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 Gaps, and Channel 37, and
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
Promoting Spectrum Access for Wireless
Microphone Operations
Expanding the Economic and Innovation
Opportunities of Spectrum Through Incentive
Auctions

To: The Commission

REPLY COMMENTS OF
OPEN TECHNOLOGY INSTITUTE AT NEW AMERICA
AND PUBLIC KNOWLEDGE

February 25, 2015
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I. INTRODUCTION AND SUMMARY

The Open Technology Institute at New America ("OTI") and Public Knowledge ("PK") hereby reply to certain of the Comments regarding proposed changes to certain of the Commission’s Part 15 rules. OTI and PK commend the Commission for opening this proceeding as a means of implementing the agency’s decision in last May’s Incentive Auction Report & Order to allow unlicensed operations in the 600 MHz duplex gap and other guard bands, Channel 37, a set-aside channel for sharing with microphones in every market, as well as the opportunity to update the current white space rules to reflect new realities and the proven effectiveness of the TV Bands Database system. As our groups and others have explained in previous filings, the emergence of a mass market for unlicensed chips, devices and services in this unique low-band spectrum – including the integration of the 802.11af standard into Wi-Fi chipsets – is wholly dependent on access to three or more 40 mW, 6 MHz channels in every market nationwide. OTI and PK applaud the Commission for its thoughtful proposals which, taken together and with some minor improvements, can fulfill that promise.

OTI and PK strongly support the Commission’s efforts to ensure that at least three to four 6 MHz channels will be available for unlicensed WSDs in every market. The record clearly supports the Commission’s tentative conclusion that the duplex gap, as well as a lower guard band of 9 or 11 MHz, can provide a contiguous 6 MHz channel for unlicensed WSDs at a power level of 40 mW or more without undue risk of harmful interference to Part 27 services.

Technical studies using real-world assumptions about filtering and propagation loss, such as

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1 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 Gaps, and Channel 37, Notice of Proposed Rulemaking, 29 FCC Red 12248 (2014) ("NPRM"). The Office of Engineering and Technology extended the deadlines for filing Comments and Reply Comments to February 4, 2015 and February 25, 2015, respectively.

Broadcom has filed and reprised in its comments, suggest that the power limits for unlicensed WSDs in the duplex gap could be at least 100 mW with a 4 MHz separation form LTE downlink. We are heartened the Commission appears to have learned from its first effort to placate the hyper-inflated interference concerns of broadcast industry licensees concerning WSDs that overly restrictive rules can deter and suffocate the tremendous potential of low-band unlicensed technologies.

OTI and PK strongly support the 4-6-1 duplex gap band plan proposed in comments filed by other leading parties in the unlicensed community. Broadcom’s analysis and the Commission’s own proposal to permit a 6 MHz unlicensed channel at 40 mW in the 9 MHz guard bands indicates a recognition that 3 MHz of separation is sufficient to protect LTE downlink operations from harmful interference.

OTI and PK question whether licensed microphones should operate in the duplex gap at all. If there is a single point of agreement among all major parties in this proceeding, it is that Part 74 microphone operations and unlicensed WSDs cannot productively cohabit the duplex gap and sufficiently protect licensed Part 27 operations. While public interest groups and other unlicensed advocates support a compromise around a 4-6-1 plan as the best balance between the needs of the various stakeholders, the microphone and wireless industries are divided on this question in a way that strongly suggests the Commission should move Part 74 microphones out of the duplex gap entirely.

On the issue of unlicensed microphone operations in the duplex gap, OTI and PK agree with Microsoft that the Commission’s proposal to “require” wireless microphone users to check a database manually to obtain a list of available frequencies is not “[u]nlicensed use . . . rely[ing] on a database” in the sense that Congress intended. OTI and PK also oppose any increase in the
Commission's proposed 20 mW power limit for wireless microphones operating in the duplex gap or other guard bands.

Channel 37 represents one of the three or four channels that will make or break the emergence of robust national markets for unlicensed WSDs. OTI and PK therefore strongly support the consensus among commenters that the Commission should permit all three types of WSDs (fixed, Mode I and Mode II) to operate subject to protection zones that are based on real world assumptions about propagation and interference risk. By neglecting to factor in real world assumptions about terrain concerning RAS and the fact that WMTS operates indoors, the Commission risks a reversion to the same over-protective, one-size-fits-all problem that plagued the original set of white space rules in 2008 and which the Commission is, ironically, proposing to remedy in other portions of this same NPRM.

OTI and PK concur with the overwhelmingly support among commenters for the Commission's proposal to relax the stringent out-of-band emission limits that inhibit the use of Channels 35-39. These restrictions are unnecessary since under the Commission's proposal to open Channel 37 for shared use, any necessary separation can be more effectively enforced by the TV Bands Database.

