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

In the Matter of	)	
	)	
Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band	)	PS Docket No. 06-229
	)	WT Docket No. 96-86
Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010	)	

COMMENTS OF THE SOFTWARE DEFINED RADIO FORUM ON NINTH NOTICE OF PROPOSED RULEMAKING

Introduction

The Software Defined Radio Forum (SDR Forum) is pleased to see the FCC propose advanced technologies of Software Defined Radio and Cognitive Radio in addressing the challenges of improving communications for the Public Safety community. The SDR Forum is an international, non-profit organization dedicated to promoting the development, deployment and use of Software Defined Radio (SDR) technologies. More than 110 organizations throughout the world are members of the SDR Forum.[1] Participants in Forum activities are decision-makers, planners, policymakers, technologists, educators, and managers from a wide variety of commercial, educational, scientific and government organizations.

The Software Defined Radio Forum also works closely with a number of national and international organizations working in our areas of interest. It participates in technology development and standards development activities.

[1] See http://www.sdrforum.org/pages/currentMembers/currentMembers.asp

The SDR Forum has worked closely with the FCC for a number of years. Forum members view this association as a valuable conduit for information, and one of the benefits of Forum membership. We are pleased to offer these comments on the subject proposal.

This document has been prepared by the Regulatory Committee of the Software Defined Radio Forum and has been approved by the Board of Directors of the Forum in accordance with its procedures. The Board believes that the position taken herein represents a consensus view of the Forum's membership, but the Board also realizes that some individual member organizations that did not participate in its preparation might offer differing opinions in their own submissions to the Commission.[2]

[2] AT&T Mobility (f/k/a Cingular Wireless), a member of the SDR Forum, is not a party to this filing of the SDR Forum

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I. SDR Forum Activities in Public Safety Communications

The SDR Forum views this NPRM as the intersection of two sequences of proceedings—the sequence of proceedings on this Docket WT 96-86 addressing the use of 700 MHz spectrum for Public Safety, and the series of proceedings on the introduction of SDR and Cognitive Radio technologies (including ET 00-47, ET 03-108 and ET 06-89). The SDR Forum also recognizes the significance of SDR and Cognitive Radio technology for Public Safety communications applications, and has chartered a Public Safety Special Interest Group (PS SIG). The focus of this Public Safety SIG is to consider the technical, operational, and regulatory challenges and approaches to harnessing SDR and Cognitive Radio technology to improve Public Safety communications capabilities.

As the SDR Forum noted in comments on the NPRM for Docket 03-108:

> Software defined radio is a rapidly evolving technology that will bring enormous benefits to the providers and consumers of wireless services. The potential of SDR technology is well known to this Commission, which has aggressively reformed its rules in a way that has helped allow SDR technology to become a reality. As it continues to develop, SDR technology will also play an important role in the development of cognitive radios and in the fullest possible exploitation of the spectrum resource. Thus, the SDR Forum supports the Commission's effort to promote the development of cognitive radio technology.[3]

And in comments filed on ET Docket 06-89, the SDR Forum noted that:

> … a key challenge is improving spectrum utilization and efficiency to enable these new applications and services without adversely affecting incumbents that utilize existing services.[4]

The SDR Forum has been studying the role of SDR and Cognitive Radio in Public Safety communications for several years. Within the Forum, the Public Safety SIG was created

[3] Comments of SDR Forum in ET Docket Nos. 03-108 and 00-47 at 2 (May 3, 2004), available at http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6516182893.
[4] Comments of SDR Forum in ET Docket No. 06-89 at 3 (July 10, 2007), available at http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6518397984.

specifically to provide a focus on activities in which the Public Safety community has an interest and to bring together Public Safety users, vendors, researchers, and regulators to identify requirements, establish research challenges, and support relevant standards development in the deployment of SDR and Cognitive Radio technology into the Public Safety community. The first major output of the Public Safety SIG was the report titled *SDR Technology for Public Safety*[5], released in April, 2006. One of the key conclusions of that report is that:

> SDR also has significant potential for both life cycle cost reduction and enabling cognitive applications that allow a radio to adjust operating parameters automatically to improve performance or better utilize spectrum that enhances performance.

