

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

and

**THE NATIONAL TELECOMMUNICATIONS AND
INFORMATION ADMINISTRATION
Washington, D.C. 20230**

In the Matter of)	
)	
Federal Communications Commission Seeks)	ET Docket No. 06-89
Public Comment on Creation of a Spectrum)	
Sharing Innovation Test-Bed)	
)	
National Telecommunications and Information)	NTIA Docket No. 060602142-6142-01
Administration Notice of Inquiry)	
)	
)	

COMMENTS OF MOTOROLA, INC.

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Motorola, Inc. (“Motorola”) hereby submits these comments in response to both the FCC’s Public Notice and NTIA’s Notice of Inquiry relating to the establishment of a Spectrum Sharing Innovation Test-Bed.¹ As further described below, Motorola supports the identification of spectrum to test sharing technologies and techniques and urges the FCC and the NTIA to proceed expeditiously.

On May 29, 2003, the President issued an Executive Memorandum initiating an examination of the existing legal and policy framework for spectrum management in order to

¹ *Federal Communications Commission Seeks Public Comment on Creation of a Spectrum Sharing Innovation Test-Bed*, ET Docket No. 06-89, Public Notice, FCC 06-77 (June 8, 2006) (“FCC Public Notice”) and NTIA Docket No. 060602142-6142-01, Notice of Inquiry, 71 Fed. Reg. 33282 (June 8, 2006) (“NTIA NOI”).

better optimize the use of Federal and non-Federal spectrum assets.² In response to this directive, the Department of Commerce issued two reports recommending the development of a Spectrum Sharing Innovation Test-Bed that could be used to determine how spectrum could be shared between Federal and non-Federal users in the future.³ To facilitate implementation of this recommendation, the FCC and NTIA are each soliciting public comment on the purpose and feasibility of the Test-Bed program as well as the logistics of creating the Test-Bed program.⁴

Motorola supports the Test-Bed concept and believes that it should not be narrowly limited to a single block of spectrum or program. The greatest gains will come from allowing implementation in a variety of bands and looking at sharing between different types of services. Accordingly, Motorola supports creation of two Test-Bed programs, one below 1 GHz and the other above 4 GHz. These two programs together will allow broader experimentation with innovative spectrum sharing techniques in a way that should ultimately improve spectrum utilization and efficiency. Further, the FCC and NTIA should authorize multiple Test-Bed experiments throughout the nation, but should allow only a single experiment to be conducted at any given time within a given geographic location on the same spectrum. This will ensure that the maximum number of entities practicable are able to obtain the benefits of the Test-Bed while providing an environment in which results can be accurately determined and in which protection against harmful interference is maintained. Similarly, the benefits of the Test-Bed will be maximized by providing participants maximum flexibility to enter into a wide range of

² *Presidential Memorandum on Spectrum Policy for the 21st Century*, 69 Fed. Reg. 1568 (Jan. 6, 2004).

³ *Spectrum Policy for the 21st Century – The President’s Spectrum Policy Initiative: Report 1 Recommendations of the Federal Government Spectrum Task Force (Recommendation 11) and Spectrum Policy for the 21st Century – The President’s Spectrum Policy Initiative: Report 2 Recommendations From State and Local Governments and Private Sector Responders (Recommendation 6(b))*, NTIA, U.S. Department of Commerce (June 2004), available at <http://www.ntia.doc.gov/reports.html/>.

⁴ FCC Public Notice at 2; *The President’s Spectrum Policy Initiative Spectrum Sharing Innovation Test-Bed*, NTIA Docket No. 060602142-6142-01, Notice of Inquiry, 71 Fed. Reg. 33282 (June 8, 2006) (“NTIA NOI”).

experiments. Finally, the FCC and the NTIA should delay adoption of specific metrics that will determine the success of the Test-Bed program and should instead commit to initiating a rulemaking to implement any successes of the Test-Bed.

I. THE PROPOSED SPECTRUM SHARING INNOVATION TEST-BED WILL IMPROVE SPECTRUM UTILIZATION AND EFFICIENCY.

A key challenge spectrum users face is improving spectrum utilization and efficiency without adversely affecting existing services.⁵ The variety of uses for spectrum is constantly expanding, resulting in calls for additional spectrum to support many services. Greater and more intensive use of spectrum for many services has made it increasingly difficult to gain access to new unencumbered spectrum and has led to increased focus on opportunities for sharing spectrum across services and users. The increased demand for spectrum and resulting spectrum shortage have led spectrum users to continually look for new ways to improve utilization of existing spectrum while responding to user needs.

