

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 Radios)

**COMMENTS OF THE WIRELESS COMMUNICATIONS ASSOCIATION
INTERNATIONAL, INC.**

Andrew Kreig
President

1333 H Street, N.W.
Suite 700 West
Washington, D.C. 20005
(202) 452-7823

May 3, 2004

TABLE OF CONTENTS

I.	INTRODUCTION.....	1
	A. The Commission Should Not Promote Cognitive Radios as a Means of Forcing Licensees to Share Their Spectrum With Third Parties.....	4
	B. The Commission Can and Should Rely on Secondary Markets to Establish When Underlays on Licensed Spectrum Are Appropriate.....	11
	C. Any Use of Cognitive Radios at Higher Power in the Unlicensed Bands Must Not Increase the Risk of Harmful Interference to Licensed Services.....	15
II.	CONCLUSION.....	18

EXECUTIVE SUMMARY

As the trade association of the wireless broadband industry, the Wireless Communications Association International, Inc. (“WCA”) has a direct interest in the Commission’s *Notice of Proposed Rulemaking* (“NPRM”) in this proceeding. The Commission correctly recognizes that cognitive radio technology, within the appropriate regulatory framework, “offers regulators, licensees and the public the potential for more flexible, efficient and comprehensive use of available spectrum.” Accordingly, subject to the caveats discussed below, WCA supports the development of Commission rules and policies that maximize cognitive radio technology’s potential without defeating the interference protection rights and investment-backed expectations of license holders.

WCA generally agrees that cognitive radios can promote spectral efficiency in a variety of contexts. However, WCA does *not* agree that cognitive radios should be utilized “to enable non-voluntary third party access to spectrum, for instance as an unlicensed device operating at times or in locations where licensed spectrum is not in use.” That idea overlooks the most fundamental limitation of cognitive radio technology: *while a cognitive radio may have the ability to accurately evaluate the radiofrequency environment (“RF”) around itself, it has no means of accurately evaluating the radiofrequency environment surrounding licensed receivers at other locations.* Inevitably, then, licensees providing services where receivers are mobile, portable, or at locations that are not a matter of public record and thus unknown to cognitive radio in advance will suffer potentially debilitating interference if they are forced to share their spectrum with unlicensed services utilizing cognitive radios. Given that, plus other limitations of cognitive radio technology that the Commission itself identifies in the *NPRM*, there is no legitimate justification for the Commission to use cognitive radio technology as a vehicle for forcing licensees of such services to share their spectrum with unlicensed users or anyone else. At a minimum, a mandate for sharing of licensed spectrum would severely undermine the interference protection rights and freedom to innovate that licensees have spent billions for in acquiring spectrum. Furthermore, forced sharing of licensed spectrum would raise a host of unprecedented technical, legal, logistical and enforcement problems that neither the Commission nor the wireless industry can or should be required to resolve.

Fortunately, the Commission and the wireless industry can avoid this quagmire by eschewing forced sharing and instead relying on voluntary secondary market transactions to promote cognitive radio-based spectrum sharing arrangements where they are appropriate. As observed by the Commission’s Spectrum Policy Task Force: “If the rights afforded to licensees are sufficiently well-defined and flexible, and the secondary market mechanism is fast and efficient with low transaction costs, licensees will have ample incentive to negotiate with potential secondary users for such access. . . . Thus, the secondary market approach has significant potential to foster opportunistic technologies . . . at reasonable transaction costs. In fact, it is anticipated that as the access-enhancing potential of these technologies continues to improve, exclusive licensees will often wish to encourage and even develop such technologies in order to provide new services and devices and serve more customers.”

For similar reasons, WCA agrees that the Commission should promote use of cognitive radios to promote voluntary frequency coordination agreements between licensees and to provide additional opportunities for licensees to achieve spectral efficiencies within their own internal

operations, *if* such agreements and internal usage are left to the discretion of licensees without excessive regulatory limitations.

Finally, WCA generally does not oppose the Commission's effort to identify optimal uses for cognitive radios in spectrum reserved for unlicensed use, provided that licensees in adjacent bands are not subject to any increased risk of interference. The dedicated unlicensed bands may prove to be the ideal test bed for cognitive radio technology — since unlicensed service providers are not entitled to interference protection and must protect all licensed users in all circumstances, they effectively already operate in a shared spectrum environment in which they must accommodate the spectrum needs of other users. For that reason, WCA does not oppose the Commission's proposal to permit unlicensed providers to utilize higher power in rural areas if they deploy cognitive radios, provided that (1) such higher power operations are limited to the unlicensed 902-928 MHz, 2400-2483.5 MHz and 5 GHz bands exclusively, and (2) the absolute level of out-of-band emissions from such higher power operations are no higher than permitted under the Commission's current rules.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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

