

**Before The
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)	
)	
Technological Advisory Council Spectrum)	ET Docket No. 17-340
Policy Recommendations)	

COMMENTS OF CTIA

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January 31, 2018

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CTIA¹ respectfully submits these comments in response to the Office of Engineering and Technology’s *Public Notice* regarding the spectrum policy recommendations of the Technological Advisory Council (“TAC”).²

I. INTRODUCTION AND SUMMARY.

The TAC’s white papers are important contributions to the efforts by the Federal Communications Commission (“Commission”) to advance spectrum policies that promote the most robust use of spectrum resources to benefit the American public. They merit close consideration by the Commission and stakeholders. Equally important, however, is the TAC’s acknowledgment in its *Basic Spectrum Principles White Paper* that, “[c]learly, ‘one policy fits all’ is not possible with such disparate requirements of various services.”³ The authors of this

¹ CTIA® (www.ctia.org) represents the U.S. wireless communications industry and the companies throughout the mobile ecosystem that enable Americans to lead a 21st-century connected life. The association’s members include wireless carriers, device manufacturers, suppliers as well as apps and content companies. CTIA vigorously advocates at all levels of government for policies that foster continued wireless innovation and investment. The association also coordinates the industry’s voluntary best practices, hosts educational events that promote the wireless industry, and co-produces the industry’s leading wireless tradeshow. CTIA was founded in 1984 and is based in Washington, D.C.

² *Office of Engineering and Technology Seeks Comment on Technological Advisory Council Spectrum Policy Recommendations*, Public Notice (rel. Dec. 1, 2017), DA 17-1165, ET Docket No. 17-340 (“*OET TAC Public Notice*”).

³ *Basic Principles for Assessing Compatibility of New Spectrum Allocations*, A White Paper at 4 (Dec. 11, 2015) (“*Basic Spectrum Principles White Paper*”).

paper emphasize that they “are not suggesting that a concrete set of regulations will fit all services in the same way.”⁴ Consistent with this recognition, the principles should be considered case by case, not applied as across-the-board mandates.

The commercial mobile services ecosystem clearly demonstrates how market forces and the mutual interests of carriers, device manufacturers, and other stakeholders have worked together to create world-leading networks and products that provide massive benefits to consumers and the economy and make efficient use of spectrum resources. Mobile providers already apply many techniques to put spectrum to intensive use and prevent or mitigate interference. And it is noteworthy that recent allocation proceedings – including the Incentive Auction and mid-band spectrum proceedings – have relied on marketplace mechanisms as much if not more than interference management to create new spectrum opportunities.⁵ The Commission should therefore be cautious about any attempt to establish top-down interference principles or rules, particularly if they were to be applied to commercial mobile services. As Chairman Pai has noted, “regulatory humility” is the right paradigm for the Commission to follow⁶ – and that applies to interference management as well.

With regard to specific principles laid out in the *Basic Spectrum Principles White Paper*, CTIA supports many of the statements and assumptions, but has some concerns as set forth below. CTIA shares the view set forth in Principle 1, which correctly recognizes that both transmitters and receivers affect the interference environment. To that end, Principle 4

⁴ *Id.*

⁵ *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, GN Docket No. 17-183, 32 FCC Rcd 6373 (2017).

⁶ Remarks of FCC Chairman Ajit Pai at the U.S. – India Business Council (March 29, 2017) at 3 (the Commission’s regulatory approach “embraces regulatory humility, knowing that this marketplace is dynamic and that preemptive regulation may have serious unintended consequences.”).

recognizes that receivers are responsible for mitigating interference outside their assigned channels, an important principle given that, although the U.S. wireless industry is at the forefront of developing robust receivers, other spectrum users are less committed to robust receivers. And although Principle 6 rightly states that transmitters should limit the amount of transmitted energy outside assigned frequencies and licensed areas, the directive that transmitters “minimize” the amount of such energy is too unclear to fully support. Principle 5 states that system operators should use interference mitigation techniques throughout the stack, a practice that commercial mobile operators already employ, and Principle 7 says that services should disclose the standards for their systems if they expect protection from harmful interference, a laudable principle that is fitting with commercial mobile systems, which use open, published standards, but which could nevertheless chill research and investment if required as a static disclosure. The TAC recommends in Principle 8 that the Commission use interference limits to quantify rights of protection from harmful interference. Although setting such limits can be daunting, in practice, similar limits are already in use in commercial mobile bands and may be a model for future multi-stakeholder processes in other bands. As for Principle 9, although quantitative analysis presented to or used by the Commission should be transparent and reproducible, such analyses should not be required, as they are not necessary in all cases, so the Commission should not require them and should apply this principle on a case-by-case basis).

