

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

In the Matter of

Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, and

ET Docket No. 14-165

Amendment of Part 74 of the Commission's Rules for Low Power Auxiliary Stations in the Repurposed 600 MHz Band and 600 MHz Duplex Gap

Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions

GN Docket No. 12-268

**COMMENTS OF QUALCOMM INCORPORATED**

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## SUMMARY

From the outset of the *600 MHz Incentive Auction* proceeding, Qualcomm has shown in numerous technical analysis that allowing unlicensed white space operations in the duplex gap and guard bands will cause harmful interference to licensed mobile operations in violation of the Spectrum Act and the FCC's own rules. This harmful interference will occur when a white space device is within 19 meters (or 62 feet) of a 600 MHz cellular device, using the FCC's proposed parameters.

Nothing has changed. Even the analysis presented in the *NPRM* — which improperly speculates that all licensed devices will perform a full order of magnitude better than industry specifications (based on one unlicensed vendor's measurement of a few devices), assumes all white space devices will be mounted at a three meter height and strains to claim body losses that do not exist when the unlicensed device and licensed device are operated side-by-side as the proposed rules allow — still finds that unlicensed devices will cause harmful interference to licensed devices operating 7 meters (or 23 feet) away. But we all know that 7 meters is not a viable, reasonable, or defensible interference protection radius. The *NPRM* seems to recognize this because it tries to downplay the 7 meter distance by citing other improper factors and in a conclusory manner to boot.

The *NPRM* claims that the 7 meter distance will be reduced because unlicensed devices use transmit power control to operate with the least amount of power necessary to ensure successful communications, but the unlicensed vendors repeatedly claimed that the proposed 40 mW (*i.e.*, 16 dBm) transmit power level already is the lowest level that can support successful communications. The *NPRM* then claims that licensed operations that suffer interference can move to other spectrum bands. This claim fails for several reasons. *First*, it is contrary to the Communications Act, the Spectrum Act, and the FCC's own Part 15 rules, none of which allow

unlicensed devices to interfere with licensed operations. *Second*, it severely disadvantages new entrants and smaller entities who do not hold licenses to other bands. *Third*, the *NPRM's* argument is sheer speculation even for carriers that do have other bands because the FCC has no way of knowing whether there is additional capacity in those other bands at any given location to add users who would have to vacate 600 MHz to avoid the interference from unlicensed. And, the argument, by its terms, would force bidders to devalue 600 MHz licensed spectrum. For all of these reasons, the FCC cannot speculate around its own finding that there will be interference when unlicensed devices are within 7 meters of licensed devices.

The *NPRM* thus is stuck with this 7 meter distance, which itself is not only arbitrary and unprecedented, but also indefensible. Devices using Wi-Fi and LTE are much closer than that all the time and virtually everywhere — at work, at home, and in public places. So, the *NPRM's* own analysis and Qualcomm's extensive technical studies both confirm that the proposed rules for unlicensed devices in the duplex gap and guard bands are untenable.

Today, both Qualcomm and CTIA are each submitting new test results. Both sets of testing independently confirm that unlicensed white space devices using the FCC's proposed parameters will cause harmful interference to licensed devices when operating within approximately 20 meters of one another. In addition, the Consumer Electronics Association, in a filing made many months before the June 2014 *600 MHz Report & Order* authorized unlicensed operations in the duplex gap and guard bands (under technical rules proposed in the current *NPRM*), showed that 600 MHz licensed mobile devices will suffer unresolvable interference from an unlicensed device operating in the 600 MHz duplex gap or guard bands at a 16 dBm transmit power level, which is the same level that the *NPRM* proposes to permit. The *NPRM* — like the *600 MHz Report & Order* — does not discuss CEA's findings.

Indeed, Qualcomm filed a Petition for Reconsideration challenging the *600 MHz Report & Order*'s decision to allow unlicensed white space devices and wireless microphones in the duplex gap and guard bands because the FCC simply expressed “confidence” that such devices could operate without causing harmful interference without providing any technical analysis and ignoring a mountain of evidence to the contrary. The *600 MHz Report & Order* went even further and authorized unlicensed operations and wireless microphones to operate in separation portions of the duplex gap, a result not proposed by any party or the FCC, and again issued without any technical support. The current *NPRM* establishes that such decisions were made in error because it admits that unlicensed operations and wireless microphones in the duplex gap and guard bands will interfere with licensed services — a result that is expressly forbidden by the Spectrum Act and the FCC's own Part 15 rules.

By basing technical rules upon unreasonable assumptions that defy the record evidence, the *NPRM* runs contrary to well-established legal precedent. See *Sorenson Commc'ns Inc. v. FCC*, 755 F.3d 702, 707 (D.C. Cir. 2014) (quoting *Motor Vehicles Mfrs. Ass'n of the U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983)) (agency acts arbitrarily and capriciously if it “entirely fail[s] to consider an important aspect of the problem, offer[s] an explanation for its decision that runs counter to the evidence before the agency, or [if it] is so implausible that it could not be ascribed to a difference in view or the product of agency expertise”); *Covad Commc'ns Co. v. FCC*, 450 F.3d 528, 550 (D.C. Cir. 2006) (agency “must respond in a reasoned manner to [comments] that raise significant problems”).

The FCC should not permit unlicensed operations in the duplex gap and guard bands because the proposed parameters — deemed necessary to support viable unlicensed operations — will unquestionably cause harmful interference to licensed mobile devices. The proposed

unlicensed operations also undermine the value of the licensed spectrum blocks that are adjacent to the duplex gap and guard bands. The *NPRM's* proposed rules, like the *Report & Order's* initial decision to allow such operations, are not legally sustainable or factually valid or in the public interest.

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Amendment of Part 74 of the Commission's Rules for Low Power Auxiliary Stations in the Repurposed 600 MHz Band and 600 MHz Duplex Gap

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GN Docket No. 12-268

**COMMENTS OF QUALCOMM INCORPORATED**

QUALCOMM Incorporated ("Qualcomm") provides these comments on the *Notice of Proposed Rulemaking* in the above-captioned proceedings<sup>1</sup> to reiterate its serious concerns with the proposed rules and to provide additional test data and technical analysis showing that the proposed operation of unlicensed white space devices and wireless microphones in the 600 MHz duplex gap and guard bands will cause harmful interference to licensed mobile operations. Enacting these proposals would thus violate the Spectrum Act, the Communications Act, and the FCC's own Part 15 rules, which prohibit unlicensed white space device and wireless microphone operations from causing harmful interference to licensed mobile services.