**COMMENTS OF THE WIRELESS COMMUNICATIONS ASSOCIATION
INTERNATIONAL, INC.**

The Wireless Communications Association International, Inc. (“WCA”) hereby submits its comments in response to the Commission’s *Notice of Proposed Rulemaking* (“*NPRM*”) in the above-captioned proceeding.¹

I. INTRODUCTION.

WCA has a direct stake in the Commission’s efforts to construct an appropriate regulatory framework for cognitive radio technology.² As noted in the *NPRM*, radios with cognitive capabilities are already used in the marketplace, and their continued development “offers regulators, licensees, and the public the potential for more flexible, efficient, and

¹ FCC 03-322 (rel. Dec. 30, 2003).

² WCA is the trade association of the wireless broadband industry. Its members include licensees, system operators, equipment manufacturers and consultants involved in the provision of wireless broadband services over licensed frequencies allocated to the Multipoint Distribution Service (“MDS”), Instructional Television Fixed Service (“ITFS”), Wireless Communications Service (“WCS”), Local Multipoint Distribution Service (“LMDS”), the 39 GHz service and the “millimeter wave” (70/80/90 GHz) services, as well as the unlicensed spectrum in the 902-928 MHz, 2.4 GHz and 5 GHz bands. Whether in its own name or through its affiliated License-Exempt Alliance, WCA has initiated or participated in virtually every major Commission proceeding relating to deployment of spectrum for wireless broadband service.

comprehensive use of available spectrum while reducing the risk of harmful interference.”³ However, for Commission licensees represented by WCA, the *NPRM* presents two fundamental issues: (1) whether the Commission should rely on the marketplace, rather than regulatory fiat, to define how, when and where cognitive radios can and should be utilized to maximize spectral efficiency, and (2) what regulatory construct should be used to ensure that use of cognitive radios not cause interference to licensed services.

While WCA certainly agrees that cognitive radios may be capable of promoting spectral efficiency in a variety of contexts, it strongly opposes any suggestion that cognitive radios should be viewed as a vehicle for imposing forced sharing of licensed spectrum. The forced sharing idea, at least as it applies to services where receivers are mobile, portable or at fixed locations that are not a matter of public record and thus not knowable to cognitive radios, is based on a false premise, *i.e.*, that a cognitive radio is capable of accurately evaluating the condition of the radiofrequency environment of the licensed receivers it is required to protect. The record already compiled in the Commission’s interference temperature docket (ET Docket No. 03-237) confirms exactly the opposite: even when a cognitive radio knows where it is and is able to evaluate the condition of the RF environment surrounding it, that evaluation will say nothing about the RF environment surrounding licensed receivers in other areas that the cognitive radio must protect. Thus, neither the Commission nor a cognitive radio user can assure that a cognitive radio’s transmissions will not actually *increase* the level of interference around licensed receivers not located at readily identifiable sites.

³ *NPRM* at ¶ 2.

Given this fundamental flaw in the technology (and other flaws the Commission itself identifies in the *NPRM*), use of cognitive radios to force involuntary sharing of licensed spectrum will be rife with legal, technical and practical difficulties that neither the Commission nor the licensed industry can or should be required to resolve. Instead, consistent with the recommendations of its Spectrum Policy Task Force (“SPTF”), the Commission should rely on secondary market transactions to define how, when and where it is most appropriate for licensees to share their spectrum with third parties. In a similar vein, the Commission should promote use of cognitive radios to facilitate voluntary frequency coordination agreements and more efficient internal uses of spectrum, provided that the Commission’s rules do not unduly constrain licensee discretion in either case.

Finally, WCA generally supports the Commission’s effort to explore potential uses of cognitive radio technology in spectrum dedicated for unlicensed use, and thus does not oppose the Commission’s proposal to permit unlicensed operators to use higher power where they use cognitive radios in rural areas. It is imperative, however, that this proposal be implemented in a manner that does not result in a greater risk of harmful interference to adjacent band licensees. Accordingly, WCA urges that the Commission to limit such higher power operation to the unlicensed 902-928 MHz, 2400-2483.5 MHz and 5 GHz bands exclusively, and modify its rules as necessary to ensure that the absolute level of out-of-band emissions from such higher power operations are no higher than permitted under the Commission’s current rules.