OTI and PK strongly support and Commission's proposal to help offset the incentive auction's huge reduction in the number of channels available for unlicensed WSDs by removing the prohibition on personal/portable device operation on channels 7 to 20. Similarly, our groups agree with the clear consensus among commenters that the Commission should adopt its proposal to allow fixed WSDs to use Channels 3 and 4. OTI and PK see little if any justification to delay making these channels available.
Finally, OTI and PK strongly support the Commission’s proposal to permit WSDs to continue operating in the 600 MHz band post-auction until the licensee gives notice that it will “commence operations” in a local area. The Commission’s proposal simply maintains the status quo since today the majority of 600 MHz spectrum is available for opportunistic unlicensed use, subject to permission enforced by the TV Bands Database. Contrary to CTIA’s efforts to maintain its members’ ability to warehouse vacant spectrum, PEAs should not be used as the geographic foundation for excluding WSDs from access to underutilized spectrum. PEAs can be larger than states and even Cellular Market Areas can extend hundreds of miles beyond a single urban area where a carrier may initially provide service. No standardized licensing area comes close to replicating what the TV Bands Database can do given very straightforward data points that are readily available to licensed carriers that, before they deploy, carefully planned out the coverage areas and link budgets for each and every base station and cell site. In reality, the reporting “burden” on licensees (to notify a TV Bands Database administrator) would be de minimus and not involve collecting any data the operator does not already have readily at hand for their own purposes.

II. THE RECORD SUPPORTS COMMISSION PROPOSALS TO MAKE ADDITIONAL 6 MHZ CHANNELS AVAILABLE FOR UNLICENSED USE

OTI and PK once again commend the Commission for its decision last May to allow unlicensed operations in the 600 MHz duplex gap and other guard bands, Channel 37, a set-aside channel for sharing with microphones in every market, as well as the initiation of this proceeding to update the current white space rules to reflect new realities and the proven effectiveness of the TV Bands Database system. Our groups and others have explained in previous filings that the emergence of a mass market for unlicensed chips, devices and services— including the integration of the 802.11af standard into Wi-Fi chipsets – is wholly dependent on access to three or more 40
mW, 6 MHz channels in every market nationwide. The promise of the Incentive Auction R&O is that the duplex gap and Channel 37 will provide at least two of those channels in nearly every market, while an updating of the current white space rules can also open new channels for both fixed and personal/portable use in most markets as well.

A. Duplex Gap, Guard Bands and Wireless Microphones

Whether the balanced outcome the Commission adopted in the Incentive Auction R&O actually comes to pass will depend on whether the technical rules adopted in this proceeding enable widespread and flexible operations that also protect incumbent licensees from harmful interference. Nowhere is this more important than in the duplex gap and lower guard bands, where competing interests (licensed microphones, mobile industry interests) are waging a full-court press to deny unlicensed users the access they need. OTI and PK believe the record clearly supports a conclusion that the Commission can ensure that the duplex gap, as well as a guard band of 9 or 11 MHz, provides a dedicated, contiguous 6 MHz channel at a power level of 40 milliwatts or more without undue risk of interference to new Part 27 services as they deploy post-auction.

1. Duplex Gap Interference and Separation from LTE Downlink

OTI and PK strongly support the Commission’s proposal to adopt rules that allow fixed and portable WSDs to operate in a 6 MHz channel at 40 milliwatts, in both the duplex gap and any guard bands that are at least 9 MHz wide, while protecting LTE downlink by requiring at least a 3 MHz buffer. As several leading commenters have observed, the technical studies submitted in this proceeding both support the Commission’s proposal and suggest that the Commission is being overly conservative, particularly with respect to the power levels and

3 NPRM ¶¶ 86-88, 93.
separation distance for unlicensed operations in the duplex gap. Technical studies using real-world assumptions about filtering and propagation loss, such as Broadcom has filed and reprised in its comments, suggest that the power limits for unlicensed WSDs in the duplex gap could be at least 100 mW with a 4 MHz separation from LTE downlink. Broadcom’s findings further suggest that particularly at a lower power level (40 or 50 mW), the 1 MHz buffer proposed for the bottom of the duplex gap (creating a total 5 MHz of separation) is not needed and could be moved to separate unlicensed from LTE uplink.

Admittedly, OTI and PK are not currently in a position to independently confirm either the Commission’s tentative technical conclusions in the NPRM or the competing assumptions relied on in the conflicting studies filed by Broadcom, Qualcomm and, most recently, CTIA. Nonetheless, we are heartened that the Commission appears to have learned from its first effort to placate the hyper-inflated interference concerns of broadcast industry licensees concerning unlicensed and spectrum sharing that overly restrictive rules can deter and suffocate the tremendous potential of low-band unlicensed technologies. What former Chairman Julius Genachowski dubbed “Super Wi-Fi” – and especially the addition of IEEE 802.11af to the Wi-Fi family – hangs in the balance. Once again, a critical mass of investment and the scale needed

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5 Comments of Broadcom at 18-19. “Unlicensed devices can safely operate at both higher power levels, and at a smaller spectral separation from LTE uplink, than the Commission has proposed. At 4 MHz separation, an unlicensed device can conservatively operate at a power level as high as 112.5 mW before the odds of interference with LTE uplink becomes significant.” Id.

to further magnify the tremendous economic and social benefits of mass-market Wi-Fi and other unlicensed innovation will fail to materialize if the Commission does not follow through on the promise of the Incentive Auction R&O to ensure the minimum of three or four 6 MHz channels for unlicensed WSDs in every market nationwide. The duplex gap and guard bands will be essential to fulfill the balanced policy the Commission voted to adopt last May.