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<sup>1</sup> See Amendment of Part 15 of the FCC's Rules for Unlicensed Operations in the TV Bands, Repurposed 600 MHz Band, Guard Bands and Duplex Gap, and Channel 37, ET Docket No. 14-165, *Notice of Proposed Rulemaking* FCC 14-144 (rel. Sept. 30, 2014) ("*NPRM*").

## INTRODUCTION

Qualcomm has been closely involved in *600 MHz Incentive Auction* proceeding since its initial stages. As a leading manufacturer of wireless technology chipsets that operate in licensed and unlicensed spectrum, Qualcomm has a direct and substantial interest in ensuring that the 600 MHz band plan is technically feasible and supports co-existence among all users of the band. For this reason, Qualcomm provided comprehensive technical analyses and input on a wide range of technical issues associated with the post-auction band plan that the FCC relied upon in its June 2014 *Report & Order*. For example, Qualcomm provided detailed technical showings in support of the Down from Channel 51 Frequency Division Duplex 600 MHz band plan and 11 MHz duplex gap that the FCC adopted.<sup>2</sup> The *600 MHz Report & Order's* analysis of issues relating to the post-auction structure of the 600 MHz licensed mobile band plan and TV station repacking was generally thorough and thoughtful.

However, and in sharp contrast to the FCC's approach defining the licensed mobile band plan, the *600 MHz Report & Order* ignored detailed record evidence and authorized unlicensed white space device operations and licensed wireless microphones in the guard bands and duplex gap without providing any analysis of whether such operations could be viable at levels that do not cause harmful interference to licensed mobile operations. Indeed, the *NPRM* proves that operations under parameters deemed necessary by unlicensed white space equipment and wireless microphone manufacturers will cause harmful interference to licensed mobile communications.

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<sup>2</sup> See Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, GN Docket No. 12-268, *Report and Order* (rel. June 2, 2014) ("*600 MHz Report & Order*") at ¶ 93 n.305 & App. C at ¶ 110.

Even with a number of questionable assumptions regarding mobile device performance, white space device antenna height, and signal losses between unlicensed white space devices and licensed mobile devices, the *NPRM*'s admittedly "preliminary analysis" demonstrates that harmful interference will occur when an unlicensed device is 7 meters (or 23 feet) away from a licensed mobile device — a wholly unreasonable interference protection distance.<sup>3</sup> The appropriate separation distance to protect licensed mobile devices from receiving harmful interference from unlicensed portable devices is 1 meter, not 7 meters (which is approximately fifty times greater than the area that represents acceptable electromagnetic compatibility). Nothing in the proposed rules even attempts to prevent a user from simultaneously operating both licensed and unlicensed devices side by side. To the contrary, we all know that, today, people in close proximity to one another use LTE and Wi-Fi interchangeably on smartphones in all sorts of locations. Thus, the proposed rules would authorize unlicensed operations that cause harmful interference to licensed mobile operations in the blocks adjacent to the duplex gap and guard bands because it is not possible to enforce a 7 meter separation distance and there is no likelihood that such a separation distance would be observed in the real world — even if one accepts the *NPRM*'s analysis and ignores its many errors and wrong assumptions.

The *NPRM* claims that the 7 meter interference distance can be reduced because the unlicensed device uses transmit power control to operate with the least amount of power to ensure successful communications, but the unlicensed vendors have claimed that the proposed 40 mW transmit power level already is the lowest level that can support successful communications and thus is unlikely to be reduced. The *NPRM* then claims that licensed operations that suffer interference can move to other spectrum bands. This not only

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<sup>3</sup> See *NPRM* at ¶ 84.

disadvantages new entrants and smaller entities who do not have spectrum rights in other bands, but it also gives unlicensed uses priority over licensed use in violation of FCC rules and concedes that unlicensed will cause harmful interference and thus violates the Spectrum Act as well.

Qualcomm's analysis shows that the required separation distance to protect licensed mobile operations from a 40 mW unlicensed white space device transmitter is much greater than 7 meters; it is 19 meters or 62 feet. Because the *NPRM* proposes no means of enforcing a 19 or even a 7 meter separation distance — and cannot possibly do so in light of the expected ubiquitous deployment of 600 MHz licensed operations — the FCC should not allow unlicensed white space device operations in the duplex gap or guard bands.

## **DISCUSSION**

### **I. The Proposed 600 MHz Duplex Gap And Guard Band Operations Will Cause Harmful Interference To Licensed Mobile Services In Violation Of The Spectrum Act, The Communications Act, and the FCC's Own Part 15 Rules**

The *NPRM's* proposed technical rules authorizing unlicensed white space devices and both unlicensed and licensed wireless microphones in the 600 MHz duplex gap and guard bands will cause harmful interference to licensed mobile operations. The proposed rules are based on a “preliminary analysis” that includes multiple technical flaws, including an assumption that all licensed mobile devices will provide 10 dB better adjacent channel selectivity than 3GPP standards actually require based upon Broadcom's measurement of a few devices,<sup>4</sup> assumed

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<sup>4</sup> See *NPRM* at ¶ 84 n.127 (citing Broadcom March 4, 2014 *ex parte* filing) but see Qualcomm May 8, 2014 Letter and Presentation (filed May 8, 2014) (explaining that Broadcom's assertion was based on measurement of a few devices, although there are hundreds of LTE device models worldwide designed to 3GPP specs, and the FCC should not rely upon such unsupported assumptions).

additional “body loss” even though the proposed rules allow the devices to be operating side-by-side in direct line-of-sight, and an assertion that an interference protection distance of 7 meters (or 23 feet) between two interfering devices is acceptable to prevent harmful interference.<sup>5</sup> The *NPRM* provides no support for the propriety of using a 7 meter separation distance; it is simply the number that resulted from its preliminary analysis, which incorporates the aforementioned unreasonable assumptions. Any one of these technically-flawed assumptions would call into question the resulting analysis, but all three in conjunction undermine the *NPRM* and are signs of improper “results oriented” decision-making, which cannot withstand judicial review.

Recognizing the impropriety of a 7 meter separation distance, the *NPRM* falls back on still other questionable factors without basis. The *NPRM* asserts that mobile licensees can move to other spectrum blocks if there is interference (and thus concedes that interference will occur) and assumes the affected 600 MHz licensee has other spectrum to move to; the *NPRM* also claims that unlicensed white space devices have transmit power control and use the least amount of power that can support successful communications; however, the unlicensed advocates have told the FCC that the 40 mW transmit power level proposed in the *NPRM* already is the minimum power level that can support viable operations.