II. DISCUSSION.

A. *The Commission Should Not Promote Cognitive Radios as a Means of Forcing Licensees to Involuntarily Share Their Spectrum With Third Parties.*

The Commission suggests, and WCA for the most part agrees, that cognitive radios can promote spectral efficiency in some contexts. However, WCA strongly opposes any suggestion that the Commission should promote cognitive radio technology “to enable non-voluntary third party access to spectrum, for instance as an unlicensed device operating at times or in locations where licensed spectrum is not in use.”⁴ Simply put, there is no legitimate justification for the Commission to use cognitive radio technology as a vehicle for forcing licensees to share their spectrum with unlicensed users or anyone else.⁵

As an initial matter, even if cognitive radios were not handicapped by fundamental technical flaws (and both the record before the Commission and the *NPRM* itself confirm that they are), it is imperative to recognize that cognitive radios that “sense” spectrum utilization (as compared to those that utilize location monitoring technology to avoid transmitting in restricted areas) cannot protect licensees from *all* potential interference from forced sharing of their spectrum. Indeed, it is inevitable that situations will arise where (1) a cognitive radio will

⁴ *Id.* at ¶ 3.

⁵ It appears that the Commission’s reference to sharing of “vacant” licensed spectrum harkens back to the Commission’s *Notice of Inquiry* in ET Docket No. 02-380, where, *inter alia*, it requested comment on the feasibility of permitting unlicensed operators to use allocated, but unlicensed television broadcast spectrum below 1 GHz. *See Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, 17 FCC Rcd 25632 (2002). There, however, the spectrum is “vacant” because it is not licensed to anyone; here, all of the “vacant” spectrum referred to by the Commission is already licensed (and, in many cases, bought and paid for at auction), and thus any forced sharing of that spectrum implicates significant technical and legal issues not present in the television broadcast context.

conclude that there is unused spectrum available for its transmissions, (2) the cognitive radio device will begin to transmit on that spectrum, and (3) a licensed transmitter will then independently start to transmit on the same spectrum and associated receivers will suffer harmful interference for an indeterminate period of time until the monitoring mechanism in the cognitive radio detects the problem, *and* takes whatever steps are necessary to eliminate the interference. The dangers to licensed services of this inevitable latency in cognitive radios' compliance with the Commission's interference protection rules are self-evident, and nothing in the *NPRM* suggests that a technological solution is available. Hence, licensed services and consumers who depend on them will be perpetually subject to interference, a result which plainly deserves the public interest.

Since the fundamental premise of forced sharing is that interference only occurs when the Commission's interference protection requirements are violated at a given licensed receiver, the most effective (but hardly fail-safe) approach to implementing forced sharing via cognitive radio technology where licensed receivers are mobile, portable or fixed at unknown locations is the following: provide all licensed receivers with the capability of distinguishing desired from undesired signals and noise (which is no trivial technical feat) and GPS or other location identification technology, along with the capability of transmitting pertinent location and RF information to all cognitive radio devices close enough to the receiver to pose a threat of interference. Cognitive radios would similarly need to be equipped with location identification technology so that they can calculate their location relative to licensed receivers, and with the intelligence to calculate their own contribution to the interference at each licensed receiver and self-adjust their operating parameters as necessary to cure the problem. Not only is this approach not 100% effective, it is impractical due to the significant costs it imposes on licensed

incumbents, the additional spectrum necessary to enable licensed receivers and cognitive radios to communicate with each other, and the adverse impact on receiver form factor and power consumption associated with implementation.

Indeed, this paradigm raises a host of complex questions. What spectrum would the receivers in the licensed services transmit on? WCA hopes the Commission is not contemplating requiring licensees to surrender some of their own licensed spectrum to support a channel devoted exclusively to communicating with cognitive radios. If all licensed receivers must have the capability of transmitting on some additional band to cognitive radios, who will bear the cost of incorporating that capability? WCA hopes the Commission is not contemplating requiring licensees to incorporate this capability at their own expense when the manufacturers and users of cognitive radios will be the beneficiaries. And, how will the Commission explain to consumers of licensed services that the form factor of their wireless devices has increased in size, and their battery life has decreased, because the Commission has mandated that all devices incorporate capability to transmit to cognitive radios?

