

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

In the Matter of )  
 )  
Creation of a Spectrum Sharing Innovation ) ET Docket No. 06-89  
Test- Bed )

**Reply Comments of Shared Spectrum Company**

Shared Spectrum Company (SSC) submits these reply comments with respect to comments filed with the Commission and the National Telecommunications and Information Administration (NTIA)<sup>1</sup> in response to the two *Notices* issued on the creation of a spectrum sharing innovation test-bed. SSC urges the Commission and NTIA to expeditiously issue a joint *Public Notice*: (1) designating appropriate bands and geographic areas that are eligible for streamlined experimental licensing; (2) specifying flexible requirements for streamlined treatment, including technology focus, interference mitigation plans and other reporting/evaluation guidelines; and (3) forbearing from limitations on market tests in the test-bed.

**I. Technology Focus for the Spectrum Sharing Innovation Test-Bed**

***A. Dynamic Spectrum Sharing and Cognitive Radio Technology Must be the Principal Focus of the Test-Bed***

Quite appropriately, most of the initial comments that addressed the issue of which technology would most likely produce substantial sharing improvements favored cognitive (or

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<sup>1</sup> Most of the comments filed with the Commission in this proceeding were also filed with the National Telecommunications Information Administration (NTIA) in response to its *Notice of Inquiry*. See <http://www.ntia.doc.gov/ntiahome/frnotices/2006/spectrumshare/comments.htm>. However, NTIA's *Notice of Inquiry* did not invite reply comments. SSC is providing a courtesy copy of these reply comments to NTIA.

“smart”) radio technology for the test-bed. In addition to SSC, the SDR Forum, Motorola, Adapt4, M2Z, Shure and ARRL support a focus on cognitive radio testing.<sup>2</sup> SSC continues to strongly advocate that the Commission and NTIA facilitate, through the test-bed and all other means, access to spectrum for innovative, dynamic spectrum sharing technologies such as those currently being developed by SSC as well as other cognitive radio technologies. This, of course, should not mean that other technologies that foster spectrum sharing should be excluded from the test-bed.

***B. Other Advanced Technologies Should be Part of the Test-Bed, but not Required***

SSC’s comments stated that other technology advancements such as MIMO, advanced modulation techniques, mesh networking and adaptive antennas could also be tested and implemented as important ancillary components of dynamic spectrum sharing systems. ArrayComm and Progeny both recommended testing smart antennas.<sup>3</sup> However, multiple antenna signal processing (MAS) should neither be the sole focus of nor a requirement for test-bed technologies. As ArrayComm states, MAS has already been “commercially proven” and “demonstrated to achieve improvements in spectral efficiency in existing personal communications systems.”<sup>4</sup> Therefore, while SSC agrees that cognitive radio will benefit from the use of MAS, it should not be a government-mandated component of the spectrum sharing innovation test-bed or cognitive radios.

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<sup>2</sup> See SSC Comments at 3-5; Software Defined Radio Forum (SDR Forum) Comments at 4; Motorola Comments at 3-4; Adapt4 Comments at 3, 6; M2Z Networks, Inc. (M2Z) Comments at 7, 11; Shure Inc. Comments at 4-6; ARRL, the National Association for Amateur Radio, Comments at 6.

<sup>3</sup> See ArrayComm LLC Comments at 2-3; Progeny Comments (filed with NTIA) at 4.

<sup>4</sup> ArrayComm Comments at 2, 3.

### *C. The Test-Bed Should Not Exclude Proprietary Technology*

The Commission and NTIA *Notices* asked whether use of proprietary technologies or information should be permitted in the test-bed and, if so, how should release of data based on such technology be handled. While SSC's comments did not address this question, two commenters suggested that proprietary technology be banned from the test-bed.<sup>5</sup> It appears that these suggestions confuse the concepts of proprietary technology and proprietary information. As to the former, the principal thrust of governmental action here should be to encourage private initiatives to develop innovative spectrum sharing technology, and the existence of proprietary rights (*e.g.*, patents) can greatly enhance incentives to develop such technology. With regard to the latter concept, which is the basis of the *Notices*' questions on this topic, well-developed principles and protections under the Freedom of Information Act are available to assure fair access to and proper fortification of sensitive, proprietary data.