Even if one assumes that the assumptions and claims in the *NPRM* are technically valid — which they are not — the *NPRM*’s analysis shows that harmful interference will occur when the two devices are located in the same room. Given that many individuals routinely simultaneously operate unlicensed and licensed devices side-by-side, the FCC’s analysis is highly suspect. Thus, the *NPRM* is unacceptable both technically and legally for it violates the Spectrum Act, the Communications Act, and the FCC’s Part 15 Rules.

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<sup>5</sup> See *NPRM* at ¶ 84.

**A. Qualcomm Presented Detailed Technical Analyses Showing That Unlicensed Operations In The 600 MHz Band Duplex Gap And Guard Bands Will Cause Harmful Interference To Licensed Mobile Services**

Qualcomm provided several lengthy and detailed interference analyses demonstrating that allowing unlicensed devices to operate within the 600 MHz duplex gap or guard bands at levels permitted under the Commission’s TV white space rules, which are essentially equivalent to the rules proposed in the *NPRM* for guard band and duplex gap operations, will result in harmful interference to licensed mobile LTE services.<sup>6</sup>

Qualcomm previously analyzed the three configurations it determined to be the most susceptible to interference given the operating parameters for white space devices under the FCC’s rules and the expected operating parameters for mobile operations at 600 MHz: (1) the licensed mobile device receiver suffering desense<sup>7</sup> due to out-of-band emissions (“OOBE”) from the unlicensed device; (2) the licensed mobile device receiver suffering blocking<sup>8</sup> due to an unlicensed base station adjacent channel power levels; and (3) the unlicensed device receiver suffering desense caused by the licensed mobile device OOBE. Qualcomm showed that with the unlicensed device transmitting at 40 mW EIRP and providing 55 dBc of adjacent channel attenuation — which are the parameters proposed in the *NPRM* and will require substantial filtering or much greater power consumption to achieve — the 600 MHz unlicensed device still causes harmful interference to a 600 MHz licensed mobile receiver located 19 meters away.<sup>9</sup>

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<sup>6</sup> See Qualcomm Reply Comments (Mar 12, 2013, refiled with corrected page numbers on Apr. 3, 2013, “Qualcomm Reply Comments”) at iv, 4-17.

<sup>7</sup> Desense is the degradation in sensitivity of the receiver caused by the interfering source.

<sup>8</sup> Receiver blocking occurs where an adjacent channel signal causes the desired signal to be suppressed.

<sup>9</sup> See Qualcomm Reply Comments at 8-10. Qualcomm’s analysis reflects the industry accepted practice that good electromagnetic compatibility requires a one meter separation distance between unlicensed devices and licensed mobile user equipment. It is an

This means that mobile phones cannot use the 600 MHz licensed spectrum adjacent to the duplex gap and guard bands if the mobile user is in the same room as an unlicensed device operating in the 600 MHz duplex gap or guard bands (or in an adjacent room) because the licensed mobile device operations would be blocked by the unlicensed device operation. This is the very result prohibited in the Spectrum Act, but nonetheless authorized in the *600 MHz Report & Order* according to terms later proposed in the instant *NPRM*.

Qualcomm also submitted multiple technical papers responding to an unlicensed vendor's claims that unlicensed operations in the duplex gap and guard bands would not impact the adjacent licensed spectrum blocks. Qualcomm showed that the vendor was, *inter alia*, using inapplicable signal propagation models, incorrectly calculating filter losses, and assuming nonexistent signal losses.<sup>10</sup>

Furthermore, the *NPRM* completely ignores the fact that licensed mobile operations will interfere with unlicensed white space devices and wireless microphone operations in the duplex gap and guard bands at even greater distances. Qualcomm found that an unlicensed device operating at 40 mW would suffer significant interference from a mobile device located up to 140 meters away.<sup>11</sup> While it is true that unlicensed operations must accept any and all interference from licensed services, one has to question the utility of authorizing white space device and

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understatement to say that 4G LTE licensed operations and unlicensed Wi-Fi operations often occur in very close proximity.

<sup>10</sup> See Qualcomm Letter and Presentation (filed Feb. 19, 2014) responding to the Broadcom *et al.* Jan. 30, 2014 filing and explaining that Broadcom's "analysis" completely overlooked the impact of blocking. See also Qualcomm Letter and Presentation (filed Apr. 3, 2014) responding to Broadcom Mar. 3, 2014 filing; Qualcomm Letter and Presentation (filed May 8, 2014) responding to Broadcom Apr. 23, 2014 filing; and see Qualcomm Letter and Presentation (filed Aug. 5, 2014) responding to Broadcom July 22, 2014 filing.

<sup>11</sup> See Qualcomm Reply Comments at 6.

wireless microphone operations in the duplex gap and guard bands that will suffer harmful interference when a 600 MHz mobile device is operating anywhere within 140 meters, or 1.5 times the length of a football field. This serious problem is not even acknowledged in the *NPRM*.

**B. Testing With Commercially-Available LTE Devices Confirms That Unlicensed Devices And Wireless Microphones In the 600 MHz Duplex Gap and Guard Bands Will Cause Harmful Interference**

In response to the *NPRM*, Qualcomm conducted testing using commercially-available LTE transceivers and FCC-compliant white space device waveforms.<sup>12</sup> This testing, which is detailed below, confirms Qualcomm's earlier technical analyses and conclusions.

Qualcomm considered the following scenarios in line with the proposals in the *NPRM*:

- White space device operations in the 600 MHz duplex gap directly adjacent to licensed mobile uplink and with a 5 MHz separation to the licensed mobile downlink;
- Wireless microphone operations in the duplex gap located 1 MHz away from the licensed mobile downlink; and
- White space device operations in the 600 MHz guard band located 3 MHz away from the licensed mobile downlink.

Qualcomm conducted testing using commercially-available LTE devices that support 3GPP Band 20 (comprised of 791 - 821 MHz and 832 - 862 MHz). Qualcomm believed Band 20 to be the most analogous band to the proposed 600 MHz band because Band 20 has an 11 MHz duplex gap and is a reverse duplex band like the 600 MHz mobile band plan. It also is a low band close to 600 MHz and has a percent bandwidth that requires percentage bandwidth filters similar to what likely will result in the 600 MHz band.