The Report also included several recommendations:

- That SDR software researchers investigate cognitive applications to enhance interoperability and performance;
- That SDR software researchers investigate quantitative data on spectrum usage across all services including Public Safety, commercial services, and other services during major events and incidents; and
- That regulatory bodies modify existing regulations to support the capabilities listed above, including rules for accommodating evolving cognitive applications.[6]

The Public Safety SIG has also been actively working with the SDR Forum Cognitive Radio Working Group to develop use cases and explore prospective application of cognitive techniques and concepts to Public Safety.

The SDR Forum has consistently encouraged the exploration of SDR technology and Cognitive Radio technology to address the critical challenges facing Public Safety communications. This NPRM has far-reaching implications for business models and licensing that must be worked out for successful implementation. While the SDR Forum acknowledges the importance of those

[5] SDRF-06-A-0001-V0.00, 14 April 2006.
[6] Op. Cit., Table 0-1.

issues, the focus of the SDR Forum's comments is on the capabilities and current technology maturity of Cognitive Radio to support the proposed rules changes.

II. Public Safety Needs Enhanced Communications Capability Subject To Stringent Requirements

The SDR Forum recognizes that the Public Safety community faces multi-faceted challenges in upgrading communications capabilities to address current needs. Those challenges range from planning response to terrorist events and natural disasters to ever more complex daily operations and budget constraints. Despite significant gains in the past few years, interoperability continues to be a significant problem; available spectrum is inadequate; and new applications and data types (such as real-time video) are developing faster than the spectrum resources to utilize them are being made available. Events such as Hurricane Katrina demonstrate the need for, and challenge of, robust and sustainable communications.

The SDR Forum also understands that mission critical voice is currently the highest priority service for emergency responder safety and the safety of the public they protect. First responder mission critical voice communications systems are designed for 99.999% reliability with 95%-97% area coverage to ensure that emergency medical (EMS), fire and law enforcement services can communicate to their dispatch and talk-group members instantly, every time they key up the radio. Public Safety sets a high bar for robustness and reliability of systems used in their licensed spectrum, including interference protection from within and outside of their licensed bands to the greatest degree possible.

The SDR Forum believes that the Public Safety community will embrace Cognitive Radio technology as it becomes proven and available. Cognitive Radio technology must be demonstrably proven not to adversely impact Public Safety mission critical communications before it becomes operational, in keeping with the high standards of robustness, reliability and

interference protection required. We support the FCC and NTIA's concept of a Spectrum Sharing Innovation Testbed,[7] which would provide the opportunity to demonstrably prove the viability of technology prior to deployment.

The Forum supports rule modifications in the Public Safety bands that would provide Public Safety with the flexibility to introduce Cognitive Radio technologies. Public Safety also needs to be provided with incentive and flexibility to innovate.

The SDR Forum recommends caution in deployment of new technology to ensure a smooth introduction. Initial application of Cognitive Radio technology should take place under controlled conditions in geography and spectrum where critical usage is low in order to minimize the probability of problems. Successful experience will reinforce the feasibility and practicality of this technology, make clear the advantages it brings, and demonstrate the level of reliability needed for use in mission critical operations.

III. Secondary Operations in Public Safety Narrow Band Spectrum

Secondary operation of broadband protocols in narrow band Public Safety spectrum represents a significant technological challenge. Under circumstances where there is no planned use of narrow band communications, no problem exists. But no technology currently is available to overcome the problems that arise when both uses are attempted in close frequency and spatial proximity. This question is the most challenging aspect of the proposed changes.

The following are some considerations:

[7] *Federal Communications Commission Seeks Public Comment on Creation of a Spectrum Sharing Innovation Test-Bed*, ET Docket No. 06-89, Published 8 June 2006.

- Secondary reuse for broadband is appropriate if no voice channels are utilized in a region. National, state and region authorization is necessary because of interoperable channels that are distributed through the narrowband voice channels. Although not used routinely, there may be an incident which will draw response from first responders outside the region, needing these channels for interoperation. Regions that have no current voice channel utilization are potentially areas where testing of Cognitive Radio technologies could be carried out.

- Likewise, the block of 700 MHz channels assigned for use by the states could receive interference from secondary reuse, requiring coordination with the particular state where the reuse is occurring, and any adjacent states within potential interference range.

- Cognitive Radio technologies for secondary spectrum use need to be proven under controlled and real-world conditions, such as those presented in the current Spectrum Sharing Innovation Testbed proposals.

