

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, DC 20554**

In the Matter of	)	
	)	
Promoting Investment in the 3550-3700 MHz	)	GN Docket No. 17-258
Band	)	

**REPLY COMMENTS OF THE GENERAL ELECTRIC COMPANY**

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**I. INTRODUCTION AND SUMMARY**

The General Electric Company (“GE”) hereby responds to comments on the Federal Communications Commission’s (“Commission’s”) October 2017 Notice of Proposed Rulemaking (“*NPRM*”) in the above-captioned proceeding.<sup>1</sup> The record in this proceeding strongly supports the Commission’s existing, innovative census-tract licensing framework for the Citizens Broadband Radio Service (“CBRS”). With census-tract licensing for Priority Access Licenses (“PALs”), a broad range of parties will gain access to licensed spectrum and develop dynamic, diverse uses of the 3.5 GHz band. This flexible, market-based licensing approach will enhance spectrum efficiency, further the statutory objectives of Section 309(j)’s auction provisions,<sup>2</sup> and help maintain U.S. leadership in the development of 5G and next-generation wireless technologies. Preserving census-tract licensing is critically important to GE and its industrial and critical-infrastructure customers since the CBRS band is an ideal spectrum platform for the “Industrial Internet of Things” (“IIoT”) and can serve as a unique catalyst for accelerated growth throughout the U.S. industrial and manufacturing sector. The major wireless

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<sup>1</sup> See *Promoting Investment in the 3550-3700 MHz Band*, Notice of Proposed Rulemaking and Order Terminating Petitions, 32 FCC Rcd 8071 (2017) (“*NPRM*”).

<sup>2</sup> 47 U.S.C. § 309(j).

carriers argue that the Commission should abandon the current CBRS framework and shift to Partial Economic Area (“PEA”)-based licensing at 3.5 GHz, but this change would extend their control over commercial mobile spectrum to yet another wireless band. The Commission should reject these carriers’ claims and move forward with this historic opportunity in the CBRS band to spark innovation, generate a host of important public interest benefits, and, in particular, realize the full potential of the IIoT for the American public.

The vast majority of commenters on the *NPRM* – representing a wide swath of the U.S. economy – supports the Commission’s existing CBRS regulatory framework and specifically opposes changes to PAL census-tract licensing at 3.5 GHz. These CBRS proponents include a wide variety of entities, such as rural broadband operators, industrial and critical-infrastructure entities, municipalities, technology companies, equipment manufacturers, and Spectrum Access System (“SAS”) developers.<sup>3</sup> These parties generally agree on several basic points relating to the CBRS framework. They believe that the Commission’s CBRS regulatory approach is a sound response to the unique spectrum environment at 3.5 GHz, which includes federal incumbents.<sup>4</sup> In the view of these commenters, myriad CBRS use cases will be initiated by a range of businesses and other 3.5 GHz users under the current rules, with this diversity of uses and users promoting innovation and technology investment and generating a variety of public interest benefits

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<sup>3</sup> See, e.g., Comments of Rural Wireless Association, Inc. at 2-4 (“RWA Comments”); Comments of the Wireless Internet Service Providers Association at 24-38 (“WISPA Comments”); Comments of Bolt Internet at 1 (Dec. 21, 2017, filed Dec. 27, 2017); Peoples Telephone Cooperative at 2-4; Comments of the Utilities Technology Council at 1, 4-6 (“UTC Comments”); Comments of the City of New York at 1, 2-3 (“NYC Comments”); Comments of Microsoft Corporation at 4-6 (“Microsoft Comments”); Comments of Motorola Solutions, Inc. at 4-6 (“Motorola Comments”); Comments of Google LLC at 1, 5-14 (“Google Comments”). (Unless otherwise indicated, all comments cited herein were filed in GN Docket No. 17-258 on Dec. 28, 2017.)

<sup>4</sup> See Comments of the Dynamic Spectrum Alliance at 10 (“DSA Comments”); Comments of Comments of Open Technology Institute at New America and Public Knowledge at 9 (“OTI/PK Comments”); Comments of Ruckus at 11-12 (“Ruckus Comments”).

(discussed further in Section III, *infra*).<sup>5</sup> Parties agree that PAL census-tract licensing will further the statutory goals of Section 309(j) of the Communications Act by avoiding an excessive concentration of licenses, fostering efficient and intensive use of the 3.5 GHz band, and encouraging the rapid deployment of 5G and other new wireless technologies in the United States.<sup>6</sup> These proponents consider the Commission’s new “Innovation Band” at 3.5 GHz a dramatic success so far, generating a wave of investment and commercial activity, digital infrastructure development, and collaboration between stakeholders.<sup>7</sup> The Enterprise Wireless Alliance sums up the views of these commenters well: “The PAL license area is a classic example of an FCC decision that isn’t broken and doesn’t require fixing.”<sup>8</sup>

As a global digital industrial company and a leader of the IIoT revolution, GE in its comments focuses on the impact of the Commission’s CBRS rules on the IIoT’s future trajectory and the industrial, manufacturing, and critical-infrastructure entities so important to the U.S. economy. Other parties in this proceeding – including the Utilities Technology Council, Union Pacific, Southern LINC, and the American Petroleum Institute and Energy Telecommunications and Electrical Association – similarly describe the benefits of PAL census-tract licensing and the use of this band for localized, secure private LTE networks in industrial and critical-infrastructure environments and other enterprise settings.<sup>9</sup>

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<sup>5</sup> See *infra* at 14-28.

<sup>6</sup> See 47 U.S.C. § 309(j)(3). See also DSA Comments at 5, 14-15; Ruckus Comments at 5, 13; Comments of Southern LINC at 15-16 (“Southern LINC Comments”).

<sup>7</sup> See, e.g., WISPA Comments at 14-21; Comments of Rajant at 4-5 (“Rajant Comments”); Southern LINC Comments at 6-7, 14-15; Comments of Next Century Cities at 3-4 (“NCC Comments”).

<sup>8</sup> Comments of Enterprise Wireless Alliance at 5.

<sup>9</sup> UTC Comments at 4-6; Comments of Union Pacific at 8 (“Union Pacific Comments”); Southern LINC Comments at 6, 14; Comments of Telecommunications Subcommittee of the

As GE described in its comments, the IIoT is already driving greater levels of efficiency, productivity, safety, and data security in industries such as power generation and distribution, oil and gas, manufacturing, healthcare, rail, and aviation. IIoT-related wireless communications are poised to deliver even greater benefits in the near future given advances in inspection, remote control, and monitoring technology, the explosive growth of industrial data, and developments in “edge” computing.<sup>10</sup> Robust IIoT applications require significant spectrum and specialized technology, however, and industrial and critical-infrastructure entities are typically unable to obtain the necessary wireless functionality from commercial mobile operators on a cost-effective basis. As GE and other parties point out, the existing CBRS licensing framework will for the first time enable these entities to control their own networks and gain meaningful access to licensed, interference-protected spectrum by actively participating in 3.5 GHz PAL auctions. As long as the Commission retains PAL census-tract licensing across all areas (urban, suburban, rural), the 3.5 GHz band will become an essential spectrum platform for IIoT that provides secure, reliable, and cost-effective connectivity, functionality, and bandwidth on a localized basis.