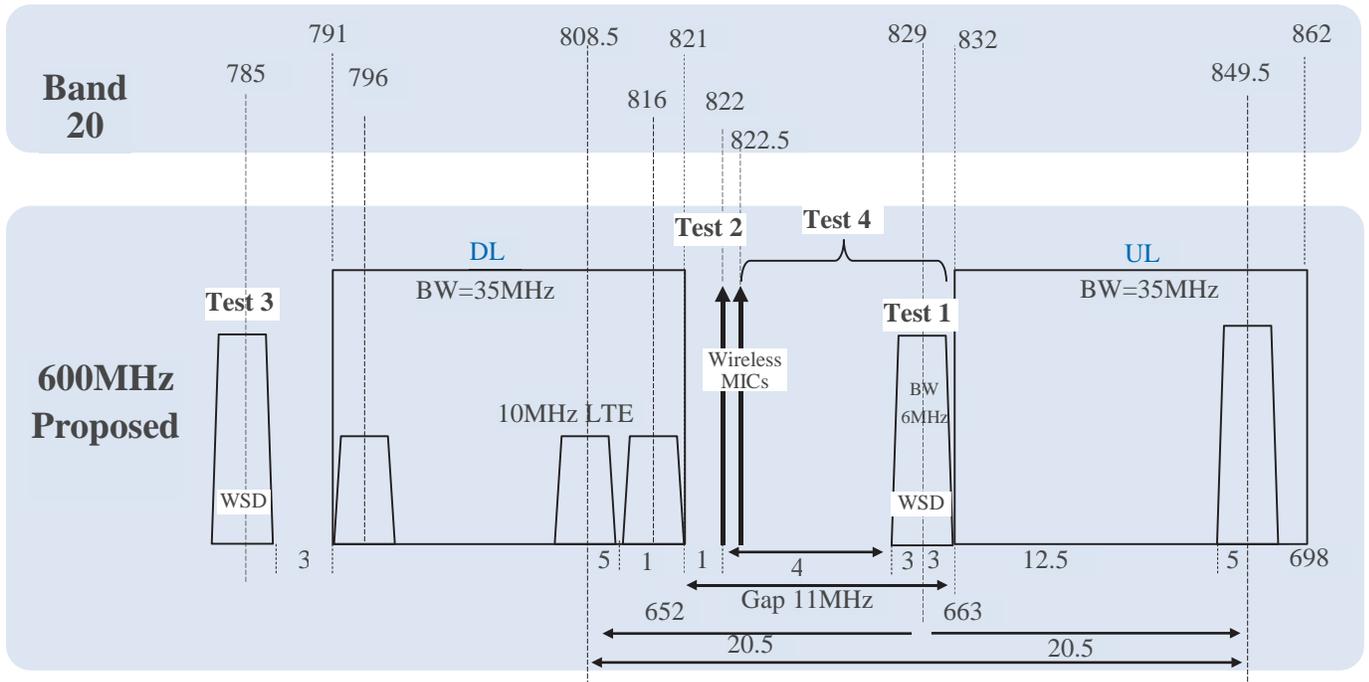
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<sup>12</sup> See *NPRM* at ¶ 82.

To gauge the onset of harmful interference, Qualcomm tested for 1 dB of desense to the LTE device, which impacts edge of cell coverage and may be experienced inside of buildings where signal loss is great. Qualcomm ran four specific test cases based on the FCC’s proposals to determine the impact of duplex gap and guard band operations on a 10 MHz LTE channel:

- **Test 1:** White space operations in the duplex gap, modeled as a 6 MHz-wide 802.11af channel placed 5 MHz away from the mobile downlink band and directly adjacent to the mobile uplink band. The white space waveform shown in Figure A-2 in Appendix A to these Comments was used for each of test cases 1, 3 and 4.
- **Test 2:** Wireless microphone signal in the duplex gap, modeled as a continuous wave (“CW”) tone, placed 1 MHz away from the mobile downlink band.
- **Test 3:** White space operations in the guard band located 3 MHz below the mobile downlink band.
- **Test 4:** Both white space operations and wireless microphone operations in the duplex gap. White space operations are in the same position as in Test 1 and a wireless microphone is located 1.5 MHz away from the mobile downlink band. This test assesses the impact of intermodulation products from white space devices and wireless mics into the mobile downlink band.

Each of these test cases is depicted graphically in Figure 1 below:



**Figure 1.** Graphical Depiction of Four Test Cases

The test configuration Qualcomm used for the testing is provided in Figure A.1 in the Appendix to these Comments. The white space device signal waveform used for the testing was based on the IEEE 802.11af waveform shown in Figure A.2 in the Appendix, and it complies with the FCC's spectral mask. This signal, which has an occupied bandwidth of 4.875 MHz, was centered on a 6 MHz-wide channel located where *NPRM* proposed to allow such operations as shown in Figure 1 above. The OOB levels for this waveform meet the proposed requirements in the *NPRM*. A CW tone was used to model the wireless microphone signal.

The detailed test results for six different phones measured over temperature (from -15°C to 60°C) are provided in Table A.1 in the Appendix. Test 1 results showed blocking from a white space device at a -42 dBm level; when one accounts for 3 dB of production variation, free space propagation loss over 1 meter of 29 dB, and a -7 dB antenna gain for the licensed mobile device, it provides a maximum allowable power level of -9 dBm EIRP for a white space device, which is 25 dB lower than what the *NPRM* proposes. This translates to an interference radius of 18 meters (or 59 feet) were the FCC to authorize white space operations at the proposed 16 dBm EIRP level.<sup>13</sup>

Test 2 results show blocking from a wireless microphone at a -65 dBm level; when one accounts for 3 dB of production variation, free space propagation loss over 1 meter of 29 dB, and a -7dB antenna gain for the licensed mobile device, it provides a maximum allowable transmit power level of -32 dBm EIRP for a wireless microphone, which is a whopping 45 dB lower than

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<sup>13</sup> The interference range calculations provided here used the signal propagation model in Section 4.1 of RECOMMENDATION ITU-R P.1411-3, Propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz.

what the *NPRM* proposes to authorize. This translates to an interference radius of 69 meters (or 226 feet) were the FCC to authorize wireless microphones at the proposed 13 dBm EIRP level.

Results are worse when one considers white space operations in the guard band placed 3 MHz away from licensed mobile downlink operations, which is analyzed in Test 3. Test 3 results show blocking from a white space device at a -47 dBm level, which provides a maximum allowable transmit power level of -14 dBm EIRP for a white space device operating in the guard band (which is 30 dB less than what the FCC has proposed to allow) when one accounts for 3 dB for production variation, 29 dB of free space loss, and -7dB licensed mobile device antenna gain. This translates to an interference radius of 29 meters (or 95 feet) were the FCC to authorize white space operations at the proposed 16 dBm EIRP level.