- Given the large block of spectrum that broadband requires and difficult technical assignment criteria for narrowband channels in urban areas, opportunity for secondary use there is limited. Potential problems with out-of-band emissions (OOBE) and intermodulation (IM) interference add complexity to the problem.

- Concern exists that premature implementation of Cognitive Radio could cause OOBE and IM interference similar to that experienced at 800 MHz, necessitating rebanding of that spectrum.
    - OFDM and similar advanced waveforms require a guard band on each side of the carriers to help minimize out-of-band emission interference to adjacent voice

systems in the narrowband 700 MHz spectrum. The FCC's previous rules provide that about one megahertz of guard band is needed on each side of a Broadband channel.

- The combination of OFDM or other advanced waveforms and narrowband voice in nearby spectrum gives rise to a potential IM problem with combinatorial complexity. Based on geometry, propagation anomalies, and characteristics of the receiving antenna and equipment, any two emissions can interact to generate interference that cannot be predicted by the transmitting stations. Nor can the receiving station determine with certainty the source(s) responsible for reduced link margin.

- Given the potential interference issues identified above, secondary use of mission critical narrowband voice channels requires that secondary users have the means to determine if a band that is a candidate for use is not needed by the primary user. A further mechanism is needed to ensure that the secondary emission can be immediately[8] and always "turned off" when a Public Safety user needs access for uses classified as primary. Current research is focused on a Cognitive Pilot Channel or Beacon operation, potentially out-of-band. While these approaches have significant potential, further development and demonstration will be required to provide adequate assurance that access is properly controlled and that clearance of the band can be accomplished within the time constraints required by Public Safety.

[8] The term "immediate" must be addressed with regard to public safety operations. The channel must be relinquished by the secondary user such that, from the time a "talk request" is initiated by a public safety user in the field, the secondary use ceases and the public safety system set-up takes place in a manner that no syllable of the public safety transmission is lost. The classic example of such a mission critical message is the consequence of cutting off the first part of a "don't shoot" law enforcement transmission.

Cognitive Radio technologies do hold the promise to meet the vision set forth in this NPRM to increase spectrum for Public Safety and improve spectrum efficiency. The substantial potential gains to be realized motivate development work to resolve these issues.

IV. Commercial Access to Broadband Spectrum With Unconditional Pre-emption

The proposed rule changes include the ability of the licensee to lease spectrum for commercial use under the condition that it can be made available immediately as needed for Public Safety use. Preemption can be accomplished in two fundamental ways. In a single network model, the same network would be used by both the Public Safety users and commercial users in the allocated spectrum. Under this situation, network control functions can determine when commercial communications needed to be pre-empted or blocked based on Public Safety requirements.

Technologies are in place to implement this single network model. In fact, such systems exist today. While Cognitive Radio technology is not required to implement this model, cognitive capabilities could enhance future network control algorithms by performing bandwidth provisioning and by anticipating demand. The underlying assumption is that network control has access to exercise control functions in an adequately short time frame.

The alternative is a multiple network model. It allows a separate commercial network in which devices are required to ensure that they are not interfering with Public Safety communications and can be pre-empted as necessary.

The multiple model with independent networks requires the non-Public Safety devices to sense the environment in such a way to know whether they can utilize spectrum. This capability, to sense and detect, has significant potential, but has not yet been demonstrated to meet the

requirements of Public Safety communications. The problem is a difficult one in that interference is a function of RF topography, and occurs at the *receiver*. However, the secondary user can only detect emissions on which to make an interference judgment from a primary user's *transmitter*.

A potential solution is use of a cognitive pilot channel for cross-network coordination. All prospective users of channels in a given location use a common protocol on a designated channel to coordinate their emissions and to avoid interference.

Beacon techniques may also be used to support interruptible access to spectrum.[9] By examining secure beacons received from the primary system, potential secondary users can determine if portions of the spectrum are available for use. Beacons may be used to authorize or to deny access to the channel. A secondary user must immediately cease transmission in the event of an indication that the channel is needed by Public Safety or an interrupted beacon signal. This safety mechanism provides a hedge in the event the beacon is shadowed or otherwise not received.

Both of these solutions must account for intermodulation distortion or out-of-band emissions. Both must also address the "hidden node" phenomenon that is particularly difficult to overcome when Public Safety users are operating in simplex mode between subscribers, as often happens for on-scene interoperability.