Virtually the only parties that favor a shift to PEA-based licensing in the 3.5 GHz band, meanwhile, are the major wireless carriers and their primary trade association.<sup>11</sup> The carriers present a variety of arguments in support of their position (GE addresses these claims in its comments below), but, at bottom, the key is that PEA-based licensing would put CBRS under these operators’ control. In contrast to an auction of census-tract PALs, carriers would be in

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American Petroleum Institute and the Regulatory and Technology Committee of the Energy Telecommunications and Electrical Association at 3 (“API/ETEA Comments”).

<sup>10</sup> See Comments of GE at 2 (“GE Comments”).

<sup>11</sup> See Comments of AT&T Services, Inc (“AT&T Comments”); Comments of T-Mobile USA, Inc. (“T-Mobile Comments”); Comments of Verizon (“Verizon Comments”); Comments of CTIA (“CTIA Comments”); Comments of United States Cellular Corporation (“USCC Comments”).

position to outbid any other parties for PEA or other large geographic-area licenses. Once holding this spectrum, the major carriers would turn CBRS into just another generic, commercial wireless band that can be integrated into their national multi-band networks to bolster wide-area mobile offerings in selected locations where additional capacity is needed. In this scenario, CBRS could no longer be considered an “Innovation Band.”

Certainly, the CBRS band is viewed differently by the diversity of entities that hope to become licensed spectrum users in the 3.5 GHz band, including GE and other IIoT interests, Wireless Internet Service Providers (“WISPs”), hospitals, commercial real estate interests, hotels and resorts, state and local government agencies, and educational institutions. While the major carriers regard the 3.5 GHz band as just another block of commercial mobile spectrum, GE and its industrial and critical-infrastructure customers look to CBRS as likely the only near-term source of licensed, interference-protected spectrum for private LTE networks and “self-provisioned” IIoT services and applications. The Commission’s actions in this proceeding are therefore critically important. If the Commission maintains PAL census-tract licensing at 3.5 GHz, the IIoT will thrive in this band, attracting new investment in digital infrastructure and stimulating rapid growth in the U.S. industrial, manufacturing, and critical-infrastructure sectors, already critical engines of productivity for the U.S. economy. Far from being the typical spectrum “tug of war” between competing telecommunications stakeholders, this proceeding thus has the unique potential to elevate a critical part of the U.S. economy. The Commission should not forego this rare opportunity in U.S. economic and spectrum policy merely so it can fashion another standard commercial band for already-dominant wireless carriers.

## **II. THE COMMISSION SHOULD NOT ADOPT PEA-BASED LICENSING IN THE 3.5 GHz BAND**

In its comments, Microsoft states that “[t]he rules governing the geographic license area will have the greatest impact on whether the Commission succeeds, or fails, to promote investment in, and robust deployment on, the 3.5 GHz band across multiple use cases and population densities.”<sup>12</sup> GE agrees that the PAL size is the most important issue in this proceeding, and it urges the Commission to preserve census-tract licensing for PALs in the CBRS band.

Under the current PAL census-tract licensing framework, CBRS barriers to entry are low and a variety of parties are currently investing substantial time and resources into developing this spectrum, including GE and IIoT users, WISPs, commercial real estate interests, hotels and resorts, educational institutions, and state and local government agencies. A Commission shift to PEA-based licensing, however, would *by itself* transform the 3.5 GHz band immediately and abruptly halt this momentum. As numerous commenters describe (and as discussed below), such action would effectively shut out these diverse interests from the band and convert CBRS into another commercial mobile band dominated by the large nationwide wireless carriers. Secondary market mechanisms would not alleviate these harms. The Commission should not make its contemplated shift to PEA-based licensing in the 3.5 GHz band.

### **A. The Record Demonstrates that PEA-Based Licensing Would Foreclose the Use of Licensed CBRS Spectrum by GE, Its IIoT Customers, and Myriad Non-Traditional Spectrum Users**

As numerous commenters describe in their comments, PEA-based licensing would exponentially raise the cost of PALs and convert licensed CBRS spectrum into a commercial

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<sup>12</sup> Microsoft Comments at 4.



mobile band like most others, controlled by the major carriers.<sup>13</sup> On average, PEAs are 178 times larger and more populous than the average census tract, and, given this size differential, PEA licenses at 3.5 GHz would be far more expensive at auction than their census-tract counterparts. As Southern LINC observes, “the cost of acquiring a PAL for an entire PEA would put a PAL out of reach of all but the largest commercial providers and limit the use of PALS to wide-area mobile 5G services – which could hardly be considered a ‘diversity of PAL uses and users.’”<sup>14</sup> Union Pacific agrees, stating that “[l]icense areas as large as PEAs are not necessary to stimulate investment and, in fact, because of the anticipated higher cost of larger-area licenses, are likely to deter or practically exclude small providers” in the 3.5 GHz band.<sup>15</sup>

As pointed out in its comments, GE’s industrial and critical-infrastructure customers would be highly unlikely to win PEA licenses at auction, even in key, targeted geographic areas. It would not be economically rational for these entities to outbid established wireless carriers for PEA licenses covering territory extending far beyond their geographically focused deployments, whether in urban, suburban, or rural areas. Various commenters agree that outbidding the major carriers for PEA-sized PALs would not be financially viable. Motorola indicates that “[w]hile many potential users in the industrial, utility, oil and gas and enterprise segments desire interference protection for business-critical operations, they will be increasingly unlikely to participate in auctions for licenses that far exceed their coverage needs,”<sup>16</sup> while the American Petroleum Institute and Energy Telecommunications and Electrical Association argue that “[a]n

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<sup>13</sup> See, e.g., DSA Comments at 5, 13-14; OTI/PK Comments at 22, 30; Comments of Cantor Telecom at 8-9 (“Cantor Comments”); Comments of NCTA – The Internet and Television Association at 7 (“NCTA Comments”); Comments of NTCA – The Rural Broadband Association at 4-5.

<sup>14</sup> Southern LINC Comments at 14.

<sup>15</sup> Union Pacific Comments at 8.

<sup>16</sup> Motorola Comments at 4-5.

oil and gas company would not be able to compete for CBRS spectrum to cover an individual refinery, for example, if the licensed area offered by the Commission is an entire PEA.”<sup>17</sup>

The record demonstrates that geographically targeted deployments at industrial and critical-infrastructure locations would constitute only a tiny fraction of the geographic area in most PEAs. In its comments, Google highlights this fact with maps (i) showing the RF coverage areas for geographically targeted CBRS deployments relative to their surrounding census tracts and (ii) comparing those census tracts to the surrounding PEAs.<sup>18</sup> At Exhibit A to these reply comments, GE provides similar maps comparing the geographically limited signal coverage at potential IIoT private network deployment sites (a hospital, an airport, and a utility facility) to the surrounding census tracts and PEAs. Given the enormous size differential between these possible IIoT deployments and the surrounding PEAs, it would make no economic sense for industrial and critical-infrastructure entities to seek PEA licenses in a CBRS auction. Under a PEA-based licensing scheme, these entities would either have to bid irrationally in an effort to obtain PEA licenses or not participate at all in those auctions.

