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
	)	ET Docket No. 00-47 (Terminated)
Authorization and Use of Software Defined Radios	)	

COMMENTS OF:

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May 3, 2004

SUMMARY

The Statewide Wireless Network, New York State Office for Technology offers comments in the above captioned proceeding. The Commission has presented a number of good points within this Notice of proposed Rulemaking & and Order that one day may be beneficial to Public Safety.

Cognitive Radio (CR) technologies can be beneficial to fostering interoperability. However, before any of these technologies are deployed in a Public Safety environment it is critical that they are thoroughly evaluated; guaranteeing they are secure and do not degrade performance of existing Public Safety and critical infrastructure licensed operations.

Increasing power level of unlicensed devices for specific functions such as WISPs would best be on channels allocated for increased power in order to prevent interference to other uses.

Spectrum sharing with unlicensed devices on the bands containing Public Safety and critical infrastructure licensed channels would be detrimental to the protection of life and property. Permitting uncontrolled shared operation would raise the noise floor and ultimately require Public Safety systems to be designed on an interference-limited basis. It has been shown that increasing the noise floor such that 10 dB more signal was required of Public Safety systems to maintain their performance and reliability would result in the need for more than three times as many transmitter sites, a significant additional financial and environmental burden.

Leasing of Public Safety spectrum is not recommended. However, within the limited application of traffic load leveling, Public Safety trunked radio systems could provide a mechanism for leasing services to commercial entities where not restricted by law. .

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I. INTRODUCTION

1. These comments from the Statewide Wireless Network, New York State Office for Technology, present the views of the State of New York (the State) in response to the Commission's Notice of Proposed Rule Making and Order (NPRM) in the above captioned proceeding, released December 30, 2003, FCC 03-322. The State offers its position on these issues - especially where they could affect the communications capabilities of Public Safety. We applaud the Commission for embarking on bold new initiatives, which, one day, could introduce advanced technologies into the Public Safety community. We are eager to participate in a forum that could result in tools for Public Safety that offer enhanced equipment functionality, facilitate greater operational interoperability, and ultimately save lives. We hope that the results of such activity will be that all issues will be adequately addressed, considering the unique requirements of the Public Safety community.

2. The New York State Office for Technology, on behalf of the State of New York, is in the process of procuring a new Statewide Wireless Network (SWN) for State, Federal and Local Governmental entities that operate within or in the proximity of New York State's geographic borders. SWN will provide an integrated mobile radio communications network that will be utilized by both Public Safety and Public Service agencies in New York State. It will provide a digital, trunked architecture that will offer both voice and data capabilities. SWN will be used in day-to-day operations, as well as for disaster and emergency situations, to more effectively and efficiently coordinate the deployment of all levels of government resources to such incidents. It will also enhance international coordination along the

US/Canadian border, and will play a critical role in supporting the homeland defense efforts within the State of New York.

3. In this response to the NPRM we consider the impacts and benefits of cognitive radio technologies upon Public Safety communications, and we offer our comments and concerns where we believe that regulatory issues related to cognitive radio operations could affect Public Safety. These include "promising aspects" of cognitive radio that could yield operational benefits by facilitating interoperability. However, the State is concerned that security and interference issues must be considered in parallel, and with a high priority, when discussing the technological features and operational capabilities of cognitive radio.

II. IS COGNITIVE RADIO NECESSARILY A FEATURE SET OF SOFTWARE DEFINED RADIO TECHNOLOGIES?

4. We believe that Cognitive Radio (CR) is a subset of Software Defined Radio (SDR) technologies. While the NPRM describes an example of a low-band VHF wireless telephone as a CR[1], in fact, that telephone is not cognitive in that it does not "learn" from its environment and modify its characteristics accordingly; it is merely following a set of rules, where, if a channel is busy, it selects another pre-programmed channel. As in this example, such a radio device can be made of purely discrete components, not even using software.
5. A CR learns from its environment and modifies its behavior based on what it learns. In an interoperability scenario, a CR learns from its environment what modulations are being used on a particular channel and adapts accordingly to permit communications with the other units on that channel.

[1] NPRM at paragraph 10.

6. In this proceeding the Commission implies that CR and SDR can be mutually exclusive of one another[2]. We disagree with that view. While software defined radios have been in existence for some time now (beginning with synthesized oscillators to generate transmit and receive frequencies), where the operating parameters of a radio are programmed into its EEPROM[3] modules, a Cognitive Radio, which is capable of modifying its parameters based on its environment is very new technology and depends upon its basic SDR capability in order that the Cognitive functions for analysis (learning) can cause modifications of the SDR operating rules and parameters. It has not been shown how a CR can perform the learning function without the use of software. Therefore, we believe that CR is a subset of the features of an SDR. As such, while an SDR can be decoupled from a CR, the reverse is not true.
7. We respectfully urge the Commission not to regulate CR and SDR as if they are the same. SDR is covered under the current rules governing authorization and certification. We are concerned that additional regulation of SDR could negatively impact innovation, development, and deployment of a very important communication technology.