Accordingly, SSC supports the well-articulated comments of the SDR Forum, Motorola, M2Z and James Whedbee on the issue of allowing proprietary technology and information as part of the test-bed.<sup>6</sup> In addition to fostering innovation, what is important here is that the Commission, NTIA and other government agencies benefit from the information and technology

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<sup>5</sup> See Cingular Wireless LLC Comments at 6-7 (“[T]he test-beds should be controlled by the government and should not be available to test proprietary technologies.”); ARRL Comments at 10.

<sup>6</sup> See SDR Forum Comments at 8; Motorola Comments at 10; M2Z Comments at 2, 6; Whedbee Comments at 1. While SSC believes in ample provision to the public of data related to interference and information that would be helpful in the conduct of policymaking, it is concerned about the proposals in Motorola's Comments (at 14) and the SDR Forum's Comments (at 11) for “peer review,” especially before or during the experimental process. Great care must be taken to avoid any possibility of enabling parties with competing technologies to impede development under the guise of “peer review.” Moreover, the Commission and NTIA are required to follow Office of Management and Budget (OMB) guidelines on peer review, which generally do not cover the results of experimental licensing actions unless the results are widely “disseminated” and contain “influential scientific information.” See OMB Bulletin, Final Information Quality Bulletin for Peer Review, 70 Fed. Reg. 2664 (Jan. 14, 2005).

that arises from the test-bed for purposes of policymaking and technology transfer.<sup>7</sup> As proposed in SSC's comments (at Appendix C), a secure web site could be used to provide up to date test information and data to the Commission and other entities it designates.

***D. The Test-Bed Should Facilitate Sharing Technologies that Support Multiple Applications and Scenarios, Including Air-Ground Communications***

Several commenters believe that the test-bed should focus on particular types of applications such as interoperable public safety communications or broadband video.<sup>8</sup> SSC and other parties, including the SDR Forum, suggest an application-neutral approach whereby the proposed technology can be adapted for a variety of services and applications, including broadband, military/homeland security, and public safety.<sup>9</sup> While multiple applications should be supported by the test-bed, it is appropriate for the Commission and NTIA to emphasize solutions to critical spectrum access problems such as those facing federal, state and local public safety officials. Although the critical missions, interoperability needs and legacy equipment of federal and non-federal users are relatively similar, dynamic spectrum sharing technologies should be designed and tested to work in a variety of scenarios in diverse environments.

For example, the Los Angeles County Sheriff's Department advocates a specific experiment involving a public safety airborne video application, but it focuses on using particular

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<sup>7</sup> See *Spectrum Policy for the 21<sup>st</sup> Century – The President's Spectrum Policy Initiative: Report 2 Recommendations From State and Local Governments and Private Sector Responders* at 23 (June 2004) ("Coordinating information developed in private and federal laboratories would provide the technical information necessary to allow standards committees, regulators, and policymakers to make meaningful decisions regarding the interference and sharing potential of new technologies.") SSC also concurs with Cingular that the test-bed should not support a single, proprietary technology, but a wide variety of technologies. See Cingular comments at 5-6.

<sup>8</sup> See, e.g., National Public Safety Telecommunications Council (NPSTC) Comments (sharing opportunities between federal users and local and state public safety agencies), Comments of Terrestrial Networks, Inc. (advocating that homeland security and public safety interoperability matters be included in whatever experiments are conducted); Comments of Los Angeles County Sheriff's Department (recommending testing of airborne video applications); Comments of Motorola at 8 (public safety broadband applications).

