

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

In the Matter of)	
)	
Facilitating Opportunities for Flexible,)	ET Docket No. 03-108
Efficient, and Reliable Spectrum Use)	
Employing Cognitive Radio Technologies)	

**COMMENTS OF THE
CELLULAR TELECOMMUNICATIONS & INTERNET ASSOCIATION**

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TABLE OF CONTENTS

INTRODUCTION AND SUMMARY 1

I. THE COMMISSION SHOULD NOT ALLOW UNLICENSED UNDERLAYS
IN CMRS SPECTRUM BANDS. 3

 A. The Commission’s Exclusive Use, Flexible Rights Policies Have Enabled
 CMRS Providers to Deploy Cognitive Radio and Other Technologies with
 Stunning Results for Consumers..... 3

 B. The Introduction of Unlicensed Underlays with Higher Power Limits
 Would Eliminate CMRS Providers’ Incentives to Achieve More Intensive
 and Efficient Use of Spectrum..... 5

 C. The Commission’s Secondary Markets Spectrum Leasing Rules Should
 Facilitate Arrangements that Involve Use of Cognitive Radio
 Technologies..... 7

II. THE COMMISSION SHOULD NOT ADOPT THE PROPOSAL TO ALLOW
HIGHER POWER UNLICENSED OPERATIONS IN AREAS OF “LIMITED
SPECTRUM USE,” INCLUDING RURAL AREAS 8

III. THE NPRM’S PROPOSALS RAISE SIGNIFICANT – AND UNANSWERED –
QUESTIONS REGARDING COMMISSION ENFORCEMENT IN LIGHT OF
THE INCREASED RISK OF ROGUE OPERATIONS. 9

IV. CONCLUSION..... 12

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The Cellular Telecommunications & Internet Association (“CTIA”)¹ hereby submits these comments in the above-captioned proceeding.²

INTRODUCTION AND SUMMARY

CTIA commends the Commission for its continued efforts to enhance spectrum efficiency and to provide additional opportunities for innovative spectrum-based services, including those that make use of cognitive radio technologies. Today, cognitive radios are enabling more intensive and efficient spectrum use. Indeed, Commercial Mobile Radio Service (“CMRS”) providers already incorporate cognitive radio technologies into their networks. These

¹ CTIA is the international organization of the wireless communications industry for wireless carriers, manufacturers, and applications providers. Membership in the association covers all Commercial Mobile Radio Service providers and manufacturers, including cellular, broadband PCS, and ESMR, as well as providers and manufacturers of wireless data services and products.

² *Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies*, ET Docket No. 03-108, Notice of Proposed Rulemaking and Order, 18 FCC Rcd 26859 (2003) (“*NPRM*”).

technologies improve carriers' ability to manage the use of their licensed spectrum, creating opportunities to use spectrum more efficiently to provide enhanced capabilities to consumers.

As detailed below, however, CTIA has concerns with several proposals put forth in the *NPRM*. Specifically, cognitive radios should not be viewed as a vehicle to introduce unlicensed underlays into licensed spectrum. The proliferation of unlicensed underlays using CMRS spectrum would degrade the coverage and capacity of existing networks and undermine incentives for licensed CMRS carriers to deploy more spectrum-efficient technologies in the future. Rather than forge ahead with cognitive radio proposals aimed at shoehorning unlicensed underlays into licensed spectrum bands, the Commission should focus on ensuring that its secondary markets policies facilitate voluntary private leasing arrangements that rely on cognitive radio capabilities to allow for additional spectrum access, while avoiding interference. A robust secondary market is a better way to maximize consumer welfare and economic efficiency than government-mandated access.

CTIA also is troubled that the *NPRM's* proposal to allow higher power unlicensed operations in the Industrial, Scientific, and Medical ("ISM") bands in geographic areas of "limited spectrum use" does not contain any meaningful analysis regarding interference risks to both in-band and out-of-band licensees. Prior to considering any proposal to increase emissions for unlicensed users of cognitive devices, the Commission must develop an enforcement program capable of addressing the increased risks of abuse posed by cognitive radio-based underlay devices.

