

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Office of Engineering and Technology)	ET Docket No. 17-340
Seeks Comment on Technological)	
Advisory Council Spectrum Policy)	
Recommendations)	

COMMENTS OF LIGADO NETWORKS LLC

Summary

Ligado Networks LLC (“Ligado”) submits these comments in support of the important spectrum management principles set out by the Technological Advisory Council (“TAC”).¹ The TAC’s principles—especially those focusing on the mutual obligations of all parties to achieve spectrum compatibility and the increased use of modern regulatory techniques such as probabilistic risk assessment—will simplify the regulatory process and increase regulatory certainty. As Nobel Laureate Ronald Coase explained, efficient spectrum usage flows from a clear understanding of the rights and responsibilities associated with that spectrum.² These principles enable such a clear understanding. By adopting them, the Commission can better achieve its goal of making more intensive and effective use of spectrum.

The Commission is well aware of the consistently increasing demand for spectrum. Mobile data demands have soared, and the coming deployment of 5G will

¹ See Public Notice, *Office of Engineering and Technology Seeks Comment on Technological Advisory Council Spectrum Policy Recommendations*, ET Docket No. 17-340, DA 17-1165 (Dec. 1, 2017) [hereinafter “Public Notice”].

² See, e.g., R. H. Coase, *The Problem of Social Cost* (1960).

only accelerate that trend.³ Moreover, widespread deployment of the Internet of Things, especially in the form of autonomous vehicles, will make spectrum an even more vital part of our economy, since spectrum holds the promise of joining our roads and interstate highways as a second “backbone” of our transportation system.

Given that spectrum is a finite natural resource, the only way to meet these growing needs is to increase its efficient allocation and use. In recent years, the Commission has, to its credit, actively promoted more efficient spectrum usage. The Commission’s decision in the 3.5 GHz proceeding, for example, is a shining model of a new spectrum approach that relies on creative mechanisms and mutual obligations to make 150 megahertz of spectrum in the 3.5 GHz band available for important mobile uses. The TAC should be commended for its instrumental role in establishing the 3.5 GHz Citizen’s Broadband Radio Service (CBRS) and seeking to institutionalize many of the important spectrum efficiency principles put to work in that and similar proceedings.

All nine recommendations from the TAC are worthy of consideration, but Ligado wishes to focus the Commission’s attention on five in particular: Principles 3, 4, 5, 6, and 9. *Principle 3* calls on all parties to be cognizant that the RF environment is always susceptible to extraordinary events and to plan accordingly, so that the Commission can regulate to everyday events and not be driven by a worst-case analysis on all spectrum issues. *Principle 4* asserts the seemingly basic but too often ignored tenet that receivers have obligations to mitigate interference outside their assigned channels. Similarly, *Principle 6* calls on transmitters to be responsible for minimizing energy

³ See Twentieth Report, *In the Matter of Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993*, FCC 17-126, WT Docket No. 17-69, ¶15 (Sept. 27, 2017).

transmitted outside their assigned frequencies and licensed areas. *Principle 5* adds another key policy component, positing that RF systems are expected to use techniques at all layers of the stack to mitigate degradation from interference. Lastly, *Principle 9* articulates an important regulatory tool that has been used effectively in other contexts: quantitative analysis of interactions between services. Depending on the circumstances of the proceeding, the Commission should consider relying on quantitative analyses before it determines an appropriate level of interference protection.

Ligado urges the Commission to adopt these principles to shape its spectrum decisions because they advance the important concept that managing and avoiding interference is not a one-way street (*i.e.*, from the transmitter to the receiver regulated by the Commission); rather, it should be a shared responsibility. Applying these principles would simplify and clarify interference analysis and, consistent with Coase's findings, thereby lead to more effective and efficient utilization of increasingly scarce spectrum resources.

I. Principles 4-6 Confirm that Managing Harmful Interference is a Mutual Responsibility

The Commission should adopt Principles 4 through 6 because they confirm that an effective spectrum environment requires the constructive, solution-oriented participation of all key players in a spectrum neighborhood. As the TAC explained in a recent white paper, to have a successful spectrum sharing policy, “it takes two to tango.”⁴ Principles 4, 5, and 6 allocate responsibility for interference management to

⁴ See Spectrum and Receiver Performance Working Group - FCC Technological Advisory Council, *Basic Principles for Assessing Compatibility of New Spectrum Allocations: A White Paper*, Release 1.1 (Dec. 11, 2015), at 8 [hereinafter “2015 TAC White Paper”].

both receivers and transmitters. Specifically, they establish that transmitters and receivers each have a role to play in maximizing the use of spectrum by minimizing or mitigating interference outside of their assigned frequencies. They also create an expectation that radio systems will use techniques at all levels or layers to mitigate degradation from interference.

