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

In the Matter of	**)**	
Amendment of the Commission's Rules with	**)**	**GN Docket No. 12-354**
Regard to Commercial Operations in the	**)**	
3550-3650 MHz Band		

To: The Commission

Comments of Shared Spectrum Company

July 11, 2014

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Shared Spectrum Company (SSC) hereby submits its Comments in the above referenced proceeding in response to the Commission's Further Notice of Proposed Rulemaking (FNPRM), FCC14-49, regarding commercial operations in the 3550-3650 MHz band, released April 23, 2014.

SUMMARY

Shared Spectrum Company is at the forefront of developing and implementing Dynamic Spectrum Access (DSA) radio technology. This DSA technology offers an embedded, turn-key software solution for enabling advanced frequency agility and spectrum sharing on existing and future software defined radio (SDR) platforms. From the outset, SSC has supported sharing the 3.5 GHz band, filing both Comments and Reply Comments in this proceeding. In those filings, SSC noted that the FCC should deploy sensing in tandem with a database (SAS) to optimize interference avoidance between primary incumbent users, such as ship-borne military radars, and newly authorized classes of users, such as Priority Access (PA) and General Authorized Access (GAA).

Particularly where higher powered users, such as fixed backhaul, may be the desired services of new entrants in the 3.5 GHz band, sensing can play a critical role in combination with the SAS in avoiding any interference into incumbent systems, such as radars or Fixed Satellite Services (FSS) earth stations.

COMMENTS

I. The Commission is Correct to Request further Study of the Exclusion Zones

A. Further Study is Appropriate Because of Prevalence of Small Cells.

The FCC noted that it had received initial studies demonstrating the propriety of reducing exclusion zones from those areas proposed in the NPRM; one example of such a study is the Qualcomm study provided in its initial Comments. However, the Commission noted in its FNPRM that further studies are ongoing concerning the exclusion zones and avoidance of interference to and from incumbent users. The Commission is wise to question the assumptions behind the NTIA proposed exclusion zones, which, as the FCC noted in its FNPRM, dated to a time when much higher power devices were proposed, and much larger cells, and not the current paradigm of mostly small cells and reduced operating powers.

In fact, the current NTIA plan for exclusion zones was based on exclusion zones designed to protect from 40W devices. The rules proposed in the FNPRM do contemplate additional uses other than small cells, such as fixed backhaul, with varying maximum transmit powers and transmitter characteristics. However,

NTIA's assumptions are simply not representative of the types of devices and applications envisioned for the *majority* of new users in the 3.5 GHz band.

Shared Spectrum Company believes that the exclusion zones should be based on the actual technical characteristics of the particular technology and network deployment of the Priority Access Licensee (PAL) and/or the General Authorized Access (GAA) user. This would mean the SAS could determine the exclusion zones individually for each network, using sensing technology to augment its intelligence about incumbent use.

In certain instances, it may be appropriate to set a low power limit for operations near protected incumbents, -- this could create much more usable spectrum for GAA users in particular. In addition, NTIA based its assumptions on a height of 60 meters for the new entrants. Setting a lower height limit for new users, such as 30 meters, would further reduce the need for large exclusion zones.

Similarly, co-channel operation with incumbent radars may necessitate a different (larger) exclusion zone than adjacent or off-channel operations. A SAS with sensing technology could help dynamically determine those factors. While further study is appropriate, SSC feels strongly that these studies will merit the reduction of the proposed NTIA exclusion zones in most, if not all, instances. A properly designed SAS could factor in the type of system used by the new entrant,

whether high power WiMax or low power, for example, and set the exclusion zone dynamically, thanks to sensing technology offered by companies like SSC.

B. The Primary Role of Exclusion Zones Should Be to Protect Incumbents from New Entrants, not *Vice Versa*.

Shared Spectrum Company points out that the type of interference which is most desirable to prevent is from the new users, GAA or PALs, into the incumbent systems, and not *vice versa*. Therefore, it should be of somewhat less concern to the FCC that interference may occur from incumbents into new GAA or PAL users.[1]

The Commission in paragraph 9 of its FNPRM noted that the radar systems that operate in the 3.5 GHz Band overcome the inherent propagation limitations of this frequency range by employing high transmitter power levels and high-gain antennas. These characteristics of the radar systems were a contributing factor to the size of the exclusion zones in NTIA's Fast Track evaluation.