Because by law unlicensed WSDs in the repurposed 600 MHz spectrum will be required to constantly recheck and renew permission to transmit in each of these frequencies – possibly as often as every 20 minutes – if years from now it turns out that harmful interference results, it will be easy enough to withdraw a particular channel from use until an appropriate fix is found. In contrast, a repeat of the failings of the 2008 rules, which attempted to placate politically powerful broadcasters with overly-restrictive rules that the Commission is only now beginning to repair in this NPRM, would be far harder to remedy. It would create a massive opportunity loss for spectrum efficiency and for consumer welfare – and yet it would be very difficult to quantify that loss or revisit overly-conservative conclusions about how well different services can coexist in practice.

OTI and PK therefore urge the Commission to err on the side of testing the outer limits of spectrum sharing, efficiency, innovation and the evolution of radio systems to coexist – and not to “split the baby” to placate self-interested lobbies (e.g., Qualcomm, CTIA) that have demonstrated for nearly a decade that they are willing to say or do almost anything to kill or cripple what they perceive as competition from unlicensed services and innovation.

2. Duplex Gap Band Plan and Licensed Microphones
OTI and PK strongly support the 4-6-1 duplex gap band plan proposed in comments filed by other leading parties in the unlicensed community. As noted above, the technical findings that the Commission relies on in the NPRM suggest that the additional 1 MHz buffer at the bottom of the proposed 1-4-6 duplex gap plan is not necessary to protect LTE downlink operations from WSDs operating at a maximum power of 40 milliwatts. Broadcom’s testing demonstrates that there is no need for 5 MHz of separation between LTE downlink and unlicensed WSDs; and the Commission’s own proposal to permit a 6 MHz unlicensed channel at 40 mW in the 9 MHz guard bands indicates recognition that 3 MHz of separation is sufficient to protect LTE downlink operations from harmful interference. Broadcom concluded:

Importantly, these results also demonstrate that the Commission can ensure sufficient protection for LTE while improving the efficiency of duplex gap operations by adopting a different partitioning scheme for the duplex gap than the one it has proposed. Specifically, by placing the 1 MHz buffer at the top of the duplex gap (between LTE uplink and the unlicensed channel) rather than at the bottom (between LTE downlink and the 4 MHz channel set aside for wireless microphones), the Commission can significantly enhance the value of the unlicensed channel while maintaining extremely robust protective margins for LTE.

Locating the 1 MHz buffer at the top of the duplex gap, thereby providing some separation between unlicensed WSDs and LTE uplink transmissions, “will effectively protect licensees while maximizing the value of the entire duplex gap.” OTI and PK agree with Wi-Fi Alliance that “creating a one-megahertz buffer between white space devices and LTE uplink will help to ensure that unlicensed operations can flourish in the duplex gap without suffering excessive interference, while at the same time providing an added layer of protection for LTE

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7 See, e.g. Comments of Google at 16-18; Comments of Microsoft at 12-14; Comments of Wi-Fi Alliance at 27-28; Comments of Broadcom at 19. 
8 NPRM at ¶ 88. See also Comments of Google at 17. 
9 Comments of Broadcom at 19. 
10 Comments of Microsoft at 12.
operations." If the Commission concludes that the 1 MHz buffer is needed to better separate wireless microphones from LTE downlink, then we agree with Wi-Fi Alliance that wireless microphones should be required to locate their 200 kilohertz transmissions in the upper 3 megahertz of their portion of the duplex gap.

Another salient issue for the Commission is whether licensed microphones should operate in the duplex gap at all. If there is a single point of agreement among all major parties in this proceeding, it is that Part 74 microphone operations and unlicensed WSDs cannot both productively cohabit the duplex gap and sufficiently protect licensed Part 27 operations. While our groups and other unlicensed advocates support a compromise around a 4-6-1 plan as the best balance between the needs of the various stakeholders, the microphone industry and mobile carriers are divided on this question in a way that strongly suggests the Commission should move Part 74 microphones out of the duplex gap entirely.

For example, microphone manufacturer Sennheiser stated in its pending Petition for Reconsideration of the Incentive Auction R&O that the duplex gap and guard bands are inadequate for microphone fidelity. It cites – and attaches to its comments in this proceeding – the results of studies the company conducted in Europe “that demonstrates the detrimental effects on wireless microphone operations by the high noise floor in the duplex gap.”

Sennheiser’s comments in this proceeding reinforce its belief that the proposed 4 MHz share of the duplex gap is unworkable, stating: “[T]he reality is that the limited bandwidth, coupled with

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11 Comments of Wi-Fi Alliance at 26-27.
12 Id. at 27.
the likelihood of a high noise floor and out-of-band emissions from adjacent wireless services, will diminish likely use.”

Similarly, Shure has opined that the duplex gap “will not provide a suitable spectrum environment for professional wireless microphones that require reliable clean spectrum due to the out-of-band emissions (‘OOBE’) from the immediately adjacent 600 MHz uplink band.”

The opinions of the two leading microphone makers strongly suggest that the Commission should not be sacrificing the utility of the one contiguous unlicensed channel to make room for microphone interests who insist that the duplex gap is unreliable in relation to the quality of service they need.