The proposed Spectrum Sharing Innovation Testbed could provide a critical opportunity to allow deployment and demonstration of appropriate sense and detect technologies.

[9] M. J. Marcus, "Real time spectrum markets and interruptible spectrum: new concepts of spectrum use enabled by cognitive radio," Proc. IEEE DySPAN, Baltimore, MD, Nov. 8—11, 2005, pp. 512—517.

While outside of the scope of the instant Notice, an incentive for developing technology which allows commercial users to utilize Public Safety spectrum unless pre-empted could also allow Public Safety users to utilize additional (and adjacent) bands in the 700 MHz commercial blocks.

The result could be that the commercial blocks and the Public Safety blocks become indistinguishable from Public Safety's perspective: it is all available to them when they need it. Public Safety can earn revenue on commercial use of their block, and could pay to use commercial spectrum.

V. Spectrum Requirement for Public Safety Broadband Use

The SDR Forum is concerned that the amount of 700 MHz spectrum allocated by the FCC to Public Safety for broadband use be sufficient to meet the current and anticipated needs of Public Safety users at the local, state, tribal and Federal level for the foreseeable future. Concern has been expressed by both Public Safety users and the private wireless industry that the Commission’s proposed 12 MHz block in the instant Notice may be insufficient to meet this need, but there is no definitive research to date that allows anyone to answer this question with any level of certainty. Should this be the case, the Commission moving forward with such a reassignment would not appear to be in the best interests of the Public Safety community.

As we note in Section VIII below, there is little quantified use information for either data or voice in the Public Safety bands. The SDR Forum stands ready to assist the Commission with such a spectrum needs study, but would propose to do so in partnership with other stakeholders such as the National Public Safety Telecommunications Council (NPSTC) and the Private Radio Section of the Telecommunications Industry Association (TIA).

The *Final Report* of the Public Safety Wireless Advisory Committee[10] is often referenced with regard to Public Safety spectrum projections through the year 2010. However, the *Final Report* did not consider two important issues that are critical to implementing the instant Notice. First, it did not address advanced technologies not projected to be needed at the time of publication in September 1996, including full-motion video that is now considered to be a Public Safety requirement and requires significant bandwidth. Second, it intentionally did not project spectrum required by Federal agencies for data services.

It is clear from recent events such as the terrorist attacks of September 11, 2001 and hurricanes Katrina and Rita that robust and reliable data and voice communications between all levels of government is essential. The SDR Forum urges the Commission complete a detailed, scientifically-based spectrum study to ensure that sufficient spectrum is assigned for broadband use to meet the projected broadband needs of all government Public Safety users for a significant period of time, and at least through 2020.

VI. Band Reconfiguration

The SDR Forum supports proposals that have been recommended by Access Spectrum, M/A-COM, Motorola, Pegasus and others which will move the narrowband blocks to be adjacent to one another. The advantages to these proposals include reducing spectrum required for guard bands and harmonizing the public safety broadband spectrum with commercial blocks. A number of these proposals have recently coalesced into a single plan called the Broadband Optimization Plan (BOP)[11] that would (a) increase the Public Safety allocation by providing an additional 3

[10] Final Report of the Public Safety Wireless Advisory Committee to the Federal Communications Commission and the National Telecommunications and Information Administration, 11 September 1996.

[11] Report of the 700 MHz Technical Working Group (TWG),October 23. 2006 to the Federal Communications Commission and Comments of Access Spectrum, LLC and Pegasus Communications Corp., WT Docket Nos. 06-109 and 96-86 (October 23, 2006).

MHz, (b) increase the commercial "A Block" by 1 MHz and relocate it adjacent to the Public Safety block, and (c) eliminate the "B block." The advantages to this proposal are numerous.

In the current band configuration, there are 3 MHz of public safety narrowband spectrum above and below the 6 MHz wideband/broadband spectrum block.[12] In order to protect the narrowband spectrum from interference from broadband transmissions, approximately 1 MHz of guard band would need to be taken from each end of the wideband/broadband spectrum. By reconfiguring the two 3 MHz narrowband spectrum blocks into one 6 MHz narrowband block the spectrum dedicated to guarding the critical narrowband spectrum is reduced by 50%.