A Commission move to PEA-based licensing would thus create substantial barriers to entry and “effectively mak[e] PALs unavailable to . . . the vast majority of potential users of the CBRS band, such as rural broadband service providers, private network operators, electric utilities and other operators of critical infrastructure, municipalities and state and local government agencies, commercial venues (such as stadiums, arenas, and shopping malls), educational institutions, and so forth.”<sup>19</sup> The dominant nationwide carriers would benefit from

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<sup>17</sup> API/ETEA Comments at 3.

<sup>18</sup> Google Comments at 10.

<sup>19</sup> Southern LINC Comments at 14.

this licensing change at the expense of the broad range of use cases that are so critical to realizing the nation's 5G and other spectrum policy goals.<sup>20</sup>

**B. The Commission's Secondary Market Mechanisms Would Not Address or Resolve the Problems Created by PEA-Based Licensing at 3.5 GHz**

In their comments, the major carriers claim that secondary market mechanisms should alleviate any potential harms from PEA-based licensing in the CBRS band.<sup>21</sup> GE and many other parties disagree and believe that the secondary market would not resolve the serious issues resulting from PEA-based licensing. The evidence in this proceeding demonstrates that “partitioning, disaggregation, and reliance on secondary market transactions are neither adequate nor appropriate as a substitute for smaller license areas.”<sup>22</sup> It will be much easier for industrial and critical-infrastructure entities and other non-traditional users to gain access to licensed CBRS spectrum and deploy their own private LTE networks through a Commission auction of census-tract PALs than it would be through the secondary market under a PEA-based licensing approach.

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<sup>20</sup> Verizon's own expert, University of Maryland economist Dr. Daniel Vincent, does “not presume to opine on the ideal partition size” for PALs in the CBRS band and states that he “ha[s] heard plausible economic arguments both for strongly complementary preferences by bidders (which would argue for larger license size) as well as for substitute preferences (which may argue for smaller size licenses).” Comments of Daniel R. Vincent, Prepared for Verizon Communications, at 5 (“Vincent Comments”).

<sup>21</sup> Verizon Comments at 14-16; AT&T Comments at 8-9; T-Mobile Comments at 12. Verizon claims it enters into dozens of spectrum transactions every year. Verizon Comments at 14.

<sup>22</sup> Southern LINC Comments at 16. The Commission's recent application of PEA-based licensing in other commercial mobile bands do not weigh in favor of a similar choice in the 3.5 GHz band. The Commission should consider the licensing and regulatory factors at 3.5 GHz separate and apart from those factors that supported PEA-based licensing in other bands. As described by GE and by numerous other parties in this proceeding, the key factors at 3.5 GHz strongly support census-tract licensing in this band, just as those factors did back in 2015. The 3.5 GHz band is truly a unique spectrum environment, with the presence of federal incumbents at 3.5 GHz requiring complex spectrum sharing.

Under a PEA-based framework, the large wireless operators holding CBRS licenses would be unlikely to transfer or lease meaningful amounts of 3.5 GHz spectrum to GE and other non-traditional spectrum users. As Google indicates, “the large wireless carriers who typically win mobile-ready spectrum in auctions only rarely engage in secondary market transactions with smaller entities, much less entities other than established telecommunications companies.”<sup>23</sup> Comcast observes that “[r]ecent experience demonstrates that larger spectrum licenses are partitioned or disaggregated infrequently, and that it is more common for license holders to aggregate smaller license areas than to disaggregate larger ones.”<sup>24</sup> Access to licensed spectrum appears particularly challenging for the array of non-traditional spectrum users currently active in CBRS development. Google tellingly points out that “[w]hile the Commission’s partitioning, disaggregation, and other secondary market rules have existed for years, factories, hotels, or hospitals have rarely, if ever, acquired licensed spectrum for their own industrial IoT or private LTE networks.”<sup>25</sup>

In his filing, University of Maryland economist and Verizon-hired expert Dr. Daniel Vincent claims that “[t]here appear to be no obvious technical hurdles that might prevent easy resale of spectrum licenses,” and that “[e]vidence appears to support the existence of a vibrant secondary market in spectrum.”<sup>26</sup> Dr. Vincent does not specifically account, however, for the secondary market disparities between different spectrum bands or the variety of incentives that would prevent major carriers from partitioning or leasing CBRS spectrum to other parties. Moreover, there is substantial evidence that large, established carriers do not generally make

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<sup>23</sup> Google Comments at 19.

<sup>24</sup> Comments of Comcast Corporation at 14 (“Comcast Comments”).

<sup>25</sup> Google Comments at 21.

<sup>26</sup> Vincent Comments at 3.

spectrum available to smaller entities and would be unlikely to do so at 3.5 GHz. In its comments, GE pointed to the findings in a 2013 report from carrier ally Mobile Future, which revealed that only 11.01% of the MHz/POPs transferred or assigned from 2003 to 2013 were conveyed from nationwide operators to non-nationwide operators and that only 8.58% of the MHz/POPs leased during that period were leased by nationwide operators to non-nationwide operators.<sup>27</sup> Comcast references similar findings in a 2014 report from NERA Economic Consulting, a study commissioned by rural broadband providers in preparation for the Incentive Auction. That report found that “larger operators may give very low priority to disaggregating small area licenses, given their small value as a proportion of overall holdings,” and that “there is little recent history of the larger carriers leasing, disaggregating or partitioning large sections of spectrum where they already have service.”<sup>28</sup>

In addition, as described in its comments, WISPA recently conducted a survey of its member rural broadband providers regarding their activities on the secondary market. Approximately 25 percent of survey respondents indicated that they sought to obtain licensed spectrum from major carriers. Of those providers, *fewer than ten percent* reported success in obtaining spectrum rights from large mobile carriers.<sup>29</sup>

In the event of a Commission shift to PEA-based licensing at 3.5 GHz, the major carriers would have no particular incentive to realize the potential benefits of CBRS for IIoT and 5G

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<sup>27</sup> Mobile Future, *FCC Spectrum Auctions and Secondary Markets Policies: An Assessment of the Distribution of Spectrum Resources Under the Spectrum Screen*, at 18-19, attached to Letter from Johnathan Spalter, Mobile Future, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-268, at 18-19 (Nov. 13, 2013).

<sup>28</sup> Comcast Comments at 14-15 (citing Richard Marsden, Chantale LaCasse, and Jonathan Pike, *Local and Regional Licensing for the U.S. 600 MHz Band (Incentive Auction): A NERA Report* (Jan. 2014), [http://www.nera.com/content/dam/nera/publications/archive2/PUB\\_NCTA\\_0114.pdf](http://www.nera.com/content/dam/nera/publications/archive2/PUB_NCTA_0114.pdf)).

