

Testimony of

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Chairman Thune, Ranking Member Nelson and members of the Committee, I am very pleased and honored to appear before you today to testify about spectrum policy. My name is Pierre de Vries and I am Co-Director of the Spectrum Policy Initiative at the Silicon Flatirons Center for Law, Technology and Entrepreneurship at the University of Colorado in Boulder.

I am a physicist by training and I have been working on spectrum policy for about fifteen years, first as an executive in a software company and a consultant, and now as a policy researcher. I am currently a member of the FCC Technological Advisory Council.

My testimony today is based on my experience and my current academic research interests. It reflects my views alone, and no opinions or recommendations that I offer should be ascribed to any of the institutions with which I am affiliated. I am testifying today entirely on my own behalf as a private citizen.

My testimony makes the following points:

- Realizing the promise of spectrum—improved public safety and national defense, new services for citizens, profits for companies, and revenue for the government—entails squeezing radio services ever more closely together and shifting as much spectrum management as is prudent from regulators to spectrum users and the marketplace. This in turn requires new approaches to planning, issuing and enforcing spectrum rights. I strongly recommend the following three:
- *First*, when making judgments about the trade-offs between the benefit of a new service and its impact on incumbents, spectrum managers like the FCC and NTIA should move away from worst case interference analysis and use risk-informed interference assessment that considers not only the consequences but also the likelihood of harmful interference. This will improve the analysis of harmful interference, and lead to wiser trade-offs.
- *Second*, when defining allocations, spectrum regulators should provide more clarity about interference rights and obligations, e.g. by providing harm claim thresholds—explicit statements of the interference that systems have to tolerate without being able to claim harmful interference. This will help parties to optimize spectrum boundaries and resolve disputes without relying on the government.
- *Third*, for cases where interference disputes cannot be resolved, parties should have the option of acting against each other directly in front of an FCC judge, and/or in a federal Court of Spectrum Claims. Fact-based, transparent, and timely adjudication will facilitate decentralized spectrum management.
- Congress can help by itself taking a risk-informed view when presented with questions of harmful interference, and not fixating on the worst case; encouraging the FCC and NTIA to be more explicit about interference rights and obligations; and creating a Court of Spectrum Claims.

1 Squeezing ever more radio services together requires new regulatory tools the planning, issuing and enforcement of rights to use spectrum

There is no need to rehearse for this Committee the explosive growth in wireless services and technologies like cellular data, Wi-Fi, airborne communications, satellite broadcasting, and radar of all sorts; the boom in the wireless economy; and the increasingly tight packing of services in spectrum bands that has resulted. The very fact that you are holding this hearing is testament to your recognition of the value of spectrum to growth and prosperity, and the imperative to rethink the spectrum policy tools we need going forward.

We are in a period of great promise as spectrum-based services offer unprecedented new value to citizens, companies and government. We are inventing new ways to put spectrum to its best use, including—notably—rethinking the division of spectrum between federal and non-federal uses.

The promise of a spectrum bonanza is at risk, however, if the government does not put in place the appropriate institutional tools to respond to the unprecedented diversity and crowding in spectrum.

The demand for the benefits that radio services can bring to both private and public operators, and to the government through auction revenues, means squeezing together more and more applications and devices—of increasing variety, that require ever more spectrum capacity—into ever-more crowded spectrum. This means ever closer packing in time, space, and frequency. To give one example along each dimension: a cellular service operating near a NOAA earth station during times when a weather satellite is below the horizon and not visible; geographic exclusion zones that grow or shrink depending on whether a mobile radar is present or absent; and eliminating frequency guard bands between allocations by using receivers that can reject interference from adjacent channels. Even though the accessible frequency range for radios keeps growing, demand is growing too. Greater proximity increases the cost of getting it wrong by flaws in allocation (the spectrum equivalent of land use zoning) or the assignment of spectrum use rights (like auctioned licenses, license

exemptions, and federal frequency assignments), and increases the risk of service breakdowns due to harmful interference.

