April 27, 2012

Ed Drocella
National Telecommunications and Information Administration
Office of Spectrum Management
1401 Constitution Avenue NW.
Room 6725
Washington DC, 20230

RE: Federal Register Notice Request for Public Comment: Spectrum Sharing Innovation Test-Bed Pilot Program, FR Doc. 2012–7373

Dear Mr. Drocella,

Thank you for the opportunity to comment on the NTIA's Phase II and Phase II programs for the NTIA Spectrum Sharing Innovation Test-Bed Pilot Program. Cognitive radio and dynamic spectrum access technologies will be critical to alleviating the spectrum crunch and the NTIA is commended for this effort to characterize the impact of spectrum sharing on users of federal spectrum.

Virginia Tech, the Center for Advanced Engineering and Research (CAER), and the Mid-Atlantic Broadband Cooperative (MBC) recently formed a collaborative partnership to find solutions to the pressing needs of ensuring reliable broadband access to rural areas of Virginia while also addressing the technical challenges of rapidly expanding wireless data traffic. Together, we are focused on researching, developing and deploying low-cost broadband spectrum sharing technologies.

Our goal is to plan, develop and operate a Cognitive Radio (CR) network testbed in the state of Virginia demonstrating the utility of spectrum sharing techniques and applications. The testbed, which would span thousands of square miles upon completion, would be a cornerstone resource for developing an economic ecosystem for this new game-changing technology within rural Virginia. The testbed would be implemented with software defined radios and LTE cellular systems and reside, to as much extent as possible, on towers on public lands and utilize the fiber backbone of MBC and lab facilities of CAER and Virginia Tech and support mobile, portable and fixed spectrum sharing experiments.

The NTIA has requested comments on the type and depth of testing to be performed in Phase II and Phase III and we wish to make three comments.

- Testing should be designed to also assess the feasibility of using FCC TVWS requirements.
- A principle objective of testing should be gathering data that can be used to develop a methodology for establishing exclusion contours.
- The pace of testing needs to quicken while increasing flexibility in test plans to accommodate new and emerging technologies.

1. **Testing should be designed to also assess the feasibility of using FCC TVWS requirements.**

The goal of opening up federal spectrum for sharing is to foster economic growth by increasing the amount of spectrum available for commercial use. While recognizing that there are fundamental differences in the types of primary users, this goal can be best met if the regulations for the 410-420 MHz and 470-512 MHz bands are similar enough to FCC regulations for the surrounding TV White Space bands to allow a single hardware design to serve both portions of the spectrum. But simply adopting FCC regulations for the new bands should not be done without first verifying that federal users will be able continue to effectively operate. Towards this end we suggest the following:

- Measure fixed antenna heights Above Ground Level (AGL) with 30 m instead of only 10 m.
- Correlate the location data being gathered each second with Height Above Average Terrain (HAAT) information (perhaps from GIS data) to assess the adequacy of FCC HAAT regulations.

As a related suggestion, it would be worthwhile to consider the impact of the various transmission parameters of the DUTs, particularly modulation, on the LMR systems as interference events are not purely a function of power spectral density.

2. **A principle objective of testing should be gathering data that can be used to develop a methodology for establishing exclusion contours.**

Currently, the testplan appears designed to demonstrate the infeasibility of a sensing-only approach and the adequacy of a location-based approach. But given the prior work by the FCC and other researchers in other bands with other devices, this appears to be a foregone conclusion. With a relatively minor tweak to the testplan whereby the collected data is compared to contours and coverage maps, it should be possible to construct maps that show the probability of an interference event given the existing coverage, expected LMR locations, and DUT transmission properties (e.g., power, frequency, and bandwidth).

Once refined, this data could be used to define a methodology for establishing exclusion contours which could then be used by individual localities to define acceptable exclusion areas for that locality or to set a nationwide policy.

Also the test plan currently reads as if a secondary objective is to find an appropriate exclusion distance, but a policy based purely on separation distance will be both simultaneously overly protective and overly permissive due to propagation variations. In practice, setting optimal exclusion zones will likely require partnerships with local agencies who know what level of coverage they desire and with vendors who designed the systems to achieve the desired coverage.

As these exclusion zones and initial regulatory practices are set for this new band, it is important that they strike the right balance between protecting existing LMR users and not impeding the development of potential business models.

3. **The pace of testing needs to quicken while increasing flexibility in test plans to accommodate new and emerging technologies.**

A secondary objective of this effort should be to promote the growth of US industry that supports this emerging field by facilitating the early deployment of Cognitive Radio, Dynamic Spectrum Access, and other spectrum sharing technologies so that US products can become de facto world standards later. When the Phase I Test Plan was initially posted, the US was significantly ahead of the regulatory curve in promoting greater spectral efficiency using CR, DSA, and other spectrum sharing technologies. But in the period between when the Phase I testplan was posted for comment (2008) and when the Phase II testplan was posted for comment (2012), the world has largely caught up.

Similarly, CR and DSA are emerging technologies and are thus evolving rapidly, as seen from a shift from an emphasis on sensing approaches to database-enabled approaches. Thus testplans should exhibit a high degree of flexibility to accommodate new CR and DSA products and approaches while testing is ongoing, and testing should be done with close collaboration with DUT providers to allow frequent software refreshes and to heighten understanding.

Longer term, as testing moves from principally an objective of establishing an appropriate initial regulatory regime to fostering continuing innovation and device certification, we suggest that these specific test procedures should evolve into more general testbeds with the following characteristics.

- The testbed should support direct collaboration between industrial, academic, and government researchers, helping to define experimental research on cognitive radio and networks with direct applicability to regulatory and standardization processes.
- The testbed should be interoperable with other testbeds with interfaces that accommodate local and remote users with varying needs and skill levels so that experimentation from users around the country are supported.
- The testbed should support a wide variety of propagation conditions, which means both indoor and outdoor nodes as well as urban, suburban, and rural settings with significant elevation differences (e.g., coastal, plains, hills, and mountains) and mobile, pedestrian, and fixed deployments
- The testbed should support a wide variety of use cases (e.g., last mile, backhaul, and machine-to-machine).

- The testbed should facilitate safe and representative testing of coexistence with a wide array of candidate primary users, such as public safety and military communications, radar, and telemetry systems. This will accelerate the transitioning of CR and DSA to additional bands.
- The testbed should support the deployment of complete solutions and individual algorithms hosted within representative solutions to support both certification and research. Similarly, with those radios that support it, the testbed should support deployment of alternate policy regimes to facilitate further innovation in regulatory regimes.

We are encouraged by the efforts the NTIA is making to support the further development of cognitive radio and dynamic spectrum access technologies, which we believe will be critical to addressing growing spectrum demands. Thank you for the opportunity to help shape the development of the test program by commenting.

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