Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Use of Spectrum Bands Above 24 GHz for Mobile Radio Services	)	GN Docket No. 14-177
	)	
Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands	)	IB Docket No. 15-256
	)	
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, And 101 to Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation for Certain Wireless Radio Services	)	WT Docket No. 10-112
	)	
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band	)	RM-11664

To: The Commission

COMMENTS OF
OPEN TECHNOLOGY INSTITUTE AT NEW AMERICA
AND PUBLIC KNOWLEDGE

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New America's Open Technology Institute ("OTI") and Public Knowledge ("PK") submit these Comments in response to the Commission's *Notice of Proposed Rulemaking* concerning the use and appropriate allocation of spectrum in the bands above 24 GHz.[1] OTI & PK appreciate the Commission's initiative to anticipate the development of future technologies that will make these millimeter wave (mmW) bands useful for the provision of high-capacity mobile device data services. As consumer advocates, our groups believe that the public interest goals of promoting innovation, market entry, competition, intensive spectrum re-use, and diverse uses and users are best served by extending the three-tier spectrum access framework the

[1] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, GN Docket No. 14-177, Notice of Proposed Rulemaking (rel. October 23, 2015) ("*NPRM*").

Commission has adopted for the 3.5 GHz Citizens' Broadband Radio Service to ensure that there is an appropriate mix of licensed, unlicensed and dynamic shared access to what will otherwise be grossly-underutilized mmW spectrum.

I. Introduction and Summary

Unlike lower-frequency spectrum, the extremely attenuated propagation characteristics of millimeter wave (mmW) bands benefit wireless carriers and consumers alike not by increasing coverage for truly "mobile" use (on the go), but rather by enhancing the density and capacity of networks (self-provisioned as well as carrier-provisioned) that support the "nomadic" use of mobile devices, mostly indoors (in homes, offices, public places) and always very close to fixed, typically wireline, backhaul. Exclusive licensing on a large geographic area basis is therefore the access framework *least* conducive to serving the public interest in widespread and intensive spectrum re-use, lower market barriers to entry, promoting mobile market competition, and stimulating innovation. Both spectrum re-use and backhaul will increasingly be more cost-effective at the edge of the network, closest to the end-user and subject to their control.

Accordingly, OTI & PK urge the Commission to promote widespread access and efficient spectrum re-use of the 28, 37 and 39 GHz bands by adopting a multi-tier spectrum sharing framework similar to the one adopted last year for the 3.5 GHz band premised on three over-arching recommendations:

First, our groups urge the Commission to ***separate the access rights for indoor ("local area") from outdoor ("wide area") use***. If testing confirms that the walls of ordinary structures will shield LMDS and future "mobile" (outdoor or wide area) deployments from harmful interference, then the Commission should separately authorize *indoor-only* use of the entire 28, 37 and 39 GHz mmW bands either for unlicensed use, or for General Authorized Access on a

license-by-rule basis under Section 37(e). Rights for indoor use should be allocated separately in order to encourage the greatest number of uses and users, including for residential and small business use.

Second, spectrum in the mmW bands is particularly well suited to ***accommodate opportunistic access ("use-or-share") on an unlicensed or GAA basis***. OTI & PK recommend that the Commission certify a mmW Spectrum Access System to facilitate more widespread and intensive use of the 28, 37 and 39 GHz bands – and make the use-or-share obligation effective immediately after the SAS is operational. There is no legitimate reason to let a large geographic license area lie fallow for five years.

Third, OTI & PK urge the Commission to ***adopt smaller licensing areas, particularly for the 37 GHz band***, which presently has no terrestrial non-Federal incumbents or service rules. The targeted, small cell capacity in-fill that is anticipated for 5G wireless is a use case that best fits smaller areas, such as census tracts, that can be purchased or leased as needed, adding greater flexibility and liquidity to secondary markets.

With respect to an access framework for the 37 GHz band, because there are currently no non-federal licensees – but there are Federal operations to protect – the band is perfectly suited for access under a variation of the three-tier framework the Commission adopted unanimously last year for the 3.5 GHz Citizens Broadband Radio Service (CBRS). We suggest the following changes to the *NPRM*'s proposed framework to optimize the utility of the 37 GHz band:

First, access to the 37 GHz band for ***outdoor or wider-area use should be divided equally between Priority Access Licenses (PALs) and General Authorized Access (GAA)***. There is no reason to believe that allocating the 37 GHz band for exclusive, wide area licenses will result in

more intensive, efficient, diverse or innovative uses of the spectrum than would the truly hybrid licensing model pioneered in the 3.5 GHz proceeding for CBRS.

Second, ***indoor-only should be separately allocated on an unlicensed basis or, if necessary, on a license-by-rule basis*** that is identical to the rules that would apply to General Authorized Access in the band. If the Commission does decide to adopt its proposal to license property holders for exclusive indoor use of 37 GHz spectrum, these indoor rights should be granted only on the licensed portion of the band (e.g., the 800 megahertz for PALs we suggest above) and should have no protection from devices outside their facility (whether PAL or GAA).

Third, the Commission should ***certify one or more mmW Spectrum Access Systems*** to both protect Federal incumbents and to manage the more intensive, efficient and opportunistic use of unused capacity that would result from extending the three-tier framework of the Citizens Broadband Radio Service.

Fourth, ***a robust "use-or-share" obligation on licensees*** would accomplish a number of objectives, including more intensive use of fallow spectrum capacity, lowering barriers of entry to a diverse uses and users, and providing added incentives for licensees to construct and operate facilities. ***The use-or-share obligation should be effective immediately*** after the SAS is operational – or at most one year after a license is granted – since there is no downside if a SAS ensures licensed operators are protected from harmful interference once they commence service.

Finally, OTI & PK urge the Commission to ***adopt smaller licensing areas***. All of the advantages of county-based licenses described in the *NPRM* would be amplified enormously by license areas based on census tracts (adopted for the 3.5 GHz CBRS) or census block groups.