Moreover, the Commission itself identifies additional basic flaws in cognitive radio technology which, as the Commission puts it, “raise[] the possibility of new types of abuse.”⁶ For example, the *NPRM* acknowledges that even with respect to services where receive sites are fixed and a matter of public record, cognitive radio technology cannot necessarily be relied upon to enforce exclusion zones surrounding licensed receivers, since the software in a cognitive radio could be reprogrammed so that it will not recognize when it is operating in an area where it will

⁶ *NPRM* at ¶ 30.

cause harmful interference to a licensed receiver.⁷ Also, the Commission itself acknowledges that databases used to determine the location of receive sites could be altered to prevent cognitive radios from identifying licensed receivers they are required to protect.⁸ And, the *NPRM* recognizes that a cognitive radio's software could be altered such that the device transmits at frequencies or power levels where it should not.⁹ The risk of this increases if, as

⁷ *Id.*

⁸ *Id.*

⁹ *Id.* The Commission's fear that permitting unlicensed operation on some licensed spectrum will prompt unlicensed users to illegally modify cognitive radios to operate on unauthorized frequencies is hardly far-fetched. Indeed, it appears that unlicensed users already may be surreptitiously modifying WiFi equipment to operate on licensed spectrum. For example, New America Foundation has promoted the "open spectrum project" of self-proclaimed industry guru Scott Rafer, whose www.FCCster.com web-site appears devoted to little more than developing "standards" for illegally modifying WiFi equipment so that it can operate without appropriate authorization on licensed spectrum. *See, e.g.* <http://www.newamerica.net/index.cfm?pg=event&EveID=313> ("Because the FCC has been slow to provide adequate spectrum for unlicensed broadband applications like Wi-Fi, growing numbers of software-savvy citizens are poised to adapt off-the-shelf Wi-Fi equipment to operate on the largely vacant, licensed bands adjacent to the crowded unlicensed frequencies."); <http://www.fccster.com/fccster/> ("The open source tools necessary to re-program existing Wi-Fi radios to use portions of the US MMDS, Satellite Radio, and UMTS bands will be broadly, though illegitimately, available by Spring 2004"); <http://www.fccster.com/fccster/archives/000002.html> ("The strawman standards goal [is] to remain backwards compatible with as much already deployed radio hardware as possible. It should be possible to simply define additional 802.11b and 802.11g channels above and below the current license-exempt range, not worrying about adding new intelligence and feature sets"); <http://www.fccster.com/fccster/archives/000007.html> ("Michael Calabrese at the New America Foundation has gotten right behind us on the education effort and has created a wonderful forum in DC next week to get the word out on the opportunities and hazards of Wi-Fi-derived pirate radio"); <http://www.fccster.com/fccster/archives/000010.html> ("The most common challenge to the FCCster casual frequency encroachment thesis is not technical feasibility. Instead, it is doubt surrounding whether there is sufficient consumer motivation to load new software on their Wi-Fi base stations. In 2004, a simple download and double-click installation process will make consumers unknowing, and largely undetectable, radio pirates.").

proposed in the *NPRM*, vendors are permitted to certify cognitive radios that operate over wider frequency ranges that encompass bands not authorized for use in the United States.¹⁰

As already discussed at length in the record compiled in the Commission's interference temperature docket (ET Docket No. 03-237), the forced sharing concept ultimately fails with respect to licensed services where the locations of receivers are not fixed or are otherwise unavailable to cognitive radios, since it overlooks cognitive radio technology's most fundamental flaw: *while a cognitive radio may have the ability to accurately evaluate the radiofrequency environment around itself, it has no means of accurately evaluating the radiofrequency environment surrounding licensed receivers at other locations.*¹¹ That is, even where a cognitive radio knows that a given frequency is not being used at its location, that evaluation will say nothing about whether the frequency is being used and received at licensed receivers in other areas that the cognitive radio must protect. This means there will be incalculable situations where a cognitive radio perceives that it is permitted to transmit when in fact its transmission will actually cause interference at licensed receivers.

For example, as the Commission itself notes in the *NPRM*, this problem manifests itself via the "hidden node" phenomenon, which occurs when a local terrain feature (natural or man-made) between a licensed transmitter and the cognitive radio receiver prevents the cognitive radio from detecting the licensee's signal, but that signal is not blocked en route to the licensed

¹⁰ *Id.* at ¶¶ 96-97.

¹¹ *See, e.g.*, Comments of Wireless Communications Ass'n Int'l, ET Docket No. 03-237, at 21-21 (filed Apr. 5, 2004); Comments of AT&T Wireless, ET Docket No. 03-237, at 5-7 (filed Apr. 5, 2004); Comments of Sprint Corporation, ET Docket No. 03-237, at 13-14 (filed Apr. 5, 2004); Comments of QUALCOMM, ET Docket No. 03-237, at 15-16 (filed Apr. 5, 2004); Comments (continued on next page)

receiver which the cognitive radio is supposed to protect.¹² In this situation, a cognitive radio does not “see” licensed transmission that the licensed receiver sees, and therefore incorrectly concludes that it may transmit without causing harmful interference to that licensed receiver.

