Rulemaking, *In the Matter of Updating Part 1 Competitive Bidding Rules*, 29 FCCRcd 12426, at n.1 (2015) (and sources cited therein).

"Radio waves don't see race. Technical rules have nothing to do with either enhancing inclusion or aggravating inequality." The time has come to correct this "blind spot" in policy. As the recent Aspen Report observed: "The shift of more and more aspects of daily life from offline to online services has had a profound impact on and compounded inequalities for historically marginalized groups. Policymakers must continue to focus on how the tools of the information economy, including spectrum policy, be employed to create a more equitable and inclusive society."[202]

Spectrum Policy's Impact on Diversity, Equity, and Inclusion

Spectrum policy can impact DEI in multiple ways. Spectrum policy may allow carriers to shift investment away from traditionally marginalized communities to focus on the most profitable urban areas. Alternatively, spectrum policy can make it possible for traditionally marginalized communities to provision themselves. Technical decisions on what power levels to permit, what frequencies are accessible, the size of license areas, whether to require a certified professional installer, whether to permit use of existing off-the-shelf hardware, or to require recertification for new uses can all impact the quality, cost, and expedient availability of spectrum services for traditionally underserved areas. The right spectrum policies can facilitate spectrum use and innovation by marginalized communities. In contrast, the wrong spectrum policies can perpetuate exclusion and aggravate inequality.

A few examples illustrate how technical policies potentially make significant differences in availability and deployment. In the FCC's "spectrum frontiers" rulemaking,[203] the Commission opened up high frequencies that bounce off solid objects (such as buildings) rather than penetrating them. Using these frequencies for mobile uses requires widely distributed

[202] Aspen Report, *supra* note 101 at 38-39.

[203] *See* F.C.C., Notice of Proposed Rulemaking, *In the Matter of Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, 30 FCC Rcd 11878 (2015); Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (2016).

"micro-cells" rather than a handful of towers covering an entire urban market.[204] This negates the traditional assumption that service in an area would automatically include traditionally "red-lined" communities because the nature of high frequency spectrum limits wireless coverage areas. But, the FCC has not taken steps to require equal service throughout a market or license area to address the potential for service discrimination. To the contrary, the Commission has expressly limited the ability of localities to use their permitting authority to ensure deployment in traditionally red-lined neighborhoods.[205] Nor did the Commission establish any mechanism to monitor deployment to ensure equitable and inclusive access to next-generation 5G wireless services.

The recent fight between the FAA and licensees of the 3.7 GHz C-Block auction provides another example of how technical decisions can unintentionally impact the availability of services to communities of color. The FAA maintains that operation of the licenses in the 3.7-3.98 GHz band creates potential interference with air altimeters—devices used to assist planes in take-off and landing.[206] To guard against potential interference, the FAA initially demanded significant exclusion zones around major airports.[207] Such exclusion zones would have disproportionately impacted minority neighborhoods. Because the negotiations took place between the FAA and the licensees (Verizon and AT&T) in private, there is no way to ascertain to what extent the FAA considered how these exclusion zones would have aggravated inequality in availability of 5G services when making this demand.

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[204] *See* Yosef Getachew, Alejandra Montoyer-Boyer & Spencer Overton, *5G, Smart Cities & Communities of Color*, Joint Center for Political and Economic Studies, 14-15 (2017).
[205] *See* F.C.C., Declaratory Ruling and Report & Order, *In the Matter of Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment*, 33 FCCRcd 9088 (2018).
[206] Brian Fung, *How Last Week's 5G Deployment Went So Wrong*, CNN Business (Jan. 28, 2022), https://www.cnn.com/2022/01/28/tech/5g-faa-fcc/index.html.
[207] Bevin Fletcher, *FAA Identifies Airports Set for 5G C-Band Buffer Zones*, Fierce Wireless (Jan. 10, 2022), https://www.fiercewireless.com/5g/faa-names-airports-set-5g-c-band-buffer-zones.

As a final example, consider the FCC's decision to require professionally certified installers for CBRS base stations.[208] This arguably provides greater protection against faulty installation that could cause harmful interference to protected services, but it significantly limits the ability of low-income communities to create their own local wireless networks (a strategy for providing affordable local broadband access) both by adding a new requirement and by raising the cost. Here again, the Commission should weigh the requirement's marginal advantage to mitigate potential interference against the barriers it creates for low-income and disadvantaged communities. Requiring professionally certified installers ignores Section 309(j)'s instruction to consider licensing and frequency use to enhance access to spectrum access for minority owned businesses, and to provide for minority-owned businesses and communities to provide access to "economic opportunity" and "the opportunity to participate in the provision of spectrum-based services."