III. COGNITIVE RADIO CAPABILITIES

8. The Commission seeks comment on how cognitive radio capabilities might function to achieve greater levels of spectrum access, efficiency and interference mitigation[4]. These included a number of features ranging from dynamic frequency selection (DFS)[5],

[2] NPRM at paragraph 10: "…The majority of cognitive radios will probably be SDRs, but neither having software nor being field reprogrammable are requirements of a cognitive radio."
[3] Electrically Erasable Programmable Read Only Memory
[4] NPRM at paragraph 23.
[5] Ibid, paragraph 24, dynamic frequency selection.

identification of the presence of other signals operating in a band[6], adaptive modulation techniques[7], transmit power control[8], geolocation information[9], and the use of techniques to enable self-regulation[10]. Our comments which follow address many of these topics along with operational aspects of these technologies together with their practical and financial implications to Public Safety.

9. It is important to understand how Public Safety systems are typically configured. Public Safety communications can be conventional or trunked, and employ analog and/or digital modulation schemes. For trunked systems, frequency assignments are automatically managed by control channel signaling, and users are assigned working channel assignments based upon talk path availability and priority. For conventional systems, access is primarily based upon a first-come-first-served basis. Conventional operations can utilize repeater stations or direct communications. Conventional operations can be on a single frequency, or on two-frequency channels (i.e. mobile-to-base station and base station-to-mobile). Trunked operations generally use two-frequency channels (i.e. mobile-to-base station and base station-to-mobile). Trunked operations usually operate on multiple channels, but can operate on a single channel. Trunked operations can operate with FDMA or TDMA[11]. Tone or Digital signaling is often employed to manage channel usage and prevent channel contention interference.

10. The Commission envisions DFS as a means to dynamically detect signals, avoid co-channel operation, and thereby reduce the possibility for interference; all very useful capabilities within Public Safety Communications. Such technology already exists in multi-channel

[6] Ibid, paragraph 25, identification of other signals operating in a band.
[7] Ibid, paragraph 26, adaptive modulation techniques.
[8] Ibid, paragraph 27, transmit power control.
[9] Ibid, paragraph 28, ability to exploit GPS data.
[10] Ibid, paragraph 31, use of technology for self-regulation.

trunked systems where reception of a "foreign" signal can result in that channel being "locked-out" from assignment until the "foreign" signal goes away. DFS could be beneficial for managing conventional operations. However, there are technical and operational issues to be overcome.

11. In determining if a channel is in use, the receiver making this determination must be capable of receiving signals from the transmitting site and, in the case of a two-frequency channel, associating the two frequencies as a single channel. This is a very significant problem given that topography and the relative geographic locations of transmitters and receivers, combined with directional antenna patterns, may easily preclude the ability to sense a transmission in progress. In some frequency bands (e.g. VHF Highband), there is no uniform channel plan where two-frequency channels are used typically for Public Safety repeater systems.
12. The NPRM suggests that the application of "cyclostationary" technology can improve the ability of a receiver to sense the presence of a signal. However, this technology requires knowledge of the transmitted waveform and requires a significant sampling integration time, which further limits its effectiveness for the intended purpose. Public Safety transmissions are typically short, e.g., 4.5 seconds. Even so, a 30 – 40 dB improvement will not be sufficient in the UHF bands where topographic signal path attenuation and directional antennas can easily negate that level of sensitivity improvement.
13. Without a proven methodology to ensure that determination of a frequency being unused can reliably be demonstrated, we believe it is imprudent to establish regulations that will permit such operations on frequencies licensed to Public Safety and Critical Infrastructure.
14. In general, DFS could work like a trunked system in reverse, where channel assignment control resides within the subscriber radio, allowing it to negotiate channels for conventional

[11] FDMA = Frequency Division Multiple Access, TDMA = Time Division Multiple Access.

operations. However, we stress that in order for DFS to be successfully utilized in this fashion, subscriber synchronization will have to be rapidly achieved in order to prevent loss of critical communications capabilities. Furthermore, the synchronization method must be secure enough to prevent communications from being maliciously blocked.

