Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Commission Seeks Comment on Licensing Models	)	GN Docket No. 12-354
and Technical Requirements in the	)	
3550-3650 MHz Band	)	

To: The Commission

COMMENTS OF
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Public Knowledge

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Table of Contents

The undersigned nonprofit groups, the Open Technology Institute at the New America Foundation and Public Knowledge (hereinafter "OTI and PK"), are pleased to submit these comments in response to the Public Notice ("*Public Notice*") released on November 1, 2013 in the above-captioned proceeding.[1]

I. INTRODUCTION AND SUMMARY

The Open Technology Institute (OTI) and Public Knowledge (PK) applaud the Commission for its innovative and balanced proposal to unlock the tremendous potential of the unused spectrum in the 3.5 GHz band. OTI and PK have enthusiastically supported the Commission's proposal to create a Citizens' Broadband Service in the 3.5 GHz band, filing comments and reply comments previously on behalf of the broader Public Interest Spectrum Coalition (PISC).[2] We view the Revised Framework in the *Public Notice* as another positive and critical step in a long-term effort to reorient the nation's spectrum policy toward *use* rather than exclusively reserved *non-use* of capacity on the public's infinitely-renewable spectrum resource.

OTI and PK strongly support the Commission's proposal to implement a three-tier access framework that ensures a robust amount of spectrum for General Authorized Access ("GAA") on a nationwide basis. A three-tier access system managed by one or more neutral, third-party database managers (a Spectrum Access System or "SAS") strikes the right balance between protecting incumbent operations and facilitating a diverse range of private sector small cell deployments.

[1] *Public Notice*, "Commission Seeks Comment on Licensing Models and Technical Requirements in the 3550-3650 MHz Band," GN Docket No. 12-354, FCC 13-144 (rel. Nov. 1, 2013 ("*Public Notice*").
[2] *See* Comments of the Public Interest Spectrum Coalition, GN Docket No. 12-354 (Feb. 20, 2013); Reply Comments of the Public Interest Spectrum Coalition, GN Docket No. 12-354 (Apr. 5, 2013)

We agree with the Commission's proposal to reserve a substantial portion of the band for GAA users in every market. The certainty of markets of national scope and scale for chips, devices, applications and services will be essential to encourage investment and deployment. It is also a likely prerequisite to a mass market for interoperable and dynamic frequency devices that can operate on either a Priority Access ("PA") or a GAA basis. OTI and PK believe that at least 50 percent of the bandwidth available to PA and GAA users in each local market should be reserved for GAA, at least initially. Because the SAS can add or withdraw permission for access to GAA spectrum at any time, if the unproven model of licensing small cells proves far more productive than GAA, the Commission can at any point increase the relative share of the band allocated for PA licenses ("PALs") in the future without stranding GAA devices or investment.

The Spectrum Access System (SAS) will also enable opportunistic GAA use of unused spectrum across the entire band, including Priority Access spectrum that has not been assigned or that is not in actual use. We agree that this "use-it-or-share-it" concept is an essential feature of the Revised Framework. Licensees lose no rights whatsoever and bear a *de minimus* burden to simply inform the Commission and/or the SAS prior to commencing substantial service in a local area, so that all GAA devices can be immediately denied permission to operate on those frequencies. This notice could be given 30 days or more in advance of actual use. This approach will encourage PA licensees to make actual use of spectrum they reserve without the need to impose strict construction or service requirements. Opportunistic GAA use also directly addresses the problem that arises because PALs will be cost-free in the absence of competing applications, encouraging speculators and brokers to roll up exclusive licenses for not just a one-year term, but for the "multiple consecutive years of PAL rights." In the absence of a very significant application and/or annual use fee, only Priority Access licensees that acquire their

PALs through competitive bidding will have any inherent incentive to deploy services quickly, or even at all.

OTI and PK generally support the Revised Framework's "building block" approach to Priority Access Licenses (PALs). We agree that open eligibility, very granular license areas and a lease-like system of one-year, non-renewable license terms is an appropriate regime for this small cell band. We recommend that the Commission adopt a number of additional features intended to accommodate a very diverse range of users and to avoid foreclosure or warehousing. We recommend that the Commission allow a licensee to aggregate no more than three one-year terms at a time – the current year plus two additional years – and to license no more than 20 MHz in a given license area. We also suggest the Commission consider whether census Block Groups (which are one-third the population of a census tract, on average) would confer the same advantages while facilitating "micro-targeted network deployments" and "intensive and efficient use of the spectrum" to a greater degree.

