Dynamic Frequency Selection (DFS) Test and Compliance Issues - Update

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DFS General Information

- U-NII Frequency Bands:
  5.15-5.35, 5.47-5.725, and 5.725-5.825 GHz

- Dynamic Frequency Selection (DFS) and Transmit Power Control (TPC):
  5.25-5.35 GHz and 5.47-5.725 GHz

Note Code “ND” use is optional for both master and client devices

- Legacy Bands
  5.15-5.25 and 5.725-5.825 GHz

DFS and TPC not required
**TCB Exclusions**

- TCBs cannot authorize DFS devices with radar detection capability.
- TCBs can authorize DFS client devices without radar detection capability:
  - Must not have an “ad-hoc” or “peer-to-peer” mode
  - Tests:
    - Channel Move Time
    - Channel Closing Transmission Time
    - Client Beacon Test
- Pre Grant sample call for devices with radar detection capability:
  - Expedited Review for qualified candidates
  - Sample monitoring by NTIA to continue
### Expedited Review Candidates – Required Information

<table>
<thead>
<tr>
<th>Required Information</th>
<th>FCC ID of New Application</th>
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<tbody>
<tr>
<td>Names of the test labs for the various Grants</td>
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<tr>
<td>Differences between the products such as TX power, modulation, receivers, processing circuitry, etc.</td>
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<tr>
<td>Differences in DFS functioning, circuitry, software, etc.</td>
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<td>Antenna information and differences for the minimum gain antennas</td>
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<td>Bandwidth information and differences</td>
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<tr>
<td>Technology: (i.e.; 802.11x, frame based, MIMO, smart antenna, etc.)</td>
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<tr>
<td>FCC ID(s) of Previously Granted DFS Devices</td>
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<td>FCC ID of New Application</td>
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UNII & DFS Reminders

- Uniform Spreading – manufacturer’s attestation statement required

- Include test frequencies used for statistical performance tests in the Test Report

- DFS threshold is based on highest EIRP of all of the bands
  - The same threshold applies to all bands

- For a Class II permissive change the power cannot be increased when adding new bands

- The 5.15-5.25 and 5.25-5.35 bands require two line items

- UNII undesired emissions must be measured with a Peak Detector (Section 15.407(b))
DFS Device Types - Update

- 802.11 based
  - DFS Standard 802.11h not finalized to date
  - Wi-Fi Alliance has adopted near-final 802.11h

- Frame Based Systems (Proprietary point-to-point systems)
  - Fixed talk/listen ratio of 45%/55% (FCC 06-96)
    - Tolerance +/- 10%
    - Lab testing has indicated that this is not a critical setting in determining DFS statistical performance
  - Fixed & dynamic talk listen ratio: stream movie

- Miscellaneous - TBD
DFS Client Beacon Test - Procedure Update

- KDB Publication #848637
- 802.11 clients not permitted to transmit beacons on DFS frequencies
  - Test required since Oct. 11, 2007
- Part 1: Non-associated test (Stand-alone client)
  - This test is no longer required
  - New requirement: The application must include a letter exhibit from the manufacturer stating that the client software and associated drivers will not permit transmission of beacon signals on DFS frequencies
Part 2: Associated test (Client link established with the master on a test frequency)

- Associate the client and master and stream the movie as specified for non-occupancy test
- Transmit Radar Bin1
- Monitor the test frequency to make sure no beacons have been transmitted for 30 min.
  - Note: If the client moves with the master, nothing should show up on the client non-occupancy test and the device is compliant. For devices that shut down (rather than moving channels), no beacons should appear
- Analyzer plot must be in the Test Report
  - Single 30 min. sweep on original client test frequency
Channel Loading

- Test the device at the minimum data rate which streams data smoothly and provides consistent statistical test data
  - This utilizes the maximum transmission time
  - Video smooth streaming: 29 frames/sec. w/ no pixilation
  - Any codec/media player is acceptable
  - Bin 1 used to determine statistical data consistency

- Effect noticed when data transmission rate is less than 25 Mbps
Channel Loading (Cont.)

Test Result for Manufacturer A

DFS Behavior Under Various TX Rates for 802.11a

- Detection %
- Duty Cycle / CH Loading %

TX Rate (Mbps)
Channel Loading (Cont.)

Test Result from Manufacturer B

DFS Behavior for 802.11n device in 20 MHz MIMO Mode

Data TX Rate (Mbps)

Percentage

Detection %  Duty Cycle / CH Loading %
Channel Loading (Cont.)

DFS Behavior for 802.11n device in 40 MHz MIMO Mode

- Data TX Rate (Mbps)
- Percentage

- Detection %
- Duty Cycle / CH Loading %
Test Mode for Test Samples

- KDB publication #594340
- Test Procedure (FCC 09-96) Section 7.1
- Upon radar detection, the test mode should disable the 30 minute non-occupancy period and return the device to the original test frequency within a few seconds.
- Display radar detections
- Easily switch between normal and test mode
- Device should be setup to start on a known frequency in normal mode
Test Issues

- Multiple Bandwidths
  - Non-MIMO: ALL BWs to be tested in full (Radar detection BW and statistical tests)
  - MIMO
    - ALL BWs to be tested in full (Radar detection BW and statistical tests)
    - Only required to have one transmission chain operating
    - Use lowest data rate that data streams smoothly

- Remaining tests performed in either BW (channel move time, CAC tests, 30-min non-occupancy, etc.)
Radar test frequencies

- Device must respond to radars within the 80% Power BW which is the minimum permissible radar detection BW
- FCC Lab typically tests at any radar frequency at least 1 MHz within the 80% power BW and the center channel of 40 MHz devices
- FCC Lab also changes radar frequencies for statistical tests (Bin1 to Bin6)

Do not test perform all statistical tests with the radar on-tune with the master device and then expect to pass FCC testing
Radiated Testing vs. Conducted Testing

- Threshold not correct
  - Must account for cable losses & manufacturer’s tolerance in antenna gain
  - Include minimum gain antenna w/ sample requests
  - It is highly recommended that a Bin 1 signal be used for a radiated test to verify that the threshold is correct before proceeding with conducted tests

The number of non-compliance issues with samples tested at the FCC Lab is falling as manufacturers continue to improve DFS performance
Questions and Answers

Thanks!