One would expect good spectrum neighbors to engage routinely in these practices, but the Commission is well aware that not all parties adhere to good spectrum policies because, unfortunately, the incentive to arrogate adjacent spectrum or forego the cost of other basic technical solutions like dynamic range or inexpensive filters is often too tempting to resist. Consequently, adoption of principles that recognize the need to distribute responsibility among all impacted parties is important to a workable spectrum environment that smartly and economically manages potential interference issues.

Ligado's own history exemplifies how this "two-to-tango" approach could work. Ligado has operationalized Principle 6, which provides that transmitters bear responsibility to minimize their emissions outside of their channels. In particular, the proposed power and out-of-band emissions (OOBE) limits under which Ligado now seeks authorization to operate its terrestrial network are designed to ensure that GPS devices operating in their allocated adjacent spectrum experience no actual harm.⁵ The protections reflected in Ligado's substantially reduced power and OOBE limits derive from two sources: 1) the co-existence agreements Ligado reached with the major GPS

⁵ See IBFS File Nos. SAT-MOD-20151231-00090, SAT-MOD-20151231-00091, and SESMOD-20151231-00981 (collectively, "Modification Applications").

device manufacturers,⁶ and 2) independent testing and assessment of how Ligado's terrestrial deployment will affect GPS devices at various power and OOB levels.⁷ These proposed limitations demonstrate how Ligado has responded to objective evidence and the concerns of its spectrum neighbors to deliver on its responsibility of minimizing its emissions into adjacent bands.

The TAC's principles make clear, however, that one-way efforts by transmitting parties are simply not enough to effectively manage interference issues: receivers also must do their part. *"Deploying a receiver without proper filtering or dynamic range because no neighboring systems are located nearby at the time of installation would be considered poor engineering practice, and future interference can be expected."*⁸ This powerful statement from the TAC captures the key issues at play in matters the Commission has spent years trying to unravel. The TAC's principles make clear that sound engineering practices call for practical mitigation techniques to be made part of a radio system.

⁶ See Letter from Gerard J. Waldron, Counsel to New LightSquared LLC, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 12-340; IB Docket No. 11-109; IBFS File Nos. SAT-MOD-20101118-00239; SAT-MOD-20120928-00160; SAT-MOD-20120928-00161; SES-MOD-20121001-00872; SES-RWL-20110908-01047; SES-MOD-20141030-00835, at 4 (Dec. 8, 2015); Letter from Gerard J. Waldron, Counsel to New LightSquared LLC, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 12-340; IB Docket No. 11-109; IBFS File Nos. SAT-MOD-20101118-00239; SAT-MOD-20120928-00160; SAT-MOD-20120928-00161; SES-MOD-20121001-00872; SES-RWL-20110908-01047; SES-MOD-20141030-00835, at 25 (Dec. 17, 2015); Letter from Gerard J. Waldron, Counsel to New LightSquared LLC, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 12-340; IB Docket No. 11-109; IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091, at 4, 7, 19 (Feb. 3, 2016).

⁷ See Roberson and Associates, LLC, "Results of GPS and Adjacent Band Co-Existence Study," IB Docket No. 11-109, at 2 (filed May 11, 2016).

⁸ See 2015 TAC White Paper at 17.

For these reasons, Ligado recommends the Commission adopt Principles 4, 5 and 6 as part of its spectrum policy and thereby signal to *all* parties that the responsibility of anticipating and mitigating interference is a joint responsibility—not the sole responsibility of a new system. This message will help ensure that all parties adhere to good engineering practices. If adopted, these principles will encourage entities developing and deploying services to work with manufacturers to ensure that their devices can tolerate lawful emissions from other operations. At the same time, those same entities will also be encouraged to minimize the energy their own operations transmit outside of their assigned channels. This balanced, even-handed approach is vital to optimizing future spectrum use.

II. Quantitative Risk Assessment Is a Useful Regulatory Tool and the Commission Should Therefore Adopt Principles 3 and 9

Spectrum allocation and management decisions necessarily require the exercise of judgment and policymaking, in which the FCC, as the expert agency, looks at the options before it and considers the benefits and consequences of a particular course of action. That is the heart of the rulemaking piece of the Commission's mission. To assist the Commission in assessing a situation and the related advantages and disadvantages, the TAC recommends that the Commission utilize risk-based assessments in its process and thus adopt Principles 3 and 9. Depending on the circumstances of each proceeding, Ligado endorses the application of that recommendation.

As the TAC's white paper on this topic explains, quantitative risk-based assessments ("QRA") are a deliberate, disciplined method of weighing and comparing

the consequences of spectrum decisions, including decisions that may lead to occasional and fleeting periods of impaired performance.⁹ The Public Notice spotlights an issue that the TAC previously detailed: in recent years, much of the Commission’s analysis of the trade-off between the benefits of a new service and the risks to incumbents—and not surprisingly, much of the advocacy by parties as to how the Commission should assess those same trade-offs—has been *qualitative*.¹⁰ That is, parties have tended to focus on the “edge cases,” those extremely rare events that conceivably could happen but are not likely to occur and thus distort the analysis of the risk of interference actually occurring. They also have tended to focus on a device at a particular moment in time when it may be most affected, ignoring that the same device might experience no impairment a mere microsecond later.