On the other hand, spectrum policy decisions can enhance spectrum access for traditionally marginalized communities and help to reduce digital inequality. The FCC's 2020 decision to create a "Tribal Priority Window" that would make licenses in the 2.5 GHz band available to Federally recognized Native American Tribes and Alaskan Native Villages has given hundreds of Tribes the opportunity to build their own broadband networks by using 2.5 GHz licenses, combined with CBRS spectrum and unlicensed spectrum.[209] Spectrum decisions expanding the use of unlicensed spectrum and CBRS spectrum have allowed schools and libraries to extend broadband into homes where residents lack access to affordable broadband.[210]

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[208] *See* 47 C.F.R. § 96.45.

[209] *See* Christopher Mitchell, *Building Connections and Capacity in Indian Country at the First Tribal Wireless Bootcamp*, Institute for Local Self-Reliance (September 21, 2021), https://ilsr.org/building-connections-and-capacity-in-indian-country-at-the-first-tribal-wireless-bootcamp/.

[210] Matthew Marcus and Michael Calabrese, *The 'To and Through' Opportunity: Case Studies of School and Community Networks Able to Close the Homework Gap for Good*, Open Technology Institute at New America

The FCC has recently recognized that even the most technical spectrum policy decisions can impact DEI. In its most recent spectrum proceedings, the FCC has explicitly sought comment on how its decisions might impact DEI. Additionally, through the FCC's digital discrimination proceeding, the FCC can consider whether the existing wireless market perpetuates existing inequalities and, if so, what steps to take to reverse course and facilitate equal access to broadband by all Americans.[211]

Shifting the Approach: The Future of Diversity, Equity, and Inclusion in Spectrum Policy

Achieving DEI requires mindfulness and a willingness to engage in the uncomfortable reality of our inequitable past. This section explores both the general future of DEI in spectrum policy and for Native Americans specifically.

General Diversity, Equity, and Inclusion Considerations

Although each spectrum proceeding will raise its own DEI issues, there are certain commonalities that the Commission should consider. In particular, the Commission should recognize that ***it is always better to prevent an inequality from happening than to try to remedy it after the fact.*** Combining this principle with the public interest backcasting principles provides a starting point of inquiry for ensuring that spectrum policies have a beneficial or at least net neutral impact on DEI.

- **Do the rules adopted facilitate direct access by traditionally marginalized communities, or otherwise affirmatively prevent traditional patterns of exclusion?**

  The most direct way to facilitate access to spectrum and spectrum-based services by minority owned businesses and marginalized communities is to establish rules that allow these businesses and communities direct access to the spectrum. This might be through unlicensed spectrum access or licensing by rule under Section 307(e) (such as that used

(2022), https://newamericadotorg.s3.amazonaws.com/documents/Anchor-Nets-Case-Studies-revisedFINAL_091422.pdf.

[211] *See* 47 U.S.C. § 1754.

for CBRS). Other non-exclusive forms of spectrum access, such as point-to-point or point-to-multipoint authorized on a non-exclusive basis, may permit greater access and more innovative uses in traditionally marginalized communities, whether urban or rural.[212]

If authorizing spectrum licensed for exclusive use, the Commission should consider whether the license area and the characteristics of the spectrum are likely to facilitate traditional patterns of underinvestment and exclusion. If so, the Commission should consider performance metrics or other strategies to monitor the situation and affirmatively prevent the inequality from occurring. The Commission should also consider corrective measures in advance, such as penalties for failure to deploy in accordance with the established metrics. Given the difficulties the Commission has had with canceling licenses,[213] the Commission should consider more realistic penalties. These might include forfeitures into digital inclusion funds, or partition of licenses to allow unserved communities to serve themselves. In addition to invoking its powers under Title III, the Commission should consider how Section 60506 of the IIJA[214] (instructing the Commission to "identify" and eliminate sources of digital discrimination) augments its traditional authority.