At the other extreme, CTIA reports testing results that lead it to the conclusion that wireless microphones in the duplex gap (or in any but perhaps 2 megahertz of an 11 MHz guard band, if there is one) are incompatible with protecting licensed LTE operations. CTIA objects to the NPRM’s proposed 1-4-6 duplex gap plan and recommends that the Commission should adopt a 5-6 allocation that limits use of the duplex gap to low-power unlicensed WSDs, separated from LTE downlink by a “true” 5 megahertz guard band. The Consumer Electronics Association (CEA) similarly argues that “the NPRM provides no support, evidence, or analysis showing that such operations [licensed microphones in the duplex gap] could operate without causing harmful interference to [licensed] mobile broadband operations.”

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14 Comments of Sennheiser at 9. Sennheiser further asserts that the NPRM’s proposed 20 mW power limit “will make wireless microphone operations, which generally operate at 50 mW, unreliable on these frequencies. The guard bands are likely to have high noise floors and out-of-band emissions from adjacent services.” Id. at 15. However, if the power limit for narrow-band microphones is 50 mW, then because anywhere between 12 and 16 microphones can operate on 6 MHz, the aggregate power output on the 6 MHz duplex gap could be as high as 600 to 800 milliwatts.


16 Comments of CTIA at 16-20.

For its part, the National Association of Broadcasters (NAB) similarly insists that the Commission must make a stark choice: Exclude unlicensed WSDs from the duplex gap so that microphones have both the bandwidth they need and the enormous separation distance from LTE that the wireless industry demands.\(^{18}\) However, NAB's demand for an all-or-nothing outcome ignores the fact that its proposal asks the Commission to reverse its adherence to Congressional intent, clearly expressed in the Spectrum Act, to allocate the 600 MHz guard bands for unlicensed TV white space (TVWS) operations without causing harmful interference to licensed LTE operations post-auction.\(^{19}\) As the Commission stated in the Incentive Auction R\&O, "Section 6407(c) was a compromise intended by the conferees to ‘create a nationwide band of spectrum that can be used for innovative unlicensed applications.’"\(^{20}\) Congress never even considered the possibility that the duplex gap or guard bands would be given over to a licensed service, let alone one that has not paid for spectrum and that would leave 99.9 percent of the spectrum capacity unused.

The NAB/Sennheiser/Shure rationale for setting aside the entire duplex gap (11 MHz!) for a smattering of occasional narrow-band microphone users is that Part 74 licensees are somehow losing their two clean, reserved channels above and below Channel 37. However, the implication that Part 74 operations are somehow losing two reserved channels is a canard. The two set-aside TV channels for microphones were always intended primarily for the far more numerous population of unlicensed microphone users and venues, since unlike Part 74 licensees, unlicensed microphones are not permitted to reserve locally-vacant TV channels in the TV Bands Database.

\(^{19}\) See Spectrum Act, § 6407(c).
Moreover, as OTI and PK have detailed in previous filings in this docket (12-268), whereas a decision not to give unlicensed WSDs use of 6 megahertz in the duplex gap would almost certainly strangle the market for low-band Wi-Fi innovation in its crib, the tiny club of Part 74 wireless microphone operators have far more spectrum relative to their needs than do unlicensed users, particularly in congested markets like New York City. Part 74 microphones have historically operated co-channel to broadcast stations in neighboring media markets that are not available for use by unlicensed devices.\(^2\) Part 74 users have and will continue to have access both to vacant channels available for use by WSDs and, in addition, access to other vacant channels not available to unlicensed devices.\(^2\) Indeed, the Incentive Auction R&O greatly expanded the areas where wireless microphones can operate co-channel to TV broadcasters, a change that OTI and PK supported.\(^2\)

\(^2\) See, e.g., Ex Parte Letter from Michael Calabrese, GN Docket 12-268 (filed May 6, 2014), at 3. For example, PISC documented in its initial comments in this proceeding that at the Rockefeller Center in New York City (home to TV production facilities for NBC Universal), the Shure Inc. microphone user look-up database shows that in addition to channels 22 and 42, which are reserved exclusively for microphones, there are ten (10) non-TVWS channels available with no broadcaster operating within 70 miles (the FCC separation distance); plus an additional six channels with no broadcaster operating within 50 miles; and yet another four channels with no broadcaster operating within ten miles. Comments of the Public Interest Spectrum Coalition, Docket No. 12-268, et al., at 32-37 (Jan. 25, 2013) (“PISC Comments”), referencing Shure Inc., Wireless Frequency Finder, available at http://www.shure.com/americas/support/tools/wireless-frequency-finder.

\(^2\) PISC’s initial comments offered a detailed analysis, based on recent microphone reservations in the TV Bands Database and Shure’s own wireless microphone channel finder database, showing that “even in the single most congested urban market, there appears to be no need for wireless microphones to occupy unlicensed TV White Space channels – or even the two vacant microphone reserve channels – except as a last resort for special events. PISC Comments at 36. Spectrum Bridge, based on its experience as a TV Bands Database operator, noted that it “is already common practice” for Part 74 microphones to use and even reserve co-channel TV spectrum not available for use by WSDs in cities like New York. Comments of Spectrum Bridge Docket No. 12-268, et al. at 9 (Jan. 25, 2013), see also PISC Comments at 35 (“common practice” for microphones to use co-channel spectrum). Google and Microsoft, both certified as TV Bands Database administrators, reported that “[c]o-channel operations are occurring, and are widespread,” a “point amply illustrated during the field tests performed by the Office of Engineering and Technology in the white spaces proceeding.” Comments of Google/Microsoft, Docket No. 12-268, et al. at 53 (Jan. 25, 2013), citing Letter from Edmond Thomas, Senior Technology policy Advisor, White Spaces Coalition, to Marlene H. Dortch, FCC, ET Docket No. 04-186 (filed Aug. 19, 2008).

