

**THE SPECTRUM SHARING INNOVATION
TEST-BED PILOT PROGRAM
FISCAL YEAR 2010 PROGRESS REPORT**



**NATIONAL TELECOMMUNICATIONS AND
INFORMATION ADMINISTRATION**

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TABLE OF CONTENTS

I.	BACKGROUND.....	1
II.	OVERVIEW OF DYNAMIC SPECTRUM ACCESS.....	2
	TECHNOLOGIES	
III.	PHASE I TEST PLAN.....	3
IV.	FISCAL YEAR 2010 ACTIVITIES	4
V.	PLANNED FISCAL YEAR 2011 ACTIVITIES.....	5

I. BACKGROUND

The National Telecommunications and Information Administration (NTIA), in coordination with the Federal Communications Commission (FCC) and the Federal agencies, has established a Spectrum Sharing Innovation Test-Bed (Test-Bed) pilot program to examine the feasibility of increased sharing between Federal and non-Federal users. This pilot program is an opportunity for the Federal agencies to work cooperatively with industry, researchers, and academia to examine objectively new technologies that can improve management of the nation's airwaves.

The Test-Bed pilot program is evaluating the ability of Dynamic Spectrum Access (DSA) devices employing spectrum sensing and/or geo-location techniques to share spectrum with land mobile radio (LMR) systems operating in the 410-420 MHz Federal band and in the 470-512 MHz non-Federal band.¹ To address potential interference to incumbent LMR spectrum users, the Test-Bed pilot program includes both laboratory and field measurements performed in three phases to characterize the interaction with DSA enabled devices:

Phase I – Equipment Characterization. Participants in the Test-Bed send equipment employing DSA techniques to the NTIA Institute for Telecommunication Sciences (ITS) in Boulder, Colorado to undergo characterization measurements of the DSA capabilities in response to simulated environmental signals.

Phase II – Evaluation of Capabilities. After successful completion of Phase I, NTIA will examine the DSA spectrum sensing and/or geo-location capabilities of the equipment.

Phase III – Field Operation Evaluation. After successful completion of Phase II, NTIA will test the DSA equipment in an actual radio frequency signal environment using an automatic signal logging capability to help resolve interference events if they occur. NTIA will establish a point-of-contact to stop Test-Bed operations if interference is reported.

NTIA selected the following parties to participate in the Test-Bed pilot program: Adapt4 LLC, Adaptrum Inc., BAE Systems, Motorola Inc., Shared Spectrum Company, and Virginia Polytechnic Institute and State University.

During fiscal years 2008 and 2009, NTIA completed the development of the Test-Bed pilot program Phase I test plan, the coordination of the test plan with the Federal agencies and Test-Bed participants, the publications and public comments of the test

1. Dynamic Spectrum Access technology allows a radio device to (i) evaluate its radio frequency environment using spectrum sensing, geo-location, or a combination of spectrum sensing and geo-location techniques; (ii) determine which frequencies are available for use on a non-interference basis; and (iii) reconfigure itself to operate on the identified frequencies.

plan, and began the laboratory testing of the first and second DSA devices. All of the documents related to the Test-Bed pilot program are available at <http://www.ntia.doc.gov/frnotices/2006/spectrumshare>.

This progress report describes the activities related to the Test-Bed pilot program that NTIA undertook during Fiscal Year 2010.

II. OVERVIEW OF DYNAMIC SPECTRUM ACCESS TECHNOLOGIES

NTIA staff members met with each of the Test-Bed participants to discuss their DSA devices. Table 1 provides a high level overview, based on information provided by the Test-Bed participants, of the different DSA devices being tested by NTIA.

Table 1.

DSA Device Parameter	Test-Bed Participants					
	A	B	C	D	E*	F
DSA Capabilities	Spectrum Sensing and Geo-Location	Spectrum Sensing	Spectrum Sensing	Spectrum Sensing	Spectrum Sensing and Geo-Location	Spectrum Sensing
Transmit Bandwidth	Fixed	Variable	Variable	Fixed	Fixed	Fixed
Channel Structure	Contiguous Channels	Non-Contiguous Channels	Non-Contiguous Channels	Single Channel	Single Channel	Single Channel
Monitoring Frequency Range	Variable	Fixed	Fixed	Fixed	Fixed	Fixed
Monitoring Time	Variable	Variable	Variable	Variable	Variable	Variable
Duplex Channel Monitoring	Yes	No	No	No	No	No
Detection Method	Power Level Exceeding Threshold	Power Level Exceeding Threshold	Power Level Exceeding Threshold	Statistical Processing	Power Level Exceeding Threshold	Power Level Exceeding Threshold
Detection Threshold	Variable	Variable	Variable	Variable	Variable	Variable
Detection Time	Variable	Variable	Variable	Variable	Variable	Variable
Cooperative Sensing	Yes	Yes	No	Yes	No	No
Feature Detection	No	No	Yes	No	No	No
Control Channel	No	Yes	Yes	No	No	No
Channel Lock-Out	Yes	Yes	Yes	Yes	Yes	Yes
Channel Clearance Time	Variable	Variable	Variable	Variable	Variable	Variable
Channel Re-Visit Time	Variable	Variable	Variable	Variable	Variable	Variable
Automatic Transmit Disable	Yes	Yes	Yes	Yes	Yes	Yes

* Test-Bed Participant E has notified NTIA that they will no longer participate in the Test-Bed pilot program.