With respect to rules for the 28 and 39 GHz bands, OTI & PK acknowledge that the 28 and 39 GHz bands present a very different situation due to existing LMDS and other licensees.

Nonetheless, we urge the Commission to take advantage of mmW propagation characteristics to add three additional features to its proposed Upper Microwave Flexible Use Service. We recommend that licenses for the 28 and 39 GHz bands should be small area (e.g., census tracts), separately authorize indoor-only use, and leverage a mmW Spectrum Access System to facilitate opportunistic public access to unused spectrum with no 5-year waiting period.

Finally, OTI & PK strongly support the Commission's proposal to extend the Part 15 operations currently permitted in the 57-64 GHz band to the adjacent 64-71 GHz band immediately above. OTI & PK further recommend that the Commission consider extending harmonized unlicensed access up to 72.5 GHz, creating an additional non-overlapping channel for WiGig connectivity and future innovation.

II. The Public Interest in Intensive Spectrum Re-Use, Innovation and Competition is Best Served by Dynamic Sharing of mmW Spectrum Based on the Three-Tier Access Framework Adopted for the 3.5 GHz Band

As OTI & PK, along with a number of other parties, observed in comments filed last year in response to the *Notice of Inquiry* in this proceeding, high-frequency bands are especially suitable for unlicensed use and dynamic sharing – and not necessarily for traditional exclusive licensing on a geographic basis.[2] Unlike lower-frequency spectrum, the extremely attenuated propagation characteristics of millimeter wave (mmW) bands benefit wireless carriers and consumers alike not by increasing coverage for truly "mobile" use (on the go), but rather by enhancing the density and capacity of networks (self-provisioned as well as carrier-provisioned) that support the "nomadic" use of mobile devices, mostly indoors (in homes, offices, public

[2] *See, e.g.,* Reply Comments of Open Technology Institute and Public Knowledge, Notice of Inquiry, GN Docket No. 14-177 at 3-5 (Feb. 18, 2015); Comments of Google, Notice of Inquiry, GN Docket No. 14-177 at 7-9 (Jan. 15, 2015) ("Comments of Google"); Comments of National Cable & Telecommunications Assn., Notice of Inquiry, GN Docket No. 14-177 at 6, 9 (Jan. 15, 2015) ("Comments of NCTA"); Comments of Consumer Electronics Assn., Notice of Inquiry, GN Docket No. 14-177 at 13 (Jan. 15, 2015) ("Comments of CEA"); Comments of Wi-Fi Alliance, Notice of Inquiry, GN Docket No. 14-177 at 4 (Jan. 15, 2015) ("Comments of Wi-Fi Alliance").

places) and always very close to fixed, typically wireline, backhaul. As the Consumer Technology Association (CTA, formerly Consumer Electronics Association) observed in its *NOI* comments, with mmW spectrum "both heavy rain and foliage can significantly reduce signal penetration and strength," and these frequencies can at best "serve a supplemental role for [mobile] service providers in urban areas" if deployments are sufficiently dense.[3] With the exception of certain point-to-point backhaul uses, the use of mmW spectrum for so-called "mobile" broadband data services is an inherently dense, small cell undertaking likely to be deployed only in geographically limited and densely populated areas.

Exclusive licensing on a large geographic area basis is therefore the access framework *least* conducive to serving the public interest in widespread and intensive spectrum re-use, lower market barriers to entry, promoting mobile market competition, and stimulating innovation. Such a licensing scheme would not allow for the largest possible number of businesses and individuals the ability to self-provision capacity for mobile data offload, the emerging Internet of Things, and other connectivity needs. While exclusive use spectrum in bands below 3 GHz continues play a role in supporting coverage and truly mobile connectivity ("on the go"), it has proven utterly incapable of meeting the public's demand for ubiquitous, high-capacity wireless connectivity at affordable prices.

Small cell spectrum re-use – and Wi-Fi offloading of mobile device data traffic onto local area wireline networks – already carries between 60 and 80 percent of mobile device data traffic in the U.S.[4] Mobidia, which measures the actual usage of tens of thousands of consumers, reports

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[3] Comments of CEA at 13, citing FCC Technology Advisory Council, Summary of Meeting at 60-61, Spectrum Frontier Working Group Presentation at Slide 5-6 (Dec. 9, 2013), *available at* . https://www.fcc.gov/encyclopedia/technological-advisory-council. *See also* Comments of NCTA at 6.

[4] Cisco, *Visual Networking Index: VNI Mobile Forecast Highlights, 2014–2019*, available at http://www.cisco.com/assets/sol/sp/vni/forecast_highlights_mobile/index.html#~Country ("57% of the United States' mobile data traffic was offloaded in 2014. 66% of the United States' mobile data traffic will be offloaded by 2019.")

that Wi-Fi is already carrying an average of 80 percent of total mobile device data traffic.[5] This is the same level of Wi-Fi offloading projected for Western Europe by the end of 2016, according to a European Commission study.[6] Both spectrum re-use and backhaul will increasingly be more cost-effective at the edge of the network, closest to the end-user and subject to their control (or, more practically speaking, determined on the fly by software in their device).

As a result, our groups urge the Commission to promote widespread access and efficient spectrum re-use by adopting primarily unlicensed and dynamic spectrum sharing rules that permit unlicensed use of mmW spectrum for indoor-only use and facilitate opportunistic access to unused capacity in the licensed portions of mmW bands on a use-it-or-share-it basis to the extent it is technically feasible. In the sections below that focus specifically on the *NPRM*'s proposed licensing scheme for the 28, 37 and 39 GHz bands, we recommend and provide more detailed comment on the following three recommendations, which we summarize here:

A. Distinguish Indoor from Outdoor Usage Rights

Our groups urge the Commission to separate the access rights for indoor ("local area") from outdoor ("wide area") use. If testing confirms that the walls of ordinary structures will shield LMDS and future "mobile" (outdoor or wide area) deployments from harmful interference, then the Commission should separately authorize *indoor-only* use of the entire 28, 37 and 39 GHz mmW bands for local area networks and other uses by the occupants of these indoor spaces. Rights for indoor use should be allocated separately in order to encourage the greatest number of uses and users, including for residential and small business use. There is no

[5] *See* Mobidia, "Network Usage Insights: Average Data Usage for LTE, 3G and Wi-Fi of Wireless Subscribers in the USA, Q3 2014" (Nov. 2014).

