

**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 ALCATEL-LUCENT**

Jeffrey A. Marks  
Senior Counsel – Director Regulatory Affairs  
Public Affairs, Americas Region  
Alcatel-Lucent  
1100 New York, Avenue, N.W.  
Suite 705 West Tower  
Washington, D.C. 20005

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Alcatel-Lucent submits these comments in response to the Further Notice of Proposed Rulemaking (“FNPRM”) issued in the above-captioned proceeding proposing rules for the 3550-3650 MHz band.

**I. INTRODUCTION AND SUMMARY**

Alcatel-Lucent is at the forefront of global communications, providing products and innovations in information and communications technology and networking to service providers, enterprises, web-service providers, and institutions throughout the world. Underpinning Alcatel-Lucent’s leadership in driving the transformation from voice telephony to high-speed digital delivery of data, video and cloud services is Bell Labs, one of the world’s foremost technology research institutes, responsible for countless breakthroughs that have shaped the networking and communications industry. Among its innovative products, Alcatel-Lucent currently sells a portfolio of small cell products with 3G, Long Term Evolution (“LTE”) as well as Wi-Fi capability, Automatic Network Discovery and Selection Function (“ANDSF”) gateways for enabling Wi-Fi/3G/4G handovers, and host-neutral, device-neutral platforms for use all over the world. Alcatel-Lucent is at the forefront of

exploring dynamic spectrum sharing arrangements<sup>1</sup> and the use of whitespace spectrum in small cells.<sup>2</sup> As such, Alcatel-Lucent has been an active participant in the prior phases of this proceeding.<sup>3</sup>

Alcatel-Lucent urges the Commission to adopt a phased-in approach to Priority Access License (“PAL”) tier and General Authorized Access (“GAA”) tier sharing, so that a portion of the 3.5 GHz band is initially reserved for PAL-only use. A phased-in approach holds the most promise for band adoption and device ecosystem development, ultimately paving the way for robust, dynamic sharing among PAL and GAA Citizens Broadband Service Devices (“CBSDs”) throughout the entirety of the band. This greater level of certainty during the initial roll-out of the band is especially important considering the current proposal for federal incumbent geographic exclusion zones, which – if not revised – would block CBSDs from reaching 60% of the U.S. population.

Alcatel-Lucent similarly advocates for a transitional approach to federal sharing, from the static geographic exclusion zones contemplated in the FNPRM, to dynamic sharing between federal users and CBSDs. Alcatel-Lucent understands that the initial roll-out of the Citizens Broadband Service will almost certainly exclude federal users from any type of dynamic sharing. Over time, however, three-tier, dynamic sharing should be the ultimate goal for the band, permitting CBSD use in high-density communities along the U.S. coastlines that would benefit most from access to this band.

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<sup>1</sup> See, e.g., M. Buddhikot, P. Kolodzy, S. Miller, K. Ryan and J. Evans, DIMSUMnet: New Directions in Wireless Networking Using Coordinated Dynamic Spectrum Access, *Bell Labs Technical Report*, (Updated Oct. 2004), available at [http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=1443488&tag=1](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1443488&tag=1).

<sup>2</sup> See, e.g., S. Sen, T. Zhang, M. Buddhikot, S. Banerjee, D. Samardzija, S. Walker, A Dual Technology Femto Cell Architecture for Robust Communication using Whitespaces (Best Paper Award), *Proceedings of IEEE DySPAN 2012*, Seattle, (Oct. 16-19, 2012), available at [http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=6478135](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6478135); M. Buddhikot, “Towards a Virtual Cellular Network in Variable Grade Spectrum: Challenges and Opportunities,” (invited paper), *ACM Mobicom 2013*, GN Docket No. 12-354 (Jan. 3, 2013) (“Alcatel-Lucent FCC Workshop Paper”).