\(^2\) The Commission amended Section 74.802(b) to permit wireless microphones to operate as close as four kilometers from the protected contour of co-channel TV stations. See Incentive Auction R&O ¶¶ 304-307.
3. Unlicensed Microphones Must Rely on an Automated Database

The Spectrum Act clearly requires that all unlicensed devices operating in the duplex gap or other guard bands in the repurposed 600 MHz spectrum must “rely on a database” or “subsequent methodology.” OTI and PK agree with Microsoft that the Commission’s proposal to “require” wireless microphone users to check a database manually to obtain a list of available frequencies is not “[u]nlicensed use . . . rely[ing] on a database” in the sense that Congress intended.

Congress was obviously aware that the automated geolocation database system already certified by the Commission to govern unlicensed access to vacant TV band spectrum – and the necessity of re-checking it periodically for permission to transmit – provides reliable protection for licensed incumbents. In contrast, adopting a requirement that hundreds of thousands of both professional and off-the-shelf microphone users should regularly go online (with a separate device) and check the database manually is at best wishful thinking and at worst an empty gesture. It seems doubly unrealistic to expect microphone users to stop a meeting, performance or church service every 20 minutes to recheck the database. Moreover, as Microsoft also explains, the Commission’s stated goal “[t]o ensure that wireless microphones used in applications such as electronic newsgathering receive protection in a timely manner” will not be achieved unless all unlicensed devices, including unlicensed microphones, incorporate automated database communication capability.

OTI and PK also oppose any increase in the Commission’s proposed 20 mW power limit for wireless microphones operating in the duplex gap or other guard bands. Sennheiser asserts that the NPRM’s proposed 20 mW power limit “will make wireless microphone operations, 

25 Comments of Microsoft at 36.
26 Comments of Microsoft at 38.
which generally operate at 50 mW, unreliable on these frequencies. However, if the power limit for narrow-band microphones is 50 mW, then because anywhere between 12 and 16 microphones can operate on 6 MHz, the aggregate power output on the 6 MHz duplex gap could be as high as 600 to 800 milliwatts. Even aside from the potential impact on Part 27 licensees, this creates a legitimate concern about whether microphone operations could undermine the expected benefit of this single, contiguous nationwide channel for unlicensed WSDs. OTI and PK therefore agree with Microsoft that “the Commission should, as it initially proposed, limit eligibility for licensed Part 74 operations in the duplex gap to ENG users only.”

B. Both Fixed and Personal/Portable WSDs Should Share Channel 37 Subject to Exclusion Zones Based on Real World Assumptions

OTI and PK commend the Commission for recognizing that using geolocation database technology as an enforcement mechanism, the FCC can enable unlicensed operations while protecting wireless medical telemetry services (WMTS) and radio astronomy services (RAS) incumbents from harmful interference. Across the United States, Channel 37 spectrum is barely used, a situation that Google correctly points out is increasingly “unacceptable in a spectrum-constrained environment.” Channel 37 offers the advantage of providing a rare contiguous frequency that will benefit unlicensed innovation. More critically, Channel 37 represents one of the three or four channels that will make or break the emergence of robust national markets for unlicensed WSDs, as the Commission implicitly acknowledged in its balanced Incentive Auction R&O last year.

OTI and PK therefore strongly support the consensus among commenters – or at least those that are not incumbent users of Channel 37 – that the Commission should permit all three

27 Comments of Microsoft at 11 [citations omitted].
28 Comments of Google at 18.
types of WSDs (fixed, Mode I and Mode II) to operate subject to protection zones that are based on real world assumptions about propagation and interference risk. Wi-Fi Alliance correctly observes that “because access will be controlled by a [geolocation] database that will know the device’s operating parameters, there is no need for a distinction between fixed and personal/portable devices.”

Although we support the Commission’s proposal to open Channel 37 for unlicensed sharing, like other leading voices in the unlicensed community OTI and PK believe the proposed exclusion zones to protect both WMTS and RAS incumbents are unnecessarily restrictive – “a needless impairment of consumer broadband.” The separation distances proposed will exclude critical portions of cities and even certain rural areas where there is no substantial risk of harmful interference to incumbent operations. By neglecting to factor in real world assumptions about terrain and the fact that WMTS operates indoors, the Commission’s staff risks a reversion to the same over-protective, one-size-fits-all problem that plagued the original set of white space rules in 2008 and which the Commission is, ironically, proposing to remedy in other portions of this same NPRM. OTI and PK urge the Commission to adjust the proposed exclusion zones for both WMTS and RAS based on real-world interference protection needs.