[6] *See* J. Scott Marcus and John Burns, *Study on the Impact of Traffic Off-Loading and Related Technological Trends on the Demand for Wireless Broadband Spectrum*, European Commission, at p. 3 (Aug. 2013). The E.C. study used data from surveys that monitored the actual activity of thousands of mobile devices to project offload rates for the U.K., France, Spain, Germany and Italy.

good reason to limit indoor-only uses to purchasers of wide area licenses since, as the *NPRM* correctly observes, "as a practical matter, local-area millimeter wave deployments will require permission of the property owner for siting, installation, backhaul, etc."[7]

OTI & PK do not agree, however, that the public interest is best served by a proposal to grant *exclusive use rights* to property owners. Assuming that indoor use is limited to a power level that will not interfere with licensed outdoor operations, OTI & PK propose that the entirety of the 28, 37 and 39 GHz bands should be available for indoor-only use on an *unlicensed* basis or, if necessary, on a license-by-rule basis, under Section 37(e), that is identical to the rules that would apply to General Authorized Access (GAA) on the band.

While we acknowledge that a license-by-rule registration in a mmW SAS (or similar geolocation database) may be a better fit with the wide area licensing that is already established in the 28 and 39 GHz bands, our groups suggest that indoor use in the 37 GHz band should be as open and "unlicensed" as possible. In section III below we urge the Commission to apply the multi-tier access framework adopted for the 3.5 GHz Citizens Broadband Radio Service (CBRS) to the 37 GHz band. Similarly, we suggest dividing the band's 1,600 megahertz equally between Priority Access Licenses and GAA. We believe that indoor-only use on an unlicensed basis should be authorized, at a bare minimum, on the half of the band we suggest should be shared on a GAA basis.

B. Enable Opportunistic Access to Unused Spectrum Capacity with Interference Protection Contingent on Reporting Actual Use to a mmW Spectrum Access System

A central feature of the hybrid approach the Commission has proposed for efficient small-cell spectrum re-use in the 3.5 GHz proceeding is *opportunistic access to unused spectrum*

[7] *NPRM* at ¶ 101-102.

capacity across the entire band on either an unlicensed or licensed-by-rule basis (e.g., General Authorized Access). Spectrum in the mmW bands is particularly well suited to accommodate opportunistic access on an unlicensed or GAA basis. In its *NOI* comments, NCTA correctly pointed out that the limited propagation of mmW spectrum means "the possibilities for spectrum re-use will be greater than in lower frequencies."[8] Network operators, including licensed users, will use these high-frequency bands strategically to target the deployment of small cells that add capacity to lower-frequency operations in high-traffic areas. In mmW bands, where transmissions are inherently short-range and coverage areas measured in meters, wide-area exclusive licensing will necessarily result in underutilized spectrum and "vast swaths of territory unserved by licensed operations."[9]

As Google correctly observed in its *NOI* comments, although mmW bands are not a good fit for a wide-area exclusive-licensing model, "the propagation and atmospheric absorption characteristics of these bands make them well-suited to line-of-sight operations that can be mapped and protected with relative ease."[10] Our groups believe that the coordination mechanism best able to facilitate millimeter wave spectrum sharing is a geolocation database management system such as the Spectrum Access System (SAS) that is already in development and which the Commission will certify to coordinate dynamic sharing among federal agencies, licensed and unlicensed users at 3550-3700 MHz.[11] OTI & PK recommend that the Commission certify a mmW Spectrum Access System to facilitate more widespread and intensive use of the 28, 37 and 39 GHz bands – and make the use-or-share obligation effective immediately after the SAS is operational. There is no legitimate reason to let a large geographic license area lie fallow for five

[8] Comments of NCTA at 6.
[9] *Id.* at 6-7.
[10] Comments of Google at 8.
[11] *See, e.g.,* Comments of CEA at 14 ("CEA supports the principles underlying the innovative real-time, database driven sharing regimes being proposed in the 3.5 GHz band"); Comments of Wi-Fi Alliance at 8.

years. A mmW SAS can not only accommodate more robust Fixed Satellite Service operations, it can also ensure the protection of Federal users, facilitate more active and efficient secondary markets for licensed spectrum access, promote more robust use-or-share opportunistic access, and enable (if needed) the registration of indoor-only use by property holders.

C. License Smaller Areas to Promote More Widespread Use and Diverse Users

OTI & PK urge the Commission to adopt smaller licensing areas, particularly for the 37 GHz band, which presently has no terrestrial non-Federal incumbents or service rules. All of the "advantages to county-based licenses" described in the *NPRM* would be amplified enormously if mmW license areas are based on census tracts (as the Commission adopted last year for the 3.5 GHz CBRS) or census block groups. As the Commission acknowledges in the *NPRM*, licensed deployments in the mmW bands, "when used in mobile applications [i.e., 5G], are expected to provide coverage of areas measured in meters, not kilometers"[12] and "will likely have limited geographic coverage, even in the aggregate."[13]

Neither fixed nor mobile use of mmW spectrum is likely to cover a geographic area larger than a census tract, and so the ability to coordinate and exercise the full rights of a licensee would not be diminished. Since the *NPRM* proposes to subdivide incumbent licenses while retaining their existing rights and license areas, there is no downside to incumbent licensees who may happen to have (or plan) a point-to-point fixed link that crosses a census tract boundary. Smaller licensing areas should provide greater flexibility and liquidity to the functioning of secondary markets. The targeted, small cell capacity in-fill that is anticipated for 5G wireless is a use case that best fits smaller areas that can be purchased or leased as needed. Smaller licensing areas also make it far easier for the Commission to identify unused spectrum and to enforce

[12] *NPRM* at ¶ 111.
[13] *Id.* at ¶ 11.

performance requirements that are far less likely to result in spectrum lying fallow even after 10 years or more.