Because of the possibility of interference from military radars into the new entrants, software developers and equipment makers are incentivized to market and deploy technologies which minimize the likelihood of their new systems receiving unacceptable levels of interference from incumbents. With a properly

[1] FNPRM at paragraph 142. Additionally, in the NPRM, the Commission stated that GAA use could be allowed in areas where small cell operations would not cause harmful interference to Incumbent Access tier users but where signals from incumbent users could possibly interfere with GAA uses. However, the NPRM noted that Priority Access users, which have quality-of-service expectations, would only be permitted where CBSD operations would not interfere with incumbent operations, and where harmful interference would not be reasonably expected from Incumbent Access tier operations.

designed SAS and sensing technology in place, there is reduced likelihood that new small cell, lower power (and possibly lower height) entrants could interfere into the incumbent radar systems, which are more powerful and will take priority with the SAS if and when they operate.

Thus, the exclusion zones should be, by reason, smaller, in order to protect new entrants in only those few instances of possible interference to the incumbent systems, such as very close proximity to radars and those select grandfathered FSS earth stations. In the case of a PAL licensee or a GAA user who has purchased equipment and set up operations too close to a possible incumbent radar system, for example, or near an exclusion zone around a FSS earth station, they should have lowered expectations of protection from unacceptable interference.

The Commission is wise to question the large geographic size of the exclusion zones. Focusing on their purpose, i.e. to protect existing users, not so much new entrants, renders it clear that these zones should be small and limited to only preventing interference into primary incumbent users from the new entrants such as the PAL and GAA licensees.

C. Exclusion Zones Can Be Significantly Reduced with SAS and Sensing.

Shared Spectrum Company believes the exclusion zones should be greatly reduced in size and scope. In particular, the FCC suggested a SAS database system for coordination of the channels assigned in time and location, including the 10 MHz

PALs and the GAA spectrum. Shared Spectrum Company notes that sensing can and should play a vital role in this SAS paradigm. A database-only approach results in the inefficient allocation of spectrum that may or may not be used by the requestor with minimal enforcement capability to generate the desired efficiencies. Sensing in combination with the database ensures that the spectrum sharing vision is realized with actual spectrum use driving the system.

Dynamic Spectrum Access (DSA) technology was first developed by SSC for DARPA in the context of military communication and jamming detection and avoidance. Here, the same technology can readily be deployed in a commercial setting.[2]

As SSC pointed out in the TV White Spaces (TVWS) proceeding, as well as other FCC rule makings, sensing technology can work in tandem with a database to more efficiently allocate spectrum among new users and existing incumbent systems. The opportunity for spectrum sharing is even greater in the 3.5 GHz band than it is in the TVWS spectrum. In fact, the TVWS consists of fixed television transmission locations which are well-known, with continuous broadcasts; and so a TVWS database can be readily deployed to predict their routine operations (although sensing is of great assistance in identifying unregistered devices in the band such as wireless microphones).

[2] However, spectrum sensing alone should not be used by the CBSDs to detect nearby FSS earth stations, due to the extremely low level satellite downlink signals with the relatively low gain antennas of the CBSDs. The FSS location information should be registered within the SAS database, in this way the SAS can instruct the CBSDs to operate outside of the FSS areas on a co-channel basis.

By contrast, in the 3.5 GHz band, the land-based, airborne, and/or ship-borne military radar incumbents are few; they operate at varying altitudes; they transmit infrequently rather than continuously; and they are transient in nature, rather than operating from fixed locations. This means that in the 3.5 GHz band, a database alone cannot adequately predict such incumbent radar operations, as it can in the TVWS proceeding.

The avoidance in the 3.5 GHz band of military radar interference to lower power, small cell devices presents a perfect application, in our view, of sensing technology. This capability can be built into the small cell infrastructure and, indeed, the end user devices over time, to permit sensing by and among the system and its end-user devices, including Citizens Broadband Radio Service Devices (CBSDs). Such information about channel availability and quality can regularly be fed from the network and its CBSDs back to the SAS, to allow the database itself to update and inform its own operations in that census bureau tract, and in neighboring areas. Sensing, when combined with an intelligent SAS and the *caveat emptor* approach noted above, will enable the marketplace to dictate which new entrants successfully operate while avoiding interference from higher powered radars and missing those FSS earth station protected areas.