1. Sharing with WMTS Incumbents:

The NPRM proposes co-channel separation distances as great as 2.8 km from WMTS for WSDs operating at 40 milliwatts. As Microsoft observes, even the smallest separation distance (300 meters at 40 mW if the antenna height is less than 3 meters) “is significantly larger than necessary to protect incumbents” based on the technical analysis done by Broadcom. While OTI and PK acknowledge a lack of independent technical research or expertise on this point, we

29 Comments of Wi-Fi Alliance at 28.
30 Comments of Microsoft at 19.
31 Id. at 20.
nevertheless agree with Broadcom, Google, Microsoft, Wi-Fi Alliance and others that it is unrealistic to assume free space propagation loss, as the Commission apparently does, when every WMTS device is indoors and separated from WSDs by at least one exterior wall.\footnote{See, e.g., Comments of Wi-Fi Alliance at 30 ("the FCC should not rely on the TM-91-1 propagation model … [which] underestimates building penetration loss, fails to adequately account for antenna heights, and fails to account for urban clutter loss.").}

As Google observes, "taking walls into account leads to greatly reduced separation distances" – and not to do so seems particularly inapt in urban areas where additional propagation loss is likely at the edge of even a modest exclusion zone. For example, Broadcom's analysis accepted the building penetration loss assumption of 20 dB put forth by GE Healthcare ("GEHC"), as well as GEHC's assumed noise floor of -110 dBm/10 KHz.\footnote{See Comments of Microsoft at 20-22.} Even so, Broadcom arrived at far smaller separation distances than the NPRM proposes.

OTI and PK urge the Commission to go the extra mile and recalculate separation distances based on real-world conditions. Between the WMTS industry database (ASHE) and the TV Bands Database, it should be possible to use less conservative exclusion zones as a baseline and then tailor them according to the specific terrain or other factors implicating the vulnerability of medical deployments. Specifically, we support Google's recommendation that "the Commission should authorize WMTS users to collaborate with white space database providers to take account of line-of-sight and non-line-of-sight propagation effects from the actual boundaries of each WMTS site."\footnote{Comments of Google at 19, referencing NPRM ¶ 112.}

2. Sharing with RAS Incumbents

OTI and PK support the Commission's commitment to protecting RAS sites from interference. However, based on the comments in the record, it appears that the exclusion areas proposed in the NPRM are in many instances unjustifiably larger than necessary because they fail...
to take terrain blockage into account – even when there are mountains between RAS and potential unlicensed users. OTI and PK urge the Commission to revisit its approach to exclusion zones for RAS and adopt instead a terrain-aware model that also takes time of operation into account.

In several cases the failure to use a terrain-aware model results in the unnecessary loss of one of only three or four possible white space channels in unlicensed-constrained urban markets that include New York City, Boston and Seattle.\(^{35}\) This leads to a number of dramatically untenable outcomes. For example, Microsoft points out that the citizens of Seattle would find themselves inside the exclusion zone of the VLBA station in Brewster, Washington. Not only is that station 200 km distant – but the Cascade mountain range lies between these two locations.\(^{36}\) Google describes how New York City and a number of other major cities would also lose access to Channel 37 unnecessarily, at least for certain WSD operations.\(^{37}\)

Unlike WMTS, a failure to take terrain into account in fashioning exclusion zones for RAS is not a question of arguable technical assumptions, but rather a failure to take a data-driven approach to better policy outcomes. OTI and PK support the strong consensus among commenters that the Commission should make every effort to use real-world assumptions and not constrain public access to the benefits of unlicensed broadband connectivity unless absolutely necessary to protect an incumbent from harmful interference.

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\(^{35}\) See Comments of Google at 27-28 ("the Commission’s proposed fixed separation distances instead of a terrain-aware model would unnecessarily foreclose white space operations at 4 W in several major population center ... including New York City").

\(^{36}\) Comments of Microsoft at 26.

C. Both Fixed and Personal/Portable WSDs Should Operate Without Restrictions on the Two Channels Above and Below Channel 37

Comments in the record overwhelmingly support the Commission’s proposal to relax the stringent out-of-band emission limits that inhibit the use of Channels 35-39 and instead require WSDs “to meet either the current adjacent channel or the Section 15.209 emission limits as appropriate.” 38 OTI and PK strongly support this approach, as well as the related proposal to permit unlicensed WSDs to operate on the nearest vacant TV channels above and below channel 37 that were previously reserved for the exclusive use of wireless microphones. 39 As Microsoft aptly states, “because the old rules that restricted operation on Channels 35-36 and 38-39 are no longer necessary to protect other authorized operations, these changes are low-hanging fruit that have the potential to make an immediate impact on the development of 600 MHz unlicensed operations.” 40

As the Commission and a number of commenters have recognized, the very stringent out-of-band emission limit that currently applies to WSD emissions into Channel 37 severely handicap the use of Channels 35, 36, 38 and 39 in every area nationwide even though WMTS and RAS incumbents need protection in only a relative handful of locations. 41 OTI and PK agree with the NPRM and the clear consensus among commenters that the Commission should expeditiously replace this over-protective one-size-fits-all approach and instead rely on the

38 NPRM ¶ 128. See, e.g., Comments of Broadcom at 21-22; Comments of Wireless Internet Service Providers Association, ET Docket No. 14-165 and GN Docket No. 12-268 (filed Feb. 4, 2015) (“Comments of WISPA”) at 6; Comments of Google at 36-37; Comments of Microsoft at 29-30; Comments of Wi-Fi Alliance at 7-8, 34; Comments of WSA at 7.
39 NPRM ¶ 25.
40 Comments of Microsoft at 29.
41 NPRM ¶¶ 126-128. See also Comments of Broadcom at 21-22.
proven ability of the TV Bands Database to enforce a prescribed separation distance between unlicensed operations and Channel 37 incumbent licensees. 42