III. The 37 GHz Band is Particularly Well Suited for a Hybrid Access Framework that Relies on a Spectrum Access System to Protect Federal Users and to Accommodate Both Priority Access Licensing and General Authorized Access

Because there are currently no terrestrial service rules or licensing for non-federal operations in the 37-38.6 GHz band, the Commission has a unique opportunity to adopt a framework that truly fulfills the *NPRM*'s stated intent "to establish a flexible rules framework that enables as wide a range of services as possible."[14] Unfortunately, the *NPRM*'s proposal for this band, emphasizing the same exclusive and wide area geographic licensing that will result in gross underutilization of the 28 and 39 GHz bands, falls short of this lofty goal.

OTI & PK strongly believe that because there are currently no non-federal licensees on the 37 GHz band – but there are Federal operations to protect – the band is perfectly suited for a access under a variation of the three-tier framework the Commission adopted unanimously last year for the 3.5 GHz Citizens Broadband Radio Service. Although we agree that conveying rights for indoor-only use to the occupants of buildings is a positive and practical rule for this band, our groups also strongly believe that access to the band for outdoor or wider-area use should be divided between Priority Access Licenses (PALs) and General Authorized Access (GAA) using a Spectrum Access System (SAS). A mmW SAS could both protect Federal incumbents and manage the more intensive, efficient and opportunistic use of unused capacity that would result from extending the three-tier framework of the CBRS.

If the Commission adopts its proposals for wide area and exclusive geographic licensing of the 28 and 39 GHz bands, OTI & PK believe that extending the dynamic spectrum sharing

[14] *Id.* at ¶ 52.

framework of the CBRS to the 37 GHz band is the best way to truly achieve a balanced, forward-looking and spectrum-efficient allocation of mmW spectrum that promotes innovation and consumer welfare. The *NPRM* correctly stated that in its *3.5 GHz Report & Order*, "the Commission established a roadmap for providing tiered access to shared spectrum on a user-priority basis, and made clear its intention to apply the same kinds of techniques in other bands."[15] Accordingly, OTI & PK suggest the following changes to the *NPRM*'s proposal to extend the Commission's historic three-tier CBRS framework to the 37 GHz band:

A. Divide the 37 GHz Band Equally Between PALs and GAA Use

OTI & PK urge the Commission to adopt a hybrid sharing model that divides wide area and outdoor rights to the band equally between Priority Access Licenses and General Authorized Access, extending the framework the Commission adopted last year in creating the Citizens Broadband Radio Service. In the 3.5 GHz band proceeding, the Commission decided to divide the 150 megahertz band on a roughly equal basis between PALs and GAA use. The Commission concluded that "ensuring that a stable and significant quantity of spectrum is available for both Priority Access Licensees and GAA will foster innovation, encourage efficient use of the band, and create an environment conducive to a wide array of potential users and uses."[16] The *Report & Order* reserved 70 megahertz for licensing and authorized up to 80 megahertz, while GAA users "potentially have access to all 150 megahertz in the band in areas where there are no PALs issued or in use and up to 80 megahertz where all PALs are in use."[17]

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[15] *Id.* at ¶ 150, citing *3.5 GHz Report & Order* at ¶ 2 ("Over time, some of the approaches we advance in the 3.5 GHz "innovation band" could lead to greater productivity in other parts of the radio spectrum").
[16] *Amendment of the Commission's Rules in Regard to Commercial Operations in the 3550-3650 Band*, Report and Order and Further Notice of Proposed Rulemaking, GN Docket No. 12-354, at ¶ 64 (rel. April 21, 2015)("*3.5 GHz Report & Order*").
[17] *Id.* at ¶ 65.

The adoption of a three-tier framework would benefit the economy by enabling intensive use of the band, promoting additional broadband development in rural areas, and lowering the barriers to entry for a diverse range of users. Ensuring a substantial open and opportunistic spectrum on a nationwide basis can also facilitate a more rapid development of markets with scope and scale for innovative and affordable chips, devices, applications and services.

There is no reason to believe that allocating the 37 GHz band for exclusive, wide area licenses will result in more intensive, diverse or innovative uses of the spectrum than would the truly hybrid licensing model pioneered in the 3.5 GHz proceeding for CBRS. In fact, quite the opposite is likely to prove true, particularly with respect to uses of mmW spectrum for small cell, high-capacity LANs. The only proven model to achieve high rates of spectrum re-use on a widespread basis and at low cost is open and opportunistic access to *unlicensed* small cell bands. The CBRS framework holds out this same promise – yet it remains to be seen whether PA licensees will deploy dense, small cell networks across areas even as small as an urban census tract using 3.5 GHz spectrum. The far more constrained propagation characteristics of 37 GHz spectrum suggest that property owners and end users (both public and private) are far more likely to extend their LANs across outdoor spaces – a beneficial outcome that will be facilitated with access to GAA spectrum and completely blocked if all outdoor spectrum capacity in the band is exclusively licensed on a wide area basis.

OTI and PK recommend that the Commission divide the band's 1,600 megahertz into two contiguous blocks of 800 megahertz for shared GAA and 800 megahertz for PA licensing. The PAL block should be further divided into two 400 megahertz licenses to ensure more than one licensee in every area. We also suggest that just like the rules adopted for the 3.5 GHz band, any

PAL spectrum that is not auctioned due to a lack of conflicting applications (or because the reserve price is not met) should be available for opportunistic GAA use in that license area.