<sup>9</sup> See SSC Comments at 5; SDR Forum Comments at 7.

bands based on existing federal and non-federal equipment and uses. Spectrum access for such applications is a growing problem. Both manned and unmanned aerial systems are inherently dependent on communications and bandwidth for control of aircraft and for transmission of collected data to other networked vehicles, ground facilities, and commanders. Under a traditional frequency spectrum management regime, static frequency assignments are made to specific systems with few changes over time. However, a critical enabling capability for these aerial systems will be agile frequency spectrum management, especially as the number of aircraft increases within a given area of operations.<sup>10</sup> SSC anticipates using this flexible test-bed opportunity to experiment with dynamic spectrum sharing technologies on board small unmanned aerial vehicles (UAVs), for which it has already been developing prototype technology.

## **II. Selection of Bands and Geographic Areas for the Test-Bed**

### ***A. Initial Testing Should Include the High VHF and Low UHF Bands (Below 1 GHz)***

In its initial comments, SSC recommended use of frequencies below 1 GHz, which generally have good propagation characteristics to allow for wide geographic coverage. Instead of identifying particular bands, SSC advocated that the Commission and NTIA use flexible criteria in pre-designating particular bands that promote development of frequency agile equipment and permit operation on the best bands available at a given location and time. A number of parties, however, recommended specific bands both below and above 1 GHz. Although many of these recommendations did not recognize the need for technology that is

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<sup>10</sup> See U.S. Air Force Remotely Piloted Aircraft and Unmanned Aerial Vehicle Strategic Vision at 18, available at [http://www.uavforum.com/library/usaf\\_uav\\_strategic\\_vision.pdf](http://www.uavforum.com/library/usaf_uav_strategic_vision.pdf).

frequency agile and extendable to a variety of bands, SSC urges the Commission and NTIA to consider the following specific band suggestions made:

(a) The VHF spectrum from 150 to 170 MHz was offered by the National Public Safety Telecommunications Council (NPSTC)<sup>11</sup> and a somewhat broader suggestion of 150 to 216 MHz was suggested by Adapt4.<sup>12</sup> These bands currently support a variety of existing federal and non-federal land mobile uses, which are currently transitioning to “narrowband” technology.<sup>13</sup> The additional spectrum suggested by Adapt4 comprises the upper-VHF television bands (channels 7-13), which are currently being transitioned to digital technology. Motorola mentioned the 76 to 88 MHz and 174 to 216 MHz bands, but suggested that they may be unattractive from an antenna standpoint.<sup>14</sup>

(b) Adapt4 suggested 222 to 242 MHz, which is used by a variety of military applications (with some amateur use at the low end);<sup>15</sup> Motorola also identified the 225 to 240 MHz band for consideration, but again warned that use of this band would require physical antenna constraints to be placed upon early test-bed systems, making this a less attractive choice.<sup>16</sup>

(c) Motorola suggested that spectrum within the 350 to 420 MHz band may be promising, with a 10 MHz block between 350 and 380 MHz potentially being the most viable.<sup>17</sup> This band is primarily used for fixed and mobile military applications.

(d) NPSTC also identified sharing opportunities in the UHF band, which is a prominent spectrum resource for significant federal public safety operations as well as a number of

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<sup>11</sup> NPSTC Comments at 4. (“NPSTC believes that the greatest initial prospect for effective sharing with the public safety service regulated by the Commission and entities under NTIA authority emanates from the VHF band. The VHF band is the overwhelming spectrum resource for local public safety agencies- emergency medical services, fire and law enforcement.”)

<sup>12</sup> See Adapt4 Comments at 2.

<sup>13</sup> See NPSTC Comments at 7; *Report and Order*, Amendment of Parts 2 and 90 of the Commission's Rules to Provide for Narrowband Private Land Mobile Radio Channels in the 150.05-150.8 MHz, 162-174 MHz, and 406.1-420 MHz Bands that are Allocated for Federal Government Use, ET Docket No. 04-243, FCC 05-69 (Released March 11, 2005).

<sup>14</sup> See Motorola Comments at 6.

<sup>15</sup> See Adapt4 Comments at 2.

<sup>16</sup> See Motorola Comments at 5.