Finally, results for Test 4, which includes both a wireless microphone interferer and a white space device interferer in the duplex gap, shows blocking at a -66 dBm level for the wireless microphone and at a -48dBm level for the white space device, which translates into a maximum allowable wireless microphone power transmit power level of -33 dBm EIRP and a white space device transmit power level of -15 dBm EIRP when one accounts for free space loss, antenna gain, and production variation outlined above.

These measured values confirm the technical analysis provided in Qualcomm's filings in this 600 MHz Incentive Auction proceeding. The FCC cannot authorize the proposed operations in the duplex gap and guard bands because it will cause harmful interference to the licensed mobile spectrum blocks closest to the duplex gap and guard bands.

This testing also demonstrates that the FCC's proposed -55 dBc OOB level is woefully insufficient to achieve good electromagnetic compatibility and prevent harmful interference. Much greater attenuation is necessary. Yet, the technical viability of a handheld white space

device even meeting a -55dBc OOB limit is dubious in at least a couple of aspects. The required tolerance on the band center and bandwidth are at the limits of available technology, and the required narrow bandwidth results in high insertion loss that has a distinctly undesirable impact on device battery life.

**C. The NPRM Itself Found That Harmful Interference Will Occur Even When Multiple Unreasonable Operational Assumptions Are Included**

The FCC found that unlicensed device operation in the 600 MHz guard band will cause harmful interference at a 7 meter separation distance even when one includes multiple unreasonable assumptions.<sup>14</sup>

To get to the 7 meter separation distance, the *NPRM* assumes that all licensed mobile devices will provide 10 dB better adjacent channel selectivity than 3GPP specifications require based on one unlicensed chipset vendor's measurement of a few LTE devices' performance in other bands.<sup>15</sup> There are hundreds of LTE devices on the market today designed to meet 3GPP specifications. Assuming that all devices will provide 10 dB better adjacent channel selectivity performance — a full order of magnitude — is patently unreasonable.

The *NPRM* also assumes all white space devices will be mounted at a three meter height, and assumes body losses that do not exist when the unlicensed device and licensed device are operated side-by-side as the FCC's proposed rules would allow.<sup>16</sup> Thus, the *NPRM* relies upon the performance characteristics of a handful of devices and signal losses that will not be present in many common use cases in setting operating parameters that will apply across the board.

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<sup>14</sup> See *NPRM* at ¶¶ 82-84.

<sup>15</sup> See *id.* at ¶ 84 n.127 (citing Broadcom March 4, 2014 *ex parte* filing in GN Docket No. 12-268, attachment at 2).

<sup>16</sup> See *NPRM* at ¶ 84.

The *NPRM's* analysis also does not consider licensed mobile device operating variability associated with power supply voltage, operating temperature, and manufacturing process which should be accounted for in any sound interference analysis.

The *NPRM* asserts that the 7 meter interference radius will be reduced because unlicensed devices use transmit power control to operate with the least amount of power to ensure successful communications; however, unlicensed vendors have claimed that the proposed 40 mW transmit power level already is the lowest level that can support successful communications. The test results provided above in Section I.B show that unlicensed transmit power levels need to be reduced to well below the levels needed to provide a viable service.<sup>17</sup>

The *NPRM* claims next that licensed operations that suffer interference can move to other spectrum bands, but this not only disadvantages new entrants and smaller entities who lack license rights in other spectrum bands, but it also is total speculation even for those who do have other bands because the FCC has no way of knowing whether there is sufficient capacity in those other bands for a particular user. More importantly, the FCC's reasoning effectively gives unlicensed users priority over licensed users in violation of the Communications Act and the FCC's own rules, and it concedes that unlicensed will cause harmful interference in direct violation of the Spectrum Act.<sup>18</sup>

In sum, allowing unlicensed devices to operate with 40 mW EIRP transmit power within a 6 MHz-wide channel, which are the specifications proposed in the *NPRM* and what those

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<sup>17</sup> This is why Qualcomm has explained that unlicensed operations should not be permitted at all in the duplex gap and guard bands.

<sup>18</sup> The *NPRM's* additional assertions that licensed services can use advanced transmission protocols and modulation schemes and still-to-be developed filter technologies to overcome interference from unlicensed services, *see NPRM* at ¶ 85, impermissibly elevates the status of unlicensed operations to that of a co-primary licensed service, which Part 15 operations are not.

parties supporting unlicensed operations in the 600 MHz mobile band plan said are needed for viable unlicensed operations,<sup>19</sup> will cause harmful interference to the licensed mobile operations in the adjacent spectrum blocks. By seeking to rely on the multiple unreasonable assumptions outlined above, the *NPRM* concedes that harmful interference will occur. This violates the Spectrum Act, the Communications Act, and the FCC's own rules.

**D. The *NPRM* Ignores The Detailed Interference Analysis From The Consumer Electronics Association Showing A Significant And Unresolvable Risk Of Harmful Interference From Unlicensed Operations In The 600 MHz Band**

Remarkably, the *NPRM* as well as the *Report & Order* that authorized the placement of unlicensed white space devices and wireless microphones in the duplex gap and guard bands completely overlook a lengthy technical study from the Consumer Electronics Association that examined all of the potential inter-service interference scenarios in the 600 MHz band among TV broadcast operations, TV receivers, licensed mobile base stations and UEs, unlicensed TV white space devices, wireless microphones, and radio astronomy, among others.<sup>20</sup> CEA's comprehensive study, which was drafted by a former Chief of the FCC's Office of Engineering and Technology, found unlicensed white space device operations in the duplex gap and guard band to present a significant and unresolvable interference risk to licensed mobile operations.

Supporting Qualcomm's conclusion and the outcome of testing commissioned by CTIA that is being submitted today, the CEA study also found that "unlicensed devices generally cannot operate in the guard bands above unacceptably low transmission power thresholds without the potential for harmful overload or OOB interference to adjacent-channel end-user

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<sup>19</sup> See Broadcom April 23, 2014 filing in GN Docket No. 12-268.