WCA submits that all of the above unquestionably reaffirms what wireless service providers and the Commission already know: use of cognitive radio technology to force unlicensed use in the licensed spectrum bands is far from fail-safe, and WCA is unable to envision a single practical mechanism by which licensees can operate without risk of interference resulting from forced sharing of their spectrum via use of cognitive radios. Regardless of how the Commission chooses to regulate to address the technology’s weaknesses, it is highly unlikely that the agency will be able to regulate the problem out of existence. The equipment certification process simply cannot be depended on to regulate or guarantee how cognitive radio users behave once their devices have been certified and have entered the marketplace. And, in any event, repairing the substantial flaws in cognitive radio technology and reconfiguring existing licensed facilities to protect against any increased interference risk will be an expensive and time-consuming process that, if forced on licensees against their will, will only drain resources better devoted to providing innovative services.¹³ In addition, consumers ultimately will bear the cost of degraded, rather than enhanced, service.

of Cingular Wireless LLC, ET Docket No. 03-237, at 25-26 (filed Apr. 5, 2004); Comments of Motorola, Inc., ET Docket No. 03-237, at 13-14 (filed Apr. 5, 2004).

¹² See *NPRM* at ¶ 25. n. 35.

¹³ Significantly, the *NPRM* avoids any discussion of how (if at all) users of cognitive radios would be required to share such costs under a forced sharing paradigm.

The Commission also must give due consideration to the serious legal implications of forcing licensees to share their spectrum with others under the cognitive radio model. Certainly, any *post hoc* mechanism for imposing mandatory sharing of licensed spectrum must be squared with the interference protection rights and freedom to innovate that licensees have spent billions for in acquiring spectrum through secondary market transactions and/or the Commission's auction process. Regarding the later, the D.C. Circuit "start[s] from the intuitive premise that an agency cannot, in fairness, radically change the terms of an auction after the fact,"¹⁴ and has confirmed that "a bidder in a government auction has a 'right to a legally valid procurement process'; a party allegedly deprived of this right asserts a cognizable injury."¹⁵ It is also clear that post-auction decisions that defeat the auction process are actionable, even where the auction itself was conducted properly – as the D.C. Circuit has noted, "[t]here is no basis for suggesting . . . that *ex post* changes can never affect the validity of a government auction."¹⁶ Equally important, Congress has directed the Commission to conduct its auctions in a manner that promotes, *inter alia*, "the development and rapid deployment of new technologies, products and services for the benefit of the public" and "the efficient and intensive use of the electromagnetic spectrum."¹⁷ Rather clearly, then, the Commission puts the integrity of its auction process at risk

¹⁴ *U.S. Airwaves v. FCC*, 232 F.3d 227, 235 (D.C. Cir. 2000) ("*U.S. Airwaves*").

¹⁵ *Id.* at 232, quoting *DIRECTV, Inc. v. FCC*, 110 F.3d 816, 829 (D.C. Cir. 1997).

¹⁶ *Id.* at 232.

¹⁷ *FCC Report to Congress on Spectrum Auctions*, 13 FCC Rcd 9601, 9616 (1997); see also 47 U.S.C. § 309(j)(3). In the case of MDS, for example, the Commission has emphasized that an MDS Basic Trading Authority ("BTA") auction winner may provide services beyond those provided at the time of the auction – indeed, the Commission adopted the MDS BTA licensing system to "[provide] both new and incumbent operators with maximum flexibility to improve and expand service and implement digital technologies." *Amendment of Parts 21 and 74 of the*

(continued on next page)

when it makes a post-auction decision to impose forced sharing (whether through cognitive radio technology or otherwise) on winning auction bidders who assumed that they were purchasing an exclusive right to use and innovate on their spectrum.¹⁸

In sum, then, the use of cognitive radios to force sharing of licensed spectrum would invite a myriad of technical, legal, logistical and enforcement problems that would expose licensed services to an unacceptable risk of harmful interference, without any timely or meaningful remedy before the Commission or any countervailing benefit to the public. For that reason, it is imperative that the Commission pursue more readily-available alternatives for promoting market-driven efficiencies in the utilization of spectrum – alternatives that do not threaten current and future licensed service offerings.

B. The Commission Can and Should Rely on Secondary Markets to Establish When Underlays on Licensed Spectrum Are Appropriate.

In its November 2002 *Report*, the SPTF recommended that the Commission manage spectrum in accordance with three cornerstone principles:

- Spectrum users should have the maximum possible flexibility to decide how spectrum will be used, so long as they comply with the technical rules applicable to their spectrum.
- Spectrum users should be allowed to choose the technology that is best-suited to their proposed use or service. They should also be given the freedom to

Commission's Rules With Regard to Filing Procedures in the Multipoint Distribution Service and in the Instructional Television Fixed Service, 10 FCC Rcd 13821, 13836 (1995)(emphasis added).