Finally, OTI and PK agree that equipment certified to operate on the band, whether on a GAA or a PA basis, should be capable of dynamic frequency selection across the entire band based on SAS channel assignments that could change depending on location, frequency or time.

II. *GENERAL AUTHORIZED ACCESS*: 3-TIER ACCESS WITH A DEFINED MINIMUM FOR GAA AND OPPORTUNISTIC ACCESS TO THE ENTIRE BAND BEST SERVES THE PUBLIC INTEREST

OTI and PK strongly concur with the Commission's proposal to establish a Citizens' Broadband Service with a three-tier framework that ensures robust General Authorized Access ("GAA") on a nationwide basis. A substantial portion of the band should always be available for GAA in every market. The certainty of markets of national scope and scale for chips, devices, applications and services will be essential to encourage investment and deployment. And

because the Spectrum Access System can add or withdraw permission for access to GAA spectrum at any time, if the unproven model of licensing small cell access (Priority Access) proves far more productive, the Commission can change the relative shares of the band allocated for PA and GAA in the future without stranding devices or investment. In addition, GAA users should be able to opportunistically access unused spectrum capacity in the band across the entire 150 MHz, subject to protecting the actual operations of Federal incumbents and secondary Priority Access licensees. Thanks to the automated enforcement of the Spectrum Access System, PA licensees face no risk or loss of rights whatsoever from the proposed "use-it-or-share-it"[3] approach since the SAS can remove their channel from the list of permitted channels during the notice period before they commence actual service in a license area.

A. Unlicensed and Opportunistic Access is the Only Proven Model for Widespread and Intensive Spectrum Re-Use

Although OTI and PK do not oppose an experiment with small cell Priority Access licensing on a portion of the 3.5 GHz band, 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. Increasingly, the widespread availability of Wi-Fi operating on unlicensed spectrum is the single most important factor in mitigating the "spectrum crunch." Inherent limitations on the capacity of the current carrier business model suggest that greatly expanded use of unlicensed and small cell spectrum by non-carrier providers and by consumers themselves will be necessary to absorb projected demand, to ensure consumers higher-speed connections, and to promote innovation in M2M connectivity more broadly.[4]

[3] *Public Notice* at ¶ 34.
[4] *See* Michael Calabrese, "Solving the 'Spectrum Crunch': Unlicensed Spectrum on a High-Fiber Diet," Time Warner Cable Research Program on Digital Communications (Fall 2013), at 6-7.

It is clear from burgeoning Wi-Fi offload trends that both consumers and even the wireless industry overall will benefit if every individual consumer, business and public space has the option to incorporate additional unlicensed spectrum into a small cell network established by the end user at the very edge of the network. Analysts estimate that despite the ongoing rollout of LTE services, offloading to Wi-Fi will continue to grow, rising from roughly 35-to-40 percent today to as much as 60-to-80 percent of the total traffic that would otherwise be on 3G and 4G networks within three to five years.[5] Alcatel-Lucent forecast an increase of "87 times [the current] daily traffic on wireless networks" over the next five years, with 50 percent of that traffic on cellular networks "while the remaining 50 percent will be offloaded to Wi-Fi."[6] Juniper Research projected this year that 63% of the data traffic generated worldwide by smartphones, tablets and feature phones will be transferred onto the fixed network via Wi-Fi and femtocells by 2015. In western Europe wireline ISPs have created clouds of connectivity by turning more than 10 million residential and business subscribers into Wi-Fi hotspots. A European Commission study released in August projected that Wi-Fi will be offloading nearly 80 percent of mobile device traffic by the end of 2016.[7] Even today, the study concluded, "we believe that a majority of traffic that would otherwise be present on the macro cellular traffic is already being off-loaded, primarily to Wi-Fi in the home."[8]

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[5] Wireless Broadband Alliance, "Next Generation Hotspot Whitepaper: Maintaining the Profitability of Mobile Data Services," October 2012 at 5.

[6] Sue Marek, "Mobile Broadband Usage Is Skyrocketing-and So Are the Number of Projections," *Fierce Wireless* (Feb. 27, 2012), *available at* http://www.fiercewireless.com/story/mobile-broadband-usage-skyrocketing-and-so-are-number-projections/2012-02-27.

[7] 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 (August, 2013), at 3. The 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.