<sup>20</sup> See CEA Technical Paper, "Protection Bands and Potential Interference at 600 MHz" (filed Dec. 16, 2013) linked [here](#).

broadband equipment, unless the ‘victim’ equipment is designed to exceed accepted performance levels by a wide margin.”<sup>21</sup> Of the thirteen inter-service interference scenarios studied, the CEA technical paper found that interference from unlicensed white space transmitters to licensed mobile receivers in the 600 MHz band to be the “most significant problem identified” that “could cause shut down of LTE UE in proximity to TVWS UE.”<sup>22</sup> CEA explained:

If both unlicensed transmitters and licensed 600 MHz receivers are operating in the same room or in close proximity, an unlicensed device operating in the guard band or duplex gap could cause an LTE UE receiver to fail. This failure is unlikely to be resolved through typical self-help [], such as a consumer moving away from the unlicensed transmitter to achieve better coverage. Instead, the interference mechanism will prevent the LTE UE receiver from receiving incoming signals.<sup>23</sup>

In overlooking the entire CEA technical paper, the *NPRM* — like the *600 MHz Report & Order* that authorized such duplex gap and guard band operations — completely misses this critical and material finding.

**E. Unlicensed Operations In The 600 MHz Mobile Band Will Destroy Fungibility Of The Licensed Spectrum Blocks And Other Core FCC Goals**

Because unlicensed operations in the 600 MHz duplex gap and guard bands at the 40 mW level proposed in the *NPRM* will cause harmful interference to the licensed mobile spectrum blocks adjacent to the duplex gap and guard bands, those adjacent spectrum blocks would be impaired when compared to the non-adjacent spectrum blocks and thus require the FCC to value them for significantly less than the non-adjacent spectrum blocks. Not only would this greatly

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<sup>21</sup> *Id.* at 6.

<sup>22</sup> *Id.* at 55. Corroborating Qualcomm’s other conclusions, CEA also found that the mobile LTE UE “could cause shut down of TVWS UE” in proximity to the mobile UE transmitter. *Id.*

<sup>23</sup> *Id.* at 35.

complicate the forward auction, but it also runs directly counter to the Commission’s goal of offering generic, and thus fungible, spectrum blocks in the forward auction.

The FCC explained in the *600 MHz Report & Order* that “[o]ffering interchangeable spectrum blocks allows us to conduct bidding for generic blocks, ... which speed[s] up the forward auction bidding process. Commenters generally support the proposal to offer interchangeable blocks but emphasize the importance of making them truly interchangeable.”<sup>24</sup> And, although the Commission recognizes that guard bands are needed to “protect[] against harmful interference” and thus “ensure that the 600 MHz spectrum blocks [offered] in the forward auction are as interchangeable as possible,”<sup>25</sup> it approved the placement of unlicensed white space device operations within the guard bands and duplex gap that — under the technical rules proposed in the *NPRM* — destroys such interchangeability.

In fact, the placement of unlicensed white space operations within the duplex gap and guard bands has a detrimental impact on all five key policy goals that the FCC identified to support the framework for adopting a wireless band plan: utility, certainty, interchangeability, quantity, and interoperability.<sup>26</sup> Unlicensed devices operating under the parameters set out in the *NPRM* will impair the adjacent licensed mobile spectrum blocks and thus impact the utility of the 600 MHz band for mobile broadband use, introduce additional uncertainty into the auction process and success of the band, impact interchangeability, lower the quantity of unimpaired spectrum, and may well introduce interoperability challenges. The Commission should not

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<sup>24</sup> See Qualcomm Petition for Reconsideration in GN Docket 12-268 (filed Sept. 15, 2014) citing *600 MHz Report & Order* at ¶ 66; see also *600 Mhz Report & Order* at ¶ 45 n.96 (“we plan to conduct bidding for generic blocks in the forward auction”); *id.* at ¶ 75.

<sup>25</sup> *Id.* at ¶ 89.

<sup>26</sup> See *id.* at ¶ 41; see also *600 MHz NPRM* at ¶ 125.

permit unlicensed devices in the duplex gap and guard bands in light of the serious harm it wreaks upon the core goals of this proceeding.

**F. Authorizing Unlicensed Operations In The 600 MHz Duplex Gap and Guard Bands In Accordance With The NPRM's Proposed Parameters Also Would Violate The Administrative Procedure Act**

As explained above, the *NPRM's* proposals to allow unlicensed operations at a 40 mW level in a 6 MHz channel in the 600 MHz band duplex gap and guard bands will unquestionably cause harmful interference to licensed mobile services and thus violate the Spectrum Act, the Communications Act, the FCC's Part 15 Rules<sup>27</sup> as well as the Administrative Procedure Act ("APA").<sup>28</sup>

The *NPRM*, like the earlier *Report & Order*, recognizes that the Spectrum Act "conditions unlicensed use of guard band spectrum on not causing harmful interference to licensed services,"<sup>29</sup> yet it proposes to authorize the operation of unlicensed devices in the 600 MHz band overlooking detailed interference studies and without serious review of multiple parties' detailed showings in the docket that such interference will occur. "Ignoring important arguments and evidence" such as those presented by Qualcomm, CTIA, and the Consumer Electronics Association, would be arbitrary and capricious in violation of the APA.<sup>30</sup> Courts

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<sup>27</sup> See 47 C.F.R. § 15.5 ("Operation of [a Part 15 unlicensed device] is subject to the conditions that no harmful interference is caused and that interference must be accepted that may be caused by the operation of an authorized radio station, by another intentional or unintentional radiator ...").

<sup>28</sup> The APA, 5 U.S.C. § 551 *et seq.*, provides that a court reviewing agency action shall consider the whole record or those parts of it cited by a party. See 5 U.S.C. § 706. Review is to be based on the full administrative record that was before the agency when it made its decision.

<sup>29</sup> *600 MHz Report & Order* at ¶ 268 n.805 (citing § 6407(e) of the Spectrum Act). See also *NPRM* at ¶¶ 79, 86, 99, & 162.

<sup>30</sup> See *David Ortiz Radio Corp. v. FCC*, 941 F.2d 1253, 1260 (D.C. Cir. 1991).

have consistently held that agencies must consider all factors relevant to the issue at hand when engaging in notice-and-comment rulemaking pursuant to section 553 of the APA.<sup>31</sup> That has not yet been done here.

**G. The Decision To Permit Licensed Wireless Microphones In The Duplex Gap Along With White Space Devices Is Unlawful And Lacks Record Support**

The decision in the *600 MHz Report & Order* to permit licensed wireless microphone operations in the duplex gap along with unlicensed white space devices<sup>32</sup> was made without any record support and in violation of the Spectrum Act, which only permits *unlicensed* operations in those bands if they do not cause harmful interference to licensed mobile services. That decision also should be withdrawn because, as shown above, the proposed licensed wireless microphone usage in the duplex gap will cause harmful interference to licensed mobile operations.