- **How do assigned power levels, interference mitigation, or other factors interact with the assigned frequencies? Do they raise the cost or limit flexibility in a manner that promotes DEI or perpetuates inequality?**

  Technical rules drive the cost of devices and services. They also limit the flexibility of services and use cases. The need for various types of mitigation will depend heavily on the frequencies under consideration, other incumbent services in the vicinity, and the power levels needed to make use of the new spectrum access regime. With all of these choices come tradeoffs. Some types of mitigation can significantly raise the cost of manufacturing devices or deploying service. Others may have significant limits on the types of uses possible in the new spectrum regime. For example, while predominantly non-white, low-income communities have used traditionally unlicensed spectrum in the 2.4 GHz band and 5 GHz band to bring affordable broadband access in urban core

[212] It is a common assumption that rural communities – if not Native American – are predominantly white. This is not true, and we find significant inequalities between majority-white rural communities and majority-non-white rural communities. Spectrum policy should certainly distinguish between urban and rural issues – but should look at both urban and rural spectrum policy with a DEI lens. *See* Dominique Harrison, *Affordability & Availability: Expanding Broadband in the Black Rural South*, Joint Center for Political and Economic Studies (2021), https://jointcenter.org/wp-content/uploads/2021/10/Affordability-Availability-Expanding-Broadband-in-the-Black-Rural-South.pdf; Kelsey Berkowitz & Jim Kesler, *The Racial Equality and Economic Opportunity Case for Expanding Broadband*, Third Way (2019), https://www.thirdway.org/report/the-racial-equality-and-economic-opportunity-case-for-expanding-broadband.

[213] *See e.g.*, FiberTower Spectrum Holdings, Inc. v. FCC, 782 F.3d 692 (D.C. Cir. 2015).

[214] 47 U.S.C. § 1754.

neighborhoods,[215] the low power levels adopted in the 6 GHz band limit the potential for this kind of use. While some portions of the band can be used outdoors at higher power levels, this requires use of an automated frequency control system and limits on antenna height, increasing the cost of deployment and further diminishing the utility of the spectrum for innovative, low-cost urban uses.

This is not to say that such mitigation methods are unnecessary. To the contrary, especially for new uses in crowded spectrum environments, new mitigation techniques that limit use or drive up cost will be inevitable. But nowhere in the record of recent proceedings has the Commission considered the impact of interference mitigation on DEI. Interference mitigation can involve multiple approaches, some of these will have greater impact on the ability of traditionally marginalized communities to use the new spectrum access regime than others. Going forward, the Commission should expressly consider to what extent proposed interference mitigation requirements impact DEI by raising cost, reducing the availability of spectrum in traditionally marginalized communities, and reducing the ability of those within these communities to use the spectrum in ways that meet their unique needs. Conversely, the Commission should consider how other approaches can enhance the ability of these communities to take full advantage of the new spectrum access regime.

The rules adopted for a service will define the use cases and the cost. These decisions, unsurprisingly, are generally driven by the companies and technologists urging the Commission to adopt the rule changes, modified by concerns of incumbents to guard against the risk of interference. Few public interest advocates have the expertise or capacity to participate in technical proceedings around new wireless services, and these lack the engineering expertise or financial resources to conduct the experiments and studies used as evidence in these proceedings.

The federal government and the philanthropic community can help to bridge this gap. NTIA, for example, operates the Institution for Telecommunications Sciences, a premier spectrum research facility in Boulder, Colorado. According to the ITS mission statement on its website:

> The mission of ITS is to ADVANCE innovation in communications technologies, INFORM spectrum and communications policy for the

[215] *See e.g.*, Red Hook Wi-Fi Initiative Homepage, (last accessed Jan. 24, 2023), https://redhookwifi.org/.

> benefit of all stakeholders, and INVESTIGATE our Nation's most pressing telecommunications challenges through research that employees are proud to deliver.[216]

In a whole of government approach to using spectrum policy to eliminate the inequity and promote inclusion, the ITS could undertake independent research advised by advocates and community members to find ways to expand spectrum access to promote DEI. This research need not be limited to open FCC proceedings. To the contrary, the ITS could conduct its own research on new ways to use existing spectrum access to promote DEI. The ITS could also research what rule changes could allow traditionally marginalized communities to take greater advantage of spectrum to promote equality and inclusiveness.

Similarly, research grants from federal institutions such as the National Science Foundation could fund research exclusively focused on the use of spectrum policy to promote DEI. This funding could go beyond technical funding. Such grants could, for example, fund research into barriers to adopting spectrum technologies "promot[e] economic opportunity and competition, and ensur[e] that new and innovative technologies are readily available" in traditionally marginalized communities.[217]

The philanthropic community, as part of its general DEI efforts, could similarly fund research and advocacy on how to unlock spectrum use for a more inclusive society. Unfortunately, the philanthropic community has generally shared the misconception that technical rules have no impact on DEI. Even foundations and individuals focused on the use of technology to address inequality and promote a more inclusive society have been slow to

[216] ITS: The Nation's Spectrum and Communications Lab, NTIA.gov (last accessed Jan. 24, 2023), https://www.ntia.doc.gov/office/ITS.
[217] 47 U.S.C. § 309(j)(3)(B).

understand the importance of "DEI by design" rather than DEI as an afterthought once rules governing new wireless technologies are established.