¹⁸ Similarly, forcing winning auction bidders to share their spectrum with third parties undermines their legitimate investment-backed expectations, and arguably is tantamount to an unlawful taking of property under the Fifth Amendment which, if not reversed, may leave the Commission vulnerable to a potentially endless parade of Tucker Act lawsuits in the Federal Court of Claims. *See Penn Central Transportation Co. v. New York City*, 438 U.S. 104, 124 (1978).

adapt their technology to their particular spectrum environment, *e.g.*, to use lower power in spectrum-congested areas and higher power in less-congested areas.

- An efficient secondary markets regime should be in place to facilitate the negotiated movement of spectrum rights from one party to another.¹⁹

Equally important, although the SPTF recommended that the Commission study the concept of interference temperature (a separate but related idea that necessarily implicates cognitive radio technology), it did so with the caveat that

the Commission can best promote economic efficiency by providing spectrum users with flexibility of spectrum use and ease of transferability in order to allow maximization of the value of the services provided. Flexibility provides incentives for economically efficient use. . . *In most instances, the application of flexible service rules and efficient secondary market mechanisms are the best means of achieving this goal.*²⁰

In other words, secondary markets, not regulation, should be the Commission's engine for promoting cognitive radio and other "smart" or "opportunistic" technologies:

If the rights afforded to licensees are sufficiently well-defined and flexible, and the secondary market mechanism is fast and efficient with low transaction costs, licensees will have ample incentive to negotiate with potential secondary users for such access. . . Thus, the secondary market approach has significant potential to foster opportunistic technologies . . . at reasonable transaction costs. In fact, it is anticipated that as the access-enhancing potential of these technologies continues to improve, exclusive licensees will often wish to encourage and even develop such technologies in order to provide new services and devices and serve more customers.²¹

¹⁹ Report of the Spectrum Policy Task Force, Federal Communications Commission, ET Docket No. 02-135, at 17 (Nov. 2002) ("SPTF Report").

²⁰ *Id.* at 21 (emphasis added).

²¹ *Id.* See also Comments of SBC Communications Inc., WT Docket No. 00-230, at 7 (filed Dec. 5, 2003) ("[i]f a smart technology does not cause interference, incumbent licensees should be eager to permit smart technologies to use their spectrum and reap the revenue that would come from doing so."); Comments of Sprint Corporation, WT Docket No. 00-230, at 3 (filed Dec. 5, 2003) ("[p]roviding access to licensed spectrum by ... 'opportunistic' third parties through secondary market mechanisms represents a far superior option to government-imposed, spectrum

(continued on next page)

The above, in other words, confirms that the Commission need not drown itself or the wireless industry in the quagmire of forced sharing of licensed spectrum to achieve its objectives. Instead, as already suggested in the *NPRM*,²² the Commission can and should rely on secondary market transactions to define when sharing of licensed spectrum is appropriate, and permit licensees and cognitive radio users to establish the terms and conditions of those transactions via arms-length negotiations. As recognized by the SPTF, the Commission's secondary markets approach correctly assumes that licensees have obvious economic incentives to maximize revenues from their spectrum, and thus gives each licensee the opportunity to determine on an individual, case-by-case basis – in its discretion and under terms of its own choosing – whether to make excess capacity on its spectrum available. At the same time, secondary markets provide cognitive radio users with a ready means of obtaining access to licensed spectrum (in amount, location and duration) best suited to their business needs. Because the contractual relationship will be crafted to reflect specific marketplace requirements, it can

easement approaches. Utilization of secondary market mechanisms would provide licensees with the important ability to identify and manage the radio frequency (“RF”) signal contributions into their licensed bandwidth, establish mitigation procedures and allocate related costs and, thus, better prevent or control interference that could otherwise be experienced by their subscribers.”). Reply Comments of T-Mobile USA, Inc., WT Docket No. 00-230, at 5-6 (filed Jan. 5, 2004) (“The Commission is at the very beginning stages of exploring the potential of opportunistic devices. . . [I]n keeping with its market-based philosophy, the Commission should first gain experience in the evolution of its recently announced secondary market regime before embarking on a more intrusive path to opportunistic devices.”) (footnote omitted); Comments of Cellular Telecommunications & Internet Ass’n, WT Docket No. 00-230, at 5 (filed Dec. 5, 2003) (“CTIA believes that the only prudent course of action at this time is to allow licensees to control secondary market rights to their spectrum in order to ensure that opportunistic devices and other new technologies or uses do not create interference issues. This approach will, moreover, promote the most efficient use of spectrum . . . because licensed users subject to intense market pressures will have significant incentives to use their spectrum as efficiently as possible.”).