<sup>3</sup> See Comments of Alcatel-Lucent, GN Docket No. 12-354 (filed Feb. 20, 2013) (responding to the initial Public Notice seeking comment in this proceeding); Comments of Alcatel-Lucent, GN Docket No. 12-354 (filed Dec. 5, 2013) (responding to the Notice of Proposed Rulemaking in this proceeding); Alcatel-Lucent FCC Workshop Paper.

With respect to the Commission’s proposed GAA spectrum floor, Alcatel-Lucent believes that once PAL rights are acquired, those PAL rights should have priority over GAA. This concern would arise in the event of dynamic entry into a portion of the band by federal incumbent users. In such cases, the federal use should preempt GAA operations first, permitting PALs to continue to operate even if that means GAA operations fall below any specified spectrum floor.

These Comments also raise certain technical concerns regarding the operation of multiple Spectrum Access Systems (“SAS”) in the 3.5 GHz band that Alcatel-Lucent believes the Commission should address. In addition, Alcatel-Lucent advocates that the service rules should allow for higher power limits than proposed in the FNPRM and that PAL and GAA devices should be subject to identical emissions mask requirements.

**II. A PHASED-IN APPROACH—BOTH FOR PAL-GAA SHARING AND FEDERAL DYNAMIC SHARING—WILL BEST ACHEIVE A ROBUST ECOSYSTEM IN THE 3.5 GHZ BAND**

Alcatel-Lucent appreciates the Commission’s efforts to unlock the promise of the 3.5 GHz band, taking spectrum previously considered undesirable for commercial operations and exploring innovative ways to put the band into more productive use. In this section, Alcatel-Lucent addresses the importance of phased-in complexities for the Citizens Broadband Service band plan as well as phased-in complexities for incumbent users (from static federal exclusion zones to dynamic sharing). These two issues are critical to the successful roll-out and sustainability of the new Citizens Broadband Service.

**A. The Commission Should Commence Operations Using a Simplified Band Plan and SAS before Evolving to Greater Dynamism**

In the FNPRM, the Commission outlines an ambitious vision for the 3.5 GHz band, reflecting its “belief that the 3.5 GHz Band could be an ideal ‘innovation band,’ well suited to exploring the next generation of shared spectrum technologies, to drive greater productivity

and efficiency in spectrum use.”<sup>4</sup> Alcatel-Lucent shares this goal and sees great promise in building on the model proposed in this proceeding.

Specifically, the Commission proposes a three-tiered approach to the 3.5 GHz band, including: (1) existing primary operations (federal users and grandfathered FSS earth stations); (2) PAL operations; and (3) GAA operations. This three-tiered approach has gained broad support, including from Alcatel-Lucent, AT&T, Verizon, Google and others.<sup>5</sup>

The major disagreement is not with the three-tier model, but rather how to successfully implement it in light of its unprecedented complexity. The network and device ecosystem and SAS technology required for a band plan mixing PAL and GAA, including dynamic spectrum assignments, is unproven. It is essential that the results of this proceeding promote adoption and actual use of the band, not just theoretical aspirations that leave the band largely fallow. The Commission’s TV whitespaces service rules, introduced in 2008 and subsequently revised in 2010 and 2012,<sup>6</sup> represent a case in point. Those rules are the Commission’s first foray into policy for shared spectrum access. However, a combination of factors, including stringent emission masks that increase device cost and lack of availability of spectrum in urban areas, has resulted in anemic deployment of services using whitespaces.

It is important to learn lessons from these earlier efforts and design rules in the 3.5 GHz band that maximize the likelihood of rapid use of the band. Industry leaders with the most experience in deploying and investing in commercial telecommunications networks caution the Commission to phase-in band plan and SAS complexity over time. For instance, Verizon and AT&T both describe frameworks that, for a limited number of years, would separate the Citizens Broadband Service into three sub-bands: (1) exclusively PAL use; (2)

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<sup>4</sup> FNPRM ¶ 3.