<sup>29</sup> WISPA Comments at 43.

development. There is no legal obligation to partition or lease spectrum, and there are in fact numerous factors that would deter large carriers from making sufficient CBRS spectrum available to GE and other non-traditional spectrum users through these secondary market mechanisms.<sup>30</sup> First, major carriers would have a disincentive to convey spectrum to parties that might use that resource to develop competitive offerings.<sup>31</sup> The American Petroleum Institute and Energy Telecommunications and Electrical Association observe that “[m]ost spectrum owners who are buying spectrum for internal operations are not interested in leasing spectrum which can be in direct competition with their own services.”<sup>32</sup> Starry, Inc. points out further that major carriers may have “assumptions about the economic value of full licenses as assets versus partial licenses” and “a reasonable desire to maintain control over the entire spectrum environment within a geographic area or frequency block.”<sup>33</sup> In addition, carriers in some locations would use 3.5 GHz frequencies for their own consumer-based offerings, making spectrum in those areas unavailable for leasing to private LTE network operators. For instance, GE’s customers have industrial and critical-infrastructure facilities in urban and suburban areas, where commercial mobile operators might use their CBRS spectrum both to densify their networks and to ensure network performance. Carriers might choose not to lease spectrum at those locations in order to minimize the risk of interference to their consumer-based services at and near those sites. Finally, major

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<sup>30</sup> As Southern LINC describes, “Such transactions are entirely voluntary and there is no requirement for any licensee to lease, partition, or disaggregate a license.” Southern LINC Comments at 3.

<sup>31</sup> See Dr. William Lehr, Analysis of Proposed Modifications to CBRS PAL Framework, WT Docket No. 17-258, at 10, 12-13 (Dec. 28, 2017) (“Lehr Analysis”) (“[T]he national cellular operators . . . have an incentive to deny access to the spectrum from other potential CBRS users because such usage threatens the national cellular operators’ businesses in multiple ways.”).

<sup>32</sup> API/ETEA Comments at 3.

<sup>33</sup> Comments of Starry, Inc. at 4-5 (“Starry Comments”).

carriers may simply conclude that it is not worth their time, staff resources, or legal costs to partition or lease spectrum in highly localized areas.

Overall, as Union Pacific states, “nothing in the current Commission record supports the presumption that large bidders are likely to make any, let alone a sufficient amount of, excess spectrum available to smaller players on the secondary market.”<sup>34</sup> Certainly, in making its decision on the future of the 3.5 GHz band, the Commission cannot rely on the *theoretical possibility* that secondary market activity will alleviate the harms from PEA-based licensing. The Dynamic Spectrum Alliance argues that “it is speculative at best to conclude that partitioning and disaggregation would mitigate the preclusive impact of PAL areas larger than census tracts. . . . National or even regional service providers have little if any incentive to support the emergence of alternative, edge-based networks, disruptive technologies, or new ISP market entrants that could turn into competitors or substitutes.”<sup>35</sup>

As a number of commenters describe, even where available on the secondary market, CBRS spectrum would likely come at an excessive and uneconomic cost under a PEA-based licensing scheme. Southern LINC points out that “[s]econdary market transactions (to the extent they are even available) would also impose significant transaction costs that would serve as an economic barrier to smaller entities and endanger the economic viability of smaller-scale, localized deployments.”<sup>36</sup> As Dr. William Lehr indicates in his report, these transaction costs would likely fall asymmetrically on non-traditional spectrum users such as IIoT customers, who

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<sup>34</sup> Union Pacific Comments at 10.

<sup>35</sup> DSA Comments at 18-19.

<sup>36</sup> Southern LINC Comments at 16. *See also* OTI/PK Comments at 22; Comments of Sacred Wind Communications, Inc. at 6; WISPA Comments at 44.

would need to induce major carriers to partition or lease their spectrum.<sup>37</sup> The process of negotiating spectrum leasing or partitioning arrangements with major carriers could be too time-consuming, costly, and burdensome for these parties. Starry, Inc. notes that the “users that demand smaller license areas generally have fewer resources to devote to the complicated process of negotiating with a large mobile operator for access to a portion of a license (in the event that the mobile licensee would even enter into negotiations).”<sup>38</sup> Finally, spectrum lease arrangements might also include terms and conditions – such as bandwidth limitations or other operational restrictions – that prevent GE and its industrial and critical-infrastructure customers from realizing the full potential of IIoT connectivity.

### **III. CENSUS-TRACT LICENSING IN THE 3.5 GHz BAND WILL GENERATE EXTRAORDINARY PUBLIC INTEREST BENEFITS**

Census-tract licensing at 3.5 GHz – and the resulting dynamic, heterogeneous ecosystem in this band – will generate extraordinary public benefits for the American public, far greater than the benefits from PEA-based licensing. If the Commission retains census-tract licensing across all areas (urban, suburban, rural), the 3.5 GHz band will become a vital spectrum platform for the IIoT and serve as catalyst for accelerated growth in the U.S. industrial, manufacturing, and critical-infrastructure sectors. Private LTE networks using CBRS PAL spectrum will enable the implementation of safe operations and processes at a wide variety of critical-infrastructure facilities across the United States, and will also help bridge the “digital divide” by energizing rural broadband development. From a purely economic perspective, census-tract licensing offers a flexible, market-based approach that will result in greater spectrum efficiency and place PALs in the hands of parties who will pay for the opportunity to make the highest and best use of this

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<sup>37</sup> Lehr Analysis at 12.

<sup>38</sup> Starry Comments at 5.



spectrum. Finally, the existing CBRS framework will help maintain U.S. global leadership in the development of 5G and next-generation wireless technologies.

**A. Census-Tract Licensing Will Enable Self-Provisioned Private LTE Networks in the CBRS Band, Which Will Have Great Benefits for the IIoT and the Public Interest**

If the Commission maintains PAL census-tract licensing at 3.5 GHz, barriers to entry will remain low in the CBRS band and industrial and critical-infrastructure entities and other enterprises will be able to use their own licensed CBRS spectrum to “self-provision” IIoT wireless connectivity over geographically targeted, private TDD-LTE networks. Self-provisioned private LTE networks in the 3.5 GHz band will catalyze scaling of the IIoT, with all of the attendant economic and social benefits, by allowing GE, its competitors, and industrial and critical-infrastructure customers to innovate, minimize costs, enhance safety and security, and optimize network and IIoT-system performance. In building out these IIoT capabilities, GE and its customers will use their licensed CBRS spectrum to take full advantage of advances in inspection, remote control, and monitoring technologies, edge computing capabilities, and cloud-based Big Data predictive analytics (as described at length in GE’s comments).<sup>39</sup>

Reliance on self-provisioned private LTE networks is a better option for industrial and critical-infrastructure entities and other enterprises than obtaining services from traditional mobile operators or mobile virtual network operators (“MVNOs”). Obtaining sufficient localized