I. THE COMMISSION SHOULD NOT ALLOW UNLICENSED UNDERLAYS IN CMRS SPECTRUM BANDS.

The *NPRM* suggests that cognitive radio technologies can be used “to enable non-voluntary third party access to spectrum” – licensed spectrum, that is.³ CTIA has previously expressed concerns with various Commission proposals to introduce unlicensed underlays into CMRS spectrum and other frequency bands.⁴ Cognitive radio technologies are not a magic bullet that can enable unlicensed underlays, while at the same time preserving licensees’ interference protection and continued incentives to make more intensive use of their licensed spectrum. CTIA, therefore, opposes any proposal to amend section 15.209 of the Commission’s rules to allow unlicensed underlays with “higher power operation” in CMRS spectrum and other frequency bands.⁵

A. The Commission’s Exclusive Use, Flexible Rights Policies Have Enabled CMRS Providers to Deploy Cognitive Radio and Other Technologies with Stunning Results for Consumers.

As the Commission recently noted in the *Interference Temperature NOI*, the Commission’s market-oriented licensing regime, adopted for CMRS and other exclusive use licenses, provides licensees with “flexibility to determine the type of services and the technologies and technical implementation designs used to provide those services.”⁶ The rules

³ *Id.* at 26861, ¶ 3.

⁴ *See, e.g.*, Comments of the Cellular Telecommunications & Internet Association, ET Docket No. 02-135 (filed Jan. 27, 2003); Reply Comments of the Cellular Telecommunications & Internet Association, ET Docket No. 02-380 (filed May 16, 2003); Comments of the Cellular Telecommunications & Internet Association, ET Docket No. 03-327 (filed Apr. 5, 2004).

⁵ *NPRM*, 18 FCC Rcd at 26874, ¶ 41.

⁶ *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, Notice of Inquiry and Notice of Proposed Rulemaking, 18 FCC Rcd 25309, 25311-12, ¶ 6 (2003).

allow CMRS licensees to deploy cognitive radio technologies, and the *NPRM* notes that CMRS providers currently use cognitive radio technologies in their networks “to allow more efficient spectrum use,” even though “there is no requirement in the rules to incorporate such capabilities.”⁷ In the highly competitive CMRS industry, market forces drive licensees to provide higher quality services and more innovative offerings. As a result, CMRS carriers have invested billions of dollars in network improvements to achieve more intensive and efficient use of their licensed spectrum. The results have been stunning for consumers.

Between 1993 and 2003, for example, the CMRS industry developed from an analog cellular duopoly to a 92 percent digital, multi-carrier market. Service offerings evolved rapidly from voice-only to voice, data, Internet access, gaming, and video – while competition continued to drive prices down. Consumer demand responded, with subscribership up ten-fold from 16 million to nearly 160 million, and annual minutes of use skyrocketing from 19 billion minutes to 830 billion minutes of use. Over those ten years, wireless licensees invested more than \$132 billion in capital to improve their networks. In few other sectors of the communications industry (or the economy, for that matter) has competition and innovation produced greater consumer benefits.

As the *NPRM* recognizes, CMRS systems have embraced cognitive radio technologies as a means to achieve greater spectrum usage efficiencies. Code Division Multiple Access (“CDMA”) and Time Division Multiple Access (“TDMA”) networks, for example, use advanced power control algorithms to operate at power levels just high enough to operate given the local noise and interference environment. CDMA handsets check in with the network 800 times per

⁷ *NPRM*, 18 FCC Rcd at 26863, ¶ 11.

second to ascertain the appropriate power level. In GSM networks utilizing Enhanced Data Rates for GSM Evolution (“EDGE”), carriers are deploying dynamic frequency channel allocation, rather than a fixed frequency reuse plan, to allocate channels depending on the RF environment. Moreover, EDGE and High Speed Downlink Packet Access (HSDPA) in Wideband CDMA utilize adaptive modulation where the radio adapts its coding scheme based on the RF environment. In each case, cognitive radio technology permits carriers to make more efficient use of spectrum.