In sum, fixed geographic exclusion zones for incumbent radar systems are very spectrally inefficient compared to only excluding use when radars are

operational. Sensing technology can enable PAL and GAA devices to operate all the way to the coast because they are non-interfering to the radar systems, and sensing technology can help to enable these new users avoid interference into and from the radar systems.

2. Licensing Framework

A. Expanding the Spectrum Available.

Shared Spectrum Company supports the proposed expansion of the Citizens Broadband Radio Service (CBRS) to include both the 3550-3650 MHz and the 3650-3700 MHz bands in Part 96. With this expansion, the Commission would create a block of 150 MHz spectrum that would enable manufacturers to realize economies of scale and investors and operators to innovate and flourish.

By permitting a minimum of 50 percent of available bandwidth to be made available for GAA use at any given time over the full 150 MHz band, SSC believes that a number of innovative technologies, including sensing systems, could be deployed, free of the traditional capital and planning restrictions imposed on auction license paradigms.

B. The Future is Upon Us.

Shared Spectrum Company fully supports the Commission's proposal to permit the SAS to dynamically assign the PAL and GAA channels in real time. The Commission proposed to require CBSDs to measure and report on their local signal level environment as set forth in the proposed rules. Gathering such detailed information over time will permit the SAS to operate with a higher level of intelligence,

and also to provide feedback to regulators going forward on the proper mix of PAL and GAA spectrum in this and future bandwidth allocations.

The FCC also proposed that mobile, portable, or fixed end-user devices may operate only if they can positively receive and decode an authorization signal transmitted by a CBSD, including the frequencies and power limits for their operation. Shared Spectrum Company suggests that unused PAL spectrum should be available to GAA users on a time and location basis, until such time as the PAL licensee indicates to the SAS it needs access to that bandwidth, in which event the SAS re-assigns or cancels the GAA usage at that time in that location and on those PAL channels. This will encourage efficient use of the spectrum by PAL auction winners, and will maximize GAA system flexibility in those instances where incumbents exist, PAL channels are purchased at auctions, and the amount of GAA spectrum (e.g., 50% of non-incumbent spectrum) is still not sufficient to meet GAA demand at all times in that census bureau tract. Such a scenario could play out in New York City, for example, if 150 MHz of possible spectrum is divided among incumbents (e.g., 30 MHz), two PAL licenses (e.g., 60 MHz total), and GAA users (e.g., 60 MHz). Those GAA users would benefit from accessing some or all of the two PAL licenses when not in use by the PALs.

In paragraph 74 of its FNPRM, the FCC proposed to adopt different transmit power levels to accommodate a range of Citizens Broadband Radio Service use cases. The Commission proposed that CBSDs and end-user devices limit their operating power to the minimum necessary for successful operation; and the FCC

observed in paragraph 77 that NTIA did not consider these proposed use cases or technical criteria in calculating the Fast Track Exclusion Zones. The FCC then asks in paragraph 77, "What effects would these additional use cases have on the size of the Exclusion Zones?"

Shared Spectrum Company believes that when power and operational parameters differ by end users, and those sensing-enabled end user devices are communicating with the SAS and providing the SAS information including their location and power, then the likelihood of interfering into incumbent systems is minimal. This means that Exclusion Zones can be significantly reduced.

Shared Spectrum Company believes that the proposed spectrum management approach of an SAS with sensing in the infrastructure of small cells, and eventually just in the CBSDs themselves, could be applied in the near future to other encumbered bands. This new world of spectrum management and channel allocation based on near-real time information, where the user's location and its need for access for a period of time are the main determining factors, will drive efficiency in overall spectrum use in other bands into the future.

CONCLUSION

The Commission is on the right track: studying the Exclusion Zones is wise, reducing them significantly is logical, and permitting widespread operations of GAA

users in a dynamic channel allocation context is appropriate. The ability of GAA users to access unused PAL spectrum, if only temporarily, should encourage more efficient spectrum use and avoid warehousing spectrum by PAL auction winners.

Eventually, the Commission should permit sensing as a stand-alone technology capable of avoiding interference and resident in all CBSDs themselves. In the meantime, using such sensing information, the SAS can more intelligently assign channels and policymakers can gather data about usage, quality of service, and similar data. By setting up the right structure in the 3.5 GHz band, future spectrum allocations will benefit from enhanced spectrum sharing policies and techniques, including sensing-based solutions.

Respectfully submitted,

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