Experimenting with methods that could conceivably improve spectrum efficiency through improved sharing techniques, however, is difficult given the need to protect incumbent operations. In many situations, entities are using spectrum for critical services and any disruption in service could cause significant harm.

The Test-Bed would provide an environment in which such entities can test new technologies and techniques that, if successful, would improve spectrum users' utilization without risking interference with incumbent operations. To achieve this objective, the Test-Bed experiments must reliably identify harmful interference and its effects in a controlled manner. In addition, the Test-Bed should focus in large part on the capabilities of cognitive radios,

⁵ See FCC Public Notice Question 1(b) (asking what challenges spectrum users face that the Test-Bed could be used to resolve).

measuring spectrum efficiency, determining ways to increase spectrum efficiency, and new, efficient technologies while responding to test users' operational requirements.⁶ If done properly, these experiments could lead to improved spectrum sharing mechanisms that encompass interference avoidance techniques and enable increased spectrum efficiency.⁷

II. THE FCC AND NTIA SHOULD ESTABLISH TWO TEST-BEDS, ONE BELOW 1 GHZ AND ONE ABOVE 4 GHZ BAND.

The FCC and NTIA should establish two Test-Beds, one below 1 GHz and one above 4 GHz. The Test-Bed below 1 GHz could be used broadly to experiment with a wide range of spectrum efficient technologies. The second Test-Bed above 4 GHz would be used exclusively for the development of efficient local area broadband technologies that would facilitate shared spectrum use between Federal and non-Federal public safety agencies.

A. 1 GHz Spectrum Sharing Innovation Test-Bed

Consistent with the President's Executive Order, the FCC and NTIA should identify a minimum of 20 MHz for a Test-Bed below 1 GHz.⁸ Ideally, two contiguous 10 MHz or larger blocks would be used. Spectrum below 1 GHz would be ideal for one of the Test-Beds to properly validate interference avoidance mechanisms under the ideal propagation conditions relevant to this spectrum. This 20 MHz should be divided into a Federal exclusive block and a non-Federal exclusive block. Cross-sharing could occur between these two blocks provided it does not cause harmful interference. It would be ideal to find spectrum that is unoccupied and contiguous.⁹ Moreover, the use of essentially unoccupied spectrum, if available, would enable

⁶ *Id.*, Question 1(a) (asking if the Test-Bed should focus on particular technologies or areas of interest).

⁷ *Id.*, Question 1(b) (asking what type of issues the Test-Bed could be expected to resolve).

⁸ *Id.*, Question 4 (asking how much spectrum should be identified and whether the FCC should identify this spectrum or allow marketplace mechanisms to do so).

⁹ *Id.*, Questions 3, 4(b) (asking what criteria should be used to identify candidate frequency band(s) and whether the Test-Bed requires contiguous or non-contiguous spectrum).

the experiments to be conducted while minimizing the impact to existing primary users. However, Motorola is fully aware that unoccupied and contiguous spectrum would be extremely difficult to attain in spectrum below 1 GHz, given current operations. Possibly the most viable approach would be to conduct the Test-Bed in geographic locations where the primary user(s) of the spectrum have not built out, if such areas exist. However, to simulate the presence of a primary user in the non-built-out area, proxy equipment would be utilized that emulates the operational characteristics for the spectrum sharing experiments. Motorola believes it is essential to provide approximately 20 MHz of spectrum to ensure an adequate amount of spectrum to support a wide range of experiments.¹⁰

In addition, spectrum chosen for the tests should be configured appropriately. Paired spectrum with the appropriate degree of spacing would be needed for technologies that employ frequency division duplex (FDD), whereas unpaired spectrum, which may be more easily attained, could support testing involving time division duplex (TDD) technologies.

Defining spectrum for use in the Test-Bed below 1 GHz is a difficult task. However, assuming that the NTIA and FCC will each identify 10 MHz of spectrum from the spectrum that they currently oversee for the Test-Bed, there are several options for both the Federal and non-Federal spectrum contributions to the Test-Bed. Of the Federal band choices, spectrum within the 350 – 420 MHz band may be promising. Given higher utilization of the band above 380 MHz, a 10 MHz block between 350 and 380 MHz may be the most viable. This choice also provides a buffer to emergency beacon channels (i.e., GMDSS in the 400 – 403 MHz band), and the heavily utilized 406 – 420 MHz band. In addition, the 225 – 240 MHz band could be

¹⁰ The Federal and non-Federal blocks do not need to be adjacent.

considered; however, use of this band would require physical antenna constraints to be placed upon the early Test-Bed system, making this a less attractive choice.