III. PHASE I TEST PLAN

NTIA completed the coordination of the Phase I test plan with the Federal agencies and Test-Bed participants in November 2008 and published the coordinated Phase I test plan in the *Federal Register* for public review and comment in December 2008.² NTIA addressed the public comments on the test plan and published a final version on the NTIA website in February 2009.³

The Phase I test plan breaks the test cases down into five categories for each Device Under Test (DUT): emission characterization, sensor characterization, spectrum access behavior, LMR emission characterization, and LMR receiver performance characterization. Figure 1 shows an overview of the proposed test cases to be performed under Phase I. All Phase I testing will be performed at the ITS laboratory.

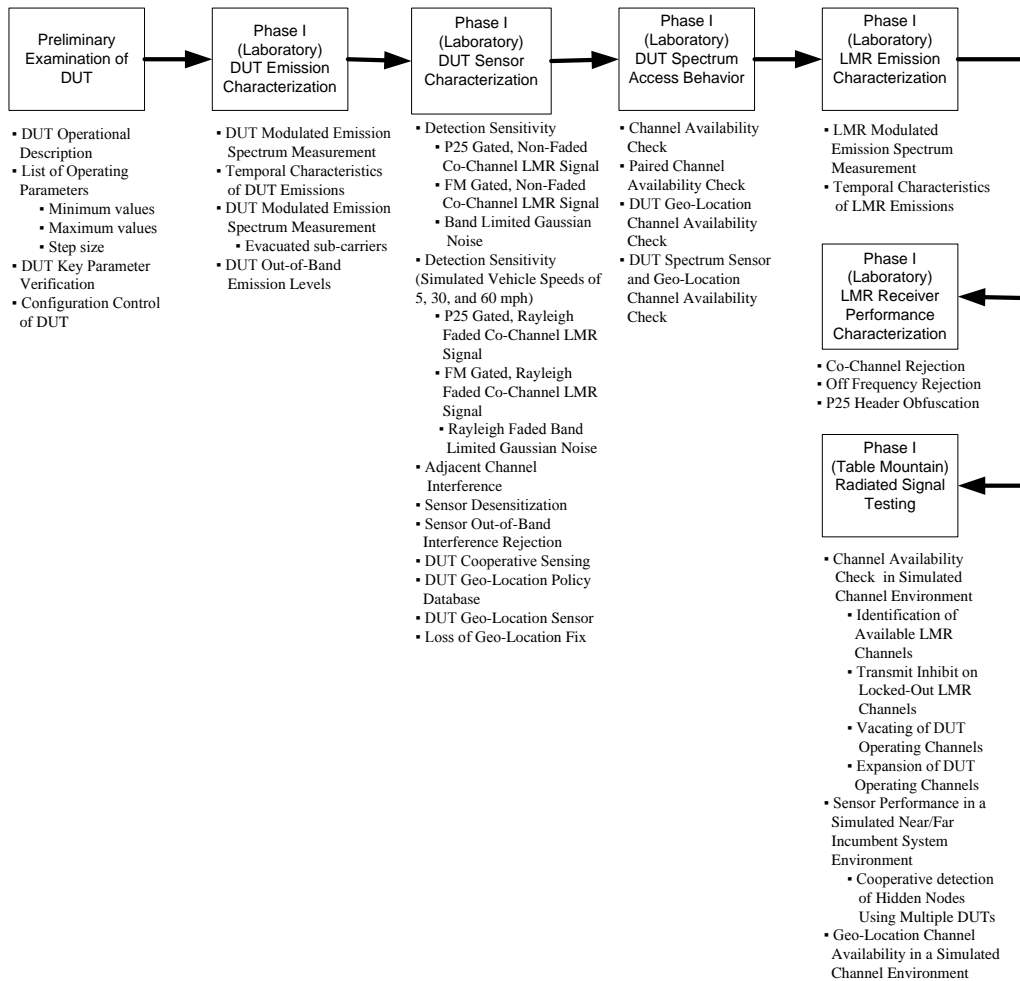


Figure 1.

2. Spectrum Sharing Innovation Test-Bed Pilot Program, 73 Fed. Reg. 76,002 (Dec. 15, 2008).

3. The final Phase I test plan and additional information on the Test-Bed pilot program are available at <http://www.ntia.doc.gov/ntiahome/frnotices/2006/spectrumshare/comments.htm>.

