

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

In the Matter of	)	
	)	
Amendment of the Commission's Rules with	)	GN Docket No. 12-354
Regard to Commercial Operations in the 3550-	)	
3650 MHz Band	)	
	)	

**COMMENTS OF FEDERATED WIRELESS, INC.**

Kurt Schaubach, CTO  
Federated Wireless, Inc.  
4301 North Fairfax Drive  
Suite 301  
Arlington, VA 22203  
(703) 650-0585

July 15, 2015

## EXECUTIVE SUMMARY

Federated Wireless is pleased to respond to two questions raised in the Second Further Notice of Proposed Rulemaking (“2<sup>nd</sup> FNPRM”) with respect to the 3550-3700 MHz band (“Citizens Band”). Federated Wireless believes the Commission should: (1) apply an engineering methodology to define when Priority Access License (“PAL”) spectrum is not in “use,” thereby ensuring availability of the spectrum for other users; and (2) permit streamlined and flexible secondary use of PAL spectrum without applying existing Secondary Markets Rules, in order to encourage timely and efficient use of the spectrum.

Federated Wireless observes that an economic-based definition of PAL “use” would inherently permit spectrum warehousing. In contrast, applying an engineering definition will enable the Commission to monitor and address potential spectrum warehousing, and ensure unused PAL spectrum is efficiently made available for General Authorized Access (“GAA”) use. Federated Wireless offers the following in further support of an engineering definition: (A) Applying an engineering definition of when PAL spectrum is in “use” is consistent with the role of the SAS, as envisioned by the Commission, and is technologically feasible; (B) Adopting an aggregate interference threshold of -80 dBm/10 MHz to delineate when PAL frequencies are in use is a good starting point, and can be reviewed and modified periodically by a multi-stakeholder body as use of the Citizens Band evolves; (C) Allowing vacant channels to be used as guard bands in the Citizens Band may be needed under some circumstances, and these vacant channels also can be used for localized communications at lower powers or for indoor operations; and (D) Using a “congestion metric” and advance planning will ensure that defining PAL “use” based on aggregate interference does not result in unfair treatment and coordination problems for GAA users.

Furthermore, Federated Wireless agrees with the Commission that permitting secondary use of PAL spectrum will increase flexibility and provide an important mechanism to match spectrum

supply and demand in the Citizens Band. However, secondary use of PAL spectrum should be permitted without applying the Commission's existing Secondary Markets Rules. Unlike other spectrum bands for which licensees must obtain prior Commission approval of Secondary Markets use of exclusively licensed spectrum, the Citizens Band is "licensed by rule" for GAA use throughout the band. Given that any number of GAA users can access and share PAL spectrum when it is unused, filing for and receiving a traditional Commission authorization for a lease right for the PAL spectrum seems misplaced and overly burdensome. Instead, all that is needed is a framework to ensure that PAL users are Commission-certified, PAL licensees consent to any secondary use of their spectrum, and the SAS Administrator is notified of such use. SASs are fully equipped to keep track of, and manage, third-party use of PAL spectrum without interfacing with the Commission.

To this end, the Commission should (A) adopt a more streamlined and flexible framework for third parties to use PAL spectrum without applying the Commission's existing Secondary Markets Rules; (B) authorize a "use it or share it" framework to enable spectrum use by building owners and other Contained Access Facilities; (C) not authorize the use of "spectrum exchanges" for secondary use of PAL spectrum because such exchanges are not needed to facilitate secondary use of PAL spectrum, and would add unnecessary complexity; (D) prohibit partitioning and disaggregation of PALs because these mechanisms would not be useful, would inhibit streamlined secondary use of PAL spectrum, and would be administratively burdensome; and (E) not count PAL spectrum toward spectrum aggregation limits because doing so would be difficult to implement in an equitable manner, and would inhibit streamlined secondary use of PAL spectrum, as well.

# TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY.....	i
I. THE COMMISSION SHOULD APPLY AN ENGINEERING METHODOLOGY TO DEFINE WHEN PAL SPECTRUM IS IN USE.....	1
A. Applying an Economic-Based Definition of PAL “Use” Would Permit Spectrum Warehousing, Whereas Applying an Engineering Definition Will Ensure Unused PAL Spectrum is Efficiently Made Available for GAA Use. ....	3
B. Adopting an Engineering Definition is Consistent with the Role of the SAS, as Envisioned by the Commission, and is Technologically Feasible. ....	6
1. Adopting an Engineering Definition is Consistent with the Role of the SAS Envisioned by the Commission.....	6
2. Adopting an Engineering Definition is Technologically Feasible. ....	7
C. Adopting an Aggregate Interference Threshold of -80 dBm/10 MHz to Delineate When PAL Frequencies are in Use is a Good Starting Point; This Threshold Can Be Reviewed and Modified Periodically by a Multi-Stakeholder Body as Use of the Citizens Band Evolves.....	7
1. The Commission Should Adopt -80 dBm/10 MHz as the Initial Interference Threshold.....	8
2. Signal Level Reporting of PAL and GAA Devices Will Provide the SAS with “Spectrum Sensing Data” to Assist the SAS in Monitoring the Interference Threshold.....	9
D. Allowing Vacant Channels to be Used as Guard Bands in the Citizens Band May be Needed Under Some Circumstances, and These Vacant Channels Also Can be Used for Localized Communications at Lower Powers or for Indoor Operations.....	10
E. Using a “Congestion Metric” and Advance Planning Will Ensure That Defining PAL “Use” Based on Aggregate Interference Does Not Result in Unfair Treatment and Coordination Problems for GAA Users.....	11
II. THE COMMISSION SHOULD PERMIT STREAMLINED AND FLEXIBLE SECONDARY USE OF PAL SPECTRUM WITHOUT APPLYING EXISTING SECONDARY MARKETS RULES.....	14
A. The Commission Should Adopt a More Streamlined and Flexible Framework for Third Parties to Use PAL Spectrum; Existing Secondary Markets Rules are Not a Proportional Solution. ....	15
1. A Traditional Secondary Markets Approach Is Not a Proportional Solution.....	15
2. A Certification and Notice Process is the Right Solution to Enable Streamlined and Flexible Use of PAL Spectrum.....	16

3.	SAS Functionality Envisioned by the Commission Will Enable Streamlined and Flexible Use of PAL Spectrum.....	18
B.	The Commission Should Authorize a “Use It or Share It” Framework to Enable PAL Use by Building Owners and Other CAFs. ....	18
C.	The Commission Should Not Authorize the Use of “Spectrum Exchanges” for Secondary Use of PAL Spectrum. ....	20
D.	The Commission Should Prohibit Partitioning and Disaggregation of PAL Spectrum. ....	21
E.	The Commission Should Not Count PAL Spectrum Toward the Commission’s Spectrum Aggregation Limits. ....	23
III.	CONCLUSION.....	23

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

In the Matter of	)	
	)	
Amendment of the Commission’s Rules with	)	GN Docket No. 12-354
Regard to Commercial Operations in the 3550-	)	
3650 MHz Band	)	
	)	

**COMMENTS OF FEDERATED WIRELESS, INC.**

Federated Wireless, Inc. submits these comments in response to the Second Further Notice of Proposed Rulemaking (“2<sup>nd</sup> FNPRM”) released by the Federal Communications Commission (the “Commission” or “FCC”) for development of the 3550-3700 MHz band (“Citizens Band”).<sup>1</sup>

Responding to questions raised in the 2<sup>nd</sup> FNPRM, Federated Wireless believes the Commission should: (1) apply an engineering methodology to define when Priority Access License (“PAL”) spectrum is not in “use,” thereby ensuring availability of the spectrum for other users; and (2) permit streamlined and flexible secondary use of PAL spectrum without applying existing Secondary Markets Rules, in order to encourage timely and efficient use of the spectrum.

**I. THE COMMISSION SHOULD APPLY AN ENGINEERING METHODOLOGY TO DEFINE WHEN PAL SPECTRUM IS IN USE.**

In the 2<sup>nd</sup> FNPRM, the Commission seeks comment on three possible methodologies for defining when PAL spectrum is in “use” – an engineering definition, an economic definition, and a hybrid economic/engineering definition.<sup>2</sup> The methodology used to define when PAL spectrum is

---

<sup>1</sup> *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, GN Docket No. 12-354, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959 (2015). The Report and Order portion of this item hereinafter is referred to as the “3.5 GHz Order.” The Second Further Notice of Proposed Rulemaking portion is referred to as the “2<sup>nd</sup> FNPRM”.

<sup>2</sup> See 2<sup>nd</sup> FNPRM, ¶¶ 420, 425, 430. The 2<sup>nd</sup> FNPRM notes a previous position taken by Federated Wireless in support of a hybrid definition that combines aspects of an engineering definition and economic definition. See 2<sup>nd</sup> FNPRM, ¶ 430. Federated Wireless strongly believes that an engineering definition should be adopted

not in use will be critical to enabling the Spectrum Access System (“SAS”) to make unused PAL spectrum available for opportunistic use by General Authorized Access (“GAA”) users, as envisioned by the Commission.<sup>3</sup> From Federated Wireless’s perspective, the key issue to consider when evaluating the three proposed definitions is to determine which definition will most efficiently protect PAL spectrum while it is in use, while ensuring that unused PAL spectrum is not warehoused by those with the economic ability to do so, or otherwise occupied by what the Commission refers to as “license savers” – *i.e.*, PAL licensees who would deploy low-cost Citizens Broadband Radio Service Devices (“CBSDs”) merely for the purpose of reserving unused PAL spectrum.<sup>4</sup> Federated Wireless believes the proposed engineering definition is the best approach to achieve the Commission’s objectives.

In support of Federated Wireless’s view that an engineering definition of “use” should be employed, Federated Wireless observes that: (A) Applying an economic-based definition of PAL use would inherently permit spectrum warehousing, whereas applying an engineering definition will enable the Commission to monitor and address potential spectrum warehousing, and ensure unused PAL spectrum is efficiently made available for GAA use; (B) Adopting an engineering definition of when PAL spectrum is in “use” is consistent with the role of the SAS as envisioned by the Commission and is technologically feasible; (C) Adopting an aggregate interference threshold of -80 dBm/10 MHz to delineate when PAL frequencies are in use is a good starting point, and can be reviewed and modified periodically by a multi-stakeholder body as use of the Citizens Band evolves; (D) Allowing vacant channels to be used as guard bands in the Citizens Band may be needed under

---

for purposes of determining when PAL spectrum is in use. Federated Wireless, however, has encouraged, and continues to encourage, the Commission to adopt mechanisms by which entities can gain access to PAL spectrum in a streamlined, cost-effective manner. Federated Wireless suggests such mechanisms in Section II herein.