Spectrum in the non-Federal portions is more difficult to identify given the extensive use of spectrum below 1 GHz by commercial, public safety and private radio entities. Initially, the FCC should attempt to avoid Public Safety, Private radio and Cellular bands, as well as other heavily used channels. Such spectrum is already heavily utilized and interference to incumbent uses could cause significant harm.

Motorola recommends the FCC identify at least 10 MHz of spectrum from the television broadcast channels 38 to 51 for use in the Test-Bed. Vacant or unused channels with appropriate guard bands could be aggregated for Test-Bed experiments in a specific geographic area. In addition, channels in 52 to 62 and 65 to 67 that have not been auctioned could be designated as an alternative when sufficient spectrum is not available within channels 38 to 51 if the Test-Bed would be completed before deployment in those bands. Use of the band for the Test-Bed should not be allowed to interfere with or delay use of the bands for licensed services. Out of this potential 150 MHz, it can be assumed that at least two or three 6 MHz channels would be available for a Test-Bed activity. The spectrum may not be contiguous, but the incumbents are easy to identify and protection criteria is well understood. Additional alternatives include channels 5 and 6 and the 174 – 216 MHz band. However, spectrum in these lower bands are unattractive candidates from an antenna standpoint.

B. 5 GHz Spectrum Sharing Innovation Test-Bed for Public Safety

Non-Federal public safety organizations currently have access to 50 MHz of spectrum at 4940-4990 MHz (4.9 GHz) for local area broadband applications. In making this allocation, the FCC determined that this 50 MHz would be needed to support the local area broadband operations of local and state public safety agencies. Since that allocation was made and final

rules were defined, over 700 local and state agencies have obtained licenses in the 4.9 GHz band. In addition, new technologies including mesh systems have been developed. Products using these technologies are now coming on the market to help provide local and state public safety additional mission critical communications tools.

Federal users have no similar allocation for local area broadband communications. Given the need to support Federal operations and improved local, state and Federal coordination, Motorola recommends that a Test-Bed Pilot program be deployed using both the 50 MHz in the 4.9 GHz band administered by the FCC and an additional 50 MHz of spectrum near-by the 4.9 GHz band¹¹ By conducting a Test-Bed pilot program in the 4.9 and 5.1 GHz bands, manufacturers, local and state public safety organizations and Federal agencies could experiment with new shared use technologies and techniques. More specifically, it would provide an ideal environment in which Federal, state, and local public safety can develop (1) effective ways of deploying joint operations, (2) efficient broadband applications, and (3) improvements to the use of public safety and Federal spectrum to benefit Homeland Security initiatives.

Accordingly, the FCC and NTIA should conduct a local area broadband pilot program with 50 MHz of spectrum in the 4.9 GHz band (allocated by the FCC) and 50 MHz of spectrum near 5.1 GHz band (allocated by NTIA). This combined 100 MHz would serve Federal, state, and local public safety, with state and local being primary in the 4.9 GHz band and secondary in the 5.1 GHz band and Federal being primary in the 5.1 GHz band and secondary in the 4.9 GHz band. This primary/secondary mechanism would provide the basis for joint operations while maintaining the security deemed necessary by Federal and state/local pilot participants. To

¹¹ Preferably the spectrum would be between 5.0 and 5.150 GHz, which is between the 4.9 GHz public safety band and the 5 GHz unlicensed spectrum. This would maximize the potential reuse of equipment, components and technology.

further promote the development of joint operations, equipment for this program would cover both the 4.9 GHz and 5.1 GHz band.

While information regarding local and state license authorizations is publicly available, similar information for Federal spectrum use is normally classified. This makes it extremely difficult to totally share spectrum on an “engineered-in” basis. Motorola believes the proposed primary/secondary approach, combined with equipment capable of covering both bands, will be an effective sharing mechanism that recognizes the operational requirements and realities of both state and local public safety entities and Federal agencies. In addition, this mechanism allows local, state and Federal leaders at an incident scene to tailor the sharing to meet specific needs of a given incident. Appropriate local, state and Federal agencies of course would need to volunteer to participate in the Test-Bed for a given area.