B. Operating Rights for Indoor-Only Use Should be Unlicensed or GAA

OTI & PK agree that because walls block mmW transmissions, local area operating rights for indoor use should be allocated separately in order to encourage the greatest number of uses and users, including for residential and small business use. As the *NPRM* correctly observes, "as a practical matter, local-area millimeter wave deployments will require permission of the property owner for siting, installation, backhaul, etc."[18] OTI & PK do not agree, however, that the public interest is best served by a proposal to grant *exclusive use rights* to property owners, pursuant to Section 307(e). Assuming that indoor use is limited to a power level that will not interfere with licensed outdoor operations, OTI & PK propose that the entire band should be available for indoor-only use on an *unlicensed* basis or, if necessary, on a license-by-rule basis that is identical to the rules that would apply to General Authorized Access on the band.

In the *3.5 GHz Report & Order*, the Commission ultimately abandoned its proposal to authorize certain "Contained Access Facilities" (CAFs) to register in the SAS for exclusive use of a portion of the 3.5 GHz band. The CAF concept was sound, but our groups and other parties objected at the time that conveying rights to property holders for indoor use would require exclusion zones around facilities that would have necessarily reduced the already fairly limited amount of 3.5 GHz spectrum available for GAA (or PAL) use.

In the 37 GHz band, the calculus is different because of both mmW propagation characteristics and the enormous bandwidth available. Because 1,600 megahertz of mmW spectrum are available in this band, we see no reason that a facility cannot meet its own needs for

[18] *NPRM* at ¶¶ 101-102.

extra short-range capacity *and* accommodate members of the public who may a need and ability to use the same spectrum. Moreover, if facilities operating indoors on the 37 GHz band are indeed shielded from harmful interference that originates from base stations outside their structure, then the property owner is in a position – where and when necessary – to put restrictions on equipment operating inside its own buildings. Because "local-area millimeter wave deployments will require permission of the property owner for siting, installation, backhaul, etc.,"[19] the property owner should be able to achieve its own desired degree of quality of service despite what would likely be incidental transmissions from mobile devices carried by visitors.

If the Commission does decide to adopt its proposal to license property holders for exclusive indoor use of 37 GHz spectrum, these indoor rights should be granted only on the licensed portion of the band (e.g., the 800 megahertz for PALs we suggest above) and should have no protection from devices outside their facility (whether PAL or GAA). Carving out exclusion zones to protect facilities would add complexity and severely undermine the availability and utility of the band. It is particularly important that the GAA portion of the band is available to the public – and to innovators, WISPs and others – whether the device is indoors or outside. It may not even be practical for devices that are certified for outdoor use to check the SAS before entering a building. But even if it is, the history of Wi-Fi's development and adoption suggests that facilitating a mass market for the sort of off-the-shelf connectivity that will be of tremendous benefit to consumers and to third-party equipment makers requires simplicity and the certainty that the device can be used on a best efforts basis in any location.

In contrast, separating indoor from outdoor rights would not diminish the utility of licenses (PALs) for wider area and outdoor use, since the signal could not be received inside a

[19] *Id*. at ¶¶ 101-102.

facility without the owner's cooperation in any event. This reinforces the rationale for authorizing indoor-only on an unlicensed basis across all, or at least a substantial portion, of the mmW bands subject to new service rules in this proceeding.

The *NPRM* asks several questions related to the scope of local area rights on a license-by-rule basis.[20] OTI & PK recommend that these rights should be indoor only, particularly if the Commission adopts our recommendation to set aside a portion of the band for GAA. While the interstitial outdoor spaces of a college or corporate campus are clearly sympathetic candidates for extending the local area rights to use 37 GHz spectrum, this will be a moot point if a portion of the band is allocated for GAA use. Even if the property owner has no guarantee against interference for its outdoor transmissions, the likelihood is high that (for example) 800 MHz of contiguous GAA spectrum will be adequate. The availability of substantial GAA spectrum would also meet the needs of extending connectivity and services to "public spaces," such as parks, plazas and streets, without requiring municipalities or nonprofits to go to auction to purchase a license for an entire county.

Concerning the eligibility of property holders, our groups see no reason to distinguish between private and public property. For the purpose of promoting the public interest in communication and efficient use of spectrum, the only relevant distinction is indoor versus outdoor use. Similarly, our groups strongly believe that if testing shows that transmissions are contained by the walls of most structures, then the usage rights should attach to the lawful occupants of the structure (or subunit thereof), which should explicitly include tenants of apartment dwellings and office buildings. Thanks to the propagation characteristics of mmW

[20] *NOI* at ¶ 102.

spectrum, this would most closely parallel the purpose and policy logic of the Commission's well-established and successful Over-the-Air Reception Devices ("OTARD") rules."[21]

C. Use a mmW Spectrum Access System to Protect Federal Users and PAL Operations

OTI & PK believe that just as the Commission authorized geolocation database coordination as a means of facilitating more intensive sharing of the 3.5 GHz band, in the 37 GHz band "developing a fully functional SAS capable from the outset of managing three tiers of authorized users would benefit the public interest, spur innovation, and encourage investment…"[22] OTI & PK therefore support the Commission's proposal to "require licensees to provide a SAS provider with the geographic coordinates and other pertinent technical information for their links."[23] The *NPRM* proposes to require licensed terrestrial operators to report this information for both the 28 GHz 27.5-28.35 GHz and 37.5-40 GHz bands.[24] With respect to the 37 GHz band, our groups agree with the Commission that the "providing [FSS] operators with information about terrestrial stations is required in order for those operators to adapt their user equipment deployment plans to take into consideration the presence of interference generated by terrestrial stations."[25]

However, the Commission should not limit the functionality of a mmW band SAS to facilitating the non-interfering operations of fixed satellite (FSS) user terminals. In the 37 GHz