<sup>3</sup> See 3.5 GHz Order, ¶ 72.

<sup>4</sup> See 2<sup>nd</sup> NPRM, ¶ 423.

some circumstances, and these vacant channels can be used for localized communications at lower powers or for indoor operations; and (E) Using a “congestion metric” and advance planning will ensure that defining PAL “use” based on aggregate interference does not result in unfair treatment and coordination problems for GAA users.

**A. Applying an Economic-Based Definition of PAL “Use” Would Permit Spectrum Warehousing, Whereas Applying an Engineering Definition Will Ensure Unused PAL Spectrum is Efficiently Made Available for GAA Use.**

The Commission’s concerns over potential warehousing of PAL spectrum by “license savers” highlights significant problems with applying the economic or hybrid economic/engineering definitions proposed in the 2<sup>nd</sup> FNPRM.<sup>5</sup> “License savers” deploying low-cost CBSDs merely for the purpose of occupying otherwise unused PAL spectrum is, in effect, similar to a PAL licensee paying to exercise an option under the proposed economic definition, or paying some form of usage fee under the proposed hybrid definition, expressly to exclude GAA access to, and use of, PAL spectrum. Although the cost of deploying “license saver” CBSDs may be lower than the direct exercise of a cash-based exclusionary option, economic-based definitions for PAL use would inherently permit spectrum warehousing in the Citizens Band. Because the proposed economic and hybrid definitions are based on monetary payments rather than actual use of PAL spectrum, they lack the ability to prevent potential spectrum warehousing in the Citizens Band, a result that runs counter to the Commission’s spectrum goals for this band.

William Lehr’s position paper, which is cited by the Commission for its discussion of the proposed economic definition, is interesting in theory but fails to provide any market simulations or other analysis to indicate how the methodology would work in practice.<sup>6</sup> Under Lehr’s economic

---

<sup>5</sup> See 2<sup>nd</sup> FNPRM, ¶ 425.

<sup>6</sup> See 2<sup>nd</sup> FNPRM, ¶ 425. In contrast, use of engineering principles to define spectrum use is at the foundation of numerous services authorized by the Commission.

“option to exclude” proposal, GAA use would be permitted in a given PAL until the option is exercised by the PAL licensee; thereafter, GAA use in the PAL spectrum would be excluded. This binary approach fails to account for the very real potential that PAL spectrum could be considered “unused” under certain technical conditions even after the PAL licensee becomes operationally active. As Federated Wireless has argued, for example, the propagation characteristics and high spatial reuse of Citizens Band spectrum permits uses within a building while affording protection to other co-channel uses outside of the building or in nearby buildings. Under economic-based definitions, technical/engineering mechanisms by which spectrum utilization could be further increased would not be available. Furthermore, Lehr’s proposal recognizes, but does not resolve, several implementation issues which could become significant problems, such as how exercise of an option could be “reversed,” how the options would be priced, and what impact, if any, auction prices have on PAL licensee behavior.<sup>7</sup>

In contrast, applying the proposed engineering definition will enable the Commission to monitor and address potential spectrum warehousing, and ensure unused PAL spectrum is efficiently made available for GAA use.<sup>8</sup> Under the engineering definition, the SASs, using data provided by the PAL licensee, would define a protection boundary, or protected service contour, around active PAL CBSDs. The SAS, in turn, would prohibit GAA user access to PAL spectrum where the corresponding interference threshold to the CBSDs in the protected boundary is

---

<sup>7</sup> Federated Wireless also is concerned that Lehr’s options framework is not fully distinguishable from a zero interest installment loan on the PAL license. The Commission’s authority is generally limited to the auctioning and licensing of spectrum, and does not extend to directly facilitating financial market-like trading of spectrum options. The C-Block PCS auction provides an example of a situation in which the Commission started with a goal of creating positive, economic incentives for licensees to acquire spectrum, but negative, unintended consequences resulted. *See, e.g., CBO Memorandum, Impending Defaults by Winning Bidders in the FCC’s C Block Auction: Issues and Options*, Congressional Budget Office (Sept. 1997), available at: <https://www.cbo.gov/sites/default/files/cblock.pdf>. The Commission should avoid direct involvement in more elaborate financial market transactions and leave those to secondary party-to-party transactions.

<sup>8</sup> *See* 2<sup>nd</sup> FNPRM, ¶ 420.

exceeded. Although there is no definitive Commission framework for assessing whether a network is truly operational and providing service, the functionality of the SAS, and the data it collects, would provide the Commission with an effective mechanism to identify and challenge claims of “use” that are effectively license savers. The CBSD data that is available to the SAS (*e.g.*, the density of CBSDs deployed by the PAL to serve a given area) and other data (*e.g.*, spectrum sensing data) would provide the Commission with an indication of which spectrum and network deployments constitute legitimate uses versus those intended merely to trigger SAS protections.

Furthermore, applying an engineering definition of use and an effective interference threshold will reduce the incentive for PAL licensees to deploy “license savers” in the first place. In the Citizens Band, a PAL licensee would not need to deploy “license saver” CBSDs to meet a construction milestone as licensees might in other bands. Apart from using “license savers” to warehouse spectrum, the sole motivation a PAL licensee would have to build “license saver” sites would be to provide additional interference protection for its deployments beyond the interference threshold. By implementing an engineering definition with an effective and flexible interference threshold, the Commission can ensure PAL licensees have adequate interference protection without the need to deploy license saver CBSDs.

Additionally, because the engineering definition is based on actual use of PAL spectrum, the definition is sufficiently flexible to evolve with the Citizens Band over time to prevent spectrum warehousing and ensure that PAL spectrum is managed efficiently. The engineering definition promotes increased spectrum utilization where the conditions of use permit it, such as GAA use of PAL spectrum within buildings when PAL protection criteria can be fully satisfied. This efficient use of spectrum in the Citizens Band is one of the Commission’s primary spectrum goals in this proceeding.

**B. Adopting an Engineering Definition is Consistent with the Role of the SAS, as Envisioned by the Commission, and is Technologically Feasible.**

**1. Adopting an Engineering Definition is Consistent with the Role of the SAS Envisioned by the Commission.**

Application of an engineering definition for PAL “use” that leverages the SAS to differentiate between used and unused PAL spectrum is consistent with the Commission’s goal of implementing the SAS as the lynchpin technology that will dynamically manage and enable all access to spectrum in the Citizens Band.<sup>9</sup> Moreover, consistent with the Commission’s goal of using the SAS to establish the Citizens Band as an “innovation band,”<sup>10</sup> use of a SAS-based engineering definition will facilitate greater flexibility and continued technical innovation in the band. For example, the aggregate interference protection threshold that the SAS would use to protect PAL spectrum that is in use would not necessarily need to remain fixed.<sup>11</sup> The definition could evolve with the Citizens Band as the number of users grows and technological innovation in the band continues.

The three-tier spectrum sharing framework adopted by the Commission for the band, together with deployment of SASs to manage spectrum use, was developed specifically to balance the priorities and needs of various user categories while accommodating flexible uses for spectrum, all while maximizing the overall efficient utilization of Citizens Band spectrum. The engineering

---

<sup>9</sup> See 3.5 GHz Order, ¶ 7.

<sup>10</sup> See 3.5 GHz Order, ¶ 2.

<sup>11</sup> As the Commission has observed, industry standards for acceptable interference rise over noise vary with technology and cell topology (*i.e.*, picocells versus femtocells) and other conditions. As an initial matter, the Commission could begin with the -80 dBm/10 MHz interference threshold and authorize a multi-stakeholder body to review and modify this threshold over time as use of the Citizens Band spectrum progresses. The threshold could be increased or decreased as the nature of dynamic SAS spectrum management evolves. Additionally, as a result of the capabilities and flexibility afforded by the SAS, license area-specific or region-specific criteria could be established, or the threshold could be based upon the anticipated or current demand for spectrum by GAA users. Federated Wireless does not suggest that the Commission apply this type of variability to the engineering definition of PAL “use” from the beginning, but these concepts illustrate the flexibility that the engineering definition can provide.

definition supported by Federated Wireless builds and expands upon these core Commission concepts.

**2. Adopting an Engineering Definition is Technologically Feasible.**

SASs are fully capable of establishing interference boundaries necessary to identify and protect PAL spectrum while it is in use, while also making unused PAL spectrum available for GAA use. As Google explains, SASs can be used to (1) enforce PAL licensee protection areas based on information such as the PAL device's location and technical characteristics; and (2) protect PAL devices from nearby GAA operations including the aggregate effect of multiple devices operating in the vicinity.<sup>12</sup>

SASs are highly automated, dynamic frequency coordinators that already will be used in the Citizens Band to protect the boundaries of PAL license areas from interference. Technologically, the process for protecting PAL spectrum that is in use within a smaller portion of a PAL license area is not much different and will be performed by the SAS without special modifications. The identification and management of unused PAL spectrum, by applying an engineering definition of "use," is merely another layer of spectrum management that SASs will perform.

**C. Adopting an Aggregate Interference Threshold of -80 dBm/10 MHz to Delineate When PAL Frequencies are in Use is a Good Starting Point; This Threshold Can Be Reviewed and Modified Periodically by a Multi-Stakeholder Body as Use of the Citizens Band Evolves.**

With respect to the specific metrics that should be used to implement an engineering definition of PAL "use," Federated Wireless urges the Commission to adopt an initial interference threshold for PAL licensees that can be reviewed and modified periodically by a multi-stakeholder body as the Citizens Band evolves. The multi-stakeholder body could conduct such review on an annual basis. Signal level reporting of PAL and GAA devices will provide the SAS with "spectrum

---

<sup>12</sup> Letter from Austin C. Schlick, Google, Inc., to Marlene H. Dortch, Secretary, FCC, GN Docket No. 12-354, Notice of Ex Parte, at 3 (Jan. 20, 2015).

sensing data” to assist the SAS in monitoring the interference threshold and making recommendations for changing the threshold over time.