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<sup>39</sup> GE Comments at 2-3, 12-13. Automated inspection capability can provide industrial and critical-infrastructure customers with real-time HD video, imaging, audio, and other bandwidth-intensive sensing, monitoring, and inspection content at oil refineries, deep-sea platforms, oil wells, pipelines, petrochemical flare stacks, and other facilities. Crawlers, robots, and other machines can undertake inspections in areas inaccessible to human inspectors, safely providing access to data that would otherwise be unavailable. Industrial and critical-infrastructure entities can use this information to troubleshoot problems on a real-time basis, ensure compliance with environmental and other regulations, and optimize their operations. This inspection technology will also reduce human exposure to hazardous and dangerous environments, thereby protecting human life and enhancing public safety.

wireless and telecommunications capability is arguably the most significant obstacle to the deployment of new, more robust IIoT applications. The major wireless carriers have placed greater emphasis on delivering commercial mobile service to consumers than on the development of data-intensive IIoT-related applications, services, capabilities, and network service level agreements to support industrial customers. As a result, major commercial mobile providers typically do not provide such services and applications on a cost-effective basis,<sup>40</sup> and procuring such wireless capability often takes too long for time-sensitive industrial and critical-infrastructure operations. Moreover, with the deployment of next-generation, automated inspection and remote monitoring technologies, future bandwidth requirements at industrial and critical-infrastructure facilities will substantially exceed throughput requirements for standard consumer-oriented commercial mobile services. Traditional carriers may not effectively support services and applications involving the transmission of such massive amounts of data. For instance, continuous real-time transmissions from a remote-monitoring HD camera in an industrial/critical-infrastructure environment will realistically generate more than 1,500 GBs of data per month, while some “ultra broadband” IIoT applications – such as HD video surveillance of a pipeline’s steel weld zones – might involve throughputs of 2 terabytes per hour or more. In contrast, an average smart-phone customer typically consumes approximately 18 GBs of data per month (through both LTE and Wi-Fi). With their own licensed private LTE networks in the

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<sup>40</sup> As Rajant explains in its comments, “Services provided by licensed operators managing costs across an entire PEA are often priced at unattractive rates that foreclose innovative use. . . . When a single carrier holds the license to provide service over the entire PEA, there is little incentive for that carrier to offer a low rate for targeted, local spectrum access.” Rajant Comments at 5. In the absence of census-tract CBRS licenses, “Rajant most likely will look into unlicensed bands for the next generation of its mobile broadband technology, with increased interference risk and decreased audience and performer benefits, or forego this innovative application, to the detriment of the public.” *Id.*

CBRS band, GE and its customers will be in far better position to manage this intensive system throughput, while being assured of interference-free wireless operations.<sup>41</sup>

Notably, a number of other industrial, critical-infrastructure, and enterprise commenters describe their planned private wireless facilities and identify the existing CBRS rules as a critical factor in those deployments. For example, Union Pacific states that along its “vast right-of-way, [it] maintains automatic equipment identification systems, hot box detectors, wheel inspection systems, and other safety critical technology that communicate with our telecommunication network,” while in its railroad yards “communications are maintained through intricate cellular networks moving locomotives and other assets by utilizing remote control technology.”<sup>42</sup> Going forward, Union Pacific also “envision[s] a railroad industry initiative to adopt a unified approach for train control, including locomotive-to-wayside and locomotive-to-back-office communication, telemetry and command and control operations.”<sup>43</sup> Union Pacific emphasizes that “[u]se of the reliable 3.5 GHz band for connected technology in railroad yards, intermodal facilities, and railroad right-of-way may be imperative,” and states that “access to the 3.5 GHz broadband and enhanced coverage would allow Union Pacific to deploy systems that support innovative, safe, productive, and more efficient operations.”<sup>44</sup>

Southern LINC states that the current CBRS framework has the potential to support “‘next generation’ electric grid applications such as video surveillance of substations and other critical assets and the deployment of phasor measurement units to achieve the next level of grid reliability

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<sup>41</sup> In implementing its industrial and critical-infrastructure customers’ private LTE networks, GE will provide customized data security solutions that meet those entities’ precise needs. For these customers, unlicensed or GAA spectrum will not provide sufficient security for the enormous amounts of mission-critical data transmitted on these networks.

<sup>42</sup> Union Pacific Comments at 5.

<sup>43</sup> *Id.* at 6.

<sup>44</sup> *Id.* at 5.

and efficiency,”<sup>45</sup> while UTC says that the existing CBRS rules will enable utilities to “provide additional capacity and coverage to support a variety of communications services, including private internal communications services that utilities use to ensure the safe, reliable and effective delivery of essential electric, gas and water services to the public at large.”<sup>46</sup> Meanwhile, Rajant has developed a broadband application for use at arenas that “facilitates multimedia communications between personnel to enhance the audience experience of [an entertainer’s] performance.”<sup>47</sup> According to Rajant, “[v]ideo from multiple camera angles contribute to the fans’ enjoyment,” and “[c]onnected to broadband tablets, the multimedia broadband during the public event also provides personnel more video and voice capability, increasing situational awareness and ultimately performer safety.”<sup>48</sup> Rajant argues that a departure from PAL census-tract licensing at 3.5 GHz will “upend planned business models for targeted local uses.”<sup>49</sup>

As long as the Commission retains census-tract licensing and maintains CBRS as a spectrum platform for industrial and critical-infrastructure use, the safety, performance, and economic benefits of the IIoT should drive dramatic productivity growth and enhance global competitiveness in the U.S. industrial and manufacturing sector, already a critical engine of U.S. economic activity. As described in GE’s Comments, multiple observers and analysts have previously concluded that IIoT will trigger substantial growth in the industrial and

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<sup>45</sup> Southern LINC Comments at 7. Southern LINC also states the Commission’s CBRS rules will support “a number of non-commercial, higher-bandwidth deployments and applications that would meet important public interest needs, such as ‘smart city’ applications like video cameras, pollution monitors, and gunshot sensors.”

<sup>46</sup> UTC Comments at 4.

<sup>47</sup> Rajant Comments at 4.

<sup>48</sup> *Id.*

<sup>49</sup> *Id.* at 5.

manufacturing sector and in the global and U.S. economies more generally.<sup>50</sup> The Commission should stay the course at 3.5 GHz and take advantage of this unique opportunity to bolster a vital part of the U.S. economy.