[8] *Id.* at 9. Among the data sets used was a 2013 survey by Informa and Mobidia finding "that at least two-thirds of mobile data for Android phones is already being off-loaded to 'self-provisioned' Wi-Fi, which equates roughly to private Wi-Fi. . . . [T]he same Informa analysis found *only 2% of otherwise mobile traffic from Android smart phones to be transmitted over managed (i.e. public) Wi-Fi hotspots*, although this fraction varied greatly from one country to the next." *Id.* (emphasis in original). *See* Informa, "Understanding the Role of Managed Public Wi-Fi in

To understand why small cell spectrum re-use is prevalent among *users* and *non-carrier providers* – but not so much among mobile carriers – it is critical to distinguish between truly *mobile* data demand (on the go) and *nomadic* data demand (indoors or outdoors near a wired connection). As the European Commission study noted just above stated: "Relatively little smartphone data usage is truly mobile." Cisco's Internet Business Solutions Group (IBSG) conducted a survey last year of more than 1,540 U.S. individual and business users of mobile data devices. The Cisco survey found that mobile devices, including smartphones, are used primarily at home and work – and overwhelmingly in locations with wired networks that either do or could easily offer Wi-Fi offload. Users reported that two-thirds of their mobile device use is at home or work, while only 10 to 15 percent is "on the go" or outside of retail and public locations that are increasingly wired for Wi-Fi access.[9]

Moreover, the application driving data demand – video – is the most nomadic of wireless device applications and is increasing the fastest.[10] Surveys of user behavior show that nearly 85% of video on mobile devices is watched at home (50%), at work (15%), or at other indoor locations. Only 15% is watched outdoors or "in transit," and no doubt much of this is or soon will be covered by Wi-Fi hotspots as well.[11]

Today's Smartphone User Experience: A global analysis of smartphone usage trends across cellular and private and public Wi-Fi networks," (Feb. 2013).

[9] Stuart Taylor, Andy Young and Andy Noronha, *What do Consumers Want from Wi-Fi? Insights from Cisco IBSG Consumer Research* (May 2012), at 5; Stuart Taylor, *What do Mobile Business Users Want from Wi-Fi? Insights from Cisco IBSG Consumer Research* (November 2012), at 6. "While two-thirds of people still use their devices on the go, the world of mobile devices is changing from a 'mobile,' on-the-go world (average usage of 0.5 hours per typical day) to a 'nomadic' world dominated by the home (2.5 hours)," the Cisco study stated.

[10] Verizon reports that already at least 50% of its mobile traffic is online video, a share the company projects will increase to two-thirds of all mobile broadband traffic by 2016. Sue Marek, "Verizon CEO: 50% of Our Wireless Traffic is Video," *Fierce Wireless*, April 10, 2013, *available at* http://www.fiercewireless.com/story/verizon-ceo-50-our-wireless-traffic-video/2013-04-10?utm_source=rss&utm_medium=rss. *See* Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2011–2016, Executive Summary, *available at* http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html.

[11] Stuart Taylor, "A New Chapter for Mobile? How Wi-Fi Will Change the Mobile Industry as we Know It," Cisco Internet Business Strategy Group, at 6 (Nov. 2011).

Although advocates of a two-tier access model of Authorized Shared Access claim that exclusive licensing with no GAA will optimize efficiency and quality of service for carriers, current mobile data offload trends suggest the opposite. It is the tens of millions of individual consumers, businesses and an array of *non-carrier providers* (e.g., cable company ISPs, retailers, building owners) that are in a superior position to leverage the infrastructure (routers, wireline connections) that is already deployed, typically on their own property, at the very edge of the network. Small cell infrastructure and a common standard (Wi-Fi) are already broadly deployed – and so additional opportunistic spectrum capacity in the 3.5 GHz band simply needs to be incorporated as a supplement to this proven business model.

To be sure, it's entirely possible that mobile carriers will be among the biggest investors in deploying small cell access points on the 3.5 GHz band. But relying primarily on carriers that have been laggards in breaking beyond a business model premised on macro cells and carrier-provisioned infrastructure would foreclose the innovation and decentralized investment that has been a hallmark of the Wi-Fi boom. For example, while U.S. carriers bemoan a "spectrum crisis," the five-company Cable Wi-Fi consortium has deployed more than 200,000 Wi-Fi hotspots using unlicensed spectrum. In five western European countries, *wireline* ISPs have turned more than 10 million customer premises into open Wi-Fi hotspots.[12] The evidence to date strongly suggests that it will be the *proliferation* of diverse non-carrier providers and consumer self-provision that will enable the most intensive spectrum re-use and innovation on this band.