**1. The Commission Should Adopt -80 dBm/10 MHz as the Initial Interference Threshold.**

Federated Wireless recommends the Commission adopt an initial interference threshold of -80 dBm/10 MHz – the same signal level that was adopted in the 3.5 GHz Order to protect the borders of PAL license areas from interference.<sup>13</sup> As noted above, the SAS functions required to protect the service contours of spectrum when it is in use by a PAL licensee is similar to the methodology required to protect neighboring PAL license areas at the census tract border. Federated Wireless believes that -80 dBm/10 MHz is a practical threshold for protection of the PAL service contour and is a useful starting point for defining when PAL spectrum is in use.

Using data provided by the licensee (or operator) of the PAL CBSD, the SAS would determine the protected service contour(s) for PAL CBSDs that are in use. For example, a GIS-based interface to the SAS could be used to depict the known location of PAL CBSDs and their associated service contours. The protected service contour then would be made available to the PAL licensee. A process would be established whereby the PAL licensee would provide additional engineering data to the SAS Administrator over time to demonstrate requested modifications to the protected service contour.

Once the service contours for the PAL CBSDs are established, GAA access to PAL spectrum would be authorized where the PAL spectrum is not in use, such that the aggregate interference at all locations within the PAL protected service contour would not exceed the -80

---

<sup>13</sup> See 3.5 GHz Order, ¶ 195. Although at ¶ 195 of the 3.5 GHz Order the Commission establishes a CBSD transmission limit or maximum signal level along the service (license) border, this signal level limit is in practice an interference protection threshold for PAL licensees. 47 C.F.R. § 96.41(d) clarifies this point, stating that CBSD transmissions for PAL and GAA users must be managed such that the aggregate received signal strength at the service area boundary of any co-channel PAL does not exceed -80 dBm per 10 MHz.

dBm/10 MHz interference threshold. Although the computational complexity of protecting individual CBSD signal contours can be managed within the SAS, Federated Wireless proposes that CBSDs that serve a contiguous area could be combined into a single signal contour.

To facilitate a common understanding of the spectrum that is in use by the PAL licensee, and where it is in use, the PAL protected service contour would be shared among multiple SASs through SAS-SAS synchronization protocols. This essentially would constitute a collection of points similar to the fixed exclusion zones protected by SASs for incumbent Federal land-based radar systems or Fixed Satellite Service systems. No special functionality would need to be developed by a SAS Administrator to manage these protected service contours. Exhibit A hereto provides figures from Federated Wireless's operational SAS illustrating the application of the proposed engineering definition in a PAL deployment scenario.

**2. Signal Level Reporting of PAL and GAA Devices Will Provide the SAS with “Spectrum Sensing Data” to Assist the SAS in Monitoring the Interference Threshold.**

Federated Wireless emphasizes the importance for PAL and GAA devices, including both CBSDs and End User Devices, to provide the SAS with spectrum sensing data upon initial operation and at regular intervals as directed by the SASs.<sup>14</sup> Sensing data will significantly improve the SAS functions for inter-tier and intra-tier spectrum management and for monitoring compliance to the engineering definition of spectrum use in the Citizens Band.<sup>15</sup> In a given PAL, the sensing

---

<sup>14</sup> 47 C.F.R. § 96.39(d) requires CBSD reporting of interference metrics for itself and associated end user devices. In ¶ 420 of the 3.5 GHz Order, the Commission encourages industry to develop detailed metrics regarding issues such as received signal strength, packet error rate, and technology specific parameters of signal and interference metrics. Given the critical role of interference reporting for management of both PAL and GAA frequencies, Federated Wireless encourages the Commission to monitor developments in this area.

<sup>15</sup> See 2<sup>nd</sup> FNPRM, ¶ 420; see also Comments of Federated Wireless, GN Docket No. 12-354, at 32 (Dec. 5, 2013) (“All PAL Infrastructure Nodes, GAA Infrastructure Nodes, PAL-UEs, and GAA-UEs will be capable of sensing power in the federal shared spectrum band. The rules for the 3.5 GHz Band to be established by the Commission need to make such Equipment Level Measurements (ELM) a requirement for every UE or Node that intends to operate using shared federal spectrum.”).

data received by the PAL from GAA devices would indicate whether aggregate interference levels exceed the interference threshold. Sensing data derived from neighboring PALs or nearby GAA users also would indicate the actual service contour for the relevant CBSDs, providing an indication of which CBSD deployments constitute legitimate uses versus those intended merely to trigger SAS protections.

**D. Allowing Vacant Channels to be Used as Guard Bands in the Citizens Band May be Needed Under Some Circumstances, and These Vacant Channels Also Can be Used for Localized Communications at Lower Powers or for Indoor Operations.**

In the 2<sup>nd</sup> FNPRM, the Commission asks whether vacant channels would ever be needed as guard bands in the Citizens Band given the technical rules adopted in the 3.5 GHz Order.<sup>16</sup> Depending on how the equipment ecosystem evolves in the Citizens Band, Federated Wireless believes there may be some scenarios in which guard bands, managed by SASs, could be needed.

Moreover, Federated Wireless notes that it may be necessary at times for the SAS to use combinations of geographic and frequency separation to satisfy the co-channel and adjacent channel protection criteria established in the 3.5 GHz Order.<sup>17</sup> This is particularly true when an operator – whether PAL or GAA – seeks to operate CBSDs near the maximum EIRP limits. Operators may elect to do this to improve deployment economics or address the practical limitations of a small cell network deployment (*e.g.*, to secure available CBSD mounting locations, backhaul, etc.). However, in cases where a vacant channel is used as a guard band for high or full power use, the vacant channel could be usable for localized communications at lower powers or for indoor operations.<sup>18</sup>

Federated Wireless confirms that such localized or indoor uses of the vacant channel would be technologically possible while still satisfying the PAL protection criteria adopted in the 3.5 GHz

---

<sup>16</sup> See 2<sup>nd</sup> FNPRM, ¶ 422.

<sup>17</sup> See, *e.g.*, 3.5 GHz Order, ¶ 184.

<sup>18</sup> See 2<sup>nd</sup> FNPRM, ¶ 422.

Order. As Federated Wireless has demonstrated previously,<sup>19</sup> the propagation characteristics of the Citizens Band can accommodate this type of spectrum reuse (*e.g.*, reuse among high power outdoor small cell systems and nearby indoor enterprise systems). Exhibit B provides examples to illustrate adjacent-channel protection requirements based on various deployment scenarios.

**E. Using a “Congestion Metric” and Advance Planning Will Ensure That Defining PAL “Use” Based on Aggregate Interference Does Not Result in Unfair Treatment and Coordination Problems for GAA Users.**

In the 2<sup>nd</sup> FNPRM, the Commission emphasizes that the prospect of basing the definition of PAL “use” on aggregate interference metrics raises “equitable and coordination challenges with respect to the GAA tier, and begs the question of which GAA user will be denied access when the aggregate threshold is exceeded.”<sup>20</sup> Federated Wireless notes that this issue is not isolated to the specific case of defining PAL “use” but relates more generally to PAL protection from GAA users in the Citizens Band. Regardless of whether the boundary for PAL protection is the service contour for the CBSDs operated by PAL licensees or the census tract border for the PAL, the aggregate interference contribution of multiple GAA users must be computed and managed by the SAS to provide interference protection for the PAL licensee.

In general, Federated Wireless anticipates a high degree of spectrum utilization among GAA users. In view of the lack of interference protection for the GAA tier, GAA users are likely to self-organize in a manner such that the general propagation characteristics of the Citizens Band are leveraged to isolate nearby users. For example, in-building deployments can occur at a very high density. The same spectrum could be assigned for GAA use in neighboring buildings, or even the same building, given the propagation loss characteristics of such uses. Therefore, the most likely

---

<sup>19</sup> See Letter from Kurt Schaubach, Federated Wireless, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 12-354, Notice of Ex Parte, at 3 (Feb. 3, 2015).

<sup>20</sup> 2<sup>nd</sup> FNPRM, ¶ 424.

scenarios for GAA congestion likely will arise when there is one or more outdoor uses by GAA users where higher power and more favorable propagation characteristics are present (*e.g.*, outdoor-outdoor and outdoor-indoor coordination).

One approach to ensure “fair” spectrum allocations among GAA users would be to use power throttling. To accommodate additional GAA users, the maximum power authorized for existing GAA users could be reduced by the SAS. This approach, however, would result in an uncertain and unpredictable operating environment for GAA users. GAA users will deploy if they can generally predict the level of service they can achieve; spotty, inconsistent coverage will not lead to investment in the Citizens Band. While the interference levels resulting from GAA users cannot be known in advance, systems can be designed and deployed using reasonable assumptions for the potential for interference.<sup>21</sup> That is, some interference margin can be applied in the system planning process. However, the potential variability for both the level of interference, and the maximum available EIRP for operation, for a GAA user creates too much variability to plan a system reliably.

Therefore, a preferred alternative approach is to expand upon the “congestion metric” proposed by the Commission in the 3.5 GHz Order.<sup>22</sup> This metric would be used to define the conditions to which the SAS will manage GAA uses to ensure a consistent level of service can be achieved as congestion occurs. One potential approach would be to establish an assured EIRP target for GAA operation in anticipated high-demand areas. GAA users would still be permitted to operate above the assured target, up to the maximum allowed EIRP, but such use would be subject

---

<sup>21</sup> Interference margins are commonly applied in the design of Wi-Fi systems, where a priori knowledge of interference levels from other Wi-Fi users is not available. *See, e.g.*, High-Density Wi-Fi Design Principles, Aerohive Networks, White Paper, *available at*: <https://www.aerohive.com/pdfs/Aerohive-Whitepaper-Hi-Density%20Principles.pdf>.

