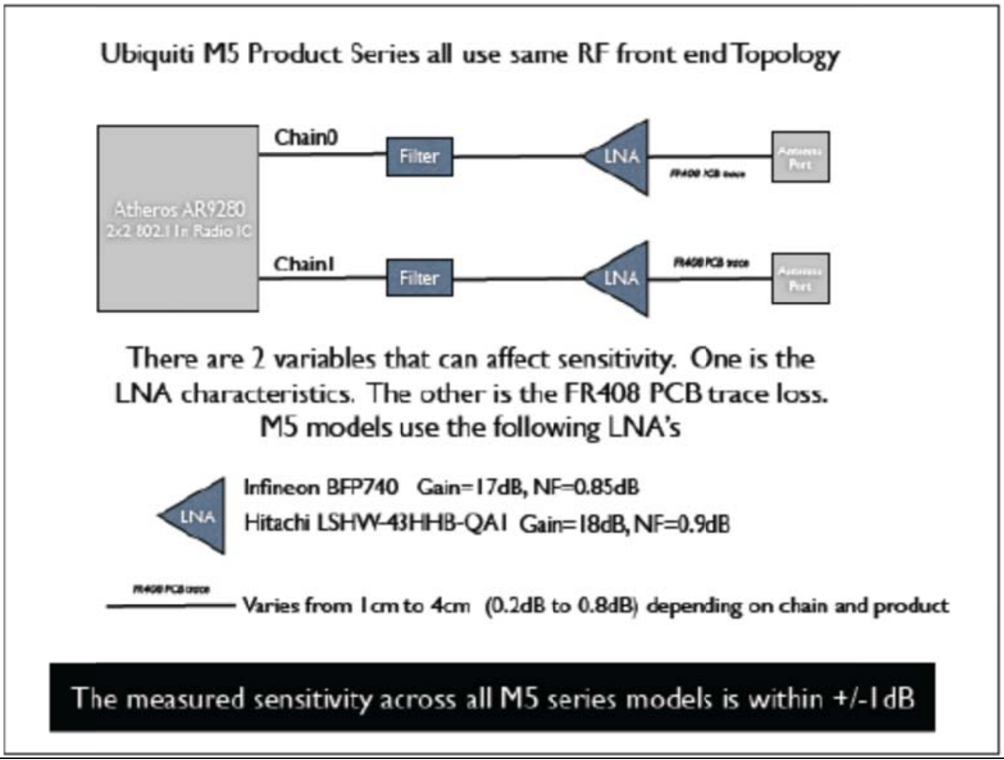
DFS Test Plan Revision 5

FCC ID	**SWX-NBM5D**	**SWX-NSM5D**	**SWX-M5LD (Completed)**	**SWX-RM5**	**SWX-PBM5D**
Model #	**NanoBridgeM5**	**NanoStationM5**	**LocoStationM5**	**RocketM5**	**PowerBridgeM5**
Master and/or Client	**Master/Client**	**Master/Client**	**Master/Client**	**Master/Client**	**Master/Client**
Antenna Gain (minimum)	25dBi Dish	16dBi Internal	13dBi Internal	External Omni (13/10dBi)	25dBi Internal
Modes Tested	5/20/40	5/20/40	5/8/10/20/30/40	20/40	8/10/30
Technology (e.g. ; 802.11x, frame based, MIMO, etc)	802.11a/n-based system supporting 2x2 MIMO in the 5GHz bands using an internal antenna, except NanoBridgeM5/RocketM5 use external antennas. . Bandwidths: SISO mode: 802.11a 20 MHz (Covered by MIMO HT20, 802.11a mode is through both ports, single port operation is not supported) MIMO mode: 6 different bandwidths – 5MHz, 8MHz, 10MHz, 20MHz, 30MHz and 40 MHz (HT5, HT8, HT10, HT20, HT30, HT40) We use 5 MHz spacing for all channels. In the compressed modes, all we do is change the phase locked loop (the clock) that determines the carrier spacing - to spread them out, or bring them in. In HT30 mode, it brings the channels closer together than they are in HT40, but also reduces carrier spacing so it looks like HT40 on the spectrum analyzer. There's no special software - all hardware and software is exactly the same, except that there is a linear scaling of timeout values They will behave exactly the same as HT20 and HT40 They work in master and slave mode - just like they do in HT20 and HT40. It's the same software same driver same configuration only the one PLL setting is changed, and some timing values used to calculate frame transmission times are scaled down. The software and hardware are configured exactly the same in every way as normal bandwidths except that we tweak that clock. Just divide or multiply to scale the carrier spacing.				
Differences in hardware	**Hardware: the 2x2 devices use the AR9287 chipset: http://www.atheros.com/technology/technology.php?nav1=47&product=80** There is slight variation of parts and layout from design to design (to accommodate different enclosures), however the critical parameters from a DFS detection standpoint are receiver sensitivity and the DFS implementation (hardware and software). Differences in these two features are addressed in this table. Note that a modular design is not suitable for these systems because of the different form factors for the enclosures.				
Differences in DFS functions	All units use the same Master DFS algorithms for detection, CAC and non-occupancy. Client algorithms are also identical (where implemented). The entire AR928x series of chips have radar pulse detection built-in, with all chips in the series using the same DSP core in the IC. There is a software component to the matching of radar pulses, which is used to prevent false-positives. It is important to note, however, that at the hardware interface on all these chips is indistinguishable from one another as far as the software is concerned. The firmware on all AR928x units is an identical binary image which has no chip-specific logic involved in the driver				