**B. Census-Tract Licensing Will Promote the Development of 5G Wireless Services in the United States and Globally**

The Commission’s innovative census-tract licensing framework at 3.5 GHz positions the United States as a global leader in the development of 5G and next-generation wireless applications. While 2G, 3G, and 4G focused on incremental improvements to conventional commercial mobile operations, the more compelling vision for 5G involves a broad-based, heterogeneous ecosystem that includes a diversity of new innovators and existing operators, technology vendors, and spectrum users. As the Open Technology Institute and Public Knowledge describe in their comments, “the ‘5G’ wireless ecosystem . . . will rely on a combination of national or regional carrier networks . . . and a far larger number of complementary, high-capacity and customized networks deployed by individual business firms,

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<sup>50</sup> For instance, Accenture estimates that IIoT could add \$14.2 trillion to the global economy by 2030, and projects that the U.S. economy will gain at least \$6.1 trillion in cumulative U.S. GDP by that same year. Paul Daugherty and Bruno Berthon, *Winning with the Industrial Internet of Things: How to Accelerate the Journey to Productivity and Growth*, ACCENTURE, at 2-3 (2015), [https://www.accenture.com/t00010101T000000Z\\_\\_w\\_\\_/\\_at-de/\\_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub\\_11/Accenture-Industrial-Internet-of-Things-Positioning-Paper-Report-2015.ashx](https://www.accenture.com/t00010101T000000Z__w__/_at-de/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_11/Accenture-Industrial-Internet-of-Things-Positioning-Paper-Report-2015.ashx). In addition, IndustryARC projects that the global IIoT market will reach \$123.89 billion by 2021, while Markets and Markets estimates that the IIoT’s market value will climb to \$195.47 billion by 2022, with an annual growth rate of approximately eight percent. See *The Industrial Internet of Things (IIoT): the Business Guide to Industrial IoT*, I-SCOOP, <https://www.i-scoop.eu/internet-of-things-guide/industrial-internet-things-iiot-saving-costs-innovation> (last visited Jan. 29, 2018); *Industrial IoT Market by Device & Technology (Sensors, RFID, Industrial Robotics, DCS, Condition Monitoring, Smart Meters, AHS, Camera System, Networking Technologies), Software (PLM Systems, MES, SCADA), Vertical, and Geography – Global Forecast to 2022*, MARKETSANDMARKETS, at Summary (Feb. 2017), <http://www.marketsandmarkets.com/Market-Reports/industrial-internet-of-things-market-129733727.html>.

property managers and individual households to meet their particular needs at a lower cost.”<sup>51</sup>

Rajant similarly emphasizes the heterogeneity of 5G applications, pointing out that “5G is not a single use case of enhanced Mobile Broadband. 5G includes the use case of massive MachineType Communications, more commonly referred to as Internet of Things and Ultra-Reliable Low Latency Communications, like remote surgery or driverless cars.”<sup>52</sup> 5G innovation will likely be driven not only by major carriers and broadband operators, but also by a mix of smaller carriers, industrial operators, varied enterprises, and other unexpected contributors with specialized and cutting-edge business models that can trigger U.S. economic growth and advance U.S. leadership on 5G.

The Commission’s current CBRS framework is consistent with this 5G vision. In contrast to PEA-based PALs, census-tract PALs will generate myriad use cases initiated by a range of businesses and other 3.5 GHz users, including GE and other IIoT providers, WISPs, hospitals, commercial real estate interests, hotels and resorts, state and local government agencies, and educational institutions. This diverse, vibrant CBRS ecosystem – including IIoT developers and users – should support the development of networks that deliver upon the promise of 5G through exponential improvements to achieve lower latency, Gigabit data throughputs, and more connectivity options for automating industrial operations. While it is true that CBRS alone cannot deliver the full benefits of 5G, the Commission’s unique framework at 3.5 GHz can serve as a significant driver toward this goal. Moreover, if the Commission’s CBRS licensing structure is

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<sup>51</sup> OTI/PK Comments at 20-21.

<sup>52</sup> Rajant Comments at 3 (citing ITU-R, Radiocommunication Sector of ITU, Recommendation ITU-R M.2083-0, *IMT Vision – Framework and Overall Objectives of the Future Development of IMT for 2020 and Beyond*, at 12, Figure 2 (Sep. 2015), [https://www.itu.int/dms\\_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf](https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf).

successful, the 3.5 GHz band in the United States will become a template for innovative spectrum management and 5G development, not only in this country but globally.

**C. Census-Tract Licensing Will Generate Greater Economic Utility and Spectrum Efficiency Than PEA-Based Licensing**

As a number of commenters point out, census-tract licensing in the 3.5 GHz band will generate greater economic utility and spectrum efficiency than PEA-based licensing. Non-traditional licensees holding census-tract PALs would have no incentive to warehouse and waste spectrum in rural and remote areas.<sup>53</sup> By contrast, Microsoft states that, under PEA-based licensing, “large amounts of spectrum in less densely populated areas within larger geographic areas will, at worst, go unused, and at best, be relegated to unprotected General Authorized Access status,”<sup>54</sup> while the Open Technology Institute and Public Knowledge point out that “[l]icense areas as large as PEAs, or even as large as counties, are likely to leave the spectrum unused for many years, and perhaps indefinitely, in low-density and hence low-ARPU environments outside of central urban areas, shopping districts and well-trafficked venues.”<sup>55</sup>

Given limited signal propagation in the 3.5 GHz band for wide-area networks, major wireless carriers will likely use CBRS spectrum for small-cell deployments and additional capacity in densely populated areas, not for macro-cellular coverage. Assuming this usage model, Google offers evidence that, under PEA-based licensing, these carriers would likely provide signal coverage to only a fraction of their PEA license areas. Based on Google’s field tests, a carrier would have to deploy 1,271 high-power base stations to cover even half of a

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<sup>53</sup> See Comments of Blooston Rural Carriers at 5-6; Comments of Frontier Communications Corporation, Windstream Services, LLC, and Consolidated Communications, Inc. at 3 (“Frontier et al. Comments”); Comments of GigaBeam Networks, LLC at 2 (“GigaBeam Comments”).

<sup>54</sup> Microsoft Comments at 5.

<sup>55</sup> OTI/PK Comments at 27.

typical PEA at 3.5 GHz.<sup>56</sup> Given the unlikely nature of such extensive network investments, it appears almost certain that traditional operators would end up with extensive fallow areas outside their core deployment areas. Despite the obvious risk of such spectrum warehousing, the major carrier proponents of PEA-based licensing “have failed to provide specific service and deployment plans and explain how PEA-sized licenses are necessary to the success of those plans, and additionally how they will make efficient utilization of all the areas covered by PEA sized licenses (*i.e.* urban, suburban, and rural).”<sup>57</sup>

The Commission’s existing census-tract framework will enable operators and spectrum users to match their wireless deployment plans with geographically tailored spectrum assets, thereby maximizing spectrum use and value.<sup>58</sup> Census-tract licensing allows for a much more precise fit between the geographic license area and the likely uses of the 3.5 GHz band.<sup>59</sup> GE, its IIoT customers, and other diverse users will make intensive use of their licensed spectrum with targeted, localized wireless network deployments across a variety of geographies that will generate jobs and economic growth, including in rural and remote areas. As the City of New York observes, “[s]maller license areas will make for more efficient use of spectrum,” since “[t]hey help ensure that licenses will be held only by providers who intend to use them in particular areas.”<sup>60</sup> GE further agrees with Google that “the far more efficient [licensing] solution in the 3.5 GHz band would be to retain census-tract-sized license areas and allow carriers as well

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<sup>56</sup> Google Comments at 4.