<sup>22</sup> *See* 3.5 GHz Order, ¶ 214.

to the congestion level and other factors.<sup>23</sup> Some pre-planning of the congestion metric and associated SAS management methodology would be needed early on. For example, census tracts could be categorized, beyond the urban/rural distinction, according to anticipated congestion level, thereby creating a common framework for multiple SASs to manage the allocation of spectrum resources for GAA users.

Given the complexity of this proposed approach and the need for SAS-to-SAS coordination, Federated Wireless recommends that the precise definition of the GAA congestion metric be left open for a multi-stakeholder organization to standardize. Although this approach would not completely ensure that every GAA user could be accommodated under all circumstances, it would create an environment in which multiple, dense uses of Citizens Band spectrum among GAA users can occur.

As a further measure, technologies that employ contention-based protocols or other mechanisms to enable coexistence can help to accommodate equitable use of the Citizens Band by GAA users. While these technologies, such as LTE-U with Carrier Sensing Adaptive Transmission or LTE-U with a Listen Before Talk (“LBT”) feature, are not explicitly required for GAA use, they would nonetheless provide additional mechanisms for sharing spectrum when disparate uses are very dense.<sup>24</sup>

---

<sup>23</sup> This concept of GAA management is a form of admission control. Admission control techniques, including those that employ soft degradation, have been widely used to manage resource allocation in telephony, IP, and mobile wireless networks. Refinements to this concept, or alternative concepts, will be derived from the studies and research conducted on admission control.

<sup>24</sup> LTE-U technologies are fully compatible with SAS operation. In particular, LTE-U with LBT would enhance SAS operation as it would provide granular, *i.e.*, detailed spatial and temporal, sensing data that the SAS could use to produce a radio environment map of high fidelity. Alternatively, LTE-U spectral efficiency can be improved through synchronization with the SAS, as the frequency and interference coordination functions of the SAS will enable the contention based protocols of LTE-U to perform more efficiently. Finally, Federated Wireless notes that LTE-U alone cannot provide sufficient interference management in the Citizens Band. Incumbent protection and inter-tier interference management, among other mandatory functions, will still reside with the SAS. For example, 47 C.F.R. § 96.35(e) authorizes the SAS to manage

## II. THE COMMISSION SHOULD PERMIT STREAMLINED AND FLEXIBLE SECONDARY USE OF PAL SPECTRUM WITHOUT APPLYING EXISTING SECONDARY MARKETS RULES.

Federated Wireless agrees with the Commission that permitting secondary use of PAL spectrum will increase flexibility and provide an important mechanism to match spectrum supply and demand in the Citizens Band.<sup>25</sup> However, streamlined and flexible secondary use of PAL spectrum should be permitted in the Citizens Band without applying the Commission’s Secondary Markets Rules.<sup>26</sup>

Unlike other spectrum bands for which licensees must obtain prior Commission approval of Secondary Markets use of exclusively licensed spectrum, the Citizens Band is “licensed by rule” for GAA use throughout the band.<sup>27</sup> Given that any GAA user can access and share PAL spectrum when it is unused, filing for and receiving a traditional Commission authorization for a lease right for certain PAL spectrum is of little utility. Any number of entities could ultimately use the “leased” PAL spectrum on a GAA basis, bringing into question the value of a Secondary Markets lease itself.

In contrast with spectrum bands where frequencies are exclusively licensed by one licensee at a time regardless of whether the frequencies are in “use” or not, permitting secondary use of PAL spectrum does not warrant formal Commission approval any more than does opportunistic GAA use of PAL spectrum, which is permitted without prior Commission approval. Instead, all that is needed is a framework to ensure that PAL licensees are Commission-certified, PAL licensees consent to any secondary use of their spectrum, and SAS Administrators are notified of such use.

---

technical parameters for CBSDs operated as GAA to minimize the potential to cause and receive interference.

<sup>25</sup> See FNPRM, ¶ 431.

<sup>26</sup> See 47 C.F.R. §§ 1.9001-1.9080.

<sup>27</sup> See 3.5 GHz Order, ¶ 4.

SASs are fully equipped to keep track of, and manage, third-party use of PAL spectrum without interfacing with the Commission.

To this end, the Commission should (A) adopt a more streamlined and flexible framework for third parties to use PAL spectrum without applying the Commission’s existing Secondary Markets Rules; (B) authorize a “use it or share it” framework to enable spectrum use by building owners and other Contained Access Facilities (“CAFs”); (C) not authorize the use of “spectrum exchanges” for secondary use of PAL spectrum; (D) prohibit partitioning and disaggregation of PALs; and (E) not count PAL spectrum toward spectrum aggregation limits.

**A. The Commission Should Adopt a More Streamlined and Flexible Framework for Third Parties to Use PAL Spectrum; Existing Secondary Markets Rules are Not a Proportional Solution.**

Permitting third parties to use PAL spectrum is critical to ensuring that PAL spectrum, and the interference protection afforded to it, can be made available to entities that are unable to acquire PALs through competitive bidding, but nevertheless need the interference protection that PAL spectrum provides. For example, owners of CAFs or other buildings, and entities that only need access to PAL spectrum for short periods of time (*e.g.*, for a special event) do not need access to PAL spectrum for an entire census tract or an entire term. For these entities, having assured use of PAL spectrum in an organized and non-opportunistic manner makes sense. However, a traditional Secondary Markets approach is not a proportional or appropriate solution. Instead, the Commission should authorize a certification and notice process. The SAS functionality envisioned by the Commission will enable streamlined and flexible use of PAL spectrum, including facilitating third-party use rights.

**1. A Traditional Secondary Markets Approach Is Not a Proportional Solution.**

The Commission’s existing Secondary Markets Rules are not appropriately tailored for the secondary use of PAL spectrum, and a more streamlined and flexible approach is needed. Under

the Commission's existing Secondary Markets Rules, entities seeking secondary access to PAL spectrum would be required to engage in a process that can take in excess of 90-120 days to negotiate a formal lease that complies with Commissions rules, and then to prepare and file applications or notices for Commission approval of the Secondary Markets lease. Requiring entities in the Citizens Band to go through this lengthy process would be unreasonable and inefficient given that PALs only have a three-year license term without renewals, and, as the Commission notes, an entity's need for secondary use of PAL spectrum may be particularly short-term.<sup>28</sup>

Additionally, given that the size of each PAL is limited to an individual census tract, requiring a lengthy traditional leasing process for each individual census tract, or a portion of a given tract, would be unworkable. If an entity needs access to PAL spectrum for several census tracts, it could take months to work through the process with several different PAL licensees. This would pose unreasonable and inefficient hurdles to short-term use of PAL spectrum.

## **2. A Certification and Notice Process is the Right Solution to Enable Streamlined and Flexible Use of PAL Spectrum.**

In order to provide the flexibility and streamlined process needed to facilitate the secondary use of PAL spectrum, Federated Wireless agrees with the Wireless Internet Service Providers Association ("WISPA") and Spectrum Bridge that prior Commission approval of secondary use of PAL spectrum should not be required.<sup>29</sup> Instead, Federated Wireless urges the Commission to

---

<sup>28</sup> See 3.5 GHz Order, ¶ 105 (establishing three-year terms for PALs); see also 2<sup>nd</sup> FNPRM, ¶ 432 (noting AT&T's comments that PAL use by be short term for purposes such as coverage for a large event).

<sup>29</sup> See WISPA Comments, GN Docket No. 12-354, at 15 (Dec. 5, 2013) ("Given the absence of build-out rules and the streamlined auction process the Commission envisions, WISPA believes that prior Commission approval of such secondary market transactions would not be necessary – especially given that there could be multiple transactions in each of the 74,000 census tracts – and that PAL holders can notify the Commission so that the transaction is recorded in the Commission's database and the SAS."); Comments of Spectrum Bridge, Inc., GN Docket No. 12-354 (July 14, 2014) at 8 ("An effective secondary market will not be successfully in the 3.5-3.7 GHz band if transactions are impeded by the existing Section 310(d) rules. The Section 310(d) review process is lengthy (months) and complex (typically requires legal counsel) and transfers are subject to Commission approval, which requires significant cost. To attain efficiency, secondary markets

establish a PAL user certification process under which an entity could apply to the Commission to be certified once as eligible to formally use (as opposed to opportunistically use) PAL spectrum. Thereafter, the certified user would be free to use PAL spectrum nationwide as long as (1) the certified user obtains the PAL licensee's consent; and (2) the certified user provides notice of its use of the PAL spectrum to the SAS Administrator. A standardized electronic certification process could be established so that PAL licensees can provide users with electronic consent, perhaps with a secure verification key or certificate, and the user can then submit the electronic consent and verification key to the SAS.<sup>30</sup>

Enabling secondary use of PAL spectrum will be managed easily by the SAS and will not present any extra computational complexity. The SAS Administrator can collect information about the certified user, register the CBSDs, and register the boundary to be protected from interference if the boundary of the PAL spectrum used by the certified user does not align with the census tract boundary. Additionally, if the Commission needs to contact a certified user for any reason, the SAS Administrator could promptly identify the user, and the Commission already will have the contact information because of its certification process.

Federated Wireless believes this approach is consistent with the Commission's desire to reduce transaction costs and allow increased automation of the secondary use of PAL spectrum.<sup>31</sup> It also will, in keeping with the Commission's 3.5 GHz philosophy, empower SAS Administrators to dynamically, and in real time, provide cooperative mechanisms for PAL licensees to efficiently make PAL spectrum available to other users. Through the collection of basic CBSD and boundary

---

transactions in this band . . . should be conducted and executed entirely between the two interested parties, without the need for legal counsel or FCC approval.”).

<sup>30</sup> The electronic certification process could be defined and standardized, together with other security-related initiatives that are already under consideration in the Wireless Innovation Forum.

<sup>31</sup> See 2<sup>nd</sup> FNPRM, ¶ 434.

information from the certified user, and with certification by the Commission and the consent of the PAL licensee, the SAS Administrator will be able to authorize a third party to gain access to spectrum that suits its particular needs – in time and geography – without unnecessarily entering into complex individual spectrum leasing arrangements pursuant to Commission rules, or engaging in filing time-consuming Secondary Markets applications.