IV. FISCAL YEAR 2010 ACTIVITIES

Phase I Testing

NTIA completed the Phase I laboratory testing of the DSA devices from Test-Bed Participant A. NTIA is currently preparing a test report for the Test-Bed Participant A devices based on the Phase I measurement data.

The ITS laboratory received DSA devices from Test-Bed Participant B in August 2009. NTIA initiated the Phase I laboratory testing of the Test-Bed Participant B DSA devices in November 2009. NTIA has completed approximately 60 percent of the Phase I laboratory testing.

The ITS laboratory received DSA devices from Test-Bed Participant F in October 2010. The Test-Bed Participant F staff provided training on the use of their devices and pertinent documentation. NTIA has completed approximately 10 percent of the Phase I laboratory testing of these DSA devices.

ITS engineers worked with Test-Bed Participants B and F to address problems encountered with the DSA device control interfaces used in the automated tests. While this impacted the pace of testing, it nonetheless has provided NTIA valuable insight into strategies to develop new processes to facilitate efficient conformity assessment of DSA devices in the future.

Test-Bed Participant C provided a demonstration of its devices to NTIA staff in January 2011. NTIA expects that Test-Bed Participant C will provide the status of their DSA devices' readiness for Phase I laboratory testing in March 2011.

Test-Bed Participant D plans to provide its sensor configuration to NTIA in May 2011.

Test-Bed Participant E staff informed NTIA in February 2010 that they will no longer participate in the Test-Bed pilot program.

NTIA staff members are developing analytical capabilities to assess the potential interference to LMR systems from DSA devices. Phase I laboratory testing is providing NTIA insight into the characteristics of the DSA devices for use in developing these analytical capabilities.

Phase II/III Testing

The test plan for Phase II/III field testing is currently being developed by NTIA/ITS staff. NTIA will coordinate this test plan with the Federal agencies on the Interdepartment Radio Advisory Committee (IRAC) and the Test-Bed participants as

well as solicit input from the public through a notice in the *Federal Register* prior to commencing the Phase II/III testing.⁴

The Phase II testing will determine the effectiveness of the DSA device in detecting the presence of land mobile radios in a live operating environment. The DSA devices will not be permitted to transmit during this test, or their transmissions will be suitably attenuated so as not to interfere with normal LMR operations. NTIA will observe the behavior of the DSA devices to assess their potential for sharing with LMR systems.

The Phase III testing will evaluate the ability of the DSA devices to operate in the presence of land mobile radios in a live environment. These tests will include a number of characteristic scenarios in which DSA devices must consistently detect and avoid incumbent LMR systems. The testing performed by NTIA will investigate the impact of DSA device operations on the received LMR signal quality, for conventional LMR base-to-mobile and mobile-to-base transmissions and the impact of DSA device operations on the control channel signaling between the base station and mobile stations for a trunked LMR system. NTIA will also examine scenarios where the LMR base station is a hidden node, and when a LMR mobile station is a hidden node.⁵ NTIA also plans a test scenario for DSA devices equipped with geo-location based capabilities. As the DSA devices move between two geographic regions, they should invoke distinct transmission characteristics that are permitted by the policy within the DSA device. The transmission characteristics will be monitored as the NTIA staff moves the DSA devices between the two regions.

NTIA will perform the Phase II/III field testing in the Boulder, Colorado area.

V. PLANNED FISCAL YEAR 2011 ACTIVITIES

The Phase I laboratory testing will continue based on the schedule shown in Table 2.

Table 2.

Test-Bed Participant	Status
A	Testing completed. Report is being prepared
B	Testing started in November 2009
C	Device delivery expected in March 2011
D	Device delivery expected in June 2011
E	Device withdrawn from Test-Bed pilot program
F	Testing started in October 2010

4. The IRAC, consisting of representatives of 19 federal agencies, serves in an advisory capacity to the Assistant Secretary of Commerce for Communications and Information.

5. A hidden node is radio whose transmissions are either too weak or too infrequent to be detected by a DSA device.

NTIA expects to complete the Phase I laboratory testing of DSA devices for Participants B and F by the end of FY 2011.

NTIA expects to complete and coordinate the Phase II/III test plan with the Federal agencies through the IRAC Technical Subcommittee. After completing coordination with the Federal agencies, NTIA will coordinate the Phase II/III test plan with the Test-Bed participants and issue a notice in the *Federal Register* soliciting comments from the public. NTIA expects to complete coordination of the Phase II/III test plan during FY 2011 and to begin the Phase II/III testing of the DSA devices from Test-Bed Participant A during this time period.

NTIA staff will continue to develop analytical capabilities to assess the potential interference to LMR systems from DSA devices during FY 2011.