The problem is not unlike that of a booming city that must make room for more and more traffic of all shapes and sizes—pedestrians, bicycles, motorbikes, cars, trucks, buses, etc.—at the same time that real estate values are exploding and space is at a premium.

The growing variety, intensity and dynamism of spectrum use demands that we find ways to shift the adjustment of rule changes from regulators to operators in more cases. We need to enable private ordering and remove the FCC from a gatekeeping role.

The challenge is particularly acute when it comes to getting the maximum value from federal spectrum, since these services are vital to that national interest, are competing for access with private uses and, in many cases, jurisdiction over spectrum bands is shared with the Federal Communications Commission (FCC). If we want to reap the full benefits from federal and other spectrum, we need to create an environment of good governance, and anticipate the problems that success will bring.

These constraints apply regardless of whether one favors spectrum sharing, clearing and reallocation, or some hybrid (like the AWS-3 blocks where cellular licensees have to protect weather satellite earth stations); and regardless of whether one prefers licensed or unlicensed allocation, or some hybrid (such as the 3.5 GHz band where unlicensed devices will be controlled by a Spectrum Access System). These choices are important, but do not change the underlying physics.

The challenges I've described must be addressed at all stages of the spectrum lifecycle: planning new allocations, issuing operating rights, and resolving interference disputes.

The three actions I recommend today correspond to these three stages:

- *When planning new allocations*, spectrum regulators should move away from worst case interference analysis and adopt risk-informed interference assessment that considers not only the consequences but also the likelihood of harmful interference.
- *When issuing operating rights*, regulators should provide more clarity about interference rights and obligations by specifying harm claim thresholds.
- *When resolving interference disputes*, parties should have the option of taking action against each other directly, either in front of an FCC judge or (particularly in the case of disputes between federal and non-federal entities) in a Court of Spectrum Claims.

2 When making the trade-off between the potential benefit of a new service and its cost to incumbents, spectrum managers like the FCC and NTIA should move away from worst case analysis and adopt risk-informed interference assessment

Should a spectrum manager like the FCC or the National Telecommunications and Information Administration (NTIA) allow a new radio service if it might diminish the value of an existing service by introducing harmful interference? This question is at the heart of spectrum regulation. It has traditionally been answered by engineering analysis focused on the worst case, followed by qualitative rather than quantitative judgments of risk. There is an alternative, however: quantitative risk-informed interference assessment.

Risk assessment sets out to answer three questions: What can go wrong? How likely is it? What are the consequences? For example, when considering whether to install a burglar alarm system one might consider the various circumstances under which unwanted people might enter your house; how likely each possibility might be; and what harm might befall in each case, from pranks and petty larceny to assault.

The purpose of risk assessment is to provide quantitative evidence to inform decisions on how to avoid and manage risks, and choose between options. In spectrum management, the risk is that of harmful interference, and the choice is between various possible operating parameter values—such as values for maximum transmit power, the amount of energy leaking into adjacent bands, and antenna directivity—including the option of not allowing a new service at all. Applying quantitative risk assessment to spectrum yields risk-informed interference assessment.

Quantitative risk assessment has been used in other regulated industries for decades but has not yet been applied to spectrum management. A working group of the FCC’s Technological Advisory Council (TAC) examined the potential of risk-informed interference assessment last year, and recently published a paper recommending that the FCC begin to use this technique.¹

2.1 Worst case analysis is inherently conservative, leading to over-protection of existing services and under-provision of new services

A worst case analysis considers the single scenario with the most severe consequence, regardless of its likelihood. However, there are many kinds of radio interference, and their impacts vary; for example, a weak interfering signal leaked into an operating channel may cause more or less harm than a strong signal in an adjacent band, depending on the circumstances. Fixating on a single interference scenario—typically a worst case—does not accurately represent reality and can lead to false confidence that the resulting rules will avert harm. The worst case may be so