CTIA has concerns with elements of Principles 2 and 3, which call for existing services to plan for future interference. Licensees that invest heavily to make efficient and intensive use of their spectrum should reap the rewards from any link margin gained by that investment and should not be forced to make any margin that is not being used at any point in time available for third-party use.

Finally, regarding the additional white paper recommendations, CTIA notes that the use of risk-informed interference assessments, as the TAC proposed, may be appropriate when reallocating spectrum from less intensive uses, because they could help the Commission determine the actual likelihood of interference based on real-world conditions, rather than relying on worst-case assumptions. CTIA also agrees that further consideration of procedures for investigating and resolving claims of harmful interference would benefit all providers and users and suggests that convening a multi-stakeholder group would be the next best step.

Overall, the TAC’s papers are intended to bring interference management to bear on the issue of efficient spectrum allocations and intensive spectrum usage looking forward. CTIA supports these goals but urges the Commission to consider individual circumstances prior to application of any of the principles.

II. THE SPECTRUM AUCTION PARADIGM DRIVES EFFICIENT SPECTRUM USE, AND APPLICATION OF THE PRINCIPLES SHOULD REFLECT THAT.

It is well understood that differing allocation schemes create differing incentives for spectrum operations, for network investment – including ongoing investment in next-generation technologies – and for intensive and efficient spectrum use. A service like commercial mobile that has ever-increasing demands for traffic and faces billions of dollars in payments to access additional spectrum has a clear incentive to “mine” its spectrum holdings and maximize efficient and intensive use.

For commercial mobile spectrum, the end-game of the *Basic Spectrum Principles White Paper* – efficient spectrum use – is already a reality. Today, mobile providers already engage in many of the techniques that the paper identifies to improve spectrum efficiency and mitigate interference – from robust filtering to limit the effect of signals outside assigned channels, to restricting the amount of “wasted” energy transmitted outside those assigned channels, to a host

of techniques such as power control, adaptive modulation and coding, and multi-input multi-output (“MIMO”) antenna systems. The wireless industry regularly invests in new generations of technologies as often as every five years, and each successive generation includes techniques to improve spectrum efficiency and mitigate interference.

The *Basic Spectrum Principles White Paper* supplies a useful framework to consider proper spectrum management, but individual circumstances – including allocation paradigms and operator incentives – must dictate any application. Commercial mobile licensees have invested hundreds of billions of dollars in intensively deploying the spectrum they bought to meet exploding demand, building the world’s best wireless networks that each day deliver immense benefits to U.S. consumers and the economy. More than 99 percent of the U.S. population has access to 4G LTE,⁷ and deployment of 5G is beginning this year. A critical element driving that success is the certainty that, when licensees acquire spectrum at auction, they know the technical parameters they must meet. That certainty enables them to invest billions of dollars each year in network deployments. The results speak for themselves: the U.S. leads the world both in mobile broadband usage and technology.

In contrast, some of the principles, if applied to existing commercial mobile licensees, would destabilize this dynamic and undercut licensees’ expectations that they can rely on stable rules. In turn, this would undermine the integrity of the auction process and depress interest in future auctions.

⁷ *Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, Twentieth Report, WT Docket No. 17-69, 32 FCC Rcd 8968 (2017) at Chart III.D.5.

III. THE PRINCIPLES SHOULD BE CONSIDERED AS GENERAL GUIDEPOSTS THAT MAY OR MAY NOT BE APPROPRIATE FOR PARTICULAR SPECTRUM BANDS.