<sup>5</sup> *See id.* ¶¶ 20-21 nn.48, 52 (citing numerous parties supporting a three-tiered approach).

<sup>6</sup> *See* 47 C.F.R. §§ 15.701-717.

mixed PAL and GAA use; and (3) exclusively GAA use.<sup>7</sup> Alcatel-Lucent supports this approach to the initial roll-out, as a prudent way to encourage early implementation of this band. Alcatel-Lucent proposes that an even further simplified, alternative phase-in approach should also be considered, including only two sub-bands in the initial stages: (1) one sub-band dedicated to exclusive PAL use; and (2) a second sub-band dedicated to PAL and GAA use, where sharing technologies can be tested and refined.

To ensure timely transition to the three-tiered sharing approach, the Commission could institute a sunset requirement that mandates that the sub-bands structure be removed after a period of time (for example, 3-5 years after initial implementation) upon successful operation of the SAS in the GAA-PAL sub-band.

This initial level of certainty is especially critical if, as discussed further below, the Commission implements the static geographic exclusion zones proposed in the FNPRM. The proposed exclusion zones include some of the most densely populated urban markets in the country—the geographic areas where wireless communications networks are facing the greatest spectrum demand and, therefore, would most benefit from new spectrum allocations. By limiting operations in the 3.5 GHz band largely to areas where the spectrum crunch is least acute, the Commission is greatly limiting the desirability of the band. Similarly, these limitations threaten to cause potential users of the band to be less tolerant of the uncertainty that will certainly accompany the novel licensing and sharing framework proposed in the FNPRM. A phased-in approach for the Citizens Broadband Service, beginning with less complexity and greater certainty for all CBSDs (*i.e.*, PAL holders and GAA users alike), will make the band more attractive as the Commission continues to work with federal incumbents to gain greater use in desirable urban areas along the coastlines.<sup>8</sup>

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<sup>7</sup> See Comments of Verizon, GN Docket No. 12-354 (filed Dec. 5, 2013); AT&T, Letter from Stacey Black, AT&T Services, Inc. to Marlene H. Dortch, FCC, GN Docket No. 12-354 (filed, May 23, 2014).

<sup>8</sup> As further discussed below, a phased-in approach would likely move us more quickly to dynamic

Alcatel-Lucent disagrees with the Commission when it raises “concerns about the impact of Balkanization of this spectrum may have in terms of limiting the development of a robust and varied shared spectrum ecosystem in the band.”<sup>9</sup> As an initial matter, Alcatel-Lucent takes issue with use of the pejorative term “Balkanization,” and respectfully disagrees that a phased-in band plan would be so limiting. To the contrary, permitting operations to phase-in complexity over time should hasten adoption of the band. Once an ecosystem begins to evolve for 3.5 GHz base stations and client devices, and scalable SAS technologies are designed, tested and refined, adjustments necessary to span the entire band and account for increasingly complex sharing scenarios will be far more achievable.

For these reasons, Alcatel-Lucent supports a phased-in approach that permits easier early adoption and deployment of the band, with a goal of phasing in greater complexity over time.

**B. Federal Incumbents Should Shrink Exclusion Zones and Phase-in Dynamic Sharing with CBSDs**

The FNPRM proposes static geographic exclusion zones, originally proffered by the National Telecommunications and Information Administration (“NTIA”), based on technical assumptions that are widely considered to be overly conservative, and that fail to contemplate the technical parameters described in the current Citizens Broadband Service proposal. The FNPRM is essentially apologetic, calling the proposed exclusion zones a “starting point.”<sup>10</sup> The separate statements of Commissioners Rosenworcel, Pai and O’Rielly all identify the proposed exclusion zones as problematic.<sup>11</sup> Alcatel-Lucent agrees and respectfully suggests

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sharing with Tier 1 government incumbents, since asking Tier 1 users to share only with known PAL holders may be more practicable than also including GAA in initial pilots.