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[21] The OTARD rules protect the specific rights of property owners or leaseholders to install communications equipment in the face of arbitrary restrictions, such as zoning laws, lease contract provisions and homeowners' association covenants. The OTARD rules concern restrictions on the physical installation of antennas, routers and related infrastructure that have the effect of precluding or impairing fixed wireless signals. *See* 47 C.F.R. § 1.4000. *See Continental Airlines Petition for Declaratory Ruling Regarding the Over-the-Air Reception Devices (OTARD) Rules*, Memorandum Opinion and Order, 21 FCC Rcd 13201, at ¶¶ 2, 12 (2006) (finding that Massport, the operator of a Wi-Fi backbone composed of Part 15 devices, has no "right" to operate it free from interference from other Part 15 devices deployed by lessee Continental Airlines).
[22] *3.5 GHz Report & Order*, *supra* note 15, at ¶ 311.
[23] *NPRM* at ¶ 152.
[24] *Id.* at ¶¶ 152, 164.
[25] *Id.* at ¶ 164.

band, the same geolocation database authorized to facilitate sharing by FSS operations can be used to enforce a protection zone around incumbent NASA and other Federal receiving earth stations, as well as military sites,[26] and the possible need to protect radio astronomy sites in the band just below 37 GHz.[27] In addition, a SAS can ensure that the Commission's proposal to impose a "use-or-share obligation" on Upper Microwave Flexible Use Service licensees both ensures that licensed operations are fully protected from harmful interference and that the public's opportunistic access to fallow bandwidth is robust.[28] For example, if the Commission adopts its proposal to auction licenses as large as counties, a mmW band SAS with the same capabilities as the 3.5 GHz band SAS will be able to enable continued opportunistic access to unused portions of the license area (sometimes hundreds of square miles) even after the licensee commences actual service in another geographic area.

D. Authorize Robust GAA Use of Unused PAL Spectrum, Enforced by the SAS

OTI & PK strongly support the Commission's proposal to adopt a "use-or-share obligation" on all Upper Microwave Flexible Use Service licensees. The Commission should conclude, just as it did last year in its *3.5 GHz Report & Order*, "that permitting opportunistic access to unused Priority Access channels would maximize the flexibility and utility of the 3.5 GHz Band for the widest range of potential users" and "ensure that the band will be in consistent and productive use."[29] Similarly, in the mmW bands, a "use-or-share" approach would accomplish a number of objectives, including more intensive use of fallow spectrum capacity, lowering barriers of entry to a diverse range of uses and users, and providing added incentives for licensees to construct and operate facilities.

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[26] *Id.* at ¶¶ 170-171.
[27] *Id.* at ¶¶ 173-176.
[28] *Id.* at ¶¶ 215-217.
[29] *3.5 GHz Report & Order* at ¶ 72.

The *NPRM* asks whether a SAS would be "the best means of administering a sharing mechanism" for opportunistic access. OTI & PK believe that an automated SAS would be the most effective mechanism, particularly since the development of a sophisticated SAS in response to the Commission's *3.5 GHz Report & Order* provides both a proof of concept and a very cost-effective means of making a SAS available for the mmW bands by the time an auction and initial deployments take place. As the Commission recognized last year when it unanimously authorized opportunistic General Authorized Access across the entire 150 megahertz of the 3.5 GHz band, PAL operators (licensees) face no risk or loss of rights whatsoever from a contingent "use-it-or-share-it" approach since the automated enforcement capability of the SAS – or any comparable geolocation database – can remove a channel from the list of channels available for GAA use in a local area during a notice period prior to the commencement of actual service in a license area.

E. Auction PALs for Smaller Areas and Shorter Terms, Similar to 3.5 GHz CBRS

The *NPRM* proposes to use counties as the geographic area unit and 10-year terms for all licenses in the 28 GHz, 37 GHz and 39 GHz bands.[30] OTI & PK urge the Commission to adopt smaller licensing areas, particularly for the 37 GHz band, which presently has no terrestrial non-Federal incumbents or service rules. All of the "advantages to county-based licenses" described in the *NPRM* would be amplified enormously if the license areas were based on census tracts (adopted for the 3.5 GHz CBRS) or census block groups. This would be particularly the case if, as we propose above, the Commission decides to make the 37 GHz band another "innovation band" by adapting the 3.5 GHz band's multi-tier framework to encourage more intensive and dynamic sharing between PAL and GAA users.

[30] *NPRM* at ¶¶ 110, 121.

The first advantage cited in the *NPRM* is the "best fit [with] the localized types of services we expect to be offered in the mmW bands."[31] The *NPRM* explains that "[t]hese bands do not propagate well over long distances, and when used in mobile applications [i.e., 5G], are expected to provide coverage of areas measured in meters, not kilometers."[32] Networks "will likely have limited geographic coverage, even in the aggregate . . .."[33] The prevalent interest in these bands is either to integrate high-capacity bandwidth in future 5G networks on a very targeted basis – primarily in congested areas or at times of high demand; or to add bandwidth for the mushrooming device connectivity needs of the emerging Internet of Things, a use that is primarily indoors. In either case, it is fairly certain that mmW licensees – or even their lessees – will not be making truly "wide area" deployments in any traditional sense. The 3.5 GHz band has far better propagation for outdoor deployments, yet the Commission settled on census tracts as the appropriate and manageable license area. Our groups believe these mmW bands should be treated similarly.

A second advantage cited in the *NPRM* is "provid[ing] licensees with additional flexibility to target their deployments to those areas where they need the capacity."[34] However, given the inherent small cell nature of the band, *smaller* license areas will enable a far larger number of potential operators to target localized needs without the need to acquire an entire county, or the need to negotiate an agreement with a major carrier uninterested in leasing small areas with high transaction costs.

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[31] *Id*. at ¶ 111.
[32] *Id.*
[33] *Id*. at ¶ 11.
[34] *Id*. at ¶ 111.

A third advantage cited in the *NPRM* is the belief that "smaller license areas reduce the potential for warehousing spectrum."[35] We agree. The problem is that *county-wide* licenses in mmW spectrum is a recipe for wasting the public's spectrum resource. County licenses also restrict competitive entry and innovation since, as the *NPRM* notes, there are currently 3,143 counties but more than 74,000 census tracts. Even many of the most populous and urbanized counties are enormous and contain many very different submarkets, including urban, suburban, exurban and rural. For example, California's San Bernardino County occupies 20,000 square miles and is home to more than 2.1 million people. Deployments in the city of San Bernardino (51 square miles) are as much as 100 miles or more from many much smaller towns in the same county. Since deployments will in most cases use only a portion of a census tract, requiring a licensee to purchase and exclusively hold a license to a county like San Bernardino – in order to operate *at all* – is also a recipe for warehousing unused spectrum, even if inadvertently. This problem is exacerbated because, in the 37 GHz band, the Commission is proposing at most four (and possibly three) licenses per county.