15. In order for DFS to be beneficial to Public Safety it must meet several basic criteria. First, DFS should provide the same level of performance and access to communications that direct mode communications provide today. In particular, the latency time delay from Push-to-Talk to received audio must be the less than 500 ms, requiring very fast signal detection and synchronization. Second, DFS must be secure, and the deployment of this technology must not occur until there is adequate assurance that it will not degrade Public Safety operations.
16. We agree that use of adaptive modulation technology would be especially beneficial to Public Safety interoperability operations.
17. Transmit Power Control (TPC), is used to dynamically adjust the output power of radiocommunications devices. It offers clear benefits in enhancing spectrum reuse, reducing interference, and increasing the battery life of subscriber devices.
18. For TPC to be successfully applied, a duplex channel is required to permit rapid adjustment of TPC during a transmission in order to maintain the quality of service (QoS). Therefore, for TPC to be fully viable in a Public Safety environment a means of providing QoS feedback must exist. TPC can be easily implemented in <u>new</u> radio system equipment.
19. Geo-location is a feature that can be used to automatically adjust the programming of a mobile radio that must operate over wide geographic areas where channel plans must be changed according to location. Geo-location can therefore be used for Regional Channel Plans. However, this type of radio system operation has been under development. However,

our understanding is that while the concept worked, the practical implementation required such a high degree of detailed information that it was judged impractical for that purpose. This probably indicates that the technology needs further development for use in an environment where signal strength and adjacent regional channel plans need to be integrated with geo-location data for conventional channel operations in rough terrain.

20. Geo-location could be used for instance to permit sharing of TV broadcast channels where the land mobile unit could operate on a set of frequencies when it was sufficiently outside a broadcast station's Grade B contour. Such an operation would be easily achieved, since the Grade B contour is an established regulatory protection.

21. Where geo-location is used between units of different systems to prevent interference, there would need to be a technical communication standard, such that all radio units would communicate location data and other parameters on a uniform format. Until such a standard is in place and used by all radio units, this technology must be limited to such applications as described above in paragraph 20.

22. The term "peer enforcement" conjures up "vigilante frequency cops". When it comes to enforcement of FCC regulations, that authority is vested with the FCC. As more and more technically sophisticated communications systems are developed, it becomes more difficult and less likely that licensee personnel will be able to determine what is causing system degradation or even to recognize that degradation is occurring. If you can't receive a signal due to an increased noise level, the call is missed and that fact is not recognized by the intended recipient. Refer to the current 800 MHz interference issues that have developed from intermixing Public Safety with incompatible cellular operations.

IV. RAISING TRANSMIT POWER ON THE ISM BAND

23. The NPRM suggests that ISM band power levels can be increased for rural areas and other under served areas. The mandatory use of transmitter power control to ensure that the minimum power required to achieve the necessary channel performance criterion is essential to preventing interference. Use of directional antennas in the use of ISM bands for point-to-point communication also serves to prevent interference.

24. The Commission has also requested comment on allowing Wireless Internet Service Providers (WISPs) to operate at higher power levels. Spectrum access opportunities will be diminished as a result of increased interference levels. While there is room for innovation in the ISM bands, the use of higher power with omni-directional antenna patterns should be based upon some criteria such as band partitioning.

25. High power operation to service a large coverage area would best be allocated dedicated spectrum channels. An alternative would be the use of wireless in the "last mile". Presently, most network connectivity in residential or rural areas is through wire line technologies such as traditional Telco, digital subscriber line, fiber, or cable. WISPs could deploy wireless points of presence on telephone poles, which are in close proximity to most homes, using a cellular (interference limited) architecture. This could be accomplished with existing or only moderately increased power levels. The use of lower powered transmitters and TPC would also reduce the level of any interference.

