

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

In the Matter of)
)
THE PRESIDENT’S SPECTRUM POLICY)
INITIATIVE -- CREATION OF A)
SPECTRUM SHARING INNOVATION)
TEST BED)

**Docket No.
060602142-6142-01**

**To: Office of the Chief Counsel
Attention: Spectrum Sharing Innovation
Test-Bed Notice**

**COMMENTS OF ARRL, THE NATIONAL ASSOCIATION
FOR AMATEUR RADIO**

ARRL, the National Association for Amateur Radio, also known as the American Radio Relay League, Incorporated (ARRL), by counsel, and pursuant to the *Notice of Inquiry* released June 8, 2006 (the Notice), hereby respectfully submits its comments in response to NTIA’s proposal to establish a spectrum test-bed. The concept would encourage experimentation with “innovative” methods for spectrum sharing among disparate users, and specifically Federal and non-Federal users, in order to enable more intensive but compatible, use of the radio spectrum. According to the Notice, NTIA and the Federal Communications Commission (FCC) propose to set up a “test-bed” (a segment or segments of spectrum) where both Federal and non-Federal users could undertake studies and experiments to test concepts and ideas to increase the efficient use of the spectrum. The NTIA Notice, and a companion *Public Notice*¹ released

¹ See, the FCC’s *Public Notice*, ET Docket No. 06-89, FCC 06-77, released June 8, 2006.

contemporaneously by the FCC each seek comment² on a variety of very generalized questions about the creation of such a test-bed, which will be called the Spectrum Sharing Innovation Test-Bed (“Test Bed”). In response to those questions, and to assist in the conceptualization of a Test Bed, ARRL states as follows:

1. ARRL, in general, supports the concept of a spectrum Test Bed. The FCC and the Administration have each expressed a strong interest in spectrum overlays in recent years. This is understandable, given the increased pressure on the radio spectrum from competing, typically commercial, proposed uses. The Amateur Service has always adapted to spectrum sharing effectively, and is appreciative of the cooperation received from NTIA in accommodating Amateur operations in Federal allocations over the years. Indeed, most Amateur allocations at VHF and above are compatibly shared with Federal government agencies. The Amateur Service is heavily dependent on the ability to share spectrum cooperatively and efficiently with Federal government uses. As well, since the beginning of radio, the Amateur Service has effectively and in an encouraging manner served as a test bed for new, experimental and developing radio technologies, and continues to do so. The FCC’s Experimental Radio Service, regulated minimally under Part 5 of the FCC’s rules, has also provided an effective and flexible method of encouraging and developing concepts and ideas to increase the efficient use of the radio spectrum. In the Experimental Radio Service, by applications which are coordinated with NTIA to protect Federal government uses, the FCC routinely permits testing, development and refinement of new and advanced concepts and technologies in frequency bands allocated to different radio services. Some experimental authorizations

² ARRL is submitting comments in both the instant NTIA proceeding and the FCC proceeding, inasmuch as the questions asked about a spectrum test-bed in each of the two proceedings are similar, but not identical.

are conducted specifically to determine compatibility with incumbent services and unlicensed devices and systems already deployed. The Experimental Radio Service therefore already serves as a very flexible mechanism for encouraging spectrum sharing and examining methods of optimizing the use of the United States' spectrum assets for Federal and non-Federal users.

2. While the FCC has procedures already in place to experiment with spectrum overlays and to accomplish the goals set in the *Presidential Memorandum on Spectrum Policy for the 21st Century* (69 Fed. Reg. 1568, January 6, 2004), NTIA and FCC could set aside some Federal government shared or exclusive spectrum for a Test Bed which might facilitate spectrum overlay experiments conducted by private sector entities. These experiments can assist specifically in ascertaining compatibility with present and future Federal (and other incumbent) uses in those bands. In ARRL's experience, there is no present shortage of incentive to conduct those experiments, and the FCC's Experimental Radio Service is available to facilitate such experimentation. However, the difference between the Test Bed concept and the present Part 5 Experimental Radio Service is that the Test Bed concept is intended specifically to explore expanded Federal and non-Federal sharing of spectrum. The participation of NTIA in the process, and the anticipated addition of non-Federal to Federal uses in a subject band adds an important dimension to the proposal that could in certain circumstances lead to increased efficiency in the use of already deployed spectrum. NTIA's expertise in spectrum allocation planning is well-established, and a collaborative effort between Federal and non-Federal users in field testing can be of value in establishing compatibility prior to introduction of sharing partners in already deployed bands.