Another important effect of these band reorganization proposals is to position Public Safety to take advantage of developments in future broadband technologies. It harmonizes the Public Safety bands with commercial blocks, potentially enabling 4G networks for Public Safety as well as commercial operators, allowing Public Safety to leverage the economies of commercial off the shelf (COTS) advanced technology. The SDR Forum notes that as spectrum policy in the Public Safety bands moves toward harmonization with commercial spectrum policy and system requirements, it is likely that cognitive radio research and development, which will take place to satisfy commercial demand, will also benefit Public Safety. This will allow Public Safety to leverage the commercial technology innovations and cost structures that are an extremely important benefit of the band optimization proposals and a central policy objective of the FCC's Ninth Notice of Proposed Rulemaking.[13]

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[12] This represents one side of the paired spectrum; a mirror image of 12 MHz represents the other pairs for these narrowband and wideband/broadband blocks.

[13] "Economies of scale and scope in production and competition in supply are important in achieving cost effectiveness" (PS Docket No. 06-229 and WT Docket No. 96-86, "Ninth Notice of Proposed Rulemaking, Released December 20,2006, at page 7).

Additionally, Public Safety may be able to create public-private relationships at a variety of levels if their spectrum is harmonized and adjacent to commercial spectrum. It is not inconceivable that Public Safety spectrum could be as valuable in the secondary marketplace as commercial spectrum. Under these proposals, Public Safety's 700 MHz allocation would contain harmonized bands, contiguous to commercial spectrum.

VII. Cognitive Radio Technologies Bring Additional Benefits to Public Safety

The SDR Forum encourages the FCC to continue to foster the development of SDR and Cognitive Radio technologies for public safety applications. There are a number of benefits that can accrue to Public Safety with the introduction of Cognitive Radio technology beyond those envisioned in this NPRM.

The SDR Forum Public Safety SIG and the Cognitive Radio Working Group are in the process of generating a report on Cognitive Use Cases for Public Safety. The purpose of this report is to identify applications of cognitive capabilities for Public Safety communications. The methodology being followed is to analyze actual or hypothesized scenarios and identify issues and situations for which a cognitive capability could improve communications.

Although this report will not be completed until later in 2007, it is already clear that Cognitive Radio technology built on SDR capabilities can provide significant benefit to Public Safety. For example, one concept under investigation is a cognitive capability to utilize peer-to-peer communications among responders cut off from their network to link back to a radio that could communicate with the network.

Another concept is cognitive capability in multiband and/or multiservice radios to facilitate interoperability by reconfiguring responders’ radios to on-scene communications channels. Other

cognitive capabilities under consideration include the ability to reconfigure Public Safety radios to provide: (1) intelligent bandwidth provisioning to ensure throughput of high priority transmission, (2) cognitive networking (smart mesh networking), (3) location awareness, (4) situational awareness, and (5) user authentication.

The Commercial Working Group of the SDR Forum, in cooperation with a broad range of internal groups and external standards organizations, is working to develop a Radio Metalanguage which will provide a Standards/Technology foundation for the capabilities envisaged in the FCC NPRM. The Metalanguage provides a capability for radios to securely exchange information about how the radios are/can be configured, who the users are and what type of information needs to be transferred. This will enable dynamic self-adaptation of the radios and their networks to allow for the most effective communications for Public Safety users

The SDR Forum believes that Cognitive Radio technology will be a critical tool in helping to meet Public Safety's future communications needs. Regulations should allow the maximum latitude to encourage innovation while recognizing and respecting the need to ensure no adverse impact to mission critical communications capabilities. Vendors should have a clear market path to encourage innovation and the development of solutions to address identified operational and technology gaps. Public Safety licensees should have proven technology and appropriate state and/or Regional Planning Committee approval for secondary use in narrowband voice channels, given the operational need to protect those channels for primary mission critical operations.

VIII. SDR Forum Comments on Related Subjects

In addition to the comments specific to the proposed rules, the SDR Forum notes two complementary activities that will help accelerate the development of Cognitive Radio

technology, and the realization of the vision set forth in the Ninth NPRM. These two benefits are: (1) implementation of the proposed Spectrum Sharing Innovation Testbed, and (2) the collection of quantitative data on Public Safety/commercial spectrum usage patterns and spectrum occupancy.