III. THE FCC SHOULD AUTHORIZE MULTIPLE CANDIDATES TO UTILIZE THE TEST-BED BY GRANTING EACH A SINGLE NATIONWIDE EXPERIMENTAL LICENSE.

The Test-Bed pilot program holds the potential of aiding a wide variety of entities in the development of spectrum-efficient technologies. Restricting the number of entities that can utilize the Test-Bed, however, would restrict the benefits achieved from the program. At the same time, allowing multiple entities to conduct experiments utilizing the same spectrum in the same location at the same time could undermine the effectiveness of the experiments. The FCC should authorize multiple candidates to utilize the Test-Bed, but should allow only a single experiment to be conducted at any given time on the same spectrum within a given geographic region.¹²

¹² FCC Public Notice Question 8 (asking whether multiple candidates should be selected).

The FCC's experimental licensing program provides an effective licensing regime within which these Test-beds can be authorized, provided they are given maximum flexibility to enter into a wide range of experiments in a variety of locations.¹³ Under the current experimental licensing program, entities must apply for a license to enter into each experiment. Given the ongoing nature of the proposed Test-Bed, however, the FCC should instead authorize each entity to participate in the Test-Bed once. Once authorized, an entity would be able to enter into an experiment in any geographic region in the United States on a non-interference basis.¹⁴ Participants should then be required to notify the FCC and NTIA and post, within a given period prior to the commencement of tests, the exact location/geographic area, time span, and frequencies of the planned experiment, as well as the generalized modulation methods utilized during the test.¹⁵

The FCC and NTIA should also consider requiring participants to submit information on, or data corresponding to, incumbents operating within the geographic area of the proposed experiment and the planned interference avoidance method to be utilized for the Test-Bed operation. This procedure and method for sharing information will allow incumbents to identify and report any interference, encourage cooperation between incumbent spectrum occupants and Test-Bed users, and help obviate the need for spectral coordination procedures.¹⁶ Similarly, if

¹³ *Id.*, Question 5 (asking whether users should be authorized through the experimental licensing program). Since a Test-Bed would include Federal spectrum as well, any experimental license would need to include both spectrum under FCC's jurisdiction and spectrum under NTIA's jurisdiction. Motorola believes that adequate mechanisms already exist for FCC to issue such experimental licenses after appropriate coordination with NTIA. However, we do recommend that such coordination be given a high priority both at FCC and at NTIA so that authorizations for Test-Beds can be issued without significant delay.

¹⁴ In order to prevent participants from utilizing the Test-Bed in inappropriate ways, the FCC should not permit Test-Bed licensees to conduct limited marketing studies in these bands.

¹⁵ FCC Public Notice Question 7 (asking what information should be provided to the FCC prior to initiating use of the Test-Bed). The FCC should not require submission of pre-experiment assumptions, analysis (modeling and simulation), and pre-experiment predictions. *Id.*

¹⁶ *Id.*, Question 9 (asking whether special procedures are necessary to coordinate Federal usage of the Test-

these procedures are utilized, FCC oversight will generally be unnecessary.¹⁷ We would, however, recommend that the FCC and NTIA implement internal procedures to ensure that the relevant FCC Regional Director with jurisdiction over the area in which the experiment will be conducted is notified of a planned Test-Bed operation and the frequency bands involved. This will help ensure open lines of communication and should provide a mechanism to help address any interference more expeditiously, should it occur, despite the best efforts of the parties involved in the Test-Bed.

IV. PARTICIPANTS SHOULD BE PROVIDED MAXIMUM FLEXIBILITY TO ENGAGE IN A WIDE VARIETY OF EXPERIMENTS.

As indicated above, the Test-Bed holds promise as a mechanism for a wide range of entities to develop increasingly spectrally efficient technologies. To fully achieve this promise, participants should be provided maximum flexibility to experiment with a wide range of technologies. For example, participants should be allowed to experiment with both standardized and proprietary technologies.¹⁸ In situations where proprietary technologies are used, the FCC could restrict what information is released to the public; e.g. only the results of the experiment. Similarly, participants should be allowed to utilize geographic areas of different size in the Test-Bed.¹⁹ Large areas are ideal because they provide a range of population densities. A large area is more likely to include both urban and rural areas than a smaller area. The inclusion of urban areas within the experiment's geographic area is particularly critical given that those are in

(Continued . . .)