²² See *NPRM* at ¶ 30.

provide for limitations on opportunistic use, impose specific interference protection standards, establish specific interference mitigation procedures, and contain specific cost allocations (including allocations of interference mitigation costs) that cannot possibly be created under any “one size fits all” regulatory construct.²³

In the same vein, just as secondary market transactions should be permitted to define how, when and where licensed spectrum should be shared, licensees should be permitted to utilize cognitive radio technology to facilitate voluntary frequency coordination between geographically or spectrally adjacent licensees, *if* such transactions are voluntary and licensees are given absolute freedom to negotiate whatever terms and conditions are most acceptable to them, again subject to the requirement that no harmful interference be caused to other licensees.²⁴

For example, WCA (along with leading representatives of the ITFS community) has proposed in WT Docket No. 03-66 a series of cochannel and adjacent channel interference

²³ In the *NPRM*, the Commission states that cognitive radio technologies “would appear to make interruptible leasing practical for the first time,” and suggests that the idea “would be particularly relevant to possible leasing by public safety licensees, whose responsibilities and spectrum usage requirements are likely to demand robust technical mechanisms to ensure interruptible spectrum leasing.” *Id.* at ¶ 51. The Commission then discusses a variety of “access/reversion” mechanisms under which public safety licensees might immediately regain use of any spectrum they have leased to third parties. *Id.* at ¶¶ 54-61. WCA takes no position on whether public safety licensees should be permitted to lease their spectrum, or on what access/reversion mechanisms should be imposed in that context. In any event, the Commission deals with those issues in the public safety context, the Commission’s rules need not mandate that *commercial* licensees utilize any particular access/reversion mechanisms when reclaiming spectrum they may have voluntarily leased to third parties on an “interruptible” or other basis via use of cognitive radios. While such rules may be appropriate in the safety context to protect public welfare, in the commercial context licensees are best qualified to determine what access/reversion mechanisms are most suitable for their own particular circumstances.

²⁴ *See id.* at ¶ 30.

protection rules designed to promote the use of both frequency division duplex and time division duplex technologies in the 2500-2690 MHz band.²⁵ Recognizing the substantial challenges associated with using these disparate technologies, those rules provide a reasonable balance between the desire of licensees to provide ubiquitous service within their authorized service area and their desire to avoid interference from adjacent licensees. However, WCA has recognized that individual licensees often will be able to craft solutions that provide better coverage and/or less interference, and has urged the Commission to permit those entering into such agreements to depart from the proposed rules.²⁶ Certainly, one possible approach would be for licensees to agree to deploy cognitive radio technology that incorporates certain coordination “rules” agreed to by the licensees to improve spectral efficiency near their common border.

Lastly, to ensure that opportunities for maximizing spectral efficiency are available in all aspects of a licensee’s utilization of spectrum, the Commission should promote usage of cognitive radios as a means of achieving spectral efficiencies within a licensee’s internal operations, again with the caveat that such internal usage of the technology is left to the discretion of licensees without excessive regulatory limitations.

C. Any Use of Cognitive Radios at Higher Power in the Unlicensed Bands Must Not Increase the Risk of Harmful Interference to Licensed Services.

WCA generally does not oppose the Commission’s effort to identify optimal uses for cognitive radios in unlicensed spectrum, provided that such uses are limited exclusively to bands

²⁵ See, e.g., Comments of Wireless Communications Ass’n Int’l, WT Docket No. 03-66, at 7-10 (filed September 8, 2003).

²⁶ See *id.* at 41-48.

dedicated for unlicensed use.²⁷ In fact, the unlicensed bands may prove to be the most appropriate testing ground for the technology — since unlicensed service providers are not entitled to interference protection and must protect all licensed users in all circumstances, in effect they already operate in a shared spectrum environment in which they must accommodate the spectrum needs of other users, even where those users expose them to harmful interference.

For that reason, WCA generally does not oppose the Commission’s proposal to permit unlicensed providers to utilize cognitive radios at higher power in rural areas, provided that such high power operations do not expose licensed services to an increased risk of interference.²⁸ In that regard, it is critical that the Commission ensure that any higher power operations in the

²⁷ See *NPRM* at ¶¶ 33-47. WCA does not however, support the unlicensed Commission’s proposal to permit unlicensed higher power operations in restricted bands, or for devices operating under rules other than Sections 15.247 and 15.249. See *id.* at ¶ 41. The *NPRM* does not address how such operations could protect sensitive wireless services in the restrictive bands from harmful interference and given the uncertainties in cognitive radio technology discussed above, there is not public interest justification for the Commission to put those services at risk in this proceeding.