In fact, no party advocated in favor of allowing the two disparate types of operations (*i.e.*, licensed wireless microphones and unlicensed white space operations) simultaneously in separate portions of the duplex gap.<sup>33</sup> Even supporters of allowing white space devices in the duplex gap and guard bands advocated against also inserting wireless microphone operations in those bands.<sup>34</sup> This is because these disparate types of operations will interfere with each other. More

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<sup>31</sup> See *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) (a decision is arbitrary and capricious if the agency fails “to consider an important aspect of the problem”).

<sup>32</sup> See *600 MHz Report & Order* at ¶ 314. The FCC proposed to partition the duplex gap so that 6 MHz is used for unlicensed white space devices operating at 40 mW, and 4 MHz is used for licensed wireless microphones. See *id.*

<sup>33</sup> See *id.* at ¶ 314 n. 953. The *600 MHz Report & Order* cites to commenters who favored allowing unlicensed white space device operations in the duplex gap and commenters who favored allowing wireless microphones in the gap. No one supported the insertion of both in discrete portions of the duplex gap.

<sup>34</sup> See Broadcom May 2, 2014 Letter, item 4, in GN Docket No. 12-268. There has been limited consideration of the existence of licensed operations interfering with unlicensed. While

importantly, as shown in Section I.B above, the proposed operation of licensed wireless microphones in the duplex gap will cause harmful interference to licensed mobile services as will the proposed operation of unlicensed devices in the gap.

In sum, this decision must be withdrawn because it violates the Spectrum Act, which does not permit the FCC to insert a *licensed service* inside the duplex gap or guard bands. Under the law, only unlicensed operations may be permitted and only to the extent that they do not cause harmful interference to licensed mobile operations.

## **II. The Commission Should Not Allow Unlicensed Use of 600 MHz Licensed Mobile Service Area Once A Licensee Has Commenced Operations**

The FCC has proposed to permit unlicensed white space devices to operate co-channel within a 600 MHz mobile licensees' licensed service area so long as the unlicensed devices remain a certain distance from the licensee's closest base station.<sup>35</sup> The Spectrum Act, however, does not permit unlicensed use of the licensed mobile spectrum blocks; it only permits unlicensed use of the 600 MHz mobile band plan duplex gap and guard bands and only if the unlicensed operations do not cause harmful interference to licensed users. As the FCC aptly recognized in the initial October 2012 *600 MHz NPRM*, “[t]he measures we propose to promote unlicensed spectrum use are limited by the bounds of our statutory authority.”<sup>36</sup> Moreover, 600 MHz mobile licensees will have purchased exclusive spectrum rights via an auction to use all of

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this may be acceptable under the FCC's Part 15 rules, enabling equipment that does not work causes commercial harm to the entire wireless ecosystem and is not in the public interest.

<sup>35</sup> See *NPRM* at ¶¶ 129-44.

<sup>36</sup> See Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, GN Docket No. 12-268, *Notice of Proposed Rulemaking*, FCC 12-118 (rel. Oct. 2, 2012) (“*600 MHz NPRM*”).

the licensed spectrum within a service area without having to share those rights with unlicensed users.

The FCC would have mobile licensees update TV bands databases constantly with deployment data to ensure that unlicensed devices do not interfere with the licensees' operations. This is particularly burdensome as mobile carriers are always modifying, densifying, extending, and upgrading their networks to meet consumer needs. The FCC's proposal to permit unlicensed use of 600 MHz licensed spectrum blocks should not be enacted because it violates the Spectrum Act, could lead to harmful interference, and impermissibly burdens mobile licensees.

## CONCLUSION

For the reasons provided herein, in Qualcomm's Petition for Reconsideration of the June 2014 *600 MHz Report & Order*, and Qualcomm's Comments, Reply Comments and multiple other filings in response to the initial October 2012 *600 MHz NPRM* in GN Docket 12-268, the Commission should not permit unlicensed white space devices and wireless microphones in the duplex gap and guard bands. The record before the Commission demonstrates that such operations cannot be inserted into the duplex gap and guard bands without causing harmful interference to the licensed mobile services operating in the 600 MHz spectrum. Thus, the proposals in the *NPRM* are not factually valid, legally sustainable, or in the public interest.

Respectfully submitted,

QUALCOMM INCORPORATED

By: 