<sup>9</sup> FNPRM ¶ 22.

<sup>10</sup> *Id.* ¶ 141.

<sup>11</sup> *Id.*, Statement of Commissioner Jessica Rosenworcel; Concurring Statement of Commissioner Ajit Pai; Statement of Commissioner Michael O’Rielly.

that the current exclusion zone proposal in no way represents the type of innovative sharing mechanisms needed to combat our growing spectrum crunch.

*First*, the proposed static exclusion zones fail to account for the innovative technologies – small cells – originally proposed expressly to shrink the exclusion zones. Rather, the proposed exclusion zones are based on a 2010 NTIA analysis which assumed secondary systems would deploy WIMAX macro cells with the antennas mounted at 5-60 meters above the terrain height and with transmit power of 40-46 dBm (*i.e.*, 10-40 W). Clearly, these computations do not apply to the proposed small cell deployments, which are characterized by very low transmit powers (*e.g.* 40mW-5W) and low antenna heights (*e.g.* 4-15 feet).

Alcatel-Lucent further urges that the Commission draw exclusion zones solely to protect *federal operations*, rather than also protecting adjacent non-federal operations. Commercial service providers should be permitted to determine for themselves the level of interference that they believe to be acceptable. Alcatel-Lucent understands that incumbent users are concerned about recurrence of the often referenced “garage door opener” fiasco, where sloppy garage door opener receivers resulted in the federal government ceding spectrum. However, there is no element of surprise here. Any Citizens Broadband Service user and equipment maker (as well as the SAS administrator(s)) will be on notice as to the interfering services, including federal uses, with which they must contend. PAL and GAA users should be permitted to assume the risk of such interference, without the federal government paternalistically prohibiting commercial operations due to the federal government’s interference into the new commercial service.

It is an odd twist for the Commission to continue to promote small cells for the band, while leaving in place the problem they were meant to solve: exclusion zones excluding 60% of the population. Rather than choosing a more realistic starting point, the Commission

appears driven by expediency to operate under the fictitious exclusion zones presented in the Fast Track report, since it was a “condition” of the “Executive Branch agree[ment] to provide access to this spectrum for non-federal use.”<sup>12</sup> As long as the U.S. coastlines are completely excluded from operations in the 3.5 GHz band, however, success of the new Citizens Broadband Service will be murky at best.

*Second*, Alcatel-Lucent takes issue with calling static geographic exclusion zones “sharing” at all. Rather than proposing sharing between the Citizens Broadcast Service and Federal users, the Commission is proposing a defined exclusive geographic license for federal operations. Exclusive geographic licensing is not sharing. There are plenty of wireless operators that hold licenses in the same spectrum band, but in separate, distinct markets. Such geographically separated operations are not commonly referred to as spectrum “sharing.” The Commission should advocate for dynamic sharing, which would permit commercial operations where the government is not actively transmitting. Without dynamic sharing by the federal incumbent, there is no “three-tier” sharing structure touted by the FNPRM, but rather only a two-tier structure where everyone is asked to innovate *except* for the government.

The goal should be to introduce three-tiered sharing that takes into account: (1) actual proposed technical parameters for non-Federal operations, and (2) actual federal activity in the band. Since the naval radar use is sporadic in time (*e.g.* warships with AN/SPY-1 radars are only occasionally entering/exiting U.S. ports and have their radars turned off when in port), the exclusion zones need to be dynamic in time – activated only when radar is transmitting.

There is no doubt that federal incumbent dynamic sharing is highly complex. Scarce federal employee resources must be brought to bear to gain a level of trust and understanding

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<sup>12</sup> *Id.* ¶ 140.

of new technical parameters that would shrink geographic exclusion zones to more realistic sizes. Further, information regarding sporadic federal use is considered sensitive and it will take new security and information distortion techniques to make it feasible in practice.