With respect to licensing terms, the *NPRM* acknowledges that "in the *3.5 GHz R&O* the Commission adopted three-year license terms on the theory that the band will be used in a flexible manner that supports myriad uses, providing spectrum to users where and when they need it."[36] The *NPRM* asks if a five-year term would be appropriate "under a similar rationale."[37] We believe that 3-year terms with no expectation of renewal would be most appropriate. Like the 3.5 GHz band, the 37 GHz band is inherently a small cell band, using relatively inexpensive access points and consumer end-user devices that will all be amortized – and likely upgraded – after three-to-five years. As we noted just above with respect to licensing areas, even if longer

[35] *Id.*
[36] *Id.* at ¶ 122.
[37] *Id.*

terms are used for consistency with existing LMDS licenses in the 28 and 39 GHz bands, at least the 37 GHz band should be considered an "innovation band" where all the benefits of the multi-tier CBRS framework at 3.5 GHz is applied to these even shorter-range frequencies to encourage entry, innovation, and a broad diversity of users and uses.

IV. Licenses for the 28 and 39 GHz Bands Should be Small Area, Exclude Indoor Use, and Leverage a mmW Spectrum Access System to Facilitate Opportunistic Public Access to Unused Spectrum

While the 37 GHz band presents an ideal opportunity for the Commission to fashion a forward-looking and intensively-shared band based on the multi-tier CBRS framework, OTI & PK acknowledge that the 28 and 39 GHz bands present a very different situation due to existing LMDS and other licensees. As the *NPRM* describes, both bands contain hundreds of active licenses to extremely large geographic areas (basic trading areas in 28 GHz and economic areas in 39 GHz) that each cover at least half of the U.S. population. As a result, the Commission's proposals to authorize what it calls "mobile" operations in the two bands seem designed to be as compatible as possible with the existing model of exclusive and very large area geographic licensing by auction.

OTI & PK nevertheless urge the Commission to take advantage of the propagation characteristics of millimeter wave spectrum to add three additional features to its proposed Upper Microwave Flexible Use Service for the purpose of making the 28 and 39 GHz bands more accessible to smaller operators, innovators and the public at large.

First, as we proposed with respect to the 37 GHz band above, our groups urge the Commission to separate the access rights for indoor ("local area") from outdoor ("wide area") use. If testing confirms that the walls of ordinary structures will shield LMDS and future "mobile" (outdoor or wide area) deployments from harmful interference, then the Commission

should separately authorize *indoor-only* use of the entire 28 and 37 GHz mmW bands either for unlicensed use or for General Authorized Access on a license-by-rule basis under Section 37(e). We propose this with the recognition that unlike the 37 GHz band, which currently has no incumbent non-federal licensees, the Commission has expressed a goal of both protecting and extending the exclusive license rights of existing LMDS licensees, as well as accommodating FSS operations to the greatest feasible extent. Allowing at least property holders to register their location in a mmW SAS for indoor-only fixed wireless use would not diminish the license rights of either incumbent LMDS operators (who are by definition not transmitting inside facilities) or future licensees (who, as the Commission acknowledged, "as a practical matter . . . will require permission of the property owner for siting, installation, backhaul, etc.").[38] The combination of the propagation characteristics and a GAA (or "light licensing") registration requirement will ensure that any risk of harmful interference to wide area licensees would be both minimized and easily remedied.

Second, OTI & PK strongly support the Commission's proposal to adopt a "use-or-share obligation" on licensees that can encourage more intensive use of these bands and "discourage warehousing and other improper behavior that result in the spectrum not being used."[39] However, our groups urge the Commission to authorize this opportunistic access as early as practical after the initial license is issued – and not allow "portions of the license area that remain unused" to lie fallow for five years. As we argued in the section above with respect to the feasibility of a use-or-share obligation in the 37 GHz band, the development and pending FCC certification of a sophisticated and automated SAS in response to the Commission's *3.5 GHz Report & Order* provides both a proof of concept and a very cost-effective means of making a

[38] *Id.* at ¶¶ 101-102.
[39] *Id.* at ¶ 215.

SAS (or even several) available for the mmW bands by the time an auction and initial deployments take place. As the Commission recognized in adopting this same mechanism for immediate implementation in the 3.5 GHz band, PAL operators (licensees) face no risk or loss of rights whatsoever from a contingent "use-it-or-share-it" approach since the automated enforcement capability of the SAS can remove a channel from the list of channels available for GAA use in a local area during a notice period prior to the commencement of actual service in a license area.

Third, as we proposed in the section above for priority access licensing on the 37 GHz band, OTI & PK recommend that the Commission adopt license areas smaller than counties. We believe that all of the considerations cited in the *NPRM* would apply as well to license areas based on census tracts, or even census block groups, as they do to counties. For example, neither fixed nor mobile use of mmW spectrum is likely to cover a geographic area larger than a census tract – and so the ability to coordinate and exercise the full rights of a licensee would not be diminished.

Moreover, if a LMDS incumbent's license is subdivided into census tracts, rather than counties, there would seem to be only positive and no negative benefits. One is that smaller licensing areas should provide greater flexibility and liquidity to the functioning of secondary markets. The targeted, small cell capacity in-fill that is anticipated for 5G wireless is a use case that best fits smaller areas that can be purchased or leased as needed. There is also no downside to incumbent licensees who may happen to have (or plan) a point-to-point fixed link that crosses a census tract boundary. Under the proposal in the *NPRM*, the incumbent will retain full rights and flexibility to all the subdivided licenses – regardless whether they are subdivided into counties, census tracts, or census block groups.