²⁸ WCA believes, however, that there is another significant difficulty with the Commission’s proposal to limit higher power unlicensed cognitive radio operations to rural areas only. The Commission is attempting to deal with this problem by proposing to define “rural area” not by geography but in terms of whether spectrum is “unused” at a particular location. *Id.* at ¶ 44. Under this construct, an unlicensed band would be considered “unused” if it has “a measured aggregate noise plus interference power no greater than 30 dB above the calculated noise floor within a measurement bandwidth of 1.25 MHz.” *Id.* As already pointed out in comments filed in this docket by equipment vendor WaveRider Communications Inc., permitting usage of a higher power cognitive radio where it detects a signal level no more than 30 dB above the noise floor will cause harmful interference to more spectrally efficient equipment that operates near or below the noise floor, and, therefore, will “discourage the use of system wide Transmit Power Control (a key cognizant radio technology) since the very act of lowering the required signal powers can result in other users/operators increasing the interference levels, and negating the advantages of the improved [equipment] sensitivities that would otherwise allow the reduction of power levels. Attention will have to turn to making higher power the objective, with the attendant negative results of higher equipment costs and higher general interference levels. This

(continued on next page)

unlicensed bands do not increase the absolute amount of out-of-band emissions from unlicensed operations into adjacent licensed spectrum.²⁹ As recognized in the *NPRM*, this result is relatively easy to achieve where the current Part 15 out-of-band emissions limits are independent of in-band power.³⁰ For example, under Section 15.209 of the rules, the general out-of-band emissions limit for unlicensed operations above 960 MHz is a field strength of 500 uV/m measured at a distance of three meters.³¹ Hence, higher power operations in the unlicensed bands should be required to meet that absolute limit where they transmit in spectrum above 960 MHz. Similarly, the out-of-band emissions limit for devices operating under Section 15.249 (*i.e.*, a limit of 50 dB below the in-band emission limit) is independent of in-band power, and thus higher power unlicensed operations should be required to comply with that requirement.³² By contrast, the *NPRM* recognizes that for devices operating under Section 15.247, the limit for out-of-band emissions outside of restricted bands currently *is* a function of in-band power (*i.e.*, 20 dB below the in-band power level of the device).³³ Thus, that rule must be modified to assure that out-of-band emissions are not increased above the current maximum level even if unlicensed facilities are permitted to operate at higher power under the Commission's proposal.³⁴

appears to be a 'zero-sum' game." Comments of WaveRider Communications Inc., ET Docket No. 03-108, at 8 (filed Mar. 29, 2004).

²⁹ See *NPRM* at ¶ 42.

³⁰ *Id.*

³¹ 47 C.F.R. § 15.209.

³² *Id.* § 15.249(d)

³³ *Id.* § 15.247 (c).

³⁴ WCA thus recommends that the Commission add a subsection to its proposed new Section 15.206 that explicitly conditions higher power operation on compliance with the Commission's
(continued on next page)

II. CONCLUSION.

Regardless of the technology at issue, the Commission must remain focused on the SPTF's core principles of flexible use and secondary markets, and let the marketplace, not regulatory fiat, determine the circumstances under which new technologies will be introduced to the public. Cognitive radio is a promising technology, but if misapplied it could have potentially debilitating consequences for innovation in and growth of licensed services. The only viable means of managing that risk is to let licensees and other spectrum users allocate it among themselves and define their usage of cognitive radios via privately negotiated agreements

existing out-of-band emission limits: To that end, WCA recommends the following language (new material is underscored):

§ 15.206 Cognitive radio devices

...

(c) Intentional radiators operating may operate at the higher power limits specified in paragraphs (a) and (b) of this section subject to the following conditions:

...

(v) Devices must comply with the emission limits set forth in Sections 15.209, 15.247(c) and 15.249(d), such that their absolute level of out-of-band emissions are no higher than permitted under those rules. Where the emission limits in Section 15.247(c) apply, a device's absolute level of out-of-band emissions shall not exceed those permitted under Section 15.247(c) for operation under the power limits set forth in Section 15.247(b).

tailored to their own individual circumstances. Any other approach will compromise the substantial progress the Commission has already made towards meaningful spectrum policy reform.

Respectfully submitted,

THE WIRELESS COMMUNICATIONS
ASSOCIATION INTERNATIONAL, INC.

By: /s/ Andrew Kreig
Andrew Kreig
President

1333 H Street, N.W.
Suite 700 West
Washington, D.C. 20005
(202) 452-7823

May 3, 2004