B. The 'Floor' for GAA Should be No Less than 50 Percent of the Band Nationwide

OTI AND PK strongly concur with the Public Notice that "[e]nsuring that a significant GAA 'floor' is maintained in all geographic areas . . . regardless of the number of Priority

[12] Calabrese, "Solving the 'Spectrum Crunch'," *supra* note 4, at 10-12.

Access tier users in the area, should encourage widespread deployment of base stations and handsets that would operate opportunistically in the band under the control of the SAS."[13] As the Commission recognized previously in the incentive auctions NPRM, making open and opportunistic spectrum available on a nationwide basis "will help to create certainty for . . . industry and promote greater innovation in new services."[14] Ensuring a substantial amount of open and opportunistic spectrum on a nationwide basis is critical for developing markets with scope and scale for innovative and affordable chips, devices, applications and services. It is also a likely prerequisite to the benefits of a mass market for interoperable and dynamic frequency devices that can operate on either a Priority Access or a GAA basis.

A substantial block of unlicensed spectrum available nationwide has been the recipe for the unprecedented success of the unlicensed band at 2.4 GHz. In contrast, the Commission's rules prohibiting unlicensed use of all but one or two of the dozens of vacant TV channels (so-called TV white space) in the very largest metro areas (New York, Los Angeles, San Francisco) is a deterrent to investment and innovation. If the Commission determines that open and shared GAA will be authorized, then it must go the essential next step and ensure that there is a very robust amount of bandwidth available in *every* market (subject, of course, to exclusion zones or other measures necessary to avoid harmful interference to incumbent services).

Accordingly, OTI and PK believe that a majority – and certainly no less than 50 percent – of the bandwidth available to PA and GAA users in each local market should at least initially be reserved for GAA. We suggest that this minimum GAA reservation be defined as "a proportional

[13] *Public Notice* at ¶ 34.
[14] *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Notice of Proposed Rulemaking, Docket No. 12-268, 27 FCC Rcd. 12357, at ¶ 232.

ratio that can scale with the quantity of spectrum available in a given location or time after protecting incumbents, rather than a fixed (megahertz) bandwidth."[15]

The Commission should also recognize that among the many virtues of three-tier access governed by a neutral geolocation database manager is that the relative allocation (ratio) is changeable over time. If the Commission requires that GAA and PA devices are capable of dynamic frequency selection across the entire 3.5 GHz band, the Spectrum Access System can enforce a change in the relative allocation of the band – or even a decision to vary the ratio by geography (e.g., making the urban core different than suburbs or exurbs). Because the SAS can add or withdraw permission for access to GAA spectrum at any time, if the unproven model of licensing small cells (Priority Access) proves far more productive than GAA, the Commission can simply increase the relative shares of the band allocated for PALs in the future without stranding GAA devices or investment.

C. The Spectrum Access System Can Manage Opportunistic Access to All Unused Spectrum without Risk to Priority Access Licensees

OTI and PK strongly support the Commission's proposal to adopt a "use-it-or-share-it"[16] concept that would authorize GAA across the entire band, including on Priority Access channels that are either not licensed, or which are licensed but not actually in use. According to the *Public Notice*, under the Revised Framework "when Priority Access rights have not been issued (e.g., due to lack of demand) or the spectrum is not actually in use by a Priority Access licensee, the SAS would automatically make that spectrum available for GAA use locally."[17] We agree that GAA users should be given temporary permission by the Spectrum Access System to operate on

[15] *Public Notice* at ¶ 28.
[16] *Public Notice* at ¶ 29.
[17] *Public Notice* at ¶ 28.

a localized basis until such time as the licensee notifies the Commission and/or the SAS administrator that the licensee intends to commence *actual service*.

OTI and PK recommend that all PALs assigned by the Commission include an explicit condition that permits GAA users to operate on a localized basis until such time as the licensee notifies the Commission and/or the Spectrum Access System of the date that the licensee intends to commence actual service.[18] Licensees lose no rights whatsoever and bear a *de minimus* burden to simply inform the Commission and/or the SAS administrator prior to commencing substantial service in a particular local area, so that all unlicensed devices can be immediately denied permission to operate on that frequency band. We suggest that this notice be given at least 30 days in advance of actual use. This would give a PA licensee the ability to check the SAS database (which should be transparent to the public) prior to the commencement of service and verify that the noticed PAL areas are no longer available for GAA use.

In addition, PA licensees should be able to notify the SAS to block GAA access to license areas on any specific dates in advance of commencement of actual service when the license holder plans to run network tests or trials that need protection. Since this is how the microphone reservation system already works in relation to the TV Bands Databases, the SAS could easily provide a similar online interface and authorization for licensees to give notice. This will also provide the Commission with invaluable data about actual use of the band.