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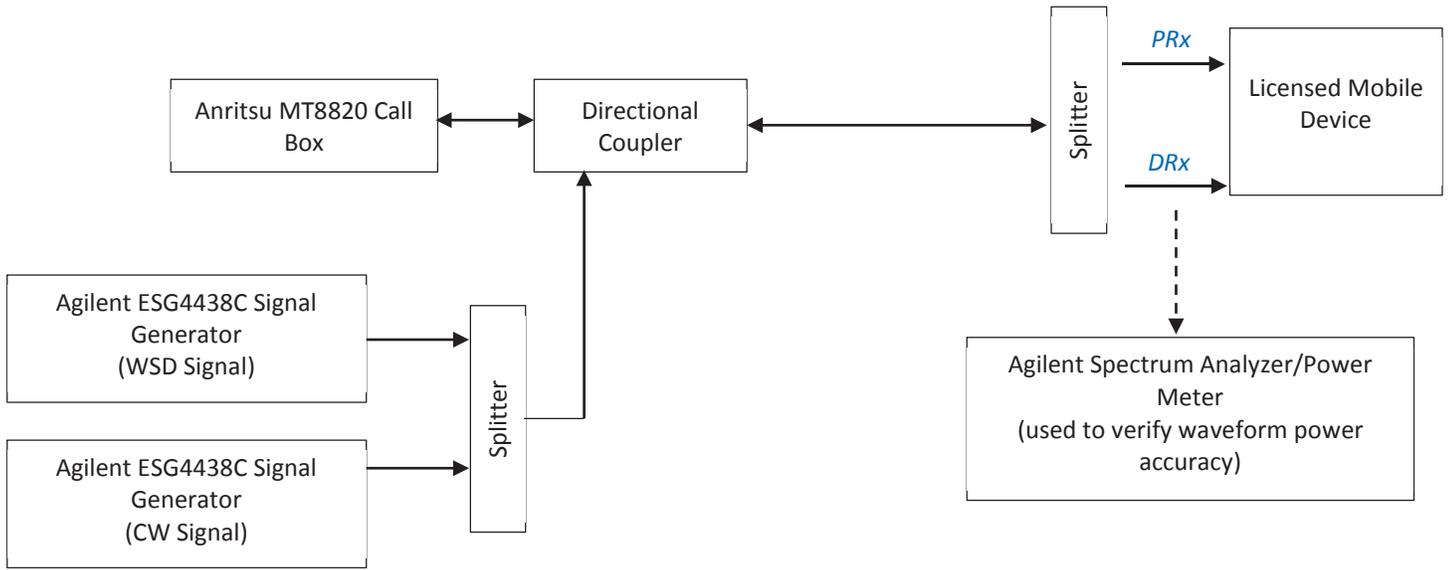
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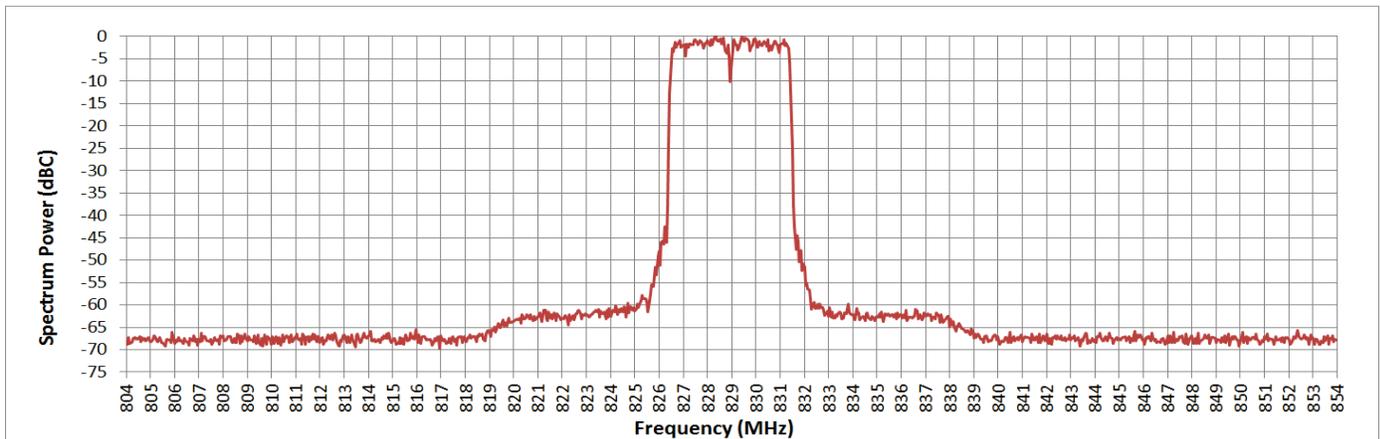
*Attorneys for QUALCOMM Incorporated*

Dated: February 4, 2015

**APPENDIX**



**Figure A-1.** Test Configuration



**Figure A-2.** WSD signal – based on IEEE 802.11af waveform and compliant with FCC spectral emissions mask

	Test-1			Test-2			Test-3			Test-4		
	EERFCN = 24325 J=829MHz WiFi			EERFCN = 24400 J=822MHz CW			EERFCN = 24200 J=785MHz WiFi			EERFCN = 24400 J1=822.5MHz CW/ J2=829MHz WiFi		
	-15°C	+25°C	+60°C	-15°C	+25°C	+60°C	-15°C	+25°C	+60°C	-15°C	+25°C	+60°C
Phone 1 (TX21)	REFSENS	-102	-101.1	-100	-100.3	-99.4	-101.6	-100.8	-100	-100.2	-99.5	+60°C
	Tx Power (ALL +1dB)	21.8	21.8	22.4	22.4	22.4	22.1	21.9	21.9	21.5	22	+25°C
	Jammer Power @ REFSENS + 1dB	-41.6	-40.7	-39.9	-64.7	-62	-44.6	-44.6	-46.2	-65/-48	-62/-48	-99.5
Phone 2 (11PN)	REFSENS	-101.6	-100.8	-100	-100.6	-99.4	-101.3	-100.5	-99.9	-100.6	-100.1	-99.5
	Tx Power (ALL +1dB)	21.3	21.5	21.4	21.3	21.5	21.3	21.5	21.6	20.9	20.9	21.1
	Jammer Power @ REFSENS + 1dB	-41	-41	-39	-65	-62	-45	-45	-46.9	-66/-46	-63/-45	-62/-42
Phone 3 (12TH)	REFSENS	-101.7	-100.8	-100.2	-100.8	-99.9	-101.5	-100.6	-100.2	-100.2	-99.5	-99.2
	Tx Power (ALL +1dB)	22.2	21.8	21.95	21.3	21.75	21.9	21.72	21.71	21.3	21.2	21.5
	Jammer Power @ REFSENS + 1dB	-41.2	-40.1	-40	-65.7	-63.2	-44.3	-45	-46.8	-66/-48	-64/-42	-62/-42
Phone 4 (11C2)	REFSENS	-101.6	-100.9	-100.2	-100.8	-100.1	-101.3	-100.8	-100.1	-100.2	-99.9	-99.5
	Tx Power (ALL +1dB)	21.74	21.74	21.71	21.3	21.7	21.8	21.6	21.58	21.6	21.3	21
	Jammer Power @ REFSENS + 1dB	-41	-40.2	-39.9	-65	-63	-44.2	-45.2	-47.3	-66/-47	-63/-44	-62/-43
Phone 5 (1334)	REFSENS	-101.7	-100.9	-100.3	-100.5	-100.1	-101.5	-100.7	-100.2	-100.3	-99.7	-98.8
	Tx Power (ALL +1dB)	21.77	21.67	21.5	22	21.66	21.6	21.92	21.5	21.7	21.7	21.4
	Jammer Power @ REFSENS + 1dB	-41.1	-40.4	-40.1	-64.9	-62.4	-44.5	-43.9	-46.5	-66/-48	-63/-42	-61/-40
Phone 6 (120B)	REFSENS	-101.8	-101.2	-100.3	-100.7	-100.1	-101.4	-100.8	-100.4	-100.8	-99.8	-99.4
	Tx Power (ALL +1dB)	21.6	21.37	21.7	21.75	22.06	21.48	21.2	20.8	20.9	21.7	21.6
	Jammer Power @ REFSENS + 1dB	-41.6	-40.8	-40	-65.4	-62.9	-44	-44	-47	-66/-48	-63/-47	-62/-42
	Minimum	-41.6			-65.7		-47.3			-66/-48		

Table A-1. Detailed Test Measurement Results