Until these changes take place, it must fall to the Commission and its engineers to examine how proposed technical rules will impact the low-income and otherwise marginalized communities.[218] The Commission must take responsibility for independently asking whether new spectrum access regimes permit these communities to innovate to meet their needs, and whether they will enjoy services and technologies developed by others. While much of the focus is on deployment of affordable broadband service through unlicensed spectrum and spectrum licensed by rule, the inquiry should not stop there. New technologies such as those used for augmented reality and virtual reality (AR/VR), or spectrum using medical devices and diagnostic tools, if not made available to marginalized communities on an equal and affordable basis, can aggravate existing inequalities or create new ones. By contrast, enabling flexible and affordable access can create new opportunities for traditionally marginalized communities to innovate and meet specific local needs.

Special Consideration for Native American Tribes

Native American reservations[219] occupy a unique position with regard to spectrum policy. As the FCC has previously acknowledged, the FCC shares the "Federal Trust responsibility" with other federal agencies.[220] This imposes obligations on the FCC both to manage spectrum to benefit the Tribes and to recognize the "inherent sovereign powers" that Tribes exercise of their

[218] The Commission has taken a first step on this front by explicitly seeking comment on the potential impact of its most recent spectrum proceeding on DEI. *See* F.C.C., Notice of Inquiry, *In the Matter of Expanding Use of the 12.7-13.25 GHz Band for Mobile Broadband or Other Expanded Use*, GN Docket No. 22-352, at ¶ 43 (rel. Oct 28, 2022).
[219] The term "Native American reservations" in this report includes federally recognized Alaskan Native Villages and Hawaiian Homelands.
[220] Tribal Spectrum NPRM, *supra* note 194.

lands and members.[221] The FCC shares these responsibilities with other federal agencies, such as federal spectrum users[222] Despite these requirements, Tribal reservations (especially in rural areas) remain among the least served areas in the United States for wireless services (and communications services generally).[223]

A chief cause of this lack of service is the unwillingness of licensees to serve rural tribal lands. Rural tribal lands are often home to relatively small and lower-income populations, which means that—in addition to the higher cost as compared to urban areas—carriers have less profit opportunity than the more affluent or populous parts of their license. Although the FCC often requires licensees to provide coverage to a certain percentage of their license's population (rather than require coverage of specific geographic areas). Because relatively few people who live on tribal lands makes it possible for carriers to avoid the high expense of providing coverage to geographically isolated rural tribes.

Some tribes have attempted to use unlicensed spectrum to build their own wireless ISPs to serve Tribal lands. For these Tribes, the limitations of unlicensed access, such as significantly lower power levels than licensed spectrum, have limited the utility of this approach. Moreover, when the FCC repurposes spectrum use (such as opening TV white spaces to unlicensed use), the FCC must negotiate coordination with Mexico and Canada. As a consequence, until the FCC concludes these international negotiations, Tribes with land along the U.S. border cannot use the newly repurposed spectrum.

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[221] F.C.C., Statement on Policy on Establishing a Government-to-Government Relationship with Indian Tribes, 16 FCCRcd 4078 (2000).

[222] *See* President Obama's Memorandum for the Heads of Executive Departments and Agencies on Tribal Consultation, 74 Fed. Reg. 57,879 (Nov. 9, 2009).

[223] Alexandra Walsh, Mary Moynihan, and Elizabeth Yin, *Hacking Broadband Access in Tribal Lands*, The Regulatory Review (Sept. 17, 2022) Available at: https://www.theregreview.org/2022/09/17/saturday-seminar-hacking-broadband-access-in-tribal-lands/.

Although tribal self-provision may provide a viable coverage alternative, the cost of participating in—let alone winning—a spectrum auction acts as a significant barrier for most tribes. Additionally, the geographic area of most licenses extends well beyond tribal lands. To meet the performance metrics associated with these licenses, Tribes would need to deploy and operate a wireless network well outside their tribal lands. Fortunately, two recent innovations by the FCC point the way to enhance Tribal spectrum access: the Tribal Priority Window in the recent 2.5 GHz auction and the CBRS multi-tiered band plan.

