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

In the Matter of	)	
	)	
Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies	)	ET Docket No. 03-108
	)	
Authorization and Use of Software Defined Radios	)	ET Docket No. 00-47
	)	

ALVARION COMMENTS TO NOTICE OF PROPOSED RULE MAKING AND ORDER

I. INTRODUCTION

Alvarion appreciates the opportunity to register official comment with respect to the FCC's Notice of Proposed Rulemaking regarding the Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies.

Alvarion is the world's leading pure play provider of wireless broadband solutions and we are a very pro-active leader. We develop and market carrier-class solutions from 800 MHz to 26 GHz, covering applications as diverse as high-speed Internet access, TDM voice, cellular backhaul, mobile broadband, public hotspots, and enterprise bridging. While Alvarion's leadership may be measured in units deployed (more than 1.5 million), countries deployed (over 125), and most any other significant metric, Alvarion has also been a principal leader in the wireless standards development process from the first IEEE 802.11 WLAN standard to the recent IEEE 802.16.

From Iceland to Chile, from India to Ireland, from Namibia to Russia, from Cambodia to New Zealand, the globe's largest wireless broadband deployments in almost every region are Alvarion based. In the U.S., approximately 200 telephone companies, 80 utilities, 1,000 ISPs, many municipalities, several large regional cellular carriers, and a number of cable MSO's are delivering wireless broadband services to several hundred thousand subscribers using Alvarion's BreezeACCESS multi-point solution.

BreezeACCESS integrates 900 MHz, 2.4 GHz, MMDS, 3.5 GHz, and multiple 5 GHz bands into a single solution with end user speeds from 3Mbps to 24 Mbps. Significant deployments can be found in markets as rural as Jefferson County, Nebraska with a population as of only 8,250, but where Diode Communications has over 1,000 fixed wireless broadband customers to as metro as San Diego County, California, where over 500 sheriff's deputy vehicles have mobile broadband access.

Accordingly, as a market leader, Alvarion accepts the responsibility and respectfully offers the following comments to the Commission.

II. DISCUSSION

As a matter of preface to our comments, Alvarion concurs with the Commissions definition of cognitive radio, "A cognitive radio (CR) is a radio that can change its transmitter parameters based on interaction with the environment in which is operates." We understand the key benefit is the ability of cognitive radio technologies to adapt a radio's use of spectrum to the real-time conditions of its operating environment to offer regulators, licensees, and the public the potential for more flexible, efficient, and comprehensive use of available spectrum while reducing the risk of harmful interference. With this being said, our comments will focus on certain technical points and the practical issues of using cognitive radio technologies for Wireless Broadband Solutions.

As stated in paragraph 11 of the NPRM, radios with cognitive capabilities are already in use. Some radios such as wireless LAN devices can learn which frequencies to use by passively scanning and listening for its access point (AP) and Unlicensed National Information Infrastructure (U-NII) devices operating in the 5.25-5.35 GHz and 5.47-5.725 GHz bands incorporate dynamic frequency selection and transmit power control to avoid interference to Federal Government operations. Additionally, in the 902 – 928 MHz and 2.4 – 2.4835 GHz bands, Alvarion has hybrid digital radios (hybrid frequency hopping digital transmitter) that can find and learn the frequencies in use by the base station radio, which has been configured to operate on unoccupied frequencies. "Listen before talk" mechanisms such as those used by wireless LAN devices have allowed for sharing of the spectrum in the time domain. The statistical nature of network traffic demands have worked well with such mechanisms. However, network traffic is becoming more deterministic because of applications such as voice over IP (VoIP) and video over IP. These applications are very sensitive to network latency, jitter, and packet losses. The requirement to maintain Quality of Service (QoS) is paramount to any broadband service, wired and wireless alike. Vendors have independently created mechanisms to increase spectral efficiency, improve spectral reuse, and maintain certain levels of QoS. Yet, there are no mechanisms compatible between vendors which allows for sharing of the spectrum while maintaining QoS to time sensitive applications. To address this problem, the IEEE 802.16 wireless broadband standards committee is currently taking under consideration the following proposal, "Spectrum sharing in License Exempt bands – protocol proposal IEEE C802.16d-04/30", which provides a mechanism for physical layer transmit synchronization between spectrum sharing between unlicensed devices.