In light of these complexities, to expedite roll-out, Alcatel-Lucent recommends a phased-in approach to complexity in federal incumbent sharing, by first shrinking exclusion zones and then phasing in dynamic sharing. If it helps facilitate the transition to three-tier dynamic sharing, Alcatel-Lucent believes that the Commission should consider introducing dynamic sharing between the incumbent users and PALs (excluding GAA) as a first step. The federal government may be able to build a relationship of greater trust, accountability and information security with a defined group of PAL holders than can be easily achieved with a more fluid population of GAA devices in the mix.

This interim phase would be an important first step in proving the feasibility of, and technologies for, dynamic sharing with the federal incumbents and would help roll out services in currently excluded coastal areas. Over time, the Commission's goal should be dynamic sharing among all three categories of users, federal incumbents, PALs, and GAA.

### **III. ADDITIONAL TECHNICAL CONSIDERATIONS**

#### **A. Any GAA Minimum Floor Should Permit Priority for PALs over GAA in the Event of Dynamic Use by Federal Incumbents**

Alcatel-Lucent is concerned about the Commission's proposal to reserve a portion of available spectrum for the GAA tier (whether a fixed number of MHz or a percentage of the band), and urges that PAL spectrum holders should be accommodated first in the event variable amounts of Citizens Broadband Service spectrum are preempted by dynamic incumbent uses.

Where the amount of available spectrum is variable due to dynamic spectrum use by the incumbent, the GAA floor can lead to operational scenarios where GAA devices continue to access spectrum, while PAL holders are denied channel allocations. Alcatel-Lucent refers

to this type of anomalous behavior that violates the three-tier spectrum access architecture as “priority inversion in spectrum access.”

Consider the following simple example, where 100 MHz of Citizens Broadband Service spectrum (3550-3650 MHz) in a region has five PALs (50 MHz) and 50 MHz reserved for GAA. If the incumbent system turns on and occupies 30 MHz of that spectrum (*e.g.*, 3600-3630 MHz), and the Commission uses a 50% floor, the SAS must reallocate the remaining 70 MHz among the CBSDs. If 50% of this 70 MHz were reserved for GAA, only 35 MHz would be available for PAL channel allocations, and at least two of the original five 10 MHz PALs would no longer be satisfied. These PAL holders would have to drop to the GAA tier which may be quite crowded and constrained – leading to priority inversion. In such a scenario, the GAA devices could continue to gain access to spectrum via the minimum floor guarantee – *itself, a form of priority access for GAA over PALs*. A fixed GAA floor, for example, of 50 MHz, would create even greater priority for GAA over PALs since *only* PALs would be disadvantaged by dynamic use by incumbent users.

This GAA spectrum floor adds further uncertainty for auctioned PALs. The simplest solution is to remove the GAA spectrum floor in the event a portion of the Citizens Broadband Service is preempted by dynamic incumbent uses. For example, in the scenario described above, when the federal incumbent commences operations in 30 MHz of spectrum, the PAL rights (all 50 MHz) would continue to be honored, and only GAA would be curtailed (down to 20 MHz). Only if the incumbent occupies more than 50 MHz would PAL rights be preempted. This is a fair and preferred policy as the PALs are sold in an auction with guarantees on spectrum access and interference protection from the GAA tier.

#### **B. Challenges Associated with Multiple SAS Operators**

The FNPRM envisions multiple SAS servers concurrently operating in all regions and

asks what implementation challenges arise from the possibility of multiple SAS providers.<sup>13</sup> While Alcatel-Lucent understands that the Commission has policy reasons for instituting multiple SASs, as a technical matter, having multiple SASs adds yet another layer of complexity to the Commission's proposal that must be proven for the band to be successful.