3. The Amateur Service has successfully shared spectrum with Federal agencies for more than sixty years. In ARRL's view, which is apparently shared by NTIA, this sharing works well.³ The success of the Federal/Amateur spectrum sharing is due in no small part to the technical review processes applied by NTIA to spectrum overlay and underlay concepts and proposals. On the other hand, ARRL has, more recently in the past few years, expressed criticism of the FCC's non-technical approach to domestic spectrum allocations planning and the means by which new, or overlay technologies have been evaluated and authorized by the FCC. Proposed spectrum uses have been advanced by the FCC and in some cases implemented without what ARRL would term a sufficient technical basis. The creation of a spectrum Test Bed offers the opportunity to objectively test and evaluate the compatibility of various incumbent and proposed overlay (or underlay) uses of spectrum prior to actually authorizing them. It brings all three parties together: the proponent of a new technology, NTIA and FCC, in an objective, evaluative process. This would prevent spectrum allocation decisionmaking based on no more than the relative success of private sector marketing of a technology by its own advocates. To this extent, ARRL supports the Test Bed concept, as a means of properly refocusing the FCC's spectrum planning effort toward technical compatibility determinations based on actual testing.

³ See, the *Spectrum Reallocation Final Report*, in response to Title VI, Omnibus Budget Reconciliation Act of 1993, NTIA Special Publication 95-32, released February, 1995 at Appendix B, Page B-2. In that report, NTIA stated as follows:

The amateur radio service has successfully co-existed with Federal fixed, mobile and radiolocation services (i.e. radar) for nearly fifty years (footnote omitted). As indicated in many of the public comments on the Preliminary Report and the FCC NOI, this sharing arrangement has been successful for both Federal and amateur spectrum users. This success is primarily due to the fact that much of the Federal spectrum usage is located away from populated areas, minimizing potential interference as well as the amateur's ability to use the guard bands placed between different types of Federal services.

4. The Notice asks whether the Test Bed should be limited to prototype/operational equipment or whether hardware simulation can also be employed. It makes sense to first do simulations, and then test in the field in the Test Bed spectrum, obtaining field measurements of prototype devices and systems. As to what techniques or sharing techniques should be implemented in the Test Bed, ARRL suggests that there should be no assignments in the Test Bed spectrum. Rather, the focus should be on code division multiplexing, rather than frequency or time division multiplexing, such as Spread Spectrum technologies or other code division multiple access systems; and on techniques that occupy the entire bandwidth of the Test Bed spectrum. The goals of the Test Bed should not, however, be preordained. In ARRL's view, the overarching goal of the Test Bed should be to create a means of conducting both theoretical testing of technologies, and practical testing, prior to authorizing the systems and devices under test. The FCC's and NTIA's intention should be to obtain hard, reliable data concerning the compatibility of incumbent and proposed additional uses, (regardless of whether the overlay technology is to be licensed or unlicensed), prior to authorizing their deployment. Another important goal is to use the test bed to evaluate aggregate effects of new technologies. Neither the FCC nor, to the best of ARRL's knowledge, NTIA, now has the ability, other than through computer modeling, to determine what the cumulative effect of RF devices is in a subject band. The Test Bed provides an opportunity, albeit somewhat limited, to evaluate cumulative effects on the noise floor, and on ambient noise levels, of multiple devices and systems. Such would contribute to preventing the "tragedy of the commons" effect in authorizing unlicensed devices which has occurred in, for example, the band 2400-2483.5 MHz.

5. The Notice asks whether there should be specific technologies or areas of interest that should be tested. ARRL suggests that the Test Bed permits a valuable forum for testing cognitive radio designs, listen-before-transmit protocols, and the functionality and sufficiency of other interference avoidance mechanisms. Often, in FCC rulemaking, the FCC suggests that certain technologies may be compatible with incumbents, merely assuming the success of interference avoidance mechanisms. Those assumptions, however, in many cases have an insufficient technical foundation. The Test Bed offers an objective means of evaluating the sufficiency of these mechanisms. Since more intensive uses of spectrum are the end goal of the FCC and of NTIA, the evaluation of interference avoidance mechanisms in ascertaining compatibility should be the focus of the Test Bed experiments.