D. Personal/Portable WSDs Should Operate on Unused Channels 7 to 20

OTI and PK strongly support and Commission’s proposal to help offset the incentive auction’s huge reduction in the number of channels available for unlicensed WSDs by removing the prohibition on personal/portable device operation on channels 14-20. 43 There appears to be virtually unanimous support in the record for this sensible proposal. 44

Like the NPRM’s proposal to remove the overly-protective OOBE restrictions on Channels 35-39, discussed just above, OTI and PK applaud the Commission’s recognition that reliance on the more fine-grained protection afforded by the geolocation database (TV Bands Database) is superior to a one-size-fits-all restriction that is not needed in most areas across the country. In this instance, public safety and certain other land mobile operations make use of Channels 14-20 in just eleven cities. The record shows widespread agreement that incumbent licensees operating in certain markets below Channel 21, including PLMRS/CMRS, “will receive adequate protection through the databases, which can easily enforce keep-out zones” on an as-needed basis. 45 Spectrum Bridge concurs, stating its belief that no rule changes would be required for the TV Bands Database it administers “to protect PLMRS/CMRS or other authorized services from harmful interference.” 46 At the same time, as Google observes in its

42 See Comments of Broadcom at 21.
43 NPRM ¶ 30.
44 See, e.g., Comments of Microsoft at 40-41; Comments of Wi-Fi Alliance at 9-11; Comments of Google at 37-38; Comments of Spectrum Bridge, Inc., ET Docket No. 14-165 and GN Docket No. 12-268 (filed Feb. 4, 2015) (“Comments of Spectrum Bridge”) at 3. An exception is the WhiteSpace Alliance, which focuses on promoting fixed wireless uses of the band and the IEEE 802.22 standard. Comments of WSA at 9-10.
45 Comments of Microsoft at 40.
46 Comments of Spectrum Bridge at 3.
comments, since the Spectrum Act requires the Commission to reallocate and auction Channels 14-20 by 2021, “opening these channels for use by personal/portable devices is not a long-term solution for white space operations.”

The NPRM also seeks comment on allowing personal/portable operations on VHF Channels 7 to 13 in addition. Once again, there appears to be a clear consensus in the record in favor of making these additional channels available for both fixed and personal/portable unlicensed use. OTI and PK likewise agree there is no good reason not to do so. Fixed white space operations at higher power levels already have access to these channels, depending on the location of broadcast licensees. And personal/portable use will remain at the same low power levels that apply to UHF channels. Opening Channels 7-13 potentially adds an additional 42 MHz of spectrum for unlicensed use and operations on a mobile basis, helping further to offset the great reduction in unlicensed access to low-band spectrum due to the incentive auction reallocation.

It is true that the value of this VHF spectrum (174-216 MHz) is less immediately evident for mobile devices, such as smartphones and tablets, since extremely low-band frequencies require larger antennas based on current technologies. However, as Google observes, “opening this spectrum for additional unlicensed uses could spur development of technologies to make more effective use of these channels.”

E. Fixed WSDs Should be Allowed to Operate on Unused Channels 3 and 4

OTI and PK agree with the clear consensus among commenters that the Commission should adopt its proposal to allow fixed WSDs to use Channels 3 and 4. Several commenters

47 Comments of Google at 38; see generally 47 U.S.C. § 1413.
48 NPRM ¶ 32.
49 See, e.g., Comments of Google at 39, Comments of Microsoft at 41; Comments of Wi-Fi Alliance at 12-13.
50 Comments of Google at 39.
note that opening the channels can help spur additional unlicensed innovation. For example, Spectrum Bridge states that in combination with Channel 2, which is already available for fixed use, Channels 3 and 4 “are capable of supporting innovative fixed VHF applications, such as long range telemetry." WhiteSpace Alliance, for its part, notes that the propagation characteristics of these channels (2, 3, 4) would benefit rural deployment and public safety communications. More generally, OTI and PK agree with Wi-Fi Alliance’s observation that opening up these channels will “encourage innovation on the part of device manufacturers to the ultimate benefit of consumers.”

As Microsoft observes, the exclusion of Channels 3 and 4 back in 2008 was designed “to protect analog television devices and will no longer be necessary once the transition is completed for all classes of television service.” In contrast, NAB acknowledges that consumer use of TV interface devices relying on Channels 3 and 4 are “diminishing,” yet it nevertheless recommends that the Commission defer unlicensed use.

OTI and PK see little if any justification to delay making these channels available. As Spectrum Bridge suggests, the most likely near-term use for fixed WSDs in this spectrum is outdoor operations that in any event are not likely to proliferate for a number of years as manufacturers develop products for this new opportunity. OTI and PK recommend that the Commission adopt its proposal and pave the runway for future innovation that can more productively use what is now the rapidly disappearing issue of TV peripherals that might be vulnerable to interference.