The virtue of QRA is that it enables spectrum regulators to use numerical estimates of probabilities and consequences to calculate risk *systematically*.¹¹ Instead of being unduly swayed by a theoretical edge-case scenario, or an impact that may be fleeting, ephemeral, or inconsequential, regulators using quantitative risk-based assessments can better understand and contextualize the probability of interference and the consequences of the new system. Ligado agrees with the TAC’s recognition that a hyper-focus on “worst-case” analysis and a single (usually extremely rare)

⁹ See April 2015 paper, “A Quick Introduction to Risk-Informed Interference Assessment”, <http://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting4115/Intro-to-RIA-v100.pdf>, at 1 [hereinafter “Introduction to Risk-Informed Interference Assessment”]

¹⁰ See Public Notice at 5; see also *id.* at 1.

¹¹ See Introduction to Risk-Informed Interference Assessment at 2.

scenario distorts the discussion and slants the decision away from one that is grounded in both statistical rigor and real-world dynamics.¹²

As the TAC explains, *quantitative* risk assessment broadens the regulatory analysis from “What’s the worst that can happen?” to “What can happen, how likely is it, and what are the consequences?”¹³ This approach leads to a both comprehensive and realistic assessment of risks and benefits. Moreover, it leads spectrum regulators to consider wide-spread but potentially low-impact events, such as small changes in the noise floor, as well as rare, catastrophic “worst case” harms and their relative probability. QRA is an important and successfully used tool that spectrum policymakers should deploy to make sure they are asking—and answering—the right questions.

The TAC properly cites other virtues of utilizing QRA. One is that it spotlights the extent of knowledge of the expert community, illuminating what spectrum experts know and do not know.¹⁴ Another is that QRA can increase the likelihood of identifying unexpected harmful interference mechanisms during the rulemaking process.¹⁵ This tool is useful because it will give the Commission objective and actionable information and enable it to better examine the benefits and drawbacks of a new service and possible adverse impact on incumbent services.

As noted above, QRA is just a tool and is not a substitute for the agency’s expert judgment. Indeed, there may be some proceedings where such specific quantitative analysis is unnecessary—for example, where the record has already been fully

¹² See *id.* at 1.

¹³ See *id.*

¹⁴ See *id.* at 11.

¹⁵ See *id.* at 11.

developed. The Commission should therefore determine whether to require QRA on a case-by-case basis. This is familiar territory for the Commission, since the agency regularly uses models that yield results needing interpretation and application of expert judgment.¹⁶ But to make those judgments, and to make better judgments that maximize utilization of spectrum resources, the Commission needs comprehensive and specific information about the likelihood of any actual impact by a new service on incumbent services, not just whether there is some imaginable scenario in which “harmful interference” may or may not occur.¹⁷ The use of QRA gives the Commission access to that information. Accordingly, Ligado recommends that the Commission adopt Principles 3 and 9.

III. Many of the TAC’s Other Principles Also Have Merit

The discussion above highlights what Ligado sees as the most important principles for incorporation into the Commission’s spectrum policy framework. Here, Ligado briefly comments on two closely related principles that should also be adopted:

- *Principle 1*—This principle is foundational: harmful interference is affected by the characteristics of both a transmitting service and a nearby receiving service in frequency, space, or time. This principle establishes the core notion that interference is a two-way street and that both transmitters and receivers need to be designed, built, and operated accordingly.
- *Principle 2*—This principle is derivative of foundational Principle 1: all services should plan for non-harmful interference from signals that are nearby in frequency, space, or time. The TAC adds, and we agree, that this principle should apply both to current and future scenarios. The Commission should adopt this principle because it sets out the fact that

¹⁶ See *id.* at 2.

¹⁷ See *id.* at 11.

interference is always present and always will be.¹⁸ Incorporating an acknowledgement of this reality into the Commission's spectrum policy would help establish a fuller context in which to evaluate spectrum sharing dynamics.

IV. Conclusion

The TAC should be commended for its multi-year effort to study how spectrum decisions are made and how the Commission can increase the simplicity and certainty of the regulatory process to reach decisions that result in more efficient spectrum use. The fruits of that work are a set of principles that can truly advance the Commission's spectrum decision-making.

In particular, Ligado recommends that the Commission promptly adopt principles 4, 5 and 6 to establish appropriate responsibilities for managing interference and adopt Principles 3 and 9 to advance the use of quantitative assessments on a case-by-case basis in its spectrum decision making. The TAC's principles are a technical embodiment of Coase's theorem that efficient spectrum use depends on a clear

¹⁸ The TAC observes that interference is omnipresent in nature, due to both natural and artificial sources, and impacts every radio signal in every frequency. See 2015 TAC White Paper at 8.

understanding of spectrum rights. These principles will provide such clarity and can help guide the Commission as it makes important spectrum decisions in the future.

Respectfully submitted,

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