A. Interference Realities Principles (1-3)

The *Basic Spectrum Principles White Paper* groups the first three recommended principles together under the heading of “interference realities.”⁸ At one level, the factual statements included in these principles are simply general observations about the interference environment. It is certainly true that “[h]armful interference is affected by the characteristics of both a transmitting service and a nearby receiving service in frequency, space or time” (Principle 1). Similarly, “services should plan for non-harmful interference from signals that are nearby in frequency, space or time” (Principle 2). And “the electromagnetic environment is unpredictable” (Principle 3).⁹ But the Commission should be cautious in broadly embracing the conclusions either embedded in the principles or a likely result thereof. As noted above, each spectrum debate is contextual.

As a general matter, CTIA supports Principle 1, which recognizes that transmitters *and* receivers are relevant in considering harmful interference. Indeed, independent of any regulatory mandate, the U.S. wireless industry is at the forefront of developing robust receivers, driven by market forces and industry consensus. Other spectrum users are less committed to robust receivers. And a band identified for a possible new allocation should not be shackled by poor-performing receivers operating in that band or nearby bands.

Principles 2 and 3 raise some concern, however. Licensees that invest heavily to make efficient and intensive use of their spectrum should reap the rewards from any link margin

⁸ *Basic Spectrum Principles White Paper* at 7.

⁹ *Id.* at 8-9.

gained by that investment. The Commission should refrain from making any margin that is not being used at a given point in time available for third-party use.

Principle 2 states that services “should plan for non-harmful interference” and should prepare “both now and for any changes that occur in the future.”¹⁰ As stated, Principle 2 leaves for elsewhere the question of what constitutes “non-harmful interference” – a challenging issue that is nonetheless inexorably relevant. And, the principle’s open-ended nature – that services must plan for “any” future changes – should be narrowed. In the mobile services context, a future reservation of “non-harmful” interference would have significant and damaging consequences. Mobile providers invest at auction and invest in their networks to meet ever-growing demand, “mining” their spectrum for all of the use that can be wrought from it. To create a better performing network that makes more intensive use of the spectrum, only to have that margin filled by a third-party service, would exacerbate risks associated with developing innovative, more efficient spectrum operations and undermine providers’ economic incentive to make the most efficient use of their spectrum.

Principle 3 is equally concerning. It highlights the unpredictability of the electromagnetic environment, and directs operators to expect and plan for occasional service degradation and outages. Because the radio environment is so variable, mobile providers make massive investments in building networks to account for it. They do this to ensure the reliability and coverage that consumers expect, even in unpredictable radio environments that dictate lower performance. The Commission should ensure that the margins designed to ensure reliability and coverage for consumers are not instead made available to third-party users, which could lead to service degradation and outage. Doing so would risk chilling investment in research and

¹⁰ *Id.* at 8.

network performance improvements because licensees would not realize the gains from their investments.

B. Responsibilities of Radio Services Principles (4-6)

Principles 4-6 consider the responsibilities that different services have with regard to the effects of interference.¹¹ The *Basic Spectrum Principles White Paper* asserts that each service should be a “good neighbor to other services” with regard to mitigating interference.¹² This is true, but the Commission must account for the trade-offs that occur in any interference mitigation efforts.

Principles 4 and 6 should be considered together because, as Principle 1 found, harmful interference is impacted “by the characteristics of both a transmitting service and a nearby receiving service.” CTIA supports Principle 4’s view that “[r]eceivers are responsible for mitigating interference outside their assigned channels.”¹³ As the paper observes, installing a robust blocking mask provides rejection of unwanted signals outside the assigned channel.¹⁴

Whereas mobile wireless standards include receiver performance requirements, as described above, receiver performance is not fully embraced by other users of licensed and unlicensed spectrum. As CTIA noted in its comments on the TAC’s 2013 white paper on receiver performance, for many spectrum users, deployment of new receivers is often driven by cost considerations rather than spectrum efficiency – *i.e.*, many manufacturers determine the

¹¹ *Id.* at 13-16.

¹² *Id.* at 8.

¹³ *Id.* at 14.