<sup>17</sup> See Motorola Comments at 5.

public safety agencies in large metropolitan areas.<sup>18</sup> Adapt4 proposed the 420 to 450 MHz band.<sup>19</sup>

(d) Motorola suggested television channels 38 to 51 (614 to 698 MHz), and possibly channels 52 to 62 and 65-67 (in the “Lower 700 MHz Bands”), which have not yet been auctioned.<sup>20</sup> Similarly, M2Z suggested testing spectrum sharing technologies in the TV-band “white spaces.”<sup>21</sup>

Some commenters suggested two test-beds, one below and one above 1 GHz.<sup>22</sup> While SSC does not object to designating multiple bands for the test-bed, it believes that bands below 1 GHz should be identified immediately for streamlined processing since such bands have more critical sharing problems in light of the variety of legacy systems and difficult transitions currently taking place. Additional bands above 1 GHz could be identified at a later time after valuable experience is gained.

Moreover, while SSC agrees with Motorola that choosing bands for the test-bed is a difficult task, the Commission and NTIA should not be artificially constrained by the initial recommendations from the President’s Spectrum Policy Initiative. Each agency should consider their respective government/non-government spectrum “contribution” as a minimum objective without feeling constrained to provide access to additional spectral resources under the test-bed program.

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<sup>18</sup> See NPSTC Comments at 4.

<sup>19</sup> See Adapt4 Comments at 2.

<sup>20</sup> See Motorola Comments at 6.

<sup>21</sup> See M2Z Comments at 11-12; *see also* Shure Comments at 7-8 n. 9.

<sup>22</sup> See, e.g., Motorola Comments at 4; SDR Forum Comments at 5.

### ***B. A Wide Range of Geographic Areas Should be Authorized for Test-Bed Experiments***

In its initial comments, SSC argued that overly conservative geographic separations or restrictions should be avoided because it is necessary to demonstrate and evaluate dynamic spectrum sharing techniques in real-world situations in a variety of urban, suburban and rural environments. Several other commenters agreed. For example, the SDR Forum advocated maximum flexibility and stated that experiments should be conducted in urban environment to obtain realistic information on in-building and multipath propagation.<sup>23</sup> Similarly, Motorola suggested that large geographic areas would be ideal because they provide a range of population densities and would be more likely to include both urban and rural areas. “The inclusion of urban areas within the experiment’s geographic area is particularly critical given that those are in greatest need of increased spectrum access and efficiencies. The benefits gained from providing such flexibility far outweigh any potential detriments that may exist, as long as appropriate steps are taken to minimize interference.”<sup>24</sup>

Cingular, on the other hand, would restrict test-bed experiments to rural areas in order to avoid causing harmful interference with incumbent users.<sup>25</sup> As articulated in SSC’s comments and other comments, this type of precaution is unnecessary and counter-productive. There are more effective and targeted approaches to avoiding harmful interference, including the detailed experimental system design guidelines proposed in Appendix B of SSC’s comments, which list

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<sup>23</sup> See SDR Forum Comments at 9. On the other hand, the SDR Forum also suggested (at 6) that test-bed experiments should not be conducted on military bases. SSC strongly opposes this. Military bases are excellent places to conduct experiments. Possible difficulties of alien access to bases should not prevent them from being used across the board.

<sup>24</sup> Motorola Comments at 10-11.

<sup>25</sup> See Cingular Comments at 5.

numerous steps that should be employed to reduce interference such as remotely reconfiguring spectrum access algorithms of radios operating in shared bands.

### **III. Procedural Matters**

#### ***A. An Expedited Experimental License Process Should Be Used***

In its initial comments, SSC suggested use of the existing Part 5 experimental licensing program as the basic procedural mechanism for the test-bed program, but with a number of adaptations to facilitate access to spectrum bands to conduct appropriate tests. Many other commenters also supported using Part 5 procedures.<sup>26</sup> Two commenters, Motorola and Whedbee also suggested streamlined or automated features, which SSC supports. Specifically, Motorola proposed authorizing each eligible entity to participate in the test-bed once and, once authorized, the entity would be able to enter into an experiment in any geographic region in the United States on a non-interference basis. Before conducting actual experiments, participants would notify the FCC and NTIA and post information about the location, time span, frequencies and other parameters of the planned experiment.<sup>27</sup> Like SSC, Whedbee identified the test-bed as an opportunity to test new frequency assignment/coordination techniques such as the web-based capability in the 70/80/90 GHz bands.<sup>28</sup>

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<sup>26</sup> See Motorola Comments at 8-9; Adapt4 Comments at 5; AARL Comments at 2 & 7; CTIA Comments at 6, TerreStarr Comments at 3; Whedbee Comments at 1.