¹ The Spectrum and Receiver Performance Working Group of the FCC Technological Advisory Council, A Quick Introduction to Risk-Informed Interference Assessment (April 1, 2015), <http://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting4115/Intro-to-RIA-v100.pdf>. For a summary, see J. Pierre de Vries, Risk Informed Interference Assessment (May 12, 2015), http://www.ntia.doc.gov/files/ntia/publications/15-05-12_csmac_risk_hand-out.pdf.

rare that it can be safely ignored; and a more common but less extreme effect may be more problematic in practice than the worst case.

A worst case approach is inherently conservative and usually inappropriate. For example, when deciding on the amount of domestic protection to buy, most consumers do not plan for a worst case like home invasion. Rather, they take a view—based on the particular threats in their neighborhood, their need for security, and costs—of various options like deadbolts, burglar bars, intrusion alarms and steel doors.

In the case of spectrum, worst case analysis all too easily leads to rules that severely limit the benefits of new services while giving incumbents more protection than they need. This approach arguably made sense when spectrum rights were not in such great demand. It is not tenable when high value services have to be squeezed ever-more tightly together.²

In engineering practice, risk is typically evaluated by considering the combination of likelihood and consequence for multiple hazards. By contrast, a worst case analysis focuses on a single scenario with very severe consequences, regardless of its likelihood.

2.2 Quantitative risk assessment is used in many regulated industries

For decades, quantitative risk assessment has been used in regulated industries from finance to food safety, including cases where safety of life is paramount:

² There are exceptions where a conservative approach remains appropriate, such as services where interruption is absolutely unacceptable and spectrum protection is the only way to guarantee it. Even when doing a worst case analysis in such cases, however, one still needs put various hazards in context by comparing interference risks with non-spectrum risks like operator error, power outages, device misconfiguration, intentional jamming, etc.

- The U.S. Nuclear Regulatory Commission adopted quantitative risk assessment in the Seventies. Its 1995 policy statement on probabilistic risk assessment (PRA) encouraged greater use of this technique to improve safety decision-making and regulatory efficiency. In 2009 it published guidance on the use of PRA to support licensee requests for changes to plant licenses.
- The U.S. Environmental Protection Agency (EPA) uses risk assessment to characterize the nature and magnitude of health risks from chemical contaminants and other environmental stressors. The EPA first issued a cancer risk assessment in 1976. A series of guidelines followed, based on a 1983 risk assessment paradigm developed by the U.S. National Academy of Sciences. Risk assessment practices are now well established at the agency and are widely used for public and environmental health protection.
- The U.S. Food and Drug Administration uses risk analysis to ensure that regulatory decisions about foods are science-based and transparent. It has developed FDA-iRisk, a publicly accessible online tool to estimate the health burden of microbial and chemical hazards in food.

Risk assessment methods are also used by other U.S. government agencies and departments including the Office of Science and Technology Policy and the Office of Management and Budget; the Departments of Homeland Security, Health and Human Services, and Transport; and the Federal Aviation Administration, NASA, and Occupational Safety & Health Administration.

2.3 Using risk assessment in spectrum policy

The FCC TAC has proposed a three step method for analyzing radio interference hazards: (1) make an inventory of all significant harmful interference hazard modes; (2) define a consequence metric to characterize the severity of hazards; (3) assess the

likelihood and consequence of each hazard mode, and aggregate them to inform decision making.³

Continuing the home safety analogy, householders would first to consider all the hazards they are exposed to, like fire, theft, windstorms and earthquake. Second, they would put them all on same footing with a common consequence metric such as dollars: how much it would cost to recover from a particular eventuality. Third, they would consider the likelihood and severity of each of these hazards, which would depend among other things on where they lived and their desire for personal security. Householders assess the likelihoods and consequences intuitively when deciding whether to buy a smoke alarm or install burglar bars; insurance companies do a quantitative analysis to calculate the insurance premiums for various risks. In the final aggregation step, the householder considers all these risks together when deciding how to allocate their limited resources on insurance policies and protective measures.