<table>
<tr><td></td><td>or DFS filtering.</td></tr>
<tr><td>Differences in software</td><td>The models all use the same software with the DFS algorithms implemented identically in each device</td></tr>
<tr><td>Receiver</td><td>All systems use the same rf transceivers and have a common topology. The only major differences are in the low noise amplifier (LNA) and the length of the trace between the antenna port and the input to the LNA. The effects of the variations in LNA (there_are_two_different_models_used) and the trace length (see_graphic_on_below) are less than +/1dB to the overall receiver sensitivity.

</td></tr>
<tr><td>Receiver sensitivity</td><td>Any differences in receiver sensitivity are only significant if the sensitivity requires a signal level greater than -64dBm at the antenna. Across the series of devices covered in this plan the sensitivity varies by no more than +/——1dB based on the differences in LNA and trace length at the receiver input.
This will be proven through an evaluation of the DFS detection probability for each version of the device while operating in the widest and narrowest bandwidths (40MHz and 5MHz) in addition to the complete evaluation across all operating bandwidths on the version with the lowest antenna gain.</td></tr>
<tr><td>Transmit power</td><td>> 200mW eirp in the 5470-5725 MHz Band</td></tr>
<tr><td>Test Lab(s) – RF</td><td>Refer to test reports submitted with applications.</td></tr>
<tr><td>Channel Plans</td><td>HT5 Mode: 5255/5300/5340MHz, 5475/5595/5720MHz
HT8 Mode:5260/5300/5330MHz, 5480/5595/5715MHz
HT10 Mode: 5260/5300/5330MHz, 5480/5590/5710MHz
HT20 Mode: 5265/5300/5320MHz, 5500/5580/5700MHz
HT30 Mode: 5275/5300/5315MHz, 5500/5500/5680MHz
HT40 Mode: 5275/5310MHz, 5510/5550/5670MHz</td></tr>
</table>

Proposed Test Plan for the 2x2 series of Ubiquiti Radios:

The test plan is based on the premise that the ability of the systems to detect radar and respond to the radar detection is dependent on receiver sensitivity and hardware/software implementation of the DFS detection mechanism.

The ability of the hardware/software implementation of the DFS detection mechanism to comply with the FCC;'s DFS requirements can be demonstrated by fully testing one system (the system with the lowest gain antenna and, therefore, the system with lowest required sensitivity) against the complete suite of requirements.

As the hardware/software implementation of the DFS functions is the same for all the systems the only remaining concern for the remaining systems is to verify that the receiver sensitivity and DFS implementation is capable of detecting radars at the required threshold level. To do this we are suggesting that we evaluate the detection bandwidth, which is evaluated at the required DFS threshold level, for the narrowest and widest channel bandwidths (5MHz and 40MHz).

In addition we will also evaluated the detection probability for the short-pulse radar type and bandwidth with the lowest detection probability from the fully tested system and the detection probability for the long pulse radar type (type 5) using the bandwidth with the lowest detection rate for that radar type from the fully tested system. This second series of tests will demonstrate that detection threshold is not an issue and also confirm the DFS mechanisms are operating correctly.

To further confirm that the DFS mechanisms are implemented correctly the channel closing time shall be measured for the narrowest and widest channel bandwidths (5MHz and 40MHz) and non-occupancy will be verified on one of those bandwidths.

To summarize:

Fully test the device with the lowest antenna gain (LocoStationM5) against all requirements for a master device:

1. Detection bandwidth – evaluate all 6 different bandwidths.
2. Detection probability for radar types 1 through 6 – evaluated all 6 different bandwidths with some bandwidths evaluated in the lower (5250-5350 MHz band) and some in the upper (5470-5725 MHz) band.
3. Radar threshold level to evaluate is -64dBm for all bandwidths (some of the narrower bandwidths may not exceed 200mW eirp)
4. Channel closing time – evaluate all 6 bandwidths
5. Non-occupancy test – evaluate any one bandwidth

For the remaining variants:

1. Confirm detection bandwidth on 5MHz and 40MHz channels (representing narrowest and widest channels)
   a. This is done at threshold using radar type 1and will be a certain indicator of any significant differences in receiver threshold from the original device tested.

2. Confirm detection probability for radar types 1 – 4 and 6 using the worst case bandwidth/radar waveform combination from the LocoStationM5 tests
3. Confirm detection probability for radar type 5 using the worst case bandwidth/radar waveform combination from the LocoStationM5 tests
4. Channel closing time – on 5MHz and 40MHz channels
5. Non-occupancy test – evaluate any one bandwidth

All devices capable of operating in a slave configuration – confirm slave mode channel closing time for all 6 bandwidths and 30 minute non-occupancy on one bandwidth.