The Commission recently adopted a Tribal Priority Window that allowed Tribes to apply for the spectrum licenses covering their lands prior to the 2.5 GHz spectrum auction. During the window, the Commission received 418 applications and amendments from 266 Tribes despite the numerous challenges Tribes faced in completing their applications during the COVID-19 pandemic.[224] This success, not only demonstrates that the demand for spectrum access amongst Tribes is high, but also that the Commission has an effective mechanism for awarding licenses to Tribes outside the auction system.[225] The FCC's authority to create the Tribal Priority Window is not limited to the EBS band. To the contrary, it applies to any spectrum auctioned under the FCC's general authority—meaning that the FCC can, and should, adopt a policy of holding a Tribal Priority Window prior to every auction.[226]

Second, the Commission's adoption of Citizens Broadband Radio Service demonstrates in an immediate sense the power of developing spectrum policy that allows communities to

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[224] Mark Colwell, *Success of Rural Tribal Window Demonstrates Need for Rural Education Window*, Voqal (Sept. 9, 2020), https://voqal.org/success-of-rural-tribal-window-demonstrates-need-for-rural-education-window/.

[225] *See* Public Notice, *Wireless Telecommunications Bureau Waives 2.5 GHz Rural Tribal Window Specific Interim and Final Performance Deadlines* (rel. July 8, 2022) (noting that FCC had at that time issued 335 licenses to over 350 Tribes in 30 states), https://www.fcc.gov/document/25-ghz-rural-tribal-window-extension- performance-deadlines.

[226] The success of the Tribal Priority Window should not justify forcing Tribes to operate their own networks. Rather, Tribes that want to provide service to their communities should have an opportunity to do so.

access spectrum in a more cost-efficient way through sharing. By allowing Tribal entities, as well as a diverse array of other stakeholders, to access CBRS spectrum by rule (instead of auction), the FCC has created a broad base of spectrum users who will help meet their communities' needs and drive innovation in CBRS devices and services. This will better help Tribal communities meet their service needs.

CBRS-type band planning also demonstrates that non-federal entities can successfully share federal spectrum with federal users without causing harmful interference. As with the use of Tribal Priority windows, the FCC (and federal users) can develop sharing mechanisms unique to Tribal lands. Section 927(b) of the Communications Act[227] allows the Secretary of Commerce, in conjunction with the FCC, to permit non-federal entities to share spectrum allocated for primarily federal use. In light of the Federal Trust Relationship, which creates a unique relationship between Tribal governments and federal agencies, it would serve the public interest to invoke this provision to permit Tribal governments access to federal spectrum on tribal lands—subject to rules established by the FCC. This access could be accompanied by formally recognizing that tribes have an interest in the electromagnetic spectrum on their tribal lands, restoring an additional measure of sovereignty to Native American Tribes.

IV. CONCLUSION

Doc Brown spends the first two "Back to the Future" movies worrying about breaking the space time continuum by messing with the past. But in the last movie, he finally comes to understand that the future is constantly in flux and that we always have the power to influence what the future has in store for us. The same is true in spectrum policy. The spectrum policies we set today will determine what our wireless future looks like.

[227] 47 U.S.C. § 927(b).

Instead of using a time-traveling DeLorean to fix our timeline and ensure a desirable future, we have the SPTF's Report, its 20-year impact on spectrum policy, and a value-based public interest framework to help us step into the past and identify key spectrum policies to create a future wireless world that benefits all of us:

- **Efficiency.** Policymakers should measure efficiency in spectrum policy by balancing metrics that benefit the public such as economic impact, consumer impact, and technical spectrum usage.
- **Access Models.** Policymakers should focus on access models that maximize spectrum access and update technical regulations based on advancements in spectrum sharing and reuse technologies.
- **The Stakeholder Dynamic.** Any successful approach to spectrum policy must take into account the spectrum stakeholder dynamic and work towards shifting the zero-sum game approach to spectrum policy.
- **Diversity, Equity, and Inclusion.** Policymakers must work to prevent inequality by considering the impact spectrum policies have on DEI and Native American Tribes.

By focusing on a value-based framework that uses public interest principles to make spectrum policy decisions, policymakers can ensure that we are headed towards a future worth looking forward to—one where all can afford reliable telecommunications services and spectrum is used effectively to increase our access to education, economic, and cultural opportunities.