<sup>27</sup> See Motorola Comments at 8-9.

<sup>28</sup> See Whedbee Comments at 1; SSC Comments at 11-12.

***B. Multiple Experimental Licensees Should Be Permitted***

SSC agrees with the SDR Forum and Motorola that multiple experimental licensees should be permitted.<sup>29</sup> SSC disagrees, however, with these parties' proposals to require a degree of exclusivity prohibiting as a general rule licensees from using the same band in the same geographic region at the same time. The fundamental goal of the test-bed program should be to produce highly flexible secondary uses of spectrum that reliably avoid interference to primary users of many types. A successful technology should also be able to avoid interference to other "co-secondary" users. This should ordinarily be expected to be accomplished by either their basic interference avoidance techniques or prior coordination. To the extent that novel secondary uses present problems not already addressed, adjustments should ordinarily be expected to take the form of programming changes. There should be a presumption against claims of a need for exclusive licensing as the solution and prior coordination among authorized experimenters or other measures should be required instead.

SSC recognizes, however, in early stages of development a technology may need the cruder form of interference protection provided by exclusive rights or wide geographic separations, but such early-stage exceptions can be accomplished within the framework of prior coordination and adequate regulatory supervision – the efficacy of which will be greatly enhanced by the provision of real-time data to the agencies and the use of remotely controlled equipment subject to rapid adjustment as proposed in SSC's Comments.<sup>30</sup> Experimenters failing to provide such capabilities have no right to exclude compliant experimental licensees.

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<sup>29</sup> See SDR Forum Comments at 4; Motorola Comments at 10-11.

<sup>30</sup> See SSC Comments at 8-9.

### *C. The Commission Should Forbear From Imposing Limits on Market Studies*

In its initial comments, SSC proposed removing the disincentive created by the prospect of FCC-imposed limitations on “market studies” under section 5.3 of the Commission’s Rules. SSC proposed that the Commission affirmatively dispense with the three limitations potentially applicable to market tests in Part 5 authorizations. However, buried in a footnote in its Comments, Motorola suggests, “in order to prevent participants from utilizing the Test-Bed in inappropriate ways,” experimental licensees should not be permitted to conduct “marketing studies” at all.<sup>31</sup> While Motorola does not describe how the test-bed could be used in “inappropriate ways,” SSC’s initial comments provide a compelling case why the Commission staff, in exercising its broad discretion under the experimental licensing rules, should encourage experimentation of sharing technology and allow market studies.

The inherently secondary nature of the technology and its amenability to rapid re-deployment out of a given band obviates the possible concern sometimes applicable to static, band-dependent technology of future preclusion of other uses in the band. Indeed, by increasing the overall communications capacity of the spectrum, advanced sharing technology eliminates the danger of precluding other uses either technically or economically. The whole concept of limiting the use of new technology to exclude commercial deployment is premised on the notion that permitting it to do so would in some fashion limit others. That concept is not applicable to the instant case. Developers of dynamic spectrum sharing technology should be provided the incentive to conduct tests on a scale sufficient to gain market acceptance.

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<sup>31</sup> Motorola Comments at 9 n. 14.

#### **IV. Conclusion**

Based on the forgoing and its initial comments, Shared Spectrum Company respectfully urges the Commission and NTIA to expeditiously issue a joint *Public Notice*: (1) designating appropriate bands and geographic areas that are eligible for streamlined experimental licensing under the test-bed program; (2) specifying flexible requirements for streamlined treatment, including technology focus, interference mitigation plans and other reporting/evaluation guidelines; and (3) forbearing from limitations on market tests in the test-bed.

Respectfully submitted,

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DATED: July 24, 2006