The admonition in the recent report and recommendations of the President's Council of Advisors on Science and Technology (PCAST) is directly relevant to the 3.5 GHz band, which

[18] PISC has proposed versions of this concept in other proceedings, noting that it can also serve as a productive alternative to more draconian "use it or lose it" buildout requirements that are difficult to enforce in practice – and which yield no utility of the fallow spectrum in the meantime. *See* Comments of New America Foundation, Consumers Union, Public Knowledge, WT Docket No. 12-70, ET Docket No. 10-142, WT Docket No. 04-356 (filed May 17, 2012). *See also* Comments of the Public Interest Spectrum Coalition, In the Matter of Promoting More Efficient Use of Spectrum Through Dynamic Spectrum Use Technologies, ET Docket No. 10-237 (Feb. 28, 2011); Michael Calabrese, "Use it or Share it: Unlocking the Vast Wasteland of Fallow Spectrum," Working Paper, presented at 39th Research Conference on Communication, Information and Internet Policy, September 25, 2011.

the PCAST recommended for opportunistic sharing: "The incongruity between concern about a 'looming spectrum crisis' and the reality that only a fraction of the Nation's prime spectrum capacity is actually in use suggests the need for a new policy framework to unlock fallow bandwidth in all bands, as long as it can be done without compromising the missions of Federal users and ideally by improving spectrum availability for Federal users."[19] PCAST proposed building on the TV Bands Database concept to enable shared access to underutilized bands without harming licensed primary operations, which is also what the Commission proposes in the Revised Framework.

Like the TV Bands Databases certified by the Commission to govern unlicensed access to locally-vacant TV channels, the SAS will be a geolocation database that will be designed specifically for the purpose of regulating opportunistic access by GAA devices. We expect that GAA users will be required to receive and renew permission periodically to continue using a particular channel in a PA license area – a permission that the SAS can withhold when a primary licensee is ready to commence service. Since this SAS notice-and-permission process is automated, consumers will typically not even be aware that frequency blocks are added to or subtracted from the list of available GAA channels.

Any potential concern that certain GAA operators could become overly dependent on the continued availability of PA spectrum can be mitigated in at least two ways: First, the Commission can permit (and perhaps require) PA licensees to give earlier notice (e.g., 90 days in advance of service), during which the SAS can flag the channel and send notices to GAA users that it will not be available after some future date. Second, the Commission can require that licensed but unoccupied PA spectrum can be utilized *only* by GAA devices that have been

[19] President's Council of Advisors on Science and Technology, *Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth*, July 2012, at 16.

certified to be multi-channel and frequency hopping. Indeed, in the final section below we recommend all broadband Internet access devices operating on the band should be capable of tuning across the entire band in order to facilitate the dynamic frequency assignment proposed in the *Public Notice*. This would eliminate any risk that a WISP or other unlicensed operation would rely solely on frequencies that will later be removed from the list of available channels for GAA use when a PA licensee initiates commercial service. Indeed, dependency on contingent access to spectrum in a band that protects Incumbent Access will simply be a fact of life for both PA and GAA users – and yet another reason why the Commission should require that all transmitters on the band are capable of dynamic frequency selection across the entire band.

Permitting opportunistic and temporary GAA use of PA spectrum not actually being used is also imperative because the Revised Framework envisions cost-free reservations of PALs except when "more applications are submitted than can be accommodated geographically, temporally, or spectrally."[20] An auction would only be triggered by mutually exclusive applications. As a result, during the first application window closes, in many areas – perhaps in most of the country – private parties will have an incentive to roll up exclusive licenses for not just a one-year term, but for the "multiple consecutive years of PAL rights"[21] (a period we suggest limiting to three years). Since these PALs will be free of charge, we expect a gold rush of spectrum speculators and brokers to file applications for tens of thousands of PALs. In the absence of a very significant application fee and/or annual use fee, investors would have every incentive to lock up multi-year license rights, particularly in urban and suburban areas where they might later be able to make middleman profits by leasing the spectrum to carriers, WISPs and other actual service providers. In all likelihood, only Priority Access licensees that acquire

[20] *Public Notice* at ¶ 23.
[21] *Id.*

their PALs through competitive bidding will have any inherent incentive to deploy services quickly, or even at all. In this context of this PA gold rush, we believe the Commission's proposed use-it-or-share-it approach will be particularly important to minimize the degree to which large portions of the Priority Access portions of the band will lie fallow for years if not indefinitely.