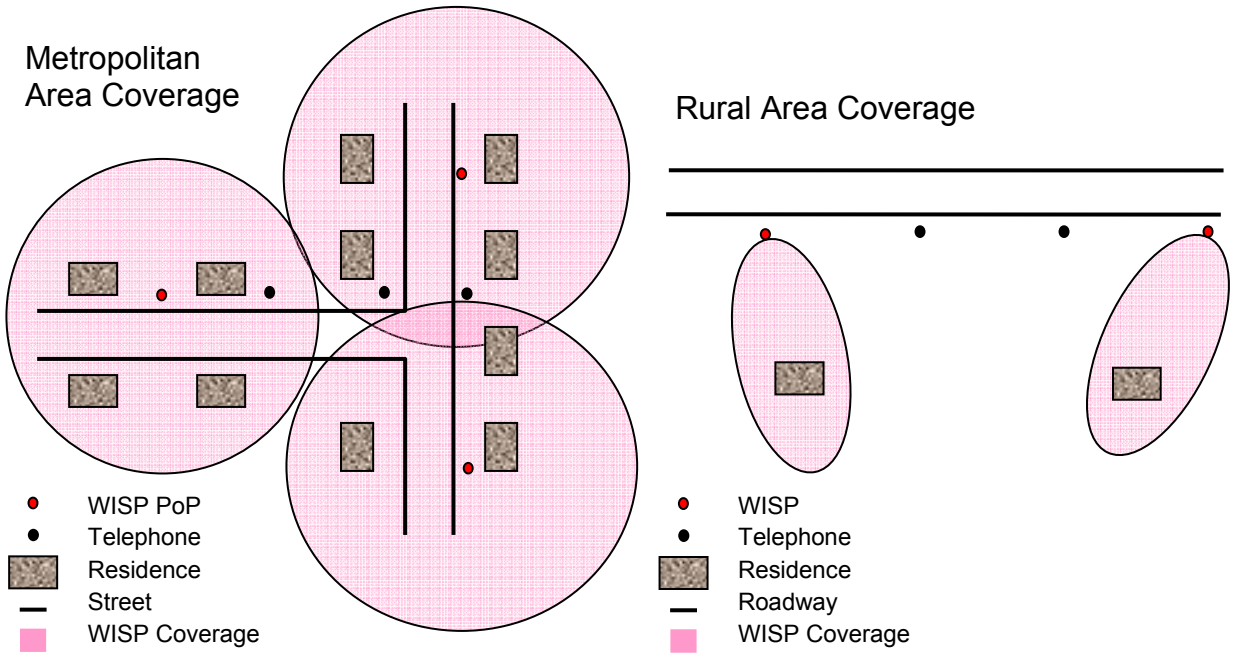


Figure 1 Local Area Coverage for Metro and Rural Environments to Minimize Interference.

V. RELAXATION OF PART 15 RULES TO PERMIT HIGHER POWER OPERATION

26. The Commission also seeks comment in paragraph 41 inquiring into the possibility of allowing higher power operation of devices operating under Part 15 rules. Increasing power levels from such devices runs the risk of making it virtually impossible to identify the source of interference. Higher power operation should be allocated to specific channels.

27. Part 15 devices should not be allowed to share spectrum in Public Safety bands. However, Licensees of Public Safety and critical infrastructure channels should be permitted to operate Part 15 devices on their own licensed channels.

28. Permitting uncontrolled shared operation would raise the noise floor and ultimately require Public Safety systems to be designed on an interference-limited basis. It has been shown that increasing the noise floor such that 10 dB more signal was required of Public Safety systems

to maintain their performance and reliability would result in the need for more than three times as many transmitter sites, a significant additional financial and environmental burden.

VI. PUBLIC SAFETY SPECTRUM LEASING ISSUES

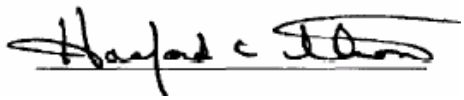
29. This topic raises many concerns. Spectrum leasing authority could distort and potentially corrupt spectrum management, worsening the already serious spectrum shortages that exist in many areas. The ability to lease spectrum could lead some state or local government entities to acquire more channel capacity than needed for their internal operations, merely to provide an asset that can be leased for financial gain, and thereby prevent another licensee from obtaining enough spectrum for their needs.
30. The 700 MHz Public Safety band is restricted by law from commercial use. State and local agencies may lack the legal authority to lease spectrum.
31. Except as restricted by law, Public Safety lease airtime on trunked systems and that would allow them to manage their airtime to maintain high priority levels to Public Safety users. While this would not require additional engineering or frequency coordination, the issue of increasing the system capacity resources exists. Our recommendation is that this could be allowed within the constraints of the Public Safety system capacity requirements, i.e. leasing system use as system availability permits, but not to justify increasing system channel capacity
32. Other types of decentralized spectrum sharing are not desirable on Public Safety and critical infrastructure licensed channels, and could be highly detrimental to the protection of life and property.

VII. CONCLUSIONS

33. It is encouraging to see the Commission initiate bold new initiatives that bring technology into the market place. The use of cognitive radio technology shows the most promise in Public Safety applications fostering interoperability and reducing interference. Cognitive radio could be extremely useful in facilitating interoperability in the future.

15. We respectfully urge the Commission to consider security implications of these technologies as they impact Public Safety. We request the Commission to thoroughly test and validate these technologies to ensure they will not cause harm to Public Safety or critical infrastructure operations.

Respectfully Submitted,



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