Bed with non-Federal usage).

¹⁷ *Id.*, Question 11 (asking whether FCC personnel should be appointed as overseers to gauge the progress of the program).

¹⁸ *Id.*, Question 14 (asking whether use of proprietary technologies should be permitted in the Test-Bed).

¹⁹ *Id.*, Question 7 (seeking comment on the geographic size over which experiments should be permitted and whether experiments could be limited to rural areas).

greatest need of increased spectrum access and efficiencies.²⁰ 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

Given this flexibility, a wide range of equipment could be used in the Test-Bed. Each participant should be required to provide all equipment necessary to conduct its own Test-Bed experiments.²¹ This should include proxy equipment to mimic both Federal and non-Federal users as well as to reliably detect and report all incidents of potential harmful interference to the equipment during the test. Absent this requirement, participants would be required to utilize standard equipment, a result that could severely limit the wide variety of experiments that could be performed in the Test-Bed.

V. THE FCC SHOULD DELAY ADOPTION OF SPECIFIC METRICS THAT WILL DETERMINE THE SUCCESS OF THE TEST-BED PROGRAM AND SHOULD INSTEAD COMMIT TO INITIATING A RULEMAKING TO IMPLEMENT ANY SUCCESSES OF THE TEST-BED.

The FCC should not prematurely set standards under which the success of Test-Bed experiments will be reviewed. It is still extremely early in the development of the proposed Test-Bed program and it is impossible to predict what the results of the experiments will be. It is likely that the success of a given experiment and its possible extension into other bands will be dependent on a great variety of factors, including the specific equipment utilized during the experiment, service requirements, the parameters of the experiment, and the specific performance metrics of the experiment, as well as multiple unanticipated factors. Accordingly, the FCC should not adopt performance metrics at this time or determine whether specific

²⁰ If, as proposed above, spectrum that is largely unoccupied is identified for inclusion in the Test-Bed, harmful interference to incumbent users will be minimized, even in the event an experiment is performed in the urban area.

²¹ FCC Public Notice Question 12 (asking what resources should parties provide for the Test-Bed program).

experiments that ultimately do meet certain performance metrics will necessarily be expanded into other frequency bands.²²

Instead, the FCC should encourage a flexible peer review process that could lead to a new rulemaking to address the expansion of a given service to new bands. A peer review process is essential to assessing the results of any given experiment.²³ Only through peer review can potential problems be identified and addressed and successes be confirmed. To facilitate this peer review, subsequent to the completion of the experiment, participants should be required to submit a report to the FCC detailing the experiment, including the goal, assumptions, methodology, and results. Results should include a summary of operational benefits encountered by use of the Test-Bed, not just a report on the spectrum management aspects of the experiment. This will help industry, the FCC and NTIA to determine which of the programs warrant initiation of a follow-up rulemaking. Once an experiment is deemed a success, the FCC should initiate a follow-up rulemaking to determine ways in which the results of the test can be incorporated into the same and/or other frequency bands on a more routine basis.²⁴ The motivation for these experiments is the expectation that a successful test will lead to more permanent spectrum sharing between Federal and non-Federal users. A rulemaking would be necessary to effect any necessary change in the rules and would ensure that appropriate safeguards are adopted to prevent harmful interference and that fail-safe mechanisms are implemented to promptly terminate spectrum sharing if unexpected harmful interference ultimately occurs.

²² *Id.*, Questions 15-16 (seeking comment on what metrics should be used in evaluating the results of the Test-Bed program and whether experiments that meet the performance metrics should be expanded to other frequency bands).

²³ *Id.*, Question 18 (seeking comment on whether users should be required to submit a report detailing the experiment at the conclusion of any experiment).

²⁴ *Id.*, Question 17 (asking whether there is an expectation that a successful experiment would translate into an FCC rulemaking proceeding to explore rule changes consistent with the experiment results).

VI. CONCLUSION

For the reasons stated above, Motorola fully supports the creation and implementation of a Spectrum Sharing Innovation Test-Bed. If successful, this Test-Bed could lead to great increases in spectrum utilization and efficiency, as well as significant operational benefits. In implementing this Test-Bed, the FCC and NTIA should provide participants broad flexibility to enter into a wide range of experiments and should not require extensive filing requirements that could significantly delay or impede utilization of the Test-Bed.

Respectfully submitted,

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