6. There should be sufficient spectrum dedicated to the project to conduct multiple experiments at once. The FCC envisions a situation in which 10 MHz is identified by the FCC for the Test Bed and another 10 MHz is identified by NTIA for the same purpose, for a total of 20 MHz. In ARRL's view, 10 MHz of shared government and non-government spectrum is ample for the Test Bed. It is unclear whether more than 10 MHz in the aggregate is necessary. Which portions of the spectrum should be identified is not clear at the moment. ARRL urges that the principal criterion to be used in identifying candidate bands for the Test Bed should be non-interference to incumbents. Higher microwave spectrum is preferable for several reasons, though that portion of the spectrum suffers atmospheric attenuation. The advantages of that segment are that it promotes frequency re-use based on geographic separation. The determination of a specific band requires further study, however, and should be the subject of specific

further rulemaking. The limitations applicable to the candidate bands should include the need for dynamic frequency selection (i.e. listen-before-transmit protocols); limitations on power spectral density; antenna beamwidth limitations (i.e. encouraging antenna directivity); and geographic separations between and among incompatible experiments. The power limitations should be modeled after the current FCC Part 15 rules for unlicensed devices. Though such limits are liberal by comparison to those of certain other administrations, they provide a base line for Test Bed experiments. Of course, proposals for new licensed services which require higher power levels should be accommodated, but with careful determination of their proximity to incumbent services. The spectrum identified should be Federal and non-Federal shared spectrum, or Federal exclusive spectrum. The Test Bed concept is premised on increased, more efficient shared use of Federal and non-Federal spectrum, and use of non-Federal exclusive spectrum does not contribute to the goals of the Test Bed. If there are two bands to be selected, one by NTIA and one by the FCC, they should be contiguous.

7. The Notice asks what processes, principles and guidelines should be applicable. In ARRL's view, multiple experiments should be conducted at once, but on a managed basis. The experiments should be separated, so that the outcomes are not corrupted by other ongoing experimentation at the same time. There is going to be required a management entity, independent of the experiment sponsors, that should provide oversight to insure the integrity of each experiment.

8. In order to provide protection for incumbent users in the Test Bed, the limitations in FCC's (Part 5) rules governing issuance of experimental authorizations should be used: All operation should be on a non-interference basis, and all experiments

should be specifically authorized by the Test Bed administrator/manager. Experiments should be terminated immediately in the event of a complaint of interference from an incumbent and should not recommence unless and until the experimenter and the incumbent licensee coordinate interference elimination. Both parties should be required to cooperate in interference resolution, but the burden of modifying operations to eliminate interference should be on the experimenter.

9. The authorization of the Test Bed experiments should be based on the FCC's Part 5 rules as well. The process should involve, prior to any Test Bed operation, Federal government-funded simulation studies, including aggregate interference predictions (if applicable) using computer modeling. Then, based on the results of those developed models, and predicted sharing compatibility results, the field testing should be conducted in the Test Bed over a period of time sufficient to yield reliable results. Information provided in the application should, at minimum, include that which is provided in an FCC Part 5 experimental license application. An exhibit to the application should list the assumed or ascertained technical parameters of incumbent operations in the Test Bed band in the geographic area(s) in which the testing will occur. A copy of the computer modeling results should be appended to the application, and at the conclusion of the Test Bed operations, the results should be compared to the modeling results in a report filed with both the FCC and NTIA. A test plan should be developed by the applicant as well. The test plan, and the application contents and simulation results should be disclosed and made publicly available for comment after filing.

10. Large geographical areas should be used for Test Bed implementation. Larger geographical areas are necessary in order to include a variety of RF environments. If

limited areas are tested, the results may be inapplicable to other RF environments. ARRL suggests that, as a minimum, specific urban, suburban, exurban and rural areas should be studied for each overlay technology under study. If a technology is determined to be compatible with incumbents in a rural RF environment but not in an urban environment, that information is critical to determining the outcome of any later rulemaking with respect to that particular overlay technology.

11. Multiple candidates should be selected. If there are competing proposals, they should be permitted to conduct experiments in separate geographical areas. The method that candidates would use to coordinate with each other would be through a publicly accessible database maintained by a Test Bed Manager. In order to conduct operations in shared Federal and non-Federal allocations, the test plans submitted by the potential experimenter should have all necessary information for NTIA's and FCC's review in the application. The preparation and submission of the test plan should be reviewed by both FCC and NTIA. However, the role of the FCC and NTIA should be a reduced role. At least one person from either NTIA or the FCC should be designated for oversight when needed, and to review applications and test plans, and to coordinate them with Federal agencies. An administrator in the private sector which is not conducting experiments in the Test Bed should be appointed as a Test Bed Manager, to handle administrative functions. The proponents of new technologies should provide the test personnel and equipment. The proponent should also be required to coordinate operations in the Test Bed with representatives of incumbent licensees.