B. The Introduction of Unlicensed Underlays with Higher Power Limits Would Eliminate CMRS Providers’ Incentives to Achieve More Intensive and Efficient Use of Spectrum.

The *NPRM* initiates a dialogue on whether to introduce higher power unlicensed operations “in almost any frequency band other than the TV bands and certain designated restricted bands,” by amending section 15.209 of the Commission’s rules.⁸ This inquiry, although limited to a single question, appears to suggest that cognitive radio technologies could enable the introduction of higher powered unlicensed operations across a broad swath of spectrum, including CMRS spectrum. CTIA opposes the introduction of such higher power unlicensed operations in CMRS spectrum.

Intensive use of spectrum driven by increased consumer demand for a range of mobile wireless services is making CMRS technologies more – not less – susceptible to interference. Higher power from unlicensed underlay devices would necessarily raise the noise floor, and decrease the coverage and capacity of today’s networks. In effect, underlays would increase the risk that consumers experience more dropped connections, lower quality voice calls, and limited

⁸ *Id.* at 26874, ¶ 41.

data throughput – at a time when consumers rely increasingly on mobile services and expect reliable, high-quality services.

The introduction of underlays would also have the perverse effect of weakening CMRS licensees’ incentives to make more efficient use of their licensed spectrum. The continued refinement of CMRS networks, by incorporation of more efficient digital modulation techniques to accommodate consumer demand for increased capacity, extended range, and advanced services, has resulted in systems that are in fact *more* susceptible to third party interference than less sophisticated technologies.⁹ Licensees that would otherwise seek to deploy cutting-edge technologies that necessarily operate with a lower signal-to-interference ratio will not bring those offerings to the public if they fear the introduction of secondary underlay operations will detract from the quality of their service offerings.

Thus, if the noise environment increases in CMRS bands, it is possible that carriers would avoid efficiencies that could render their networks more vulnerable to interference. The result would be that both licensed and unlicensed users would lose the benefits that would have flowed from increased spectrum efficiency. In effect, underlays in the CMRS bands would limit technology options and mark a return to “command and control” regulation in which the Commission dictates spectrum usage in licensed bands.

In order to maintain service quality for consumers and preserve incentives to continue investment in spectrum efficient technologies, the Commission must ensure that carriers have the

⁹ For example, in response to marketplace demand for advanced services, terrestrial mobile systems have transitioned to “interference-limited” digital modulation designs that feature multiple, low-power base stations with intensive frequency reuse and mobile hand-off from cell-to-cell throughout a small geographic area.

ability to manage use of their spectrum. CTIA therefore opposes the Commission's proposal to amend section 15.209 and permit higher power operation for unlicensed devices.

C. The Commission's Secondary Markets Spectrum Leasing Rules Should Facilitate Arrangements that Involve Use of Cognitive Radio Technologies.

As economist Michael Katz noted in a paper attached to CTIA's *Interference Temperature NOI* comments, "before concluding that regulation is needed to create and police the use of underlay rights, the Commission should ask whether market forces can be relied upon instead."¹⁰ CTIA respectfully submits that there is a better way to facilitate spectrum access opportunities in CMRS bands: foster a robust secondary market that enables private parties to voluntarily negotiate spectrum leasing arrangements that take advantage of new technological capabilities, including cognitive radio.

The *Secondary Markets Further Notice* sought comment on whether the new leasing rules provide sufficient flexibility "for dynamic leasing arrangements" that would involve opportunistic uses or underlay operations in licensed spectrum bands.¹¹ As the *NPRM* observes, cognitive radio technology could "enable voluntary spectrum leasing transactions" that "would not otherwise be possible without such technology."¹² The Commission should foster leases that do not easily fit into the defined terms of spectrum frequency, geography or time and should

¹⁰ Michael L. Katz, *Don't Let Short-Term Reforms Interfere with Long-Term Policy Goals* (submitted as an attachment to Comments of Cellular Telecommunications & Internet Association, ET Docket No. 03-237 (filed Apr. 5, 2004) at 9).