Striking the balance between encouraging innovation and protecting mission critical voice communications under today's rules generally requires either that technology first be deployed in non-Public Safety bands (which may slow deployment to Public Safety or preclude development of capabilities specific to Public Safety) or in Public Safety situations that are not mission critical (which may not always be feasible). An alternative, proposed by the FCC in ET Docket No. 06-89, is the Spectrum Sharing Innovation Testbed. The challenges cited herein would be ideal to address in the context of a testbed. As the SDR Forum noted in comments on the Concept of Creation of Spectrum Sharing Innovation Testbed:[14]

> The Test-Beds should provide an environment in which new technologies to improve spectrum utilization can be tested without risking interference to incumbent operations. In order to achieve this objective, the Test-Bed should focus specifically on (1) the capabilities of cognitive radios, (2) ways to reliably identify harmful interference, (3) measuring spectrum efficiency, (4) determining ways to increase spectrum efficiency, and (5) investigation of new efficient technologies. In addition, the Test-Bed experiments must be executed in a controlled manner in order to reliably detect and report incidents of harmful interference and avoid conflicts between simultaneous uncoordinated experiments. If done properly, these experiments could lead to improved spectrum sharing mechanisms that enhance interference avoidance capabilities while enabling increased spectrum efficiency.[15]

The testbed could be part of the process that encourages innovation by adopting the suggestion proposed by the SDR Forum with respect to the testbed that

[14] *Federal Communications Commission Seeks Public Comment on Creation of a Spectrum Sharing Innovation Test-Bed*, ET Docket No. 06-89, Published 8 June 2006.

[15] Comments of SDR Forum in ET Docket No. 06-89 at 4 (July 10, 2007), available at http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6518397984.

> After an experiment is deemed a success through peer review, the FCC should initiate a rulemaking to determine ways in which the results of the test can be incorporated.[16]

Experimentation in shared spectrum testbeds will facilitate the innovation needed to advance the technology in response to the challenges noted herein and will provide means to prove the technology to avoid adverse impact to mission critical communications. We strongly encourage the Commission to proceed with the creation of the Testbed so that any potential secondary user of the 700 MHz spectrum can benefit from the results of subsequent research. The FCC should expedite Spectrum Sharing Innovation Testbed opportunities to allow real-world experimentation that will help move Cognitive Radio technologies forward to help realize this opportunity.

The other step that will accelerate the technology development of Cognitive Radio and spectrum sharing is quantitative data on Public Safety and commercial spectrum usage patterns and spectrum occupancy. The FCC's Ninth NPRM (at 40) cites the Public Safety SIG report which states:

> Software defined radio and cognitive radio technologies likely are to be important enabling technologies for efficient secondary use of Public Safety spectrum by the national licensee.

One of the recommendations from the Public Safety SIG Report called for more spectrum occupancy measurements:[17]

> There is a need to build a body of quantified data on spectrum utilization across all services (e.g., Public Safety radio services, commercial services, other private wireless services, federal government, etc.) during routine, pre-planned event, and emergency incident situations. Collection and analysis will require specialized data collection equipment development. These data would support spectrum planning, sharing, and usage modeling activities. . .

[16] Ibid, pg 11.
[17] SDRF-06-A-0001-V0.00, 14 April 2006, Sec. 4.3.4.

> Research should be undertaken to collect, document and analyze additional spectrum usage monitoring data.

In 2002, the FCC's Spectrum Policy Task Force Report stated that

> It is generally understood that certain types of spectrum users, such as the public safety community, have significant variability in their spectrum use and, as such, much of their allocated spectrum lies fallow during non-peak periods. For example, the Task Force received some usage data [that] indicate[d], for the measurement period, typical channel occupancy was less than 15%, while the peak usage was close to 85%.[18]

However, the Task Force emphasized that

> More information . . . is needed in order to quantify and characterize spectrum usage more accurately so that the Commission can adopt spectrum policies that take advantage of . . . spectrum white spaces. Currently, no federal agency or other organization systematically measures temporal spectrum use.[19]

As mentioned in the Public Safety SIG Report, in mid-2004 the Public Safety SIG assisted in the planning for a major collection effort across all services in the 30-3000 MHz band in New York City during the Republican National Convention, 30 August–01 September 2004. Collection was performed by Shared Spectrum Company (SSC) and the Stevens Institute of Technology. With funding from the National Science Foundation, SSC and the Illinois Institute of Technology conducted similar comprehensive measurements in Chicago, Illinois, 16-18 November 2005.[20] These "snap shot" spectrum occupancy studies, along with five others performed by SSC, provide a baseline for efforts to better understand the overall utilization of spectrum in the United States and provide a valuable indication of the spectral areas where interference is, and likely will continue to be, a particularly difficult challenge for current and future spectrum sharing. While these results provide a body of data that will help establish criteria for evaluating and developing new SDR and CR technologies for the Public Safety sector, the published