¹⁴ *Id.*

current interference environment and attempt to utilize the lowest cost receiver possible.¹⁵ These cost-driven decisions often are not forward-looking, and should adjacent spectrum usage or characteristics change, these embedded, low-cost receivers may be ill-equipped to deal with raised interference levels. Moreover, any receiver improvements (and associated costs) would not necessarily improve the experience of the incumbent and may raise concerns about disruption to its ongoing operations. Incumbents in other spectrum-based services, therefore, may be incented to assert interference caused by new operations rather than working to develop and deploy better technology.¹⁶ CTIA thus supports Principle 4.

According to Principle 6, transmitters should limit “the amount of their transmitted energy that appears outside their assigned frequencies and licensed areas.”¹⁷ Principle 6 actually says that transmitters should “minimiz[e]” that amount of such energy, but this term is too unclear to support. Whereas the Commission has adopted out-of-band emissions limits and/or power flux density limits, Principle 6 suggests that a licensee could design its network to comply with those limits, yet would still be responsible for “minimizing” RF energy *below* those limits. Doing so could require operating fewer transmitters, cutting back power – or both – resulting in less robust deployment, counter to the Commission’s key spectrum policy’s objective to expand deployment. In one sense, however, mobile providers have clear incentives to “minimize” the energy they transmit out of band to ensure that consumers’ devices perform well: energy transmitted outside the band does not contain communications data but drains battery power just the same.

¹⁵ *Office of Engineering and Technology Invites Comments on Technological Advisory Council (TAC) White Paper and Recommendations for Improving Receiver Performance*, ET Docket No. 13-101, Comments of CTIA – the Wireless Association (filed July 22, 2013), at 4.

¹⁶ *Id.*

¹⁷ *Basic Spectrum Principles White Paper* at 17.

CTIA agrees with the basis of Principle 5 that system operators should use interference mitigation techniques throughout the stack. Mobile providers use such techniques whenever and wherever possible. The White Paper recognizes as much, noting that modern cellular networks are “[a]n example of the successful implementation” of many mitigation techniques (e.g., power control, adaptive modulation and coding, and MIMO antenna systems), resulting in “simultaneous reliable links [that] are achieved in challenging RF environments.”¹⁸ Mobile providers largely use these techniques to make for even more efficient use of the spectrum and increase network performance. The end result helps to limit degradation from interference. More services should do so as well.

C. Regulatory Requirements and Actions Principles (7-9)

Principles 7-9 are intended to help make informed decisions about frequency allocations. While these principles are worthy of consideration, they raise a number of issues that the Commission should carefully consider and address.

Principle 7 states that services should “disclose the relevant standards, guidelines and operating characteristics of their systems to the Commission if they expect protection from harmful interference.”¹⁹ As the TAC notes, many standards (for example, 3GPP) are publicly available. Test and measurement results for certified mobile devices and equipment deployed by commercial mobile providers are also publicly available on the Commission’s website, and revisions to those standards are also publicly available. More generally, publicly available standards promote the deployment of network equipment and devices through the global marketplace. But the fact that a standard has been publicly disclosed should not imply that the

¹⁸ *Id.* at 16.

¹⁹ *Id.* at 18.

standard is static, and disclosure requirements should not lock equipment manufacturers and network operators into a specific generation of technology. That could chill research and investment necessary to allow networks to evolve to meet the public's growing demand for ever faster, more robust and reliable communications.

There are, however, some radio technologies that are not based on open, publicly available standards. When receiver performance specifications are not publicly available, it is exceedingly difficult for other stakeholders to advance more efficient spectrum use and introduce new services. As the *Basic Spectrum Principles White Paper* observes, “[a] spectrum user that refuses to provide such information cannot expect the Commission to provide as much protection from interference as it could with all of the details.”²⁰ The Commission and NTIA can serve an important role as stewards of U.S. spectrum in encouraging more transparency regarding receiver performance specifications.