The benefits of risk-informed interference assessment include:

- Providing quantitative information to policy decision-makers who are balancing the benefits of a new service against its adverse technical impact on incumbents, including services that are essential to life safety and national security;
- Providing a single framework for comparing different interference scenarios and assessments, in other words, enabling apples-to-apples comparisons of different kinds of interference; and
- Enhancing the completeness of analysis and increasing the chances of identifying unexpected harmful interference mechanisms.

³ Spectrum and Receiver Performance Working Group, *supra* note 1.

Achieving widespread use of risk-informed interference analysis will take time, not only to work through spectrum-specific technical issues but also to shift the management culture from a worst case to a risk-informed worldview. However, the sooner we start applying these methods, the sooner citizens, industry, and the Treasury will reap the benefits of squeezing services more tightly together. In other words: *Start small, but start soon.*

Congress should encourage spectrum managers like the FCC and NTIA to start using quantitative risk assessment in their own work; to publish the analyses and results so that others can learn from them; and to pilot risk-informed interference assessment in limited-impact cases. There is no need to start with headline-grabbing initiatives; an incremental approach will build expertise and confidence. Congress can also set a good example by itself taking a risk-informed view when faced with arguments about harmful interference, and not fixating on the worst case.

3 When defining operating rules, spectrum managers should provide harm claim thresholds—explicit limits on the interference that systems have to tolerate without being able to claim harmful interference

Users operate their radios within the constraints set by regulators. These constraints are codified in operating rules—maximum transmit power, allowed out-of-band emissions, antenna directivity, and so on—made by the FCC and NTIA. These arrangements aim to strike a balance between the interests of incumbents, whose operations should be protected against harmful interference, and entering services that could deliver significant new value such as wireless broadband, home healthcare, and the much-vaunted Internet of Things.

Given the imperfect information available to the regulators, the balance they strike is likely to be sub-optimal, that is, it is unlikely to minimize costs and maximize benefits. Even if it is perfect, the chosen balance is likely to become obsolete as technologies, businesses and missions evolve. For example, there might be a net social gain if the benefit of faster data services, enabled by increased transmit power, outweighed the cost of increased interference to an adjacent service or the

cost of improving receivers to be more impervious to such interference. Adjustments to the rules are therefore inevitable and desirable.

At the moment, adjusting the rules requires action by the regulators in almost all cases. This is slow and inefficient, since regulators have limited resources and imperfect knowledge, and the variety, intensity and dynamism of spectrum use keeps increasing. We need to enable as much spectrum management as possible by spectrum users themselves, individually and collectively, and minimize the FCC's gatekeeping role.

There are a few cases where parties do successfully renegotiate spectrum boundaries—that is, the operating parameter values such as license area boundaries, frequency band edges, time of operation, or limits on transmitted power that demarcate spectrum rights—typically in situations where there is a small number of parties, ideally all in the same business; the adjustment of cellular service boundaries is an oft-cited example.

Sufficient clarity helps parties to an interference negotiation or dispute to know what their rights and obligations actually are. This is essential when parties have limited information about each other's technology and business, as is usually the case at spectrum boundaries or in bands shared among very different services, and/or when they do not negotiate repeatedly.⁴ Harm claim thresholds—the explicit statement in the operating rules that govern a service of the interfering signal levels that it needs to tolerate without being able to bring a harmful interference claim—provide the required clarity.⁵ They are good fences that will make for good neighbors.

⁴ These constraints usually do not apply to negotiations between cellular operators—perhaps the reason why they can bargain successfully about adjusting spectrum boundaries.

⁵ J. Pierre de Vries, *Optimizing Receiver Performance Using Harm Claim Thresholds*, 37 *Telecomm. Pol'y* (2013), <http://dx.doi.org/10.1016/j.telpol.2013.04.008>.