<sup>57</sup> Ruckus Comments at 12-13.

<sup>58</sup> *Id.* at 11.

<sup>59</sup> Under this approach, parties will not be forced to purchase spectrum in areas where they lack build-out plans.

<sup>60</sup> NYC Comments at 3.



as other operators with different business models and deployment plans to acquire spectrum in the locations where they will actually use it.”<sup>61</sup>

Unlike PEA-based licensing, census-tract licensing will put CBRS licenses into the hands of the parties that value this spectrum the most. Entities that are pursuing geographically targeted deployments – such as private LTE networks at manufacturing plants and other industrial facilities – likely value the spectrum at such locations more than a traditional carrier. As Google points out, while PEA licenses would draw higher absolute prices at auction, “would-be licensees excluded from the market would likely have placed a greater value per square kilometer or per population in their geographic area of interest than the entity that ultimately prevails at auction. A factory owner, for example, may value the spectrum that covers its facility and nearby areas far more than a large carrier would.”<sup>62</sup>

While some traditional carriers claim that the presence of GAA operations at 3.5 GHz would moot spectrum efficiency concerns for PEA-based licensing,<sup>63</sup> this is not the case. Unlicensed, unprotected GAA operations are not a substitute for PAL operations. PEA PAL licensees would likely waste their *interference-protected* spectrum across much of their PEAs, in the process preventing other more efficient spectrum uses that would benefit from PAL interference protection. As Southern LINC describes in its comments, “PALs confer the benefits of access to a guaranteed amount of spectrum on a protected basis, which are not available to users of the band on an opportunistic GAA basis. The foreclosure is therefore not

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<sup>61</sup> Google Comments at 7. Ruckus similarly states that “PAL license size should support these targeted deployments by operators, allowing them to focus on those areas where they need capacity (i.e., the metropolitan areas), instead of having license sizes so large that operators end up with fallow areas outside their desired target geographies.” Ruckus Comments at 10.

<sup>62</sup> Google Comments at 12.

<sup>63</sup> Verizon Comments at 7; AT&T Comments at 5; CTIA Comments at 7-8; USCC Comments at 8.

from the band itself, but from the ability or opportunity to obtain the benefits of the use of the band on a PAL basis.”<sup>64</sup>

**D. Census-Tract Licensing at 3.5 GHz Will Have Important Public Interest Benefits for U.S. Critical Infrastructure and Rural Broadband**

GE agrees with commenters who point to the inherent value of an alternatively licensed “innovation band” that yields public interest benefits even beyond a quantitative economic impact. As Southern LINC observes, “from a public interest and public policy standpoint, potential future investment in a specific commercial use case and other ‘dollar-based’ metrics are not necessarily indicative as to whether the nation’s spectrum resources are in fact being put to their most valuable use.”<sup>65</sup> The Commission needs to “ensure that the nation’s spectrum resources are being managed in way that . . . ‘provide[s] long-lasting value to society as a whole.’”<sup>66</sup>

GE and other commenters point out that the existing CBRS framework will produce significant public safety benefits for the nation’s critical infrastructure.<sup>67</sup> Census-tract licensing and geographically targeted IIoT deployments will help ensure the resiliency, reliability, safety, and efficiency of utilities and other critical-infrastructure facilities. Enhanced IIoT capabilities will help critical-infrastructure entities to prevent serious system failures and proactively avoid life-threatening and high-risk scenarios. These are important public policy goals given the crucial nature of these facilities, which provide safe transport, clean water, electricity, oil and gas power, nuclear energy, and other important societal resources. Private wireless networks at these facilities must maintain communications

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<sup>64</sup> Southern LINC Comments at 13.

<sup>65</sup> *Id.* at 8-9.

<sup>66</sup> *Id.* at 9.

<sup>67</sup> *See, e.g.*, GE Comments at 30-33; UTC Comments at 3-4.

capabilities during natural disasters and other emergencies and support connectivity in remote areas beyond commercial coverage.<sup>68</sup>

Numerous parties observe that the existing CBRS framework will also generate substantial public interest benefits for rural communities around the United States.<sup>69</sup> As WISPA describes, “With 23 million rural Americans unconnected to the digital economy, our nation faces the challenge of finding ways to bridge the digital divide.”<sup>70</sup> The most cost-effective and expeditious means of making affordable broadband service available in these rural areas is through fixed wireless technology, and the 3.5 GHz band is ideal spectrum for the provision of such rural wireless broadband offerings.<sup>71</sup> Under the current CBRS rules, “[h]undreds of existing small broadband providers are standing ready to invest private, at-risk capital to put this spectrum to use to help connect the unconnected, and indeed, many have invested significant resources to do so.”<sup>72</sup> A shift to PEA-based licensing would effectively prevent these providers from participating in PAL spectrum auctions, “thereby depriving millions of rural Americans

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<sup>68</sup> CBRS will deliver the cost-effective capacity and functionality necessary to support low-latency, data-intensive IIoT wireless operations using localized (and often self-provisioned) private LTE networks. Enhanced IIoT capabilities will enable critical-infrastructure entities to prevent serious system failures and proactively avoid life-threatening and high-risk scenarios.

<sup>69</sup> See, e.g., Comments of Cal.net, Inc. at 6-7; Frontier et al. Comments at 5-7; GigaBeam Comments 2; RWA Comments at 4.

<sup>70</sup> WISPA Comments at iv.

<sup>71</sup> As described in a recent analysis from The Carmel Group, fixed wireless broadband access can be deployed at one-seventh the capital expense of fiber-to-the-home and about one-fourth the capital expense of cable broadband. See Jimmy Schaeffler, *Ready for Takeoff: Broadband Wireless Access Providers Prepare to Soar with Fixed Wireless*, *The BWA Industry Report: 2017*, THE CARMEL GROUP (Sept. 2017), [https://carmelgroup.com/wp-content/uploads/2017/12/TCG\\_2017\\_BWA\\_Full\\_Report.pdf](https://carmelgroup.com/wp-content/uploads/2017/12/TCG_2017_BWA_Full_Report.pdf). In addition, in his December 28, 2017 report, Dr. William Lehr stated that “using fixed wireless instead of wired broadband to solve our rural broadband problem could save the U.S. economy upwards of \$30 billion to \$60 billion in investment.” Lehr Analysis at 20-21.