51 Comments of Spectrum Bridge at 3.
52 Comments of WSA at 9.
53 Comments of Wi-Fi Alliance at 9.
54 Comments of Microsoft at 46.
55 Comments of NAB at 13.
III. THE COMMISSION CAN PERMIT CONTINUED UNLICENSED USE OF VACANT 600 MHZ SPECTRUM WHERE CARRIERS HAVE NOT COMMENCED OPERATIONS WITHOUT RISK OF HARMFUL INTERFERENCE OR IMPOSING UNDUE BURDENS ON LICENSEES

OTI and PK strongly support the Commission’s specific proposal to permit WSDs to continue operating in the 600 MHz band post-auction until the licensee gives notice that it will “commence operations” in that local area.\(^\text{56}\) As the Commission has recognized in this proceeding, due to the repurposing of broadcast spectrum for auction and the repacking of broadcast licensees, there will be precious little spectrum left to nurture a national market for low-band unlicensed devices and services – particularly connectivity for personal/portable devices (e.g., the 802.11af standard) that require a minimum of 18 to 24 MHz in every market nationwide. Ongoing, temporary access to unused 600 MHz spectrum on a localized basis is not only the most efficient spectrum policy – and does no harm to licensees, thanks to the TV Bands Database system – but it also may prove essential to the viability of unlicensed operations.

In the past, auction delays and 10-year buildout requirements based on population, however meritorious or unavoidable, have proven to be a recipe for leaving spectrum capacity fallow for extended periods – and particularly so in rural and other underserved areas. In this proceeding, however, the Commission correctly acknowledged there is a governance mechanism in place to ensure that unused spectrum “white space” in the 600 MHz band remains available for use – or withdrawn from use – depending on the actual operations of the primary licensee. The TV Bands Databases certified by the Commission are designed precisely to govern opportunistic access by unlicensed devices that must seek permission each 24-hour period to continue using a particular channel – a permission that the TV Bands Database can withhold when a primary licensee is ready to commence service.

\(^\text{56}\) Incentive Auction Order at ¶ 680; Part 15 NPRM at ¶¶ 131-144.
It is important to recognize that the Commission’s proposal simply maintains the status quo. Today the majority of 600 MHz spectrum is not used by licensees and is available for unlicensed use. Opportunistic access to fallow 600 MHz spectrum is the default: When a broadcast licensee is not operating on a channel, in that local area the spectrum becomes available for unlicensed use to the extent WSDs will not interfere with another licensee. And if a new broadcaster is assigned a channel, or an existing licensee is relocated to a new channel, the TV Bands Database withholds permission for unlicensed use of that 6 MHz block within the broadcaster’s service area (plus a buffer). All this is automated; consumers will typically not even be aware that frequency blocks are added to or subtracted from the list of available channels, depending on the status of the primary licensee, any more than they would be aware of the automated updating of available channels if their device moves from one media market to another.

In short, the Commission’s proposal to permit continued, temporary use of unused 600 MHz spectrum post-auction is the closest thing imaginable to a spectrum efficiency “free lunch.” Thanks to the automated enforcement mechanism of the TV Bands Database, there is absolutely no downside or risk for licensees, who would maintain all of their rights to use the public resource – they would only lose the ability to warehouse it. The reporting “burden” on licensed carriers is also minimal considering that they obviously have the required information readily at hand as part of their process of preparing link budgets, deploying base stations and determining when they can commence commercial service.

OTI and PK also agree with Wi-Fi Alliance, and Microsoft that the Commission should authorize both Mode I and Mode II personal/portable devices in the repurposed 600 MHz band.57 Wi-Fi Alliance correctly states that the TV Bands Database “can specify appropriate operating

57Comments of Wi-Fi Alliance at 34-35; Comments of Microsoft at 17-19.
parameters (including power) for both fixed and personal/portable devices based on the spectrum landscape. There is therefore no reason to distinguish between the two types of devices.\textsuperscript{58}

The record in this proceeding shows strong support for the Commission’s proposal.\textsuperscript{59} And yet, not surprisingly, CTIA, the wireless industry association, and Qualcomm, the industry’s proprietary chip vendor, struggled to find a reason to oppose it. We address those concerns below.

A. Proposals to Bar Unlicensed Use of Vacant Spectrum if a Licensee Commences Service Anywhere in a Partial Economic Area Would Undermine Spectrum Efficiency, Rural Broadband and a Robust Market for WSDs

CTIA and Telecommunications Industry Association (TIA) do not dispute the basic concept of permitting unlicensed operations to continue using the “repurposed” 600 MHz band on a temporary basis until such time as a licensee commences commercial service. However, in a transparent attempt to kill the concept – and to give carriers the option to keep virtually any or all of their licensed spectrum fallow at its discretion – CTIA suggests that when a licensee initiates commercial operations \textit{anywhere} in the license area, the TV Bands Databases must deny permission for use of fallow spectrum \textit{everywhere} in the license area.\textsuperscript{60} Specifically, CTIA suggests that “white space device operations should cease in a PEA [Partial Economic Area] as soon as the commercial licensee has initiated service anywhere in the market.”\textsuperscript{61}

PEAs should not be used as the geographic foundation for excluding WSDs from access to underutilized spectrum. There are only 416 PEAs in the entire United States, including U.S.

\textsuperscript{58} Comments of Wi-Fi Alliance at 34;
\textsuperscript{59} See Comments of WISPA at 16-17; Comments of Wi-Fi Alliance at 34-35; Comments of Microsoft at 48-49; Comments of Spectrum Bridge at 6.
\textsuperscript{61} Comments of CTIA at 38.