**3. SAS Functionality Envisioned by the Commission Will Enable Streamlined and Flexible Use of PAL Spectrum.**

The functionality envisioned for the SAS in the 3.5 GHz Order, and the current work within the Wireless Innovation Forum standards body, confirm that an SAS should fully support and enable streamlined and flexible secondary use of PAL spectrum. Analogous to the scenario presented above for managing the service area of the primary PAL, the same engineering definition and spectrum management methodology is extensible to this secondary use of spectrum. While the SAS will need to perform additional computations, such as to provide interference protection for secondary use of PAL spectrum by certified third parties, these additional computations are well within the capability of a cloud-based SAS platform.

**B. The Commission Should Authorize a “Use It or Share It” Framework to Enable PAL Use by Building Owners and Other CAFs.**

In order to provide adequate spectrum capacity, it is necessary for facilities above a certain size to have assured access to licensed spectrum that is protected from interference. In the 3.5 GHz Order, the Commission declined to adopt its initial proposal to allow CAFs to request a certain amount of reserved frequencies from the GAA pool for use within their facilities.<sup>32</sup> Nevertheless, building owners and other CAFs, including commercial buildings, still need assured access to PAL spectrum, with interference protection that will allow QoS guarantees, in their facilities.

To this end, the Commission should consider implementation of a “use it or share it”

---

<sup>32</sup> See 3.5 GHz Order, ¶ 164.

framework for secondary use of PAL spectrum. Under this approach, if a PAL licensee has held its license for six (6) months or more, a building owner in the PAL licensee's census tract could notify the PAL licensee if its in-building broadband capacity is insufficient. Upon such request, the PAL licensee would have thirty (30) business days to notify the building owner that it will either deploy service in the building or provide a use right for the PAL spectrum. Depending on the election, if the PAL licensee has not deployed service in that building within six (6) months, or has not entered into a use arrangement with the building owner within two (2) months, then the PAL licensee would be required to share its PAL spectrum with the building owner. The building owner would need to file for PAL certification from the Commission and, after it is granted, provide written notice of its intended use to the PAL licensee and the SAS Administrator. Thereafter, the building owner would be permitted to use the PAL spectrum for purposes of deploying reliable in-building service with interference protection. The SAS Administrator then would create a boundary around the building, providing it with PAL protection. This protection would be maintained for the term of the license for the underlying PAL licensee.

This proposed "use it or share it" model is similar to the mechanism adopted by the Commission to bring service to "unserved areas" in the Cellular Service by initially giving licensees a specific time period to provide service in a Cellular Market Area ("CMA"), and then licensing unserved areas within the CMAs to other parties after the licensees' initial window to provide coverage had expired.<sup>33</sup> Implementing the proposed "use it or share it" model in the Citizens Band

---

<sup>33</sup> Initially, with respect to the Cellular Service, the Commission issued a single cellular license for each CMA and channel block. The licensee of the initial license was provided a five-year period to provide cellular coverage within the CMA. After the five-year period ended, the areas not covered with cellular service reverted back to the Commission for licensing to additional parties. The Commission then established a two-phase licensing approach for areas that reverted back to the Commission. Phase I was a one-time process that started as soon as the initial five-year period ended and allowed parties to file an application to operate a new cellular system or expand an existing cellular system. Phase II rules allow applications to be filed at any time. Under 47 C.F.R. § 22.911, an Unserved Area is defined as an "area outside of all existing Cellular Geographic Service Areas ("CGSA") on either of the channel blocks." A CGSA is the composite of the service areas of all of the cells in the system, excluding any Unserved Areas or area within the CGSA of

will ensure that facilities have sufficient in-building access to licensed, protected spectrum where needed.

**C. The Commission Should Not Authorize the Use of “Spectrum Exchanges” for Secondary Use of PAL Spectrum.**

The Commission and a number of commenters have noted that “spectrum exchanges” could facilitate a secondary market for PAL rights.<sup>34</sup> Spectrum exchanges should not be authorized because they would serve functions that already are authorized to be provided by a certified SAS Administrator, and would add unnecessary complexity to the framework for the Citizens Band.

Cantor Telecom Service, L.P. (“Cantor”), for example, proposes a spectrum exchange managed by an independent third party that would integrate SAS functions in order to provide market participants with use right information and to resolve interference issues.<sup>35</sup> The Commission further notes that a spectrum exchange could “improve the ability of individual licensees to obtain micro-targeted (in geography, time, and bandwidth) access to priority spectrum rights narrowly tailored to their needs on a highly customizable, fluid basis.”<sup>36</sup> As already explained in Section II(A) above, however, the SAS Administrator will perform these functions. As InterDigital, Inc. notes, the SAS can effectively function as the spectrum exchange and manage secondary uses.<sup>37</sup> Adding a third party to manage a separate spectrum exchange would only add unnecessary complexity to

---

another cellular system. Under 47 C.F.R. § 22.949, applicants for authority to operate a new cellular system or expand an existing CGSA in an Unserved Area must propose a CGSA or CGSA expansion of at least 50 contiguous square miles. There is no limit to the number of Unserved Area applicants that may be granted on each channel block of each CMA. Therefore, Unserved Area applications are mutually exclusive only if the proposed CGSAs would overlap.

<sup>34</sup> See 2<sup>nd</sup> FNPRM, ¶ 433.

<sup>35</sup> See generally Comments of Cantor Telecom Services, Inc., GN Docket No. 12-354 (July 14, 2014).

<sup>36</sup> 2<sup>nd</sup> FNPRM, ¶ 433.

<sup>37</sup> See Comments of InterDigital, Inc., GN Docket No. 12-354, at 22 (July 8, 2014) (“The SAS could even act as a spectrum exchange to deal with the secondary markets, suggested by the Commission.”).

secondary use of PAL spectrum.

Moreover, Cantor’s proposal that a spectrum exchange could integrate certain SAS functions is problematic. The notion that a spectrum exchange might perform any of the functions already performed by the SAS is fundamentally inconsistent with the Citizens Band paradigm, established in the 3.5 GHz Order, in which SAS standards are developed and SASs are certified by the Commission to manage all access to spectrum in the Citizens Band. Spectrum exchanges are not needed, were not contemplated, and would needlessly complicate the SAS management and allocation of Citizens Band spectrum.

Furthermore, only a fully functional SAS would have sufficient knowledge of the radio environment and spectrum utilization to confirm whether a proposed transaction and the associated technical parameters meet the conditions necessary to operate. A spectrum exchange would not be able to provide a reasonable guarantee that the spectrum to be acquired for use truly meets the intended service requirements (*e.g.*, coverage, capacity throughput, performance, etc.).

Finally, there also are questions about privacy protections and security, including the risk of a spectrum exchange exposing information outside of the SAS. Unlike SASs, the proposed spectrum exchanges would not be certified to securely handle SAS data.<sup>38</sup>

**D. The Commission Should Prohibit Partitioning and Disaggregation of PAL Spectrum.**

Federated Wireless agrees with the Commission that it should prohibit further segmentation

---

<sup>38</sup> See 3.5 GHz Order, ¶¶ 345-346 (“After review of the record, we [the Commission] adopt our proposal to require secure and reliable communications among and between CBSDs and SASs. We will also require SASs to protect themselves from unauthorized data input or alteration of stored data. Secure and reliable communication pathways between SASs and CBSDs and between different SASs are essential for the success of the Citizens Broadband Radio Service. Due to the nature of the Citizens Broadband Radio Service, sensitive information relating to network configuration and operations will be routinely sent between CBSDs and SASs. This information must be protected from interception or modification – during transmission and while stored in an SAS - to ensure that the proprietary and confidential information provided by licensees is not compromised. . . . [W]e require potential SAS Administrators to develop and demonstrate that their systems include robust communications and information security features during the SAS Approval process.”).

of PALs through partitioning and disaggregation given the relatively small size of PALs (census tracts) and PALs' limited three-year license terms.<sup>39</sup> Partitioning and disaggregation of PALs would prove both administratively burdensome and unnecessary.

As a general concept, providing flexible licensing mechanisms can be valuable but, in the Citizens Band, PAL licenses are no more than 10 MHz blocks. Disaggregation of PALs into smaller spectrum blocks likely would not be useful.<sup>40</sup> Partitioning also is unnecessary because a SAS can create whatever boundaries are desired by a PAL licensee or a secondary user without Commission intervention.

Further, pursuant to the Commission's existing rules, each time parties wish to disaggregate or partition spectrum, they must first apply for, and obtain from the Commission, authorization for partial assignment of a license.<sup>41</sup> With respect to the Citizens Band, this would result in lengthy application processes and significant administrative burden for the Commission, and would only inhibit the streamlined and flexible secondary use of spectrum proposed by Federated Wireless in Section II(A) above. Together, the allocation of PAL and GAA spectrum, enabling easy third party use of PAL spectrum, and the "use it or share it" mechanism proposed by Federated Wireless to provide needed capacity to CAFs will be sufficient to ensure that spectrum in the Citizens Band will be used efficiently and made available to those who need it. Additional mechanisms to disaggregate or partition PAL spectrum would add little value.

---

<sup>39</sup> See 2<sup>nd</sup> FNPRM, ¶ 434.

<sup>40</sup> Channel bandwidths of less than 10 MHz are generally not useful for mobile broadband, the primary application envisaged for the Citizens Band. Federated Wireless recognizes that other applications, such as the Internet of Things ("IoT"), may take hold in the band. In general, IoT applications will not require broadband data rates, but such applications are far more likely to use the Citizens Band on an opportunistic GAA basis, than through use of a PAL license that has been disaggregated for this specific use.

<sup>41</sup> See 47 C.F.R. §§ 1.948, 27.15.

**E. The Commission Should Not Count PAL Spectrum Toward the Commission’s Spectrum Aggregation Limits.**

Federated Wireless urges the Commission not to count PAL spectrum toward its spectrum aggregation limits. By its nature, PAL spectrum likely will not be used full-time by a PAL licensee and, when not in use, will be dynamically shared with GAA users.<sup>42</sup> Accordingly, it would not be equitable to count a PAL licensee’s entire PAL spectrum toward the aggregation limits. If the Commission were to count PALs toward the aggregation limits, the Commission would need to establish a threshold of how much “use” of a PAL license is enough to count the spectrum toward the aggregation limit. Establishing such a threshold and monitoring PAL licensees’ use of spectrum to determine when that threshold is met on a continuous basis would be difficult, complex, and administratively burdensome for the Commission.