Finally, the *Public Notice* asks how the Commission should define "use" in this context. As the *Public Notice* suggests, OTI and PK agree that "use" should mean *actual and substantial service* within a specific Priority Access License area. Testing or license-saver transmissions without actual service delivery should not trigger foreclosure. The notification by the PA licensee should include a list of each individual PAL area where actual service will commence and the corresponding dates, so that the capability of the SAS to regulate access on a granular basis is fully realized. If PA license areas are very granular, the definition of "use" will be less important since any actual substantial service would largely occupy a small cell (e.g., a census block or census Block Group). However, if the Commission adopts a relatively large license area – such as a census tract – then it should strive to define "use" based on the actual protection needs of the PA licensee, since even after service commences in one area within a census tract, there could be other areas miles away where a GAA user could continue to operate without any risk of interference to the licensed service within the same PAL area.

D. The Commission Should Authorize Higher Power Operations in Rural Areas

As OTI and PK stated in their original comments in this proceeding, filed on behalf of the Public Interest Spectrum Coalition, we believe that the Higher Power Operation Zones should be authorized on both a PA and GAA basis in all non-urban areas, so that WISPs and other rural broadband providers can potentially operate across the entire 150 MHz from 3550 to 3700 MHz

at higher power levels. This would give WISPs and other rural service providers the option to apply for a PAL, or to rely on GAA spectrum, or a combination (which we believe will turn out to be the most likely outcome). The ability to offer far more bandwidth with roughly the same cost of capital holds great potential for more cost-effective, higher-speed service to unserved rural and small town homes and businesses, as well as increased competition to wireline and satellite services. This means a substantially smaller total amount of Priority Access spectrum should be licensed in rural areas for exclusively small cell use.

If the Commission determines that small cell GAA and higher-power fixed wireless operations are incompatible on the same frequency band, then some share of the GAA spectrum should be reserved for small cell use even in rural areas, or at least in PA licensing areas above a threshold population density. Although outdoor use of low-power, small cell devices seems likely to be minimal in rural areas, and especially in remote areas, individual homes, businesses, schools, shopping malls and other facilities will tend to exhibit the same demand for added small-cell capacity as they will in most urban and suburban areas. Therefore, although the Commission should craft rules that facilitate fixed wireless deployment by WISPs and other rural broadband providers, the option to deploy small cells at lower power for added capacity and localized M2M applications should not be foreclosed.

III. *PRIORITY ACCESS LICENSING*: PALS SHOULD BE LIMITED INITIALLY TO NO MORE THAN HALF THE BAND AND ONE-YEAR LICENSE PERIODS

OTI and PK generally support the Revised Framework's "building block" approach to Priority Access licenses (PALs) that is described in the *Public Notice*.[22] We agree that open eligibility, very granular license areas and a lease-like system of one-year, non-renewable license terms is an appropriate regime for a small cell band and will promote deployments by a wide

[22] *Public Notice* at ¶¶ 12- 21.

range of service providers. Since exclusive small cell licensing is an unproven concept that has not been embraced voluntarily by the marketplace (despite the Commission's progressive rules on flexible licensing, secondary markets and leasing), we recommend that initially no more than half of the 3550-3650 MHz band should be available for PALs. Thanks to the governance model proposed in the revised framework – with dynamic frequency assignments optimized and enforced by a geolocation database (SAS) – this proportion can be changed over time depending on the relative demand and public interest benefits of actual PA and GAA activity on the band.

OTI and PK also agree that under this Revised Framework, allowing opportunistic GAA use of all Priority Access spectrum not in actual use would make specific construction or service requirements unnecessary. At the same time, our groups recommend that the Commission adopt a number of additional features intended to accommodate a very diverse range of users and avoid foreclosure or warehousing of the Priority Access spectrum.

Time/License Terms: OTI and PK support the one-year, non-renewable license terms proposed in the *Public Notice*.[23] The access points, routers and other equipment likely to be deployed for low-power, small cell services are far less costly and likely to be amortized over far shorter periods than the macro cell infrastructure commonly associated with long-term CMRS licensing. More critically, pre-payment for one-year license terms covering small geographic areas will dramatically lower the barriers to entry for innovation and competition in the band. By essentially leasing the right to interference protection for Priority Access on a year-by-year basis, the Commission wisely makes it more practical for a very diverse range of potential users and service providers to operate, including on a very localized basis.

[23] *Public Notice* at ¶ 13.