Smaller licensing areas also make it far easier for the Commission to identify unused spectrum and to enforce performance requirements that are far less likely to result in spectrum lying fallow even after 10 years or more. Under the Commission's proposal for performance requirements based on countywide licensing, "if a licensee provides coverage to a census block or multiple census blocks that have a total population equal to 40% of the population of the county, the licensee would be deemed to meet the performance requirement and would retain the license for the entire county."[40] Since the *NPRM* "propose[s] to measure [population] coverage at the census block level," a census tract would fit the Commission's proposed methodology equally well, but allow a more granular performance requirement that would better enable a new licensee – or lessee or at least use-or-share opportunistic access – to census tracts that would otherwise lie fallow.

V. Authorizing Open Access to the 64-71 GHz Band Under Part 15 Rules Harmonized with the 57-64 GHz Band Best Serves the Public Interest

OTI & PK strongly support the Commission's proposal to extend the Part 15 operations currently permitted in the 57-64 GHz band to the adjacent 64-71 GHz band immediately above.[41] As the Commission notes, there are currently no licensed operations across this entire 14 GHz of spectrum, making the band particularly well suited for shared unlicensed use. In 2013 the Commission raised the power limits and generally expanded the utility of the 57-64 GHz unlicensed band for both indoor and outdoor use. OTI & PK agree that the Commission's conclusion that authorizing Part 15 operations in the 64-71 GHz band, in conjunction with the existing 57-64 GHz band, will "double the spectrum available for the next generation of unlicensed broadband technologies such as ultra-high-speed audiovisual content streaming and

[40] *Id*. at ¶ 207.
[41] *Id*. at ¶¶ 58-59.

WiGig connectivity that will offer low latency and security-protected connectivity between devices."[42]

In its *NOI* comments, the Wi-Fi Alliance pointed out that this expansion would double the number of possible channels available for WiGig technologies using the IEEE 802.11ad standard, permitting information transfers between devices at up to seven gigabits per second.[43] A wider band would support denser deployments and increased data rate capacity. Because of the very short transmission ranges at that frequency – and because most expected use would be indoors – OTI & PK agree that authorizing use of the entire Extended 60 GHz Band under the existing Part 15 rules would best serve the public interest in open access, very high-capacity spectrum for data transfers.

Reserving at least one large and contiguous mmW band for purely unlicensed sharing will help meet the rapidly growing demand for low-power, end-user applications (such as wireless High-Definition Multimedia Interface transmissions) on a plug-and-play basis. Moreover, as noted above, the very short-range propagation characteristics of the spectrum at 57-71 GHz strongly support both the efficient spectrum re-use and greater consumer welfare that results from a Wi-Fi model, permitting individuals and firms to self-provision connectivity based on a diverse and thriving market of end-user equipment, applications and services.

The record to date indicates little if any disagreement with this proposal, even among mobile carrier interests that otherwise advocate for the exclusive geographic area licensing of bands below 60 GHz.[44] And as the *NPRM* notes, equipment and chipmakers including Ericsson, InterDigital, Qualcomm and SiBeam all supported authorizing operations in the 64-71 GHz band

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[42] *Id.* at ¶ 58.
[43] Comments of Wi-Fi Alliance at 4-5.
[44] *See, e.g.*, Comments of T-Mobile at 7-8; Comments of Qualcomm at 14 ("[t]he Commission should . . . expand the current 60 GHz unlicensed band (i.e., the 57 to 64 GHz band) to include the 64 to 71 GHz band Identified in the NOI").

under Part 15.[45] Although Nokia and Samsung expressed support for exclusive licensing, OTI & PK agree with the Commission's tentative conclusion that the 28, 37 and 39 GHz bands can offer very large and contiguous blocks on a licensed basis – and at frequencies that are generally considered more advantageous for quality of service offerings.

OTI & PK further recommend that the Commission consider extending harmonized unlicensed access at the top of the 60 GHz band, up to 72.5 GHz, creating an additional non-overlapping channel for WiGig connectivity and future innovation. Under the Commission's current proposal, the extended band would support a total of six non-overlapping WiGig channels, based on the ITU-R M.2003.1 channelization recommendations. This would place the upper edge of the highest frequency channel at 70.20 GHz. By extending the band further – to 72.5 GHz – the Commission would permit seven non-overlapping channels and ensure that hundreds of megahertz of adjacent but unutilized spectrum are harnessed instead to enrich the ecosystem for pervasive connectivity for all consumers and other end users.

VI. Conclusion

Open, shared and opportunistic access to small cell spectrum is a proven success in the Part 15 bands where Wi-Fi offload and other wireless innovation is booming. The Commission should extend the balanced approach exemplified in the agency's proposed 3.5 GHz band Citizens' Broadband Radio Service to the mmW bands to the greatest extent possible. The 37 GHz band, which is currently not licensed to non-federal users for terrestrial use, is a prime candidate to create another flexible and intensively used "innovation band" that also promotes the widest possible range of uses and users. The Commission should also take advantage of its

[45] *See Notice of Inquiry* Comments of Ericsson at 39; Comments of InterDigital at 4, 19-21; Comments of Qualcomm at 17-18; Comments of SiBeam at 3-5. *See also* Comments of IEEE 802 at 3; Comments of Google at 10-11; Comments of Wi-Fi Alliance at 4-6.

ability to separate indoor ("local area") and outdoor ("wide area") operating rights to make all, or at least most, indoor use of mmW spectrum available to the public on an unlicensed or General Authorized Access basis. In addition, the 57-64 GHz unlicensed band should be extended to include 64-71 GHz under harmonized Part 15 rules. This balanced approach, avoiding the waste and warehousing inherent in relying primarily on exclusive geographic area licensing in mmW spectrum, best serves the public interest by promoting a wide variety of uses and users, intensive and efficient spectrum re-use, innovation, market entry and the prospect of greater competition.

Respectfully Submitted,

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