NPRM paragraph 31 seeks comment on all issues related to the application of cognitive radio technology, including the frequency bands and services that are most likely to benefit from this technology. While we contend the capabilities described in NPRM paragraphs 22 – 30 would enhanced spectrum sharing, we want to emphasize the issues that arise between the two expected co-existence scenarios for cognitive radios.

A. Co-existence between unlicensed devices

Co-existence between unlicensed devices (cognitive or non-cognitive) will not be on an equal fair level. Unlicensed devices currently exist in vast numbers today and are not cognitive and many employ no means of sharing spectrum. (We understand this is a key motivator for the commission to adopt new rules). However, as an example, if a new wireless broadband cognitive radio system is put into service by a Wireless Internet Service Provider (WISP) and then a cognitive or non-cognitive indoor device (cordless phone, WLAN, etc.) starts to transmit, (and is received above the proposed threshold) the cognitive WISP radio will be forced to yield, either reducing power or vacating the channel. Either way, the WISP subscriber suffers an outage to service, however brief. In the same scenario, the indoor devices may comply with the proposed high power detection threshold, yet will not receive the signals from the WISP base station above the detection threshold at the same level the outdoor subscriber does, the indoor device then starts transmitting at the higher power level. For this reason we feel that indoor devices, that share the same spectrum as outdoor devices used for broadband services, should not be permitted to use higher transmitter power levels. Wireless broadband systems require a high level of predictability and consistency in order to offer service. This includes enough spectrum to deliver the subscribed data service, the abilities to plan coverage (cell planning), and as mentioned earlier, mechanisms to allow QoS. A key word here is "plan." A typical wireless operator will, after determining the business feasibility in his target area, perform a spectrum and site survey to determine how much spectrum and at what level it is in use, determine the locations to install base stations to cover the target area, and make a cell plan using the available spectrum. The cell plan involves determining which frequencies to assign to each sector of each cell and base station. As well, the plan must account for a predictable cell range relative to the band used and the power allowable. The proper method ensures that adjacent channel interference and cell-to-cell interference is minimized along with the making the most efficient use of the available spectrum. This is a complex and coordinated effort, even when the planning is limited to a single band. While some cognitive capabilities will help minimize these complexities, others will make it extremely difficult to offer any type of deterministic service, as each band a cognitive radio may move to will have distinct propagation characteristics and power rules. Allowing higher transmitter power levels could have destabilizing effects on wireless broadband operations without proper coordination.

The Commission proposes to define "unused spectrum" as spectrum with a measured aggregate noise plus interference power no greater than 30 dB above the calculated thermal noise floor within a measurement bandwidth of 1.25 MHz, and that a device must be able to sense across the entire authorized band of operation to determine spectrum occupancy before commencing transmissions at higher power. This represents a -83 dBm/MHz threshold for "unused spectrum." This level of signal will leave many wireless broadband subscribers, capable of operating reliably at signal levels in the low 90's, in the "unused spectrum" category and subject to increased levels of interference from a nearby transmitter that switched to high power mode. Most wireless broadband systems transmit bursts of packets to their subscriber units. Determining if the spectrum is available is therefore a function of measurement time. Any "spectrum in-use" sensing method should take into account the average signal level measured over enough time to take into count the duty cycle of the other unlicensed system. The spectrum may be "in-use", but at a low duty cycle, allowing another system to transmit in the gaps. Transmitting at a high power level should be permitted if, 1) the transmitted energy outside the occupied bandwidth is attenuated sufficiently to prevent interference with systems on adjacent frequencies and, 2) high-power device identifies itself by using a special frame start marker (reference IEEE C802.16d/04-30 mentioned earlier). Otherwise, the "unused spectrum" threshold must be lower than -83 dBm/MHz. The last thing we want to see is a "shouting" contest that ripples throughout the wireless broadband service area where transmitters are switching between high power and low power as they falsely detect "unused spectrum."