The benefits of short-term and small area licenses can be undermined, however, if a single entity can effectively lock up multi-year rights that prevent potential entrants from bidding for access. Although we agree that allowing licensees "to aggregate multiple consecutive PALs to obtain multi-year rights to spectrum within a given geographic area" can encourage investment in infrastructure, this must be balanced against the benefits of facilitating entry and competition. OTI and PK recommend that the Commission allow a licensee to aggregate no more than three one-year terms at a time – the current year plus two additional years. Each succeeding year the licensee could apply for an additional PAL, which would effectively renew the three-year term.

A shorter lock-up period would also reduce the moral hazard inherent in a system premised on annual payments. OTI and PK agree that the payment for each PAL should be "due annually prior to the license start date and a license would terminate automatically if the payment is not made."[24] This lease-like mechanism will promote entry and innovation. However, without a down-payment or other penalty for the failure to pay for a default on a multi-year bid, licensees will be able to acquire a low-cost option to hold a PAL for multiple years, thereby blocking or deterring other potential licensees who must assume that the PALs in an area are unavailable for years to come. Rather than require upfront payments for future PALs, at least initially it seems preferable to limit the maximum lock-up period. Although licensees will prefer longer-term certainty, it is actually less important in this band since even if an incumbent PA licensee is outbid and denied an additional year, it would have both two years notice and substantial access to GAA spectrum (and possible access to other bands) as an alternative.

[24] *Public Notice* at ¶ 24.

Geography: OTI and PK support the Commission's goal to "establish the geographic component of PALs in a way that allows flexible, micro-targeted network deployments, promoting intensive and efficient use of the spectrum, but also allowing easy aggregation to accommodate a larger network footprint."[25] The *Public Notice* proposes census tracts as an appropriate building block for small cells, in part because they are standardized units that frequently track natural and political boundaries, and that also vary in size depending on population density (varying from less than one square mile to 10,000 square miles or more in remote areas).

While census tracts offer many advantages, we believe the Commission should also consider whether census Block Groups would confer the same advantages while facilitating "micro-targeted network deployments" and "intensive and efficient use of the spectrum" to a greater degree. Block Groups (BGs) are contiguous components of census tracts and "are generally defined to contain between 600 and 3,000 people."[26] There are roughly three times as many BGs as census tracts. Although this difference would be computationally trivial to a licensing and access system administered by the algorithms of a geolocation database (SAS), it could make a very significant difference with respect to the number of network providers, particularly those focused on extending connectivity over a discrete geographic area, such as a shopping district, college campus, or office complex. A more granular license area would have little downside – but it could make a PAL more affordable, encourage more micro-targeted deployments, and reduce the potential waste inherent in a scenario where these small deployments leave the PA spectrum fallow over most of a license area that is three times larger.

[25] *Public Notice* at ¶ 14-15.
[26] United States Census Bureau, "Geographic Terms and Concepts – Block Groups," available at http://www.census.gov/geo/reference/gtc/gtc_bg.html.

Frequency/Bandwidth: OTI and PK support the Commission's proposal to designate PALs as 10 MHz unpaired channels. The Commission should also put a low limit on the number of PALs that an entity (and related entities) can hold at one time in any given license area. Our groups recommend that an entity (and any related entities) should be eligible to license no more than 20 MHz at any one time in a given license area. As we explain above, it would best serve the public interest to set aside at least half of the available spectrum in each area for GAA use, at least initially, and make the remainder available as an experiment to see if small cell licensing engenders the sort of deployments and innovation typical of small cell unlicensed spectrum. If, for example, the Commission allocates up to 50 MHz in each area for PA licensing, then a limit of 20 MHz would permit at least three entities to acquire the interference protection of a PAL.

In the absence of competing applications, the Commission could permit a licensee to aggregate more than 20 MHz. However, in that situation the Commission should still restrict an aggregation greater than 20 MHz to a single license term, so that future entrants and potential competitors are not foreclosed from bidding over a multi-year period.

Administrability: The *Public Notice* states that the PAL concept is intended to streamline and automate the licensing process for what could turn out to be hundreds of thousands of granular licenses. Accordingly, the Commission requests comment on whether SAS managers should be permitted to administer the auction process.[27] There are obvious advantages to automating the PAL application and auction process through a SAS manager certified and supervised by the Commission. The SAS would need to be designed to track occupancy and actual use of every PA license area, just as the TV Bands Database must track the site-based licensing information of every broadcast station licensee in order to determine whether and

[27] *Public Notice* at ¶ 25.

where unlicensed devices can be given permission to operate in unoccupied channels. With this granular geolocation database as a sunk cost, it would be a marginal cost for a SAS manager to accept online applications, run a simultaneous auction among competing applicants, and transfer relevant information provided by the winning bidders to both the Commission and to the public portal that would make spectrum assignments transparent. Another advantage is that the SAS will presumably be privately financed, as the TV Bands Databases will be, through small user fees (most likely a one-time device registration fee purchased wholesale by manufacturers). If the administration of the assignment, automated auction and information collection process is considered a cost of this service, then those same user fees could cover that cost as well.