[18] FCC Spectrum Policy Task Force, ET Docket No. 02-134, November 2002, pp 10-11.
[19] Ibid, pg 10.
[20] Reports on these studies can be found at http://www.sharedspectrum.com/?section=measurements

spectrum occupancy studies address limited geographic areas and often cover a relatively short periods of time.

Important questions remain concerning the spectrum occupancy measured from other observation sites and times, potential seasonal effects, the rate of occupancy growth, and usage statistics reflecting routine, pre-planned event, and emergency incident situations. In addition, it is increasingly important to understand who is (or is not) using the spectrum, when and where is it being used, and the "why" behind the usage pattern.

Further, the collected data would be useful to better understand both the potential of secondary use of Public Safety spectrum, and the potential for Public Safety to utilize spectrum outside their normal allocations in emergency situations.

Accordingly, the Commission should support and encourage further research in this area. It should explicitly recognize the importance of long-term, multi-city spectrum usage studies in support of the Commission's ongoing efforts to promote Cognitive Radio technology, especially in new and existing bands upon which Public Safety relies.

IX. Summary and Conclusions

The SDR Forum supports the forward-looking concept of using Cognitive Radio technology to address needs for increased spectrum utilization and Public Safety requirements for additional spectrum. We believe that initial deployment of these capabilities should be done in a manner that avoids possible degradation of mission-critical voice communications.

The SDR Forum supports programs such as the Spectrum Sharing Innovation Testbed proposal and development of a Metalanguage to enhance understanding and application of Cognitive Radio technology. We have a number of projects currently underway to achieve these goals.

The seven items below summarize the SDR Forum positions:

1. SDR and Cognitive Radio technologies have significant potential for enabling life-saving applications and improving radio performance and spectrum efficiency, recognizing that they must be proven to meet Public Safety's robustness and reliability requirements, and not to cause interference nor be subject to received interference prior to deployment for mission critical communications.

2. Secondary operation in the presence of narrowband voice channels is the most technically challenging aspect of the NPRM. Current technology does not provide an adequate solution to the problems of out-of-band emissions and intermodulation interference, the distribution of national interoperability and state channels in the bands, and in the limited allocation of narrowband voice spectrum. The need for immediate access by Public Safety is likewise as challenging.

3. Pre-emptable commercial access to broadband channels can be achieved with proven technology on a single network. Technology is evolving to achieve this capability in

the case of separate networks but needs significant further development and testing prior to deployment that involves or could impact mission critical communications.

4. The Commission is urged to complete a detailed scientific study to determine the actual amount of broadband spectrum needed to support local, state, tribal and Federal Public Safety users through the year 2020. This will avoid implementing a solution that could prove to be significantly bandwidth-limited for the national Public Safety broadband network portion of this Notice. The SDR Forum is available to assist the Commission with such a study, but would propose to do so in partnership with other appropriate stakeholders.

5. An alternative 700 MHz band configuration of the narrowband voice channels into a combined 6+6 MHz block would facilitate, and make more effective, the introduction of Cognitive Radio technology, while significantly reducing the potential for broadband interference and promoting the use of COTS broadband technologies by Public Safety.

6. In addition to applications envisioned in this NPRM, there are significant additional capabilities that Cognitive Radio can provide to Public Safety communications.

7. Three key steps will accelerate the technology development and deployment:

    - The Spectrum Sharing Innovation Testbed, which will provide the industry a means to evaluate and improve technologies prior to deployment,

    - Evaluation and publication of available spectrum innovations testbed data, results and reports by qualified organizations such as the SDR Forum, and

- Data collection to better understand spectrum demand across Public Safety and commercial bands during normal and incident response operations.

The Software Defined Radio Forum thanks the Commission for this opportunity to submit comments. The Software Defined Radio Forum stands ready to assist the FCC in resolution of issues identified herein. We will also continue our pursuit of improvement of Public Safety communication capabilities.

Respectfully submitted,

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