¹¹ *Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets*, Report and Order and Further Notice of Proposed Rulemaking, 18 FCC Rcd 20604, 20694, ¶ 236 (2003).

¹² *NPRM*, 18 FCC Rcd at 26877, ¶ 49.

provide a notification procedure for such “opportunistic” leasing, distinct from the more traditional spectrum block leasing.

If underlay operations prove to be technically feasible and economically efficient, licensees in a competitive market like CMRS have the economic incentive to lease spectrum usage rights and maximize revenue. Cognitive radio technologies may make such arrangements more viable. The Commission should revise its rules to permit more dynamic definitions of leased spectrum.

II. THE COMMISSION SHOULD NOT ADOPT THE PROPOSAL TO ALLOW HIGHER POWER UNLICENSED OPERATIONS IN AREAS OF “LIMITED SPECTRUM USE,” INCLUDING RURAL AREAS

The *NPRM* proposes to increase the power limits allowed under sections 15.247 and 15.249 of the Commission’s rules for unlicensed devices operating in ISM bands by up to 6 times (approximately 8dB) in areas of “limited spectrum use,” including rural areas.¹³ While the proposal is intended to assist unlicensed wireless broadband providers by providing a greater transmission range, it fails to consider the potential costs associated with an increase in power. The increase in interference, for example, creates the potential for lost CMRS coverage in rural areas that may be located at the edge of mobile wireless networks. Such an outcome would be unacceptable to CMRS customers, who increasingly rely on their wireless connections and have little tolerance for interference.¹⁴

¹³ *See id.* at 26872-73, ¶ 38.

¹⁴ As the Commission considers the introduction of underlays that could degrade the provision of CMRS service, it should be noted that the Commission recently required CMRS providers seeking eligible telecommunications carrier (“ETC”) designation to satisfy certain conditions related to quality of service, including participation in CTIA’s Consumer Code for Wireless Service and consumer complaint reporting requirements. *See Federal-State Joint Board on Universal Service Virginia Cellular, LLC Petition for Designation as an Eligible Telecommunications Carrier in the Commonwealth of Virginia*, CC Docket No. 96-45, Memorandum Opinion and Order, 19 FCC Rcd 1563 (2004); *Federal-State Joint Board on* (continued on next page)

As an initial matter, CTIA expresses concern that the proposal does not contain any meaningful assessment of the risk of interference to existing licensees – either in-band or out-of-band. Although the *NPRM* devotes considerable attention to the introduction of higher power unlicensed devices in the ISM bands, the Commission has not provided any basis on which to conclude that the proposal addresses the risks to licensees.

CTIA has specific concerns regarding the proposal’s impact on CMRS operations. The out-of-band emission limit for spread spectrum devices operating under section 15.247 is a function of in-band power (20 dB below the in-band power).¹⁵ As a result, increasing transmit power by 6 times would increase permissible out-of-band emissions by 6 times as well. Applied in the 902-928 MHz band, the proposal raises interference concerns for CMRS providers in the 800 MHz band. Applied to the 2400-2483.5 MHz band, the proposal also raises interference concerns for Multi-Point Distribution Service (“MDS”) and Instructional Television Fixed Service (“ITFS”) licensees operating in the nearby 2500-2690 MHz band. At a minimum, in order to protect existing licensees in nearby frequency bands, the Commission should conclude that out-of-band emissions must not exceed existing limits.

III. THE NPRM’S PROPOSALS RAISE SIGNIFICANT – AND UNANSWERED – QUESTIONS REGARDING COMMISSION ENFORCEMENT IN LIGHT OF THE INCREASED RISK OF ROGUE OPERATIONS.