B. Co-existence between unlicensed devices and licensed devices

Co-existence between unlicensed devices and licensed devices is much simpler since the licensed devices are at a known location, with known power and on known frequencies. This may not be the case with all primary licensed users of a band, never the less the variables are fewer. Cognitive capabilities such as DFS and TPC already demonstrate the abilities for unlicensed equipment to share the spectrum with licensed devices. In paragraph 11 of section B, the Commission asks for comment on the use of geo-location technologies for the unlicensed device to determine if it is to operate away from licensed systems. Incorporating GPS or other geo-sensing technologies would be both unreliable and burdensome. If the receiver were shadowed by buildings or trees, the GPS signal may be blocked and not provide accurate location information. Also, the addition of more electronics to the equipment drives the cost up at a time in the industry life cycle when wireless broadband equipment is already under price pressure because of declining costs of cable and DSL modems. We agree that frequency bands that are geographically under-utilized offer an ideal opportunity for unlicensed wireless broadband. In addition to cognitive capabilities such as "in use spectrum" sensing, central coordinated DFS and TPC, we support the idea of an operational permit. Such a permit would be obtained by the wireless broadband operator by completing an application online through a system like the FCC Universal Licensing System, supported by the FCC. The online system would require information such as location, height, desired frequency band and EIRP of the proposed base stations and service areas (by zip code or other means). The application would be compared to FCC and/or NTIA databases to determine if the proposed system would be in conflict with any licensed service. If no conflict is determined, the permit would be granted. If a conflict is determined, the online system could offer suggest alternate frequency bands and/or a reduced transmitter power limit.

C. Proposed changes to Sections 15.247 and 15.249 of the rules

The Commission proposes to allow a transmitter power increase of up to 6 times (approximately 8 dB) higher than the current limits in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands under Section 15.247 of the rules, and in the 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz and 24.0-24.25 GHz bands under Section 15.249 of the rules. Specifically, the proposed maximum transmitter power levels or maximum field strength levels in areas with limited spectrum use would be:

a. Spread Spectrum Devices (§ 15.247)

- 6 watts for digital transmission systems and the following frequency hopping systems: systems in the 2400-2483.5 MHz band using at least 75 hopping channels, all systems in the 5725-5850 MHz band and systems in the 902-928 MHz band using at least 50 hopping channels
- 1.5 watts for frequency hopping systems in the 902-928 MHz band using at least 25, but fewer than 50 hopping channels
- 0.75 watts for frequency hopping systems in the 2400-2483.5 MHz band using fewer than 75 hopping channels

b. Unlicensed operation in the 900 MHz, 2.4 GHz, 5.8 GHz and 24 GHz bands (§ 15.249)

- 125 millivolts per meter at a distance of 3 meters in the 902-928 MHz, 2400-2483.5 MHz and 5725-5875 MHz bands
- 625 millivolts per meter at a distance of 3 meters in the 24.0-24.25 GHz band.

We agree with higher power limits established above, however, we have concern that without any in-band spectral mask requirement some wide-band systems will amplify the fundamental signal along with the side lobes making adjacent channel operation impossible. The current rules for the ISM bands are written to limit the power spectral density by promoting wideband transmission. While this will cause lower power on any given frequency, it does have the effect of distributing energy outside of the bandwidth needed for transmission. We propose the Commission consider higher transmitter powers for systems using lesser occupied bandwidth. This would promote higher spectral efficiency of the digital transmitter, and minimize the impact on the noise floor of adjacent spectrum. We agree TPC should be used along with an improved method for determining "in-use spectrum" (refer to earlier comments).

We have comment on Section 15.247(h); we feel this rule no longer has merit since digital transmission systems can transmit on all frequencies in the band and do not monopolize the spectrum.

The Commission seeks comment on whether there are any possible problems with unlicensed devices operating at higher power levels meeting the RF safety limits. We agree with the assessment that while it may be relatively easy for a WISP provider to increase its power, from a central base station, a user's ability to increase its power on the return path may be constrained due to battery or RF safety issues and product cost considerations. In addition to the base station using sector antennas to overcome this perceived limitation, new wireless broadband systems based on the IEEE 802.16 standard may use up-link OFDMA, which increases the up-link system gain by up to 15dB, while keeping the same power level as current devices. This allows for operation with highly asymmetrical power values, and still complies with RF safety requirements.

III. CLOSING

In closing, Alvarion appreciates the Commissions attempts to be progressive and consider possibilities outside that of traditional regulatory thinking. While we are confident cognitive radio will help make the task of spectrum sharing easier, it can not be a substitute for the careful planning and network design required to make a wireless broadband system with the same reliability and service offerings as its wire line peers.

As always, Alvarion is pleased to be a party to this comment process, and we look forward to participating in future comment processes.

Respectfully submitted,

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