Among the complexities will be ensuring coordination among the SASs. It is necessary to clearly specify the minimum set of information that multiple SAS servers must share among each other. The rules also must clearly define (a) the minimum measurement set that a CBSD must supply to the SAS, (b) the specific information that needs to be shared among all peer SASs, and (c) if CBSDs can optionally supply additional information to a given SAS (or, similarly, whether individual SASs may demand more than the minimum data required by Commission rules).

Further, the dynamic channel allocation envisioned by the Commission requires that each CBSD, at any spatial location, be assigned a unique channel, recognized among all SASs in real time, even though the request may be made to a single SAS. This requires that the process of channel allocation must be "atomic" (*i.e.*, at any given instance only one SAS can handle assignment of a channel at a given location). Multiple SASs attempting to allocate the same channels could easily create conflicts. In spectrum-constrained markets, the speed of one SAS compared to another to allocate a channel may be crucial to determining whether a proposed user gets an allocation or not. In sum, when the entire band in the same geographic area is managed simultaneously by multiple SASs, channel allocation and coordination is challenging.<sup>14</sup> Alcatel-Lucent therefore suggests that the Commission clearly specify parameters for peering and channel allocation among multiple SAS operators.

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<sup>13</sup> *Id.* ¶ 91.

<sup>14</sup> M. Buddhikot and K. Ryan, "Spectrum Management in Coordinated Dynamic Spectrum Access Based Cellular Networks," *Proceedings of the First IEEE DySPAN 2005*, (Nov. 8-11, 2005) available at [http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=1542646](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1542646); A. Subramanian, H. Gupta, S. Das and M. Buddhikot, "Fast Spectrum Allocation in Coordinated Dynamic Spectrum Access Based Cellular Networks," *Proceedings of IEEE DySPAN 2007*, (Apr. 17-21, 2007) available at

### **C. Power Limits for Secondary Use**

The FNPRM tentatively adopts a conducted power limit (interpreted as input power at the antenna port) of 24 dBm (250 mW) and, for rural devices, 30 dBm (1 Watt).<sup>15</sup> These limits – especially those for rural areas – appear to be overly prescriptive and arbitrary. In most non-coastal regions of the country, incumbent usage is sparse or non-existent, and the CBSDs should be allowed to use higher power. The 3.5 GHz PALs may be most valuable to capacity scaling in dedicated carrier deployment of (outdoor and indoor) small cells. However, outdoor small cell deployments need higher power for high capacity, adequate spatial coverage and efficient offloading. As such, allowing greater than the proposed 30 dBm (1W) limit could foster rapid adoption of 3.5 GHz in outdoor metro cells.

Alcatel-Lucent appreciates that the Commission proposes to allow neighboring users to coordinate a higher signal strength level,<sup>16</sup> but we believe that the SAS should also have discretion to permit higher power levels based on location of the CBSD and knowledge of the presence or absence of incumbents in the region. Just as the FNPRM already proposes that the SAS be permitted to set maximum power limits below these recommended maximum power levels,<sup>17</sup> the SAS should similarly be permitted to authorize higher power operations.

### **D. Identical Emission Masks for PAL and GAA Devices**

The FNPRM's current proposed rule setting emissions and interference limits for CBSD devices suggests that the emission masks for GAA and PAL devices will be identical.<sup>18</sup> Alcatel-Lucent agrees that the same emissions masks should be mandated for GAA and PAL devices because it can help guarantee better co-existence between these two

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<http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.133.2495>; A.P. Subramanian, M. Al-Ayyoub, H. Gupta, S. Das and M. Buddhikot, "Near Optimal Dynamic Spectrum Allocation in Cellular Networks," *Proceedings of IEEE DySPAN 2008*, (Oct. 14-17, 2008) available at [http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=4658252](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4658252).

<sup>15</sup> FNPRM ¶ 74,

<sup>16</sup> *Id.* ¶ 79.

<sup>17</sup> *Id.*, Appendix A (proposed § 96.38 (b)(3)).

<sup>18</sup> *Id.*, Appendix A (proposed § 96.38(d)).