PAL Assignment Process: OTI and PK generally support the Commission's proposal to use an annual application window and streamlined auctions as the means to resolve mutually exclusive applications for PALs. To the extent that the Commission does offer multiple consecutive years of PAL rights, this application and auction should be done at the same time as current year PALs. As noted above, OTI and PK strongly favor annual payments prior to the start date of each PAL and the automatic termination of a PAL for non-payment.

IV. BROADBAND ACCESS DEVICES SHOULD OPERATE ACROSS THE ENTIRE BAND TO FACILITATE DYNAMIC FREQUENCY ASSIGNMENT BY THE SAS

The *Public Notice* requests comment on "whether authorized base stations, handsets, and other user equipment should be required to be capable of operating across the entire 3.5 GHz Band."[28] The Commission observes that this would be necessary to enable the SAS to "dynamically assign specific frequencies within given geographic areas," rather than rely on a static channel model. This capability would both "ensure that lower tier users do not interfere

[28] *Public Notice* at ¶ 30.

with higher tier users and . . . minimize interference among users in the same tier."[29] OTI and PK agree that equipment certified to operate on the band, whether on a GAA or a PA basis, should be capable of dynamic frequency selection across the entire band based on an SAS channel assignment that could change depending on location, frequency or time.

Dynamic frequency assignment by the SAS will confer a number of important public interest benefits for users overall. First, it can better accommodate and protect Incumbent Access operations, such as naval radar, including the evolution of their systems in the future. If channels are assigned on a static basis, the need to protect a federal incumbent system on a particular channel could shut down a particular Priority Access licensee completely, whereas with dynamic assignment the SAS can at least attempt to assign an alternative channel. No equipment would be "stranded" even if a particular channel became permanently unavailable.

Second, dynamic assignment facilitates more intensive and productive use of the entire band. As the SAS evolves, dynamic assignment should make it possible to fit more users and uses in a given geography, particularly if the precise location, transmit power, interference tolerance and perhaps sensing data from devices in an area can be factored into the calculations. Conversely, dynamic assignment can prevent any potential "tragedy of the commons" since the SAS can, if necessary, limit the number of GAA users on a channel in any particular area.

Third, dynamic assignment can also facilitate the coexistence of small cell and higher power users in rural areas. There are currently more than 2,000 active licensees operating at higher power in tens of thousands of registered locations on the 3650-3700 MHz band under the Commission's Part 90, Subpart Z "light licensing" rules. Although we support making a substantial portion of the 3550-3650 MHz band available for higher-power operations in rural areas that enable WISPs and other users, this must also be coordinated with small cell users to

[29] *Ibid.*

achieve the "coexistence . . . between disparate systems" that the *Public Notice* correctly identifies as a goal.[30] The Commission should require the SAS to dynamically assign PAL and GAA frequencies to minimize interference between higher power and small cell users.

Finally, a requirement of capability to tune across the entire band will further encourage common standards and interoperability among both PA and GAA devices. As Wi-Fi has demonstrated, a common standard across a sufficiently wide band of spectrum can spur scale economies that reduce costs and encourage adoption.

V. CONCLUSION

OTI and PK generally support the Commission's Revised Framework. As we noted in our initial comments, the proposed Citizens' Broadband Service and Spectrum Access System represent a potential landmark in the Commission's progress away from static "command and control" licensing rules and toward more flexible and spectrum-efficient approaches that begin to harness the full potential of the nation's spectrum resources. Establishing the three-tier spectrum access system proposed in the Commission's Revised Framework, with a substantial set-aside for GAA use nationwide, opportunistic GAA use of all unused spectrum, and governed by a neutral geolocation database administrator, is a critical foundation for unlocking underutilized spectrum not only in the 3.5 GHz band, but in a number of additional Federal bands in the future. We encourage the Commission to move as rapidly as possible to adopt a Final Order so that investment, innovation and deployments can begin.

Respectfully Submitted,

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[30] *Public Notice* at ¶ 47.

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