Policing unlicensed transmitters presents enormous challenges in any underlay use of licensed spectrum. Unlike licensed transmitters, unlicensed devices enter the marketplace in an

Universal Service Highland Cellular, Inc. Petition for Designation as an Eligible Telecommunications Carrier in the Commonwealth of Virginia, CC Docket No. 96-45, Memorandum Opinion and Order, FCC 03-37 (rel. Apr. 12, 2004).

¹⁵ 47 C.F.R. § 15.247(c).

uncontrolled manner and enforcement efforts are, for all practical purposes, non-existent.¹⁶ Cognitive radio technologies make such enforcement even more complicated. As the *NPRM* acknowledges, proposals that rely on cognitive radio technology to limit the risk of interference create “the possibility of new types of abuse.”¹⁷ The *NPRM*, however, contains only a few sporadic paragraphs related to security and the need for a yet-to-be-defined enforcement program.¹⁸ The *NPRM* makes no specific proposals to limit the increased risk of abuse.

Because cognitive radio by definition modifies a device’s operating parameters, post-manufacture “re-engineering” can expand operations beyond lawful bounds. The *NPRM* identifies three new types of abuse that could be exploited by modifying the cognitive radio capabilities intended to limit interference:

- “A GPS receiver in a radio could be re-programmed with a geographic offset that would make the radio behave as though it were at a location far from its actual location.”
- “[D]atabases used to determine the location of other transmitters and/or receive sites could be altered so a device would not ‘know’ about the presence of other uses that require protection from interference.”
- “[S]oftware used to select the appropriate operating parameters could be altered to make a radio transmit at frequencies, power levels or locations where it should not.”¹⁹

Unfortunately, the potential for rogue unlicensed operations is not mere theory. Some elements of the unlicensed community intentionally modify their equipment to operate at

¹⁶ See, e.g., *Review of Part 15 and Other Parts of the Commission’s Rules*, First Report and Order, 17 FCC Rcd 14063, 14067 (2002) (finding that certain radar detectors caused harmful interference to VSATs in the 11.7 -12.2 GHz band but concluding that “identifying [these] radar detectors is not practical . . . because these devices are mobile and therefore interfere intermittently.”).

¹⁷ *NPRM*, 18 FCC Rcd at 26870, ¶ 30 (emphasis added).

¹⁸ See e.g., *id.* at 26870, ¶ 30 & 26893, ¶ 94.

¹⁹ *Id.* at 26870, ¶ 30.

unlawful power levels or in unauthorized frequencies. The Chief of the FCC's Office of Engineering and Technology recently acknowledged this reality, noting that the FCC is about to "get serious" about unlawful unlicensed operations and that the Commission would soon "go after abusers of unlicensed spectrum."²⁰

Yet the *NPRM* makes no proposals to address the "new types of abuse" that arise in the cognitive radio context. Absent adoption of a meaningful enforcement program, the Commission should be wary of creating further opportunities for rogue behavior.²¹

²⁰ *OET Chief Sees Potential Solution for 'White Space' TV Proposal*, COMMUNICATIONS DAILY (Apr. 19, 2004) at 3.

²¹ CTIA likewise does not support the proposal to allow certification of Part 15 devices that are capable of operating on non-Part 15 frequencies. See *NPRM*, 18 FCC Rcd at 26895, ¶ 97. The risk of interference to licensed carriers outweighs any purported benefit for manufacturers.

IV. CONCLUSION

CTIA commends the Commission for its ongoing commitment to enhance spectrum efficiency. While CMRS licensees and other providers are already deploying cognitive radio technologies to achieve more intensive and efficient spectrum usage, CTIA urges the Commission to refrain from viewing cognitive radio as the vehicle to introduce unlicensed underlays into licensed spectrum. Rather than shoehorning unlicensed underlays into licensed spectrum, the Commission should focus its energies on strengthening its secondary markets spectrum leasing rules to ensure that interested parties can enter arrangements that make use of cognitive radio technologies.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I, Christine Blomquist, hereby certify that on this 3rd day of May 2004, the foregoing Comments of the Cellular Telecommunications & Internet Association were filed electronically on the FCC's Electronic Comment Filing System and copies were served via email mail to the following:

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