12. The selection criteria discussed at Item III of the Notice are, in general, not useful. However, one proposed criterion, how well the proposed technology or service

addresses the potential impact on incumbent spectrum users, is of critical importance. This should be a principal criterion. Perceived public benefit, however, should not be a factor at all. Public benefit is difficult to measure, is subjective, and is not a good selection criterion. Indeed, if the proposed service or technology is unlicensed, the perceived public benefit cannot as a matter of law be offset against the interference potential of the device or service. The entire purpose of the Test Bed is, in ARRL's view, a means of avoiding subjective predictions of public benefit, or predictions based on unknown future conditions and anticipated demand. Instead, it is a means of making objective the compatibility analysis and evaluating the effect of a new technology on incumbent licensees and Federal uses. Any prediction of public benefit of a service is directly contrary to the principal benefit of the Test Bed.

13. The simulations that ARRL suggests as a precondition to use of the Test Bed should be Federally funded so as to insure feasibility of the experiment prior to its being conducted in the Test Bed. Proprietary technologies should not be permitted in the Test Bed. The benchmark of the concept should be that all experiments are conducted openly and based on a publicly available database. The test plan, the database, the application, and the computer modeling should all be public information. The test plan should be prepared and submitted by the parties involved. It should be evaluated in terms of interference potential to incumbent services. The experiment should not be authorized if the computer modeling shows a significant interference potential to licensed or Federal incumbents, and, once commenced, it should be terminated if it results in interference to incumbent licensed or Federal government services in the Test Bed more than one (1) percent of the time. The extent to which the noise floor at an incumbent's receiver is

increased should be measured and determined. The test plan should specify who is responsible for analyzing and evaluating the data from the experiment. Status report should be provided every six months, as is currently required for experimental authorizations issued by the FCC under Part 5 of its rules.

14. If the experiment meets the performance metrics, it should not automatically be permitted to remain in the Test Bed or expanded to other frequency bands. Each test should be complete and separate from others, and should be evaluated on its merits thereafter. At the conclusion of the Test Bed operation, the experimenter should be required to submit a public report, stating the goals, assumptions, methodology, and claimed results of the experiment and any conclusions drawn. There should be no prejudgment of the service at the conclusion of the test, except as conducted through normal allocations processes such as notice and comment rulemaking. However, success in the Test Bed would be a significant factor in evaluating any separate, later rulemaking or application process needed to implement the technology after the conclusion of the experiment. The experiment should not necessarily be left in the Test Bed spectrum, however. If the tests reveal no significant interference potential, or the potential to preclude future Test Bed experiments, and if there is a compelling need for the technology or service in the short term, it could be permitted to remain in the Test Bed. However, that should be determined through rulemaking, and the rulemaking should rely heavily on the publicly accessible findings from the Test Bed experiments in order to expedite the decisionmaking process. The key to the success of the Test Bed concept is, ARRL would argue, the public availability of the test plan; the application for the Test Bed experiment; the periodic reports, and the final evaluative report. At every stage, a

publicly accessible database should be maintained by the Test Bed Manager in order that interference reporting and resolution is facilitated.

15. The Notice asks whether initial conditions should change or be re-evaluated periodically, such as additional locations, spectrum modifications, or the time frame of the experiment. That should be determined for each test individually, based on the results of the test.

16. In summary, ARRL supports the Test Bed concept. The extent to which there are compatible means of intensifying the use of existing shared Federal and non-Federal spectrum obviously requires study. The Test Bed concept, in ARRL's view, makes the process of determining compatibility in this process objective, rather than subjective or predictive. The Amateur Service has long shared successfully with Federal government users. It is far more challenging to add commercial uses to bands used by Federal government agencies, often intensively. Sharing in bands already occupied by Federal and Amateur operations is especially problematic where the overlay technology is commercial; uses a relatively high transmitter power; has a high aggregate number of transmitters or intentional emitters in heavily populated areas, and/or has a high duty cycle. But ascertainment of increased sharing opportunities is best done through a combination of computer modeling and simulations, and through field measurements in varied geographic and RF environments. The Test Bed concept is a welcome, objective addition to a domestic spectrum allocation process that has, more often than not in recent years, been premised on policy or political expediencies, rather than on hard technical fact. The FCC and NTIA are to be congratulated for this initiative. It is overdue.

Therefore, the foregoing considered, ARRL respectfully requests that NTIA

implement the spectrum Test Bed in accordance with the foregoing comments.

Respectfully submitted,

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