Harm claim thresholds give manufacturers and operators the information they need to determine the best way to tolerate potentially interfering signals in adjacent bands without the government placing requirements on their designs. For example, vulnerable operators can invest in high performance receivers that tolerate interference in adjacent bands even when their own desired signals are weak; or they can deploy more basic receivers and invest in increasing the desired signal level by deploying more transmitters. Conversely, harm claim thresholds allow potentially interfering operators to plan their transmissions so that they are not vulnerable to claims of harmful interference.

In cases where the initially assigned harm claim threshold is not (or is no longer) economically optimal, it can be adjusted by negotiation among affected neighbors. If a service can generate additional value by operating above a set threshold, it will have to share some of that value with the affected service—which is entitled to protection against interference above the threshold—to be allowed to breach the threshold. This is like a utility paying a property owner for an easement that allows their pipeline or cables to cross a piece of land; the land owner is willing to allow some encroachment on their rights in return for a payment.

Making analogies between spectrum and property is a tricky business since all metaphors have their limits.⁶ However, it is worth recalling that real estate transactions depend on clear definitions of property boundaries, and the associated rights and obligations. Transactions will only flourish if purchasers know what they are buying, whether it's an easement or the property itself. It is also essential that they can be confident that their rights will be enforced—a topic tackled later in the recommendations on adjudication.

⁶ J. Pierre de Vries, *De-Situating spectrum: Rethinking radio policy using non-spatial metaphors*, 3rd IEEE Symposium on New Frontiers in Dynamic Spectrum Access Networks (2008), <http://dx.doi.org/10.1109/dyspan.2008.63>.

Setting a harm claim threshold thus has a variety of benefits:

- It reduces uncertainty about the rights and obligations regarding interference for both interfering and affected parties, allowing them to plan and invest with more confidence.
- It shifts decisions about system design, including receiver performance, away from government to where it belongs: with manufacturers and operators.
- It allows parties to adjust operating rights and spectrum boundaries among themselves, which reduces rent seeking and the load on regulators; it facilitates such negotiations by providing an unequivocal starting point, unlike the current obligation not to cause harmful interference—which lacks a quantitative definition.

The implementation details of a harm claim threshold approach have been discussed elsewhere.⁷ I will note just a few key points here.

- Different allocations can have different thresholds; the approach is not one-size-fits-all. An allocation's harm claim threshold can be customized—for example, lower interference thresholds to provide more protection for life-safety services. It can also be used to allocate costs in ways that best serve the public interest, for example by imposing interference mitigation requirements on the party that can most easily meet them.
- A harm claim threshold is not a receiver performance specification. It merely describes the interference conditions an affected system needs to tolerate without claiming harm. It does not prescribe how a receiver should perform

⁷ Receiver & Spectrum Working Group, FCC Tech. Advisory Couns., Inference Limits Policy: The use of Harm Claim Thresholds to improve the interface tolerance of wireless systems (2013), <http://transition.fcc.gov/bureaus/oet/tac/tacdocs/WhitePaperTACInterferenceLimitsv1.0.pdf>.

in the presence of such signal levels, but relies on the marketplace to find the best solution.

- Harm claim thresholds may not be sufficient in cases where receivers are not controlled by a license holder (such as television or GPS), for life-safety systems like aviation, or for unlicensed devices. Additional measures may be required to ensure that receivers operate adequately.

The use of harm claim thresholds will also facilitate the enforcement of spectrum rights, the subject of the next recommendation.