Furthermore, not counting PAL spectrum toward the Commission’s spectrum aggregation limits will facilitate a more streamlined process for secondary use of PAL spectrum because it will not require an evaluation of the aggregation limits each time PAL spectrum is used by a third party. In contrast, if PAL spectrum is counted toward the aggregation limits, it would be necessary for the Commission to analyze the spectrum aggregation limits for each secondary use of PAL spectrum, resulting in the delays associated with requiring prior Commission Secondary Markets approval discussed in Section II(A) above. This outcome would undermine the efficient use of PAL spectrum.

**III. CONCLUSION.**

Federated Wireless commends the Commission’s work and dedication to create the Citizens Broadband Radio Service. Federated Wireless is committed to working with the Commission and other industry stakeholders to ensure that the Citizens Band serves as a true “innovation band.” To

---

<sup>42</sup> See 3.5 GHz Order, ¶ 72 (permitting opportunistic access to unused PAL spectrum by GAA users).

this end, and for the reasons discussed above, Federated Wireless believes the Commission should:

(1) apply an engineering methodology to define when PAL spectrum is not in use so that the spectrum can be made available to others for use; and (2) permit streamlined and flexible secondary use of PAL spectrum without applying existing Secondary Markets Rules, in order to encourage timely and efficient use of the spectrum. By adopting the proposals discussed herein, the Commission can build on the foundation established in the 3.5 GHz Order and ensure that spectrum in the Citizens Band is managed and used as intensively and efficiently as the Commission envisions.

Respectfully submitted,

\_\_\_\_\_/s/\_\_\_\_\_  
Kurt Schaubach, CTO  
Federated Wireless, Inc.  
4301 North Fairfax Drive, Suite 301  
Arlington, VA 22203  
(703) 650-0585

July 15, 2015

# EXHIBIT A

## Exhibit A

### Proposed Engineering Definition of “Use”

#### 1. Background

In the 3.5 GHz Order, the Federal Communications Commission (“FCC”) determined that allowing opportunistic access to unused PAL spectrum would maximize the flexibility and utility of the 3.5 GHz Band (“Citizens Band”) for the widest range of potential users. When PAL rights have not been issued or the spectrum is not actually in use by a PAL licensee, the SAS will automatically make that spectrum available for GAA use. The FCC termed this form of opportunistic sharing of unused PAL spectrum by GAA users “use it or share it”.

In the 3.5 GHz Order, the FCC noted broad support for the “use it or share it” rule, but no consensus regarding the specific implementation of the rule. In the 2<sup>nd</sup> FNPRM, the FCC seeks comment on options for defining “use” by PAL licensees.

#### 2. Engineering Definition of Use

In the 2<sup>nd</sup> FNPRM, the FCC seeks comment on whether it should adopt an engineering, economic or hybrid engineering-economic definition of use. Federated Wireless recommends that the FCC adopt an engineering definition of when PAL spectrum is in “use” based on the following observations:

*It is consistent with the role of the Spectrum Access System (SAS).* As the FCC noted in the 3.5 GHz Order, the engineering definition of use leverages the SAS to both define a boundary delineating the spectrum in use by the PAL, and protect PAL CBSDs from nearby GAA operations.

*It is technologically feasible.* Protecting the service area of PAL devices and managing unused PAL spectrum can be performed by the SAS without special modifications.

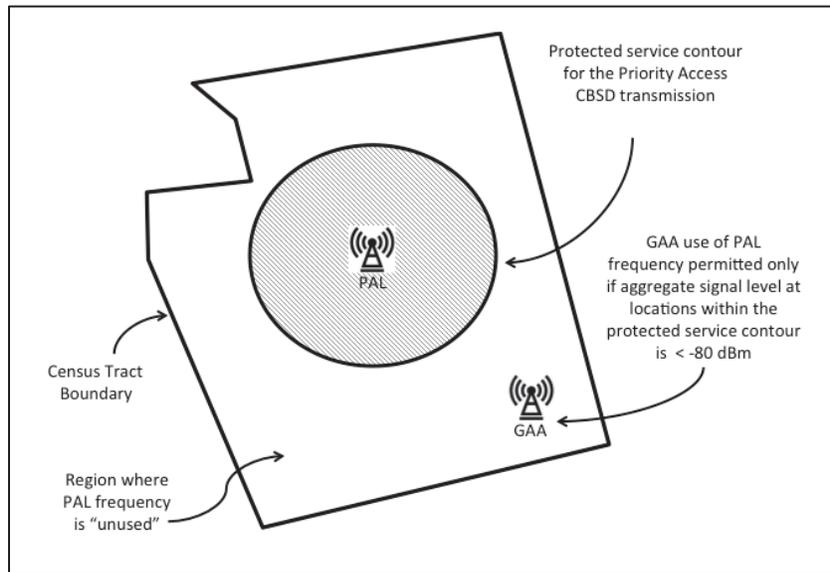
*It increases spectrum utilization.* Use of the SAS to identify and manage unused spectrum prevents outright spectrum warehousing or deployment of sites whose purpose is to occupy otherwise unused PAL spectrum.

*It encourages technological innovation.* Once the engineering-based analysis method to determine use is established, the specific metrics or criteria used in the analysis are easily adjusted. These metrics can thereby be adjusted to reflect improvements in technology (e.g., technologies that can tolerate a higher level of interference) or changes in the spectrum environment (e.g., increased congestion).

The proposed engineering definition and implementation of PAL “use” is as follows:

- Using data provided by the PAL licensee or operator of the PAL CBSDs, the SAS would determine the protected service contour(s) for PAL CBSDs that are in use. Each CBSD may have an individual contour or a dense deployment of multiple CBSDs may be treated as one contour if the area served is contiguous.<sup>1</sup>
- The protected service contour used by the SAS to designate spectrum that is in use by the PAL licensee would be made available to the PAL licensee for its review and approval.
- A process would be established whereby the PAL licensee would provide additional engineering data to the SAS Administrator to demonstrate requested modifications to the protected service contour.
- To facilitate a common understanding of the spectrum that is in use by the PAL licensee, and where that spectrum is in use, the PAL protected service contour would be shared among multiple SASs through SAS-SAS synchronization protocols.
- Protection of a PAL protected service contour is based on threshold of -80 dBm per 10 MHz.
- GAA access to PAL spectrum would be authorized where the PAL spectrum is not in use, such that the aggregate interference at all locations within the PAL protected service contour would not exceed the -80 dBm per 10 MHz interference threshold.

Figure 1 below depicts the proposed engineering definition.



**Figure 1. Depiction of Proposed Engineering Definition of Use**

<sup>1</sup> For consistency, the data and methods employed to determine the protected service could be developed by a multi-stakeholder group.

### 3. Illustrative Example Using the Federated Wireless SAS

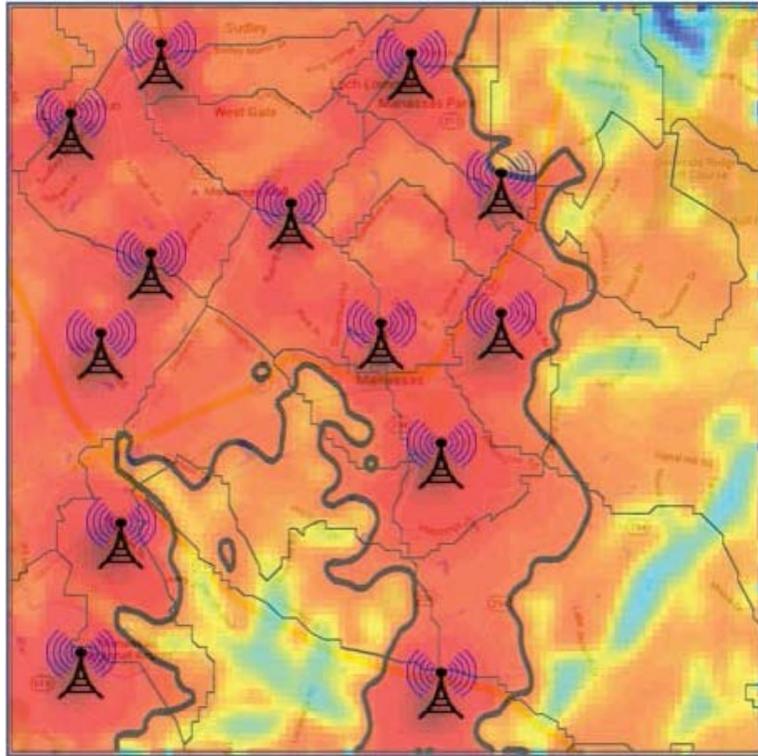
The Federated Wireless SAS is used to illustrate the application of the engineering definition of use in a practical PAL/GAA deployment scenario.

A representative 3.5 GHz band small cell deployment covering Manassas, VA, is depicted in Figure 2 below. The map represents a 10 km x 10 km region for Manassas City and the surrounding areas. The thick blue lines on the map depict the census tract borders (or PAL license boundaries). In this case, the PAL licensee holds licenses covering contiguous census tracts, so the coverage of the sites can span across the PAL boundaries.



Figure 2. Representative PAL licensee deployment in Manassas, VA, covering contiguous PAL census tracts.

The RF signal coverage for the representative PAL deployment is depicted in Figure 3 below. The average CBSD coverage range is 300 – 400 meters. The 13 CBSD locations comprise a contiguous protected service area, shown as the thick grey line. For illustration, the protected service area for the Priority Access Licensee deployment is determined based on a CBSD (forward link) received signal level of -80 dBm.



**Figure 3. Protected service contour for PAL licensee deployment in Manassas, VA, covering contiguous PAL census tracts.**

In Figure 4 below, a GAA user attempts access to unused PAL frequencies. As shown, a GAA CBSD is located in an area outside of the protected service contour for the PAL licensee. As a visual aid, a signal contour of -80 dBm for the GAA user CBSD is depicted as the thick blue line.