<sup>72</sup> WISPA Comments at v.

that lack access to fixed broadband service of the best and most expeditious means by which they can obtain affordable access to high-quality broadband service in their homes.”<sup>73</sup> The Commission should avoid this “sharp stick in the eye” of rural America.<sup>74</sup>

**E. Under Census-Tract Licensing, the Major Wireless Carriers Will Be Able to Utilize the 3.5 GHz Band to Help Meet Their Wireless Capacity Needs**

In their comments, the large wireless carriers complain that census-tract licensing will make it difficult for them to maximize their use of the 3.5 GHz band.<sup>75</sup> In fact, census-tract licensing will do nothing to prevent carriers from using CBRS spectrum to satisfy their wireless capacity needs in high-traffic areas.<sup>76</sup> As many commenters point out, the major carriers will be able to aggregate census tracts to cover large contiguous areas. Microsoft states that “[b]ecause census tracts nest into counties, and counties nest into PEAs, an operator interested in serving a larger area can do so by bidding on multiple census tracts.”<sup>77</sup> Similarly, Southern LINC

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<sup>73</sup> *Id.* at 1-2. Given the benefits of census-tract licensing for rural broadband development, the Commission’s existing CBRS framework is consistent with recent Trump Administration efforts to stimulate rural broadband development. *See Presidential Executive Order on Streamlining and Expediting Requests to Locate Broadband Facilities in Rural America*, Jan. 8, 2018, <https://www.whitehouse.gov/presidential-actions/presidential-executive-order-streamlining-expediting-requests-locate-broadband-facilities-rural-america/>; *see also Presidential Memorandum for the Secretary of the Interior re: Supporting Broadband Tower Facilities in Rural America on Federal Properties Managed by the Department of the Interior*, Jan. 8, 2018, <https://www.whitehouse.gov/presidential-actions/presidential-memorandum-secretary-interior/>; Fact Sheet, *President Donald J. Trump Is Working to Revitalize Rural America*, Jan. 8, 2018, <https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-working-rebuild-rural-america/>.

<sup>74</sup> WISPA Comments at 2.

<sup>75</sup> *See* Verizon Comments at 10-11; AT&T Comments at 5-6; T-Mobile Comments at 9.

<sup>76</sup> Even if industrial and critical-infrastructure entities and other enterprises obtain census-tract licenses and deploy private LTE networks at 3.5 GHz, major carriers such as Verizon and AT&T will still earn revenue and benefit from such operations, because they typically own the backbone facilities that connect such private networks to the Internet and the public switched telephone network.

<sup>77</sup> Microsoft Comments at 5.

observes that “[i]n addition to enabling targeted, local, and rural deployments, licensing on a census tract basis would still allow those seeking to cover larger geographic areas to do so by combining multiple census tracts in a way that would still enable more efficient and tailored deployment than would be possible through the use of PEAs.”<sup>78</sup> Furthermore, GE agrees with the Open Technology Institute and Public Knowledge that “it would be far easier for carriers to assemble larger contiguous areas by acquiring census tracts than it would be for hundreds or thousands of other potential users to either win a PEA or county license at auction.”<sup>79</sup>

Of course, outside 3.5 GHz, the major nationwide carriers have spectrum across a variety of frequency bands that can be used to meet capacity requirements in their core business areas. For instance, in addition to their deep spectrum inventories in established commercial mobile spectrum bands, Verizon and AT&T now have or are acquiring significant spectrum assets in the millimeter wave bands that were the subject of the Commission’s “Spectrum Frontiers” rulemaking over the past two years.<sup>80</sup> Carriers will also be able to use License Assisted Access (“LAA”) and MulteFire technology in free, unlicensed 5 GHz spectrum to gain additional

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<sup>78</sup> Southern LINC Comments at 15.

<sup>79</sup> OTI/PK Comments at 6. In its comments, Starry, Inc. similarly observes that “the marginal cost of a bidder designing an auction bidding strategy to aggregate smaller license areas is likely far less than the cost of negotiating with potentially hundreds of other users to partition or disaggregate portions of their licenses.” Starry Comments at 5.

<sup>80</sup> *Application of Cellco Partnership d/b/a Verizon Wireless and XO Holdings for Consent to Transfer Control of Local Multipoint Distribution Service and 39 GHz Licenses*, Memorandum Opinion and Order, 32 FCC Rcd 10125 (2017); *Application of Verizon Communications Inc. and Straight Path Communications, Inc. for Consent to Transfer Control of Local Multipoint Distribution Service, 39 GHz, Common Carrier Point-to-Point Microwave, and 3650-3700 MHz Service Licenses*, ULS File No. 0007783428, Memorandum Opinion and Order, DA 18-52 (rel. Jan. 18, 2018); Public Notice, *AT&T Mobility Spectrum LLC and FiberTower Corporation Seek FCC Consent to the Transfer of Control of 24 GHz and 39 GHz Licenses*, 32 FCC Rcd 1932 (2017). See also *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (2016).

capacity in high-traffic areas. Finally, the Commission this year will likely initiate a rulemaking proceeding on expanded terrestrial wireless use of other mid-band spectrum, including the 3.7-4.2 GHz band.<sup>81</sup>

As the Commission considers its licensing approach at 3.5 GHz, it should bear in mind that, for the traditional wireless carriers, CBRS represents just another potential block of spectrum in their wide-ranging commercial portfolios. Just like a host of other spectrum bands, the 3.5 GHz band can be integrated into major carriers' national multi-band networks in order to bolster their wide-area, macro-cellular networks in selected locations. While the major carriers would gain from control of this additional spectrum, their marginal benefit would be only nominal given the extent of their spectrum holdings elsewhere. In contrast, for non-traditional users, the CBRS band represents a rare and perhaps one-time opportunity to access licensed spectrum. As the Dynamic Spectrum Alliance explains, "unlike large mobile carriers, these enterprise and industrial users will not have the benefit of aggregating CBRS spectrum (whether PAL or GAA) with exclusively licensed spectrum on other bands. For large service providers, PALs represent *additional capacity* to augment carrier aggregation in high traffic and high ARPU areas – and not the single and only opportunity to customize an internal IoT or other network that incorporates at least a modest amount of interference-protected bandwidth."<sup>82</sup> For

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<sup>81</sup> See *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, 32 FCC Rcd 6373 (2017) ("*Mid-Band NOI*"). Contrary to T-Mobile's suggestion, any delay in that mid-band spectrum proceeding does not justify revision of the Commission's fundamentally sound licensing framework in the nearby CBRS band. T-Mobile Comments at 3.

<sup>82</sup> DSA Comments at 20-21. Similarly, the Open Technology Institute and Public Knowledge state that "unlike the big mobile carriers, WISPs (who typically rely on unlicensed spectrum) and new enterprise and industrial users will not have the benefit of aggregating CBRS spectrum (whether PAL or GAA) with exclusively licensed spectrum on other bands. For large [carriers], PALs represent *additional capacity* to augment carrier aggregation in high traffic and high ARPU areas – and not the single and only opportunity to customize an internal IoT, neutral

industrial and critical-infrastructure entities seeking to maximize use of the IIoT, the marginal benefits from the existing CBRS framework are potentially enormous.

#### **IV. LIKE PEAS, COUNTIES ARE TOO LARGE FOR PAL LICENSING AT 3.5 GHz**

GE appreciates the cable industry’s recognition of the harms of PEA-based licensing at 3.5 GHz and the