4 More adjudication options are required for cases when interference disputes cannot be resolved, including the option for parties to act against each other directly in front of an FCC judge, and/or in a Court of Spectrum Claims

The current regime for resolving interference disputes limits the value of spectrum use because it is too often not fact-based, transparent, or timely. The problem is particularly pressing where federal and private systems are squeezed tightly together because it is not clear where intractable disputes between the parties will be resolved.⁸

Conflict between neighbors about spectrum use is inevitable, and will become more prevalent as more users and uses are squeezed together. While increasing numbers of disputes will be resolved by negotiation—especially so if my first two recommendations are adopted—adjudication is a necessary backstop; it provides a framework and incentive for negotiation, and a means of resolving intractable

⁸ Close coexistence will not just occur in so-called shared bands, but also as a result of clearing and reallocating federal bands. Given the universal need to squeeze services more tightly together, the result in both cases will be narrow frequency guard bands and small exclusion zones.

disagreements. As is often the case in civil disputes, the mere threat of litigation and opportunity for document discovery can aid the parties in moving to a settlement.

The FCC's adjudication process is ad hoc and unpredictable. Many interference disputes—since records are generally not public, I do not know how many—are resolved by field agents of the Enforcement Bureau. However, the agency's capabilities, both in terms of personnel and equipment, are limited. When a conflict cannot be resolved in the field, FCC enforcement is often delayed or addressed through notice-and-comment rulemaking when adjudication would have been more appropriate and efficient.

The shared jurisdiction between the FCC and NTIA means that there is currently no venue where intractable disputes between them can be resolved; the FCC is responsible for managing non-federal, including commercial licensees, and the NTIA is responsible for managing federal authorizations.⁹ Since a substantial collection of frequency bands is already shared between federal and civil users, jurisdictional disagreements occasionally arise between FCC and NTIA.¹⁰ It is an open question how intractable disputes between federal and non-federal users will be resolved. Coordination between the NTIA and FCC is the only currently available mechanism; this will fail when they themselves disagree.

In collaboration with Dean Weiser of the University of Colorado Law School, I have proposed an adjudication regime that moves from the current ad hoc, politically charged, and notice-and-comment driven process to a more-fact-based process of

⁹ The NTIA is part of the Executive branch, while the FCC is an independent regulatory authority whose mandate and authority derives from Congress and the Communications Act of 1934.

¹⁰ Executive Office of the President, President's Counsel of Advisors on Science and Technology, Report to the President Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth (July 2012), http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf2.

hearings before specialized judges.¹¹ I will now describe the two components: more intensive use of judges by the FCC, and the establishment of a federal Court of Spectrum Claims. The measures we recommend address non-urgent harmful interference cases, and not those that pose an immediate threat to the safety of life or property.

4.1 Using FCC judges to resolve disputes between parties under FCC jurisdiction

First, regarding the FCC, the development of a specialized interference adjudication function would involve building or co-opting a capacity it does not currently have. One solution would be to second technical advisers to the existing Office of Administrative Law Judges (ALJs) from other parts of the agency; another is to appoint Administrative Judges.¹²

In order to advance this proposal, the Samuelson-Glushko Technology Law & Policy Clinic at the University of Colorado Law School and I requested that the Commission initiate a rulemaking to provide a fact-based, transparent, and timely adjudication process for spectrum interference disputes.¹³ We proposed that the Commission should:

¹¹ J. Pierre de Vries & Phillip J. Weiser, *The Hamilton Project, Unlocking Spectrum Value through Improved Allocation, Assignment, and Adjudication of Spectrum Rights*, (March 2014), http://www.hamiltonproject.org/files/downloads_and_links/THP_DeVries-WeiserDiscPaper.pdf. For a full set of related resources see, Hamilton Project, http://www.hamiltonproject.org/papers/unlocking_spectrum_value_through_improved_allocation_assignment/ (last visited July 20, 2015).

¹² The key difference is that Administrative Judges are not a formal part of the federal government-wide system for selecting such officials. Since the FCC does not have many ALJs on staff (only one, at present) and those in place may lack the specialized knowledge that would enable more effective adjudication in this area, using Administrative Judges may be an appealing alternative.