To determine whether the GAA can be granted access, the SAS computes the signal attributed to the proposed GAA CBSD at locations contained *within* the protected service contour of the Priority Access licensee. As the visual aid suggests, however, transmissions for the GAA CBSD will be managed such that the -80 dBm interference protection threshold is satisfied. In this example, the GAA user is granted access to unused PAL frequencies.

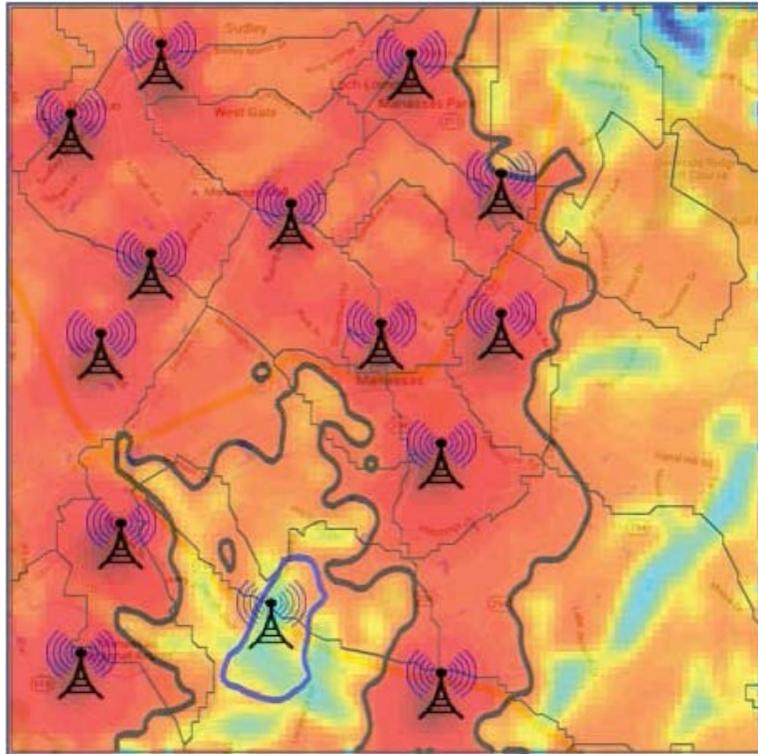
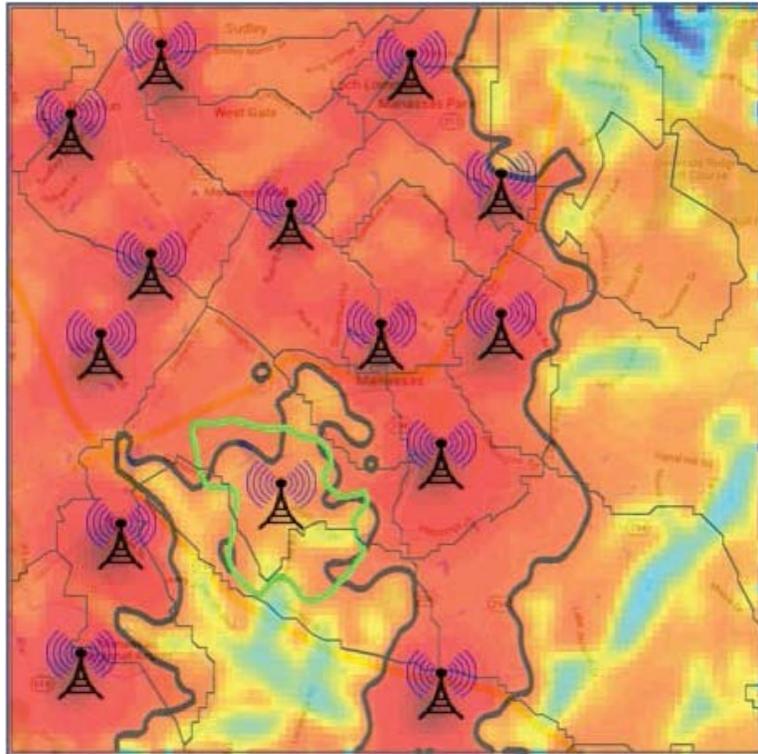


Figure 4. GAA granted access to unused PAL frequencies (interference threshold is satisfied).

In Figure 5 below, a GAA user attempts access to unused PAL frequencies. The GAA CBSD is situated outside of the protected service contour for the PAL licensee. As a visual aid, a signal contour of -80 dBm for the GAA user CBSD is depicted as the thick green line.

As the visual aid suggests, however, transmissions for the GAA CBSD will result in a signal level in excess of -80 dBm within the protected service contour of the PAL licensee. This is illustrated as the area overlapping the GAA CBSD contour and protected service contour of the PAL licensee. In this example, the GAA user is denied access to unused PAL frequencies.



**Figure 5. GAA denied access to unused PAL frequencies (interference threshold is exceeded).**

## **EXHIBIT B**

## Exhibit B

### Adjacent Channel Protection Requirements for 3.5 GHz Band Operations

#### 1. Overview

In the 2nd FNPRM, the Federal Communications Commission (“FCC”) asks whether vacant channels would ever be needed as guard bands in the 3.5 GHz Citizens Broadband Radio Service (“Citizens Band”) given the technical rules adopted in the 3.5 GHz Order. As demonstrated herein, and depending on how the equipment ecosystem evolves in the Citizens Band, there may be some scenarios in which guard bands, managed by SASs, would be needed.

Using LTE as a candidate technology for the Citizens Band, a study of adjacent channel protection requirements is conducted for various deployment scenarios. It is demonstrated that there are some scenarios where the SAS has to avoid allocating two adjacent channels to PAL and/or GAA users that are operating in close proximity, and consider at least one vacant channel among the assigned channels.

#### 2. Background

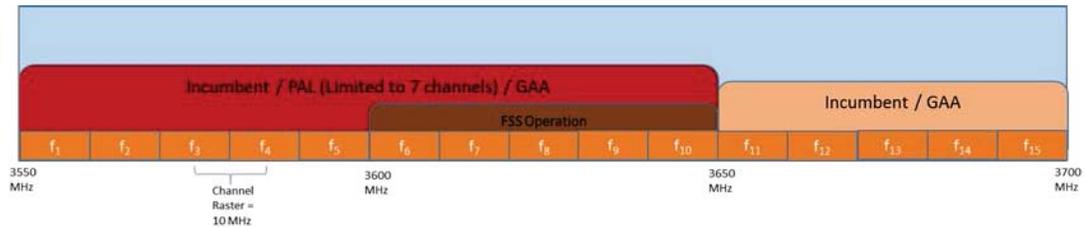
In the 3.5 GHz Order, the FCC declined to establish a bandplan for 3.5 GHz, but instead suggested that industry work toward agreement on a common bandplan. The FCC, however, observed in the 3.5 GHz Order that a bandplan similar to the one shown in Figure 1 below could promote efficient use of the band and simplify coordination between SAS Administrators.



Figure 1. FCC representative bandplan.

Building on the FCC’s observation, a potential bandplan for 3.5 GHz is depicted in Figure 2, where the entire 150 MHz band is simply divided into 15 consecutive channels, each having a 10 MHz bandwidth, and with no gap among the adjacent channels. While industry may ultimately agree upon a different bandplan for 3.5 GHz, the simplified plan shown in Figure 2 will be applied in our analysis.

The issue addressed herein is whether two adjacent channels could be allocated to two independent entities (either PALs or GAA users) without causing harmful adjacent channel interference. The main consideration is the potential interference impact of out-of-band emissions from a transmitter operating on one channel to a receiver operating on the adjacent channel.



**Figure 2. Simplified bandplan.**

To this end, we assume the two adjacent channels depicted in Figure 2, (say  $f_1$  and  $f_2$ ) are of interest. There are then several deployment scenarios to examine the impact of adjacent channel operations for channels  $f_1$  and  $f_2$ , which are depicted in Figure 3.

- A. The two channels are allocated to the same PAL operator (Fig. 3.a).
- B. The two channels are allocated to two PALs (or a PAL and GAA user) operating in two adjacent Census Tracts, with a geographical gap among them (Fig 3.b).
- C. Both  $f_1$ , and  $f_2$  are allocated to a PAL, and  $f_2$  is allocated to another PAL (or GAA user) operating in two adjacent Census Tracts, with a geographical gap among them (Fig 3.c).
- D. The two channels allocated to two PALs (or a PAL and GAA user) operating in two adjacent Census Tracts, without a geographical gap among them (Fig 3.d).
- E. Both  $f_1$ , and  $f_2$  are allocated to a PAL, and  $f_2$  is allocated to another PAL (or GAA user) operating in two adjacent Census Tracts, without a geographical gap among them (Fig 3.e).
- F. The two channels are allocated to two different service areas operated by two different entities (e.g. operators) within the same Census Tracts, without overlapped geographical area (Fig. 3.f).
- G. The two channels are allocated to two different service areas operated by two different entities (e.g. operators) within the same Census Tracts, with overlapped geographical area (Fig. 3.g).