Principle 8 recommends that the Commission “may apply interference limits to quantify rights of protection from harmful interference.”²¹ In the abstract, the concept of interference limits could advance interference management and more efficient use of spectrum, but the realities of setting such limits are daunting. In practice, similar limits are already in use in commercial mobile wireless bands such as cellular, Personal Communications Service, Advanced Wireless Service, and 700 MHz band. In those bands, licensees already self-regulate adjacent-band and geographic use of the spectrum based on industry standards and without Commission involvement. CTIA believes that the commercial mobile radio services could be a valuable model for studying interference limits through a multi-stakeholder process.

²⁰ *Id.* at 19.

²¹ *Id.* at 20.

Government-developed interference limits could be too challenging. Set too high, rules may not supply sufficient protection and thus not achieve their purpose. Set too low, they could adversely affect systems by imposing restrictions that preclude intensive spectrum use.

Determining what level constitutes “harmful” interference is always the most contentious part of any spectrum-based proceeding, and Principle 8 – examined in a multi-stakeholder context – could prove useful. The Commission could also consider choosing a single new or less efficiently used allocation (or allocations) as a pilot to test the use of such an approach.

As for Principle 9, any quantitative analysis presented to or used by the Commission should meet both “transparency and reproducibility” requirements for credibility purposes.²² It goes too far, however, to insist that the Commission “require” participants in major spectrum management proceedings to supply such rigorous quantitative analysis. Not all matters necessitate such burdensome regulatory mandates, and this principle should be applied on a case-by-case basis.

IV. RISK-INFORMED INTERFERENCE ASSESSMENTS MAY BE USEFUL FOR SOME BANDS.

OET also seeks comment on a separate TAC white paper recommending that the Commission consider the use of risk-informed interference assessments to evaluate the potential for harmful interference.²³ Statistical risk assessments may be appropriate when reallocating spectrum from less intensive uses that oppose new allocations. Such data-based assessments could help the Commission to determine the actual likelihood of interference based on real-world conditions, rather than relying on assumptions that are often created only to keep a new entrant from accessing a band.

²² Id. at 23.

²³ *A Quick Introduction to Risk Interference Assessment*, Version 1.00 (April 1, 2015).

V. IMPROVING INTERFERENCE RESOLUTION IS AN APPROPRIATE ISSUE FOR MULTI-STAKEHOLDER INVOLVEMENT.

Finally, OET seeks comment on an additional TAC white paper, *A Study to Develop the Next Generation Systems Architecture for Radio Spectrum Interference Resolution*.²⁴ This paper recommends that the Commission take a variety of actions, including creating a public database of past interference-related enforcement activities, using interference hunters, and working with stakeholders to conduct a study to consider a next-generation interference resolution system.

CTIA agrees with the TAC that developing improved methods for resolving harmful interference quickly and effectively is an important objective that will benefit all wireless providers and spectrum users. Given that consumers, businesses, and government at all levels increasingly depend on the reliability of wireless networks, robust interference resolution is a priority. CTIA's members have a clear interest in promptly addressing interference when it occurs, and have been continuously engaged in evaluating how to enhance current resolution procedures.

The *Interference Resolution White Paper* recognizes that these efforts can best be pursued through collaboration among the Commission and other agencies, academia, and the private sector.²⁵ Multi-stakeholder participation is vital to ensure that all ideas are on the table, that all stakeholders' experiences with detecting and resolving interference can be brought to bear, and that solutions have broad support. Cooperative industry efforts are likely to prove a more efficient path forward. The Commission should convene a multi-stakeholder group to consider improved resolution methods and procedures.

²⁴ *A Study to Develop the Next Generation Systems Architecture for Radio Spectrum Interference Resolution*, Version 1.0 (March 9, 2016) ("*Interference Resolution White Paper*").

²⁵ *Id.* at 2, 22.

VI. CONCLUSION.

CTIA appreciates the TAC's work to offer recommendations to address the increasing challenges for minimizing interference as wireless networks continue to expand and more spectrum bands are put to use to meet growing demand. Market forces and the mutual interests of carriers, manufacturers, and other stakeholders in building and operating reliable wireless networks have addressed (and will address) many interference scenarios. Several of the TAC's recommendations offer useful approaches for addressing certain interference situations that market forces are less likely to address, and these approaches can further promote robust and reliable wireless services to serve the American public.

Respectfully submitted,

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