¹³ Petition: Samuelson-Glushko Tech. Law & Pol'y Clinic and J. Pierre de Vries, *Petition for Rulemaking: Spectrum Interference Dispute Resolution* (May 8, 2015), <http://apps.fcc.gov/ecfs/comment/view;ECFSSESSION=qTgSVtcPYBypk93Q6ryZQXghc2sKTVJ5NQnRLzGHLQV216sFnT8Q!-1954627099!-774309124?id=60001031161>. Notice:

- Permit a private party to file a spectrum interference complaint against another private party directly with the Office of Administrative Law Judges, thereby providing operators with fact-based, transparent, and timely process to resolve harmful interference disputes;
- Modify existing rules to add deadlines to the adjudication process; and
- Make resources available as and where needed to ensure the adjudication process is fact-based and timely; for example, by providing support staff, hiring or loaning additional ALJs, and obtaining spectrum engineering advice from inside or outside the agency.

FCC adjudication would not be appropriate in all cases. Cases that fall within its scope are those where appropriate FCC rules already exist; where both parties are under the FCC's jurisdiction; and where one private party claims that another private party is causing harmful interference. The ALJ option would be ideal for small bilateral disputes, while rulemaking by the Commission would be more appropriate for multi-party disputes, and single-party cases that highlight broader problems.

The ALJ option would not be appropriate for disputes between the government and private parties—the situation I turn to next.

4.2 Creating a Court of Spectrum Claims to resolve disputes between federal and non-federal users

Even with the FCC acting as an expert adjudicator, Dean Weiser and I proposed that Congress establish a Court of Spectrum Claims that could hear cases in this field. Such a body would be housed within the existing United States Court of

Fed. Comm'n Comm'n, Consumer and Gov't Aff. Bureau Reference Info. Center Petition for Rulemaking Filed, Proceeding RM-11750, Report No. 3023 (June 11, 2015), <http://apps.fcc.gov/ecfs/comment/view;ECFSSSESSION=qTgSVtcPYBypk93Q6ryZQXghc2sKTVJ5NQNRLzGHLQV216sFnT8Q!-1954627099!-774309124?id=60001060847>.

Federal Claims, the court that hears cases involving claims against the U.S. government. It would consist of specialized decision makers who could hear cases regarding spectrum matters.

Such a venue is essential if Congress wants to see more delegated, dynamic negotiation and reassignment of spectrum rights between federal and private users. Federal and non-federal users will be operating in ever-closer proximity regardless of the spectrum management regime: both band sharing and band reallocation will lead to ever-tighter packing of radio services in time, space and frequency. Consequently, spectrum disputes between federal on non-federal users become ever more likely.

Mutually beneficial arrangements between parties are most likely if both sides know their rights and are confident claims will be enforced. A government agency or department would be loath to give up control and allow sharing if it cannot depend on reliable enforcement—and that might be doubly true of a company buying spectrum access from the government in an auction, or by contract with a federal entity. Most contract disputes do not go to court, but the backstop of judicial recourse gives parties the confidence they need to enter into a contract. The Court of Federal Claims provides this backstop for entities contracting with the federal government; a division for spectrum claims would fulfill that function in the specialized case of federal/non-federal spectrum cooperation.

The CSMAC Enforcement Subcommittee addressed the question of how spectrum sharing arrangements between federal and non-federal operators could be enforced, and by whom.¹⁴ Even if implemented, this industry recommendation—that the NTIA and FCC enact parallel dispute resolution tools, and that a joint NTIA/FCC coordination committee would oversee federal/non-federal sharing—is not

¹⁴ Commerce Spectrum Management Advisory Committee, NTIA, Enforcement Subcommittee Report (May 12, 2015), http://www.ntia.doc.gov/files/ntia/publications/csmac-enforcement_sc_responses_050415.pdf.

sufficient.¹⁵ It promises to be a good mechanism for avoiding disputes and facilitating their resolution, assuming good will on all sides. However, it is not clear that the NTIA has the ability to order a recalcitrant agency or department to turn off an interfering device or system, and the CSMAC recommendation does not address how a disagreement between the NTIA and FCC themselves would be resolved.¹⁶ For this, a backstop adjudicator with authority over both federal and non-federal operation—such as a Court of Spectrum Claims—is required.