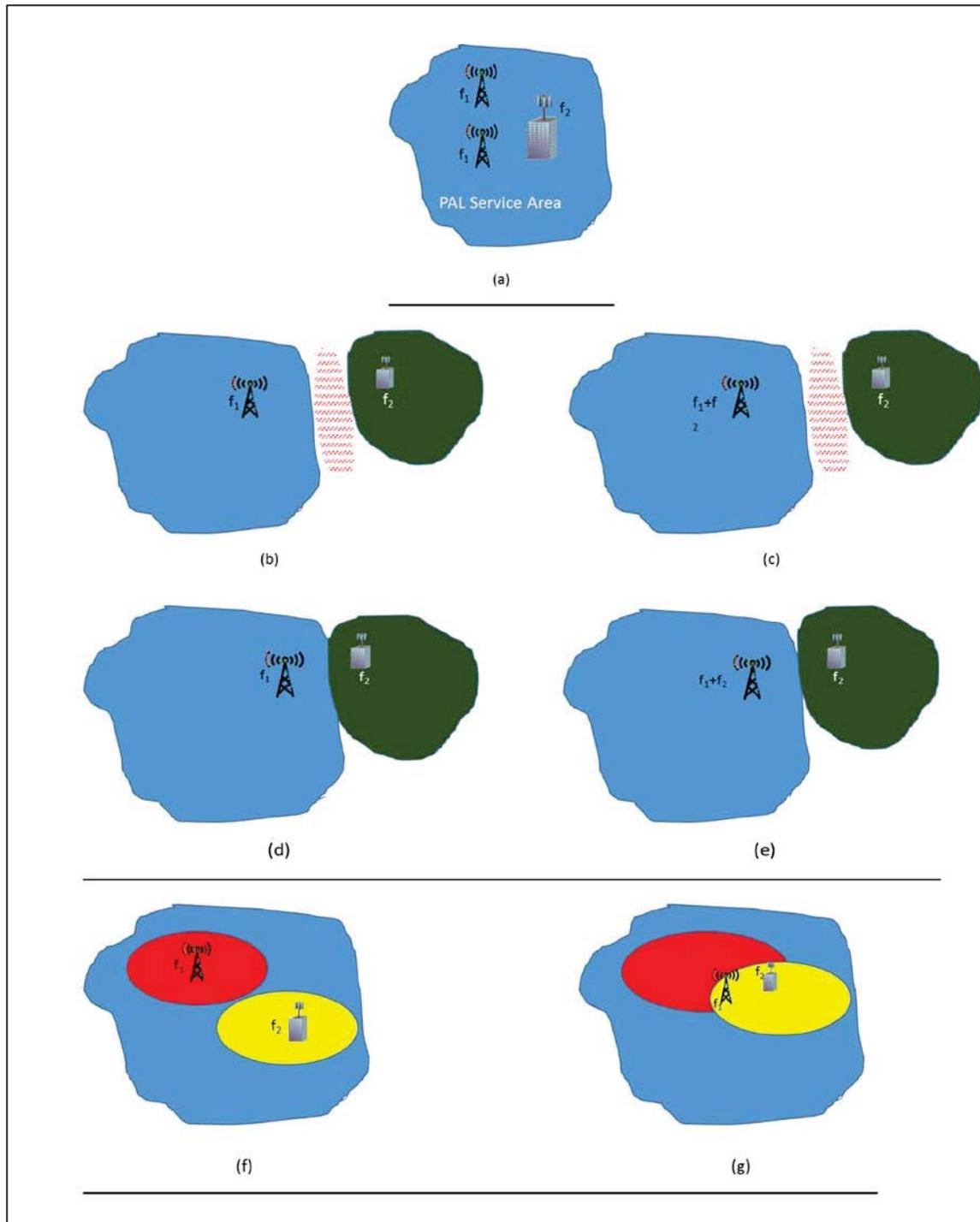


Figure 3. Two Adjacent Channel Allocation Scenarios: (a) coincident PAL service area; (b) adjacent PAL service areas with geographic separation; (c) adjacent PAL service areas with geographic separation, one PAL assigned two channels; (d) adjacent PAL services areas without a geographic separation; (e) adjacent PAL service areas with geographic separation, one PAL assigned two channels; (f) non-overlapped PAL service areas within the same census tract license area; and (g) overlapped PAL service areas within the same census tract license area.

### 3. Analysis

In this analysis, CBSDs and End User Devices are assumed to comply with the requirements set forth in the 3.5 GHz Order, including managing transmissions to an aggregate signal level of -80 dBm per 10 MHz (or -90 dBm/MHz) at the PAL license boundary, and a -13 dBm/MHz out of band emission limit 0 – 10 MHz away from the edge of assigned channel. For PAL operation on adjacent channels within the same PAL license area, however, we assume that no signal limit is at the border of service areas for each operator (i.e., the FCC did not set signal limits to protect adjacent channel operations within the same PAL).

It is also assumed that the frequency reuse 1/1 is used in LTE deployment. In other words, all cells/sectors within an operator’s network use the same carrier (or aggregation of same group of carriers). Therefore, we assume that the operator exploits interference management features to avoid or mitigate interference in co-channel deployment scenario. These measures could include sectorization, fractional frequency reuse, antenna configuration (azimuth and tilting), power control, beamforming, ICIC (or eICIC), and appropriate receiver design for interference mitigation mechanisms based on signal processing techniques, such as L-MMS, etc. Those techniques could clearly manage the interference in cases where two adjacent carriers are used in nearby CBSDs (Fig. 3.a).

In all deployment scenarios depicted in Figs. 3.b and 3.d, the assumption is that the appropriate filtering and network planning measurements are used, so that the aggregate interference at the PAL borders would not exceed -90 dBm/MHz. Assuming the CBSDs comply with 3GPP ACLR requirement of 45 dB for category A and category B base stations [Reference 1, Table 6.6.2.1-2], and the End User Devices comply with the 3GPP 30 dB ACLR requirement for UEs [Reference 2, Table 6.6.2.3.1-1], Table 1 below calculates the impact of unwanted emission from one CBSD within a PAL area using carrier  $f_1$  into an LTE victim UE using carrier  $f_2$ , in an adjacent PAL or GAA.

**Table 1: The unwanted emission for Figures 3.b & 3.d**

Parameter	Value	Unit
Aggregate Interference at the PAL Boundary	-90	dBm/MHz
ACLR	45	dB
Receiver Ant Loss + Body Loss	8	dBi
TX noise at carrier $f_2$ (antenna connector)	-143	dBm/MHz
TX noise at carrier $f_2$ (antenna connector)	-203	dBm/Hz
UE Noise Figure	9	dB
Acceptable noise at the RX carrier for 1 dB RX desensitization	-170.9	dBm/Hz
Acceptable noise at the RX carrier for 3 dB RX desensitization	-165.0	dBm/Hz
Margin for 1 dB Desensitization (IOT)	32.1	dB
Margin for 3 dB Desensitization (IOT)	38.0	dB

Table 1 demonstrates that, with 45 dB ACLR, margins of 32.1 dB and 38 dB for 1 dB and 3 dB desensitization, respectively, can be achieved. The analysis further demonstrates that considerable margins can be achieved, when the aggressors are the UEs, with ACLR of 30 dB, and the receiver base station is the victim. Therefore, adjacent channel assignment is feasible for Figs. 3.b & 3.d.

In Figs 3.c & 3.e, if we assume carriers  $f_1$ , and  $f_2$  are deployed in aggressor CBSDs or UEs in one PAL area, and the victim is deployed in CBSDs and UEs in an adjacent area. In this case, the co-channel interference at the boundary in both carriers are assumed to be no more than -0 dBm/MHz. Using the values of Table 1, the aggregate of co-channel and adjacent channel transmit noise at the PAL boundary is

$$P = 10 \log (10^{[-90-8]/10} + 10^{[-120-8]/10}) \sim -98 \text{ dBm/MHz}$$

The geographical separation in Fig. 3.c would reduce the TX noise by the propagation loss of at least 43 dB (for 1 meter separation at least), and therefore better margins than Table 1 can be achieved. However, in Fig. 3.e, the overall TX noise is -98 dBm/MHz (-158 dBm/Hz), and therefore using the values in Table 1, the achieved desensitization (IOT) would be 7.8 dB. This is at least 9 dB better than the IOT assumed by the FCC in calculating the -80 dBm limit. However, to achieve a 6 dB desensitization value (used for LTE blocking analysis), an acceptable TX noise is -160.3 dBm/Hz, which is 2.3 dB more stringent than the -158 dBm/Hz calculated above.

In Figs. 3.f-g, the FCC limit of -80 dBm is not applicable. Here, we assume that the CBSD using carrier  $f_1$  is the aggressor, and the UEs using carrier  $f_2$  are the victims, and we further assume that independent operators use the two service areas. As a result, no interference coordination is considered. Assuming that the required out of band emission limit applies, that is -13 dBm/MHz at the antenna connector, with an CBSD antenna gain of 16 dBi, Table 2 calculates the required separation between the aggressor CBSD and victim UE for 17 dB and 6 dB desensitization values (IOT).

**Table 2: Required Separation between Aggressor CBSD and Victim UE**

Parameter	Value	Value	Unit
OOBE at the antenna connector	-13	-13	dBm/MHz
CBSD antenna gain	16	16	dBi
UE Receiver Ant Loss + Body Loss	8	8	dBi
TX noise at carrier f2 (antenna Connector)	-5	-5	dBm/MHz
TX noise at carrier f2 (antenna Connector)	-65	-65	dBm/Hz
UE Noise Figure	9	9	dB
Acceptable desensitization at the RX carrier	6.0	17.0	dBm/Hz
Acceptable noise at the RX carrier	-148.3	-136.1	dBm/Hz
Required Separation between Aggressor CBSD and victim UE	397	98	meter

Assuming 397 m of separation between the CBSD and victim UE is acceptable in Fig 3.f, where the service areas of the two carriers are not overlapped. However, in Fig. 3.g, where the two service areas are overlapped, this is not a reasonable assumption, especially in small cell environments. Therefore, either the FCC has to reduce the OOBE at frequencies from 0 to 10 MHz away from assigned channel edge, or the SAS has to prohibit the allocation of two adjacent channels to two operators, operating within the same Census Tract. Using the FCC requirement for an OOBE limit of -25 dBm/MHz at frequencies beyond 10 MHz away from channel edge, the required separations in Table 3, would reduce to 99.7 m and 24.6 m for 6 dB and 17 dB desensitization, respectively.

As a result, we recommend that in scenarios depicted in Fig. 3.g, the SAS ensures at least one carrier gap between the assigned channels to the two operators.

#### **4. Conclusion**

In this paper, we analyzed the impact of adjacent channel allocation by SAS in different scenarios depicted in Fig. 3, assuming the co-channel and adjacent channel requirements defined by the FCC are met. We concluded that there are some scenarios where the SAS has to avoid allocating two adjacent carriers to PAL licensees or GAA operators, and consider at least one vacant channel among the assigned channels. One such scenario is depicted in Fig. 3.g.

#### **5. References**

- [1] 3GPP TS 36.104 “E-UTRA Base Station Radio Transmission and Reception, Release 12”, 3GPP, March 2015, <http://www.3gpp.org/DynaReport/36104.htm>
- [2] 3GPP TS 36.101 “E-UTRA User Equipment Radio Transmission and Reception, Release 12”, 3GPP, March 2015, <http://www.3gpp.org/DynaReport/36101.htm>