Thus, even if the FCC were operating effectively as an adjudicator (and the establishment of such a federal body would greatly enhance that likelihood), the FCC is not set up to handle disputes involving the federal government as a party. The establishment of a specialized court outside of the FCC would enable the U.S. government to sue or be sued when appropriate.

Dean Weiser and I also recommend that the Court of Spectrum Claims be allowed to hear disputes between two private parties, ending the FCC's monopoly on hearing such claims and providing a choice of forum. This Court would provide an alternative and a check against the FCC's possible failure to operate effectively in this area. In all events, appeals from either the FCC or the Court of Spectrum Claims would proceed to the Court of Appeals for the District of Columbia to promote uniformity of decisions in both forums.

In summary, courts with expertise in spectrum policy, either in the FCC and/or in a newly created Court of Spectrum Claims, can transform adjudication from the current ad hoc and sometimes politically charged process to a more fact-based, transparent, and timely procedure that could resolve spectrum-related disputes more expeditiously.

¹⁵ The parallel dispute resolution approach contemplates that federal users could rely on the FCC's authority over non-federal spectrum users to enforce sharing arrangements, and non-federal entities could rely on the NTIA to take necessary actions against federal users.

¹⁶ Neither the CSMAC recommendation nor this proposal addresses interference events that are immediate threat to life and property.

5 The three initiatives complement each other

While each of the three proposals outlined here—using risk-informed interference assessment, defining harm claim thresholds, and allowing parties to resolve interference disputes before a judge—will bring noteworthy benefits on their own, there are significant synergies between them.

Harm claim thresholds realize their full promise when parties can use them to (re)negotiate spectrum boundaries that are closer to the optimum without the cost and delay associated with relying upon spectrum regulators.

Such bargaining and contracting is facilitated by a well-functioning system of dispute resolution that includes the backstop of adjudication. If a dispute arose—for example, about whether and how entitlements were breached—the parties could resolve the matter through negotiation, mediation, or formal adjudication either at the FCC or in the Court of Spectrum Claims.

In its turn, adjudication will be facilitated by objective criteria for establishing whether harmful interference has occurred. This will be aided by clear statements of the rights and obligations regarding interference protection, e.g. through harm claim thresholds.

For its part, risk-informed interference assessment supports both efficient allocation (including the setting of harm claim thresholds) and efficient rights enforcement (including inter-party adjudication) by providing an objective, flexible tool for balancing the interests of interfering and affected services.

6 Action by Congress can lay the foundation for continued growth in spectrum use

If the nation is to reap the full value of federal and other spectrum, Congress needs to create the tools of good governance and anticipate the problems that success will bring.

Action by Congress can unlock the potential of federal and non-federal spectrum and lay the groundwork for continued growth in all three stages of the spectrum lifecycle: planning new allocations, issuing operating rights, and resolving interference disputes.

- *Regarding the planning of new allocations*, Congress should avoid the temptation of worst case analysis and nightmare scenarios, and instead itself make—and encourage the FCC and NTIA to use— risk-informed interference assessments that consider both the likelihood and consequences of interference harms.
- *Regarding the issuing of operating rights*, Congress should support and encourage the FCC and NTIA to bring greater clarity to interference rights and obligations, such as through the use of harm claim thresholds.
- *Regarding the resolution of interference disputes*, Congress should put in place any instruments that are needed to allow parties, both federal and non-federal, to take action against each other directly in front of a judge, including by the creation of a Court of Spectrum Claims within the existing United States Court of Federal Claims.

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Mr. Chairman that concludes my testimony. Once again, I want to express my appreciation for being invited to testify here today on this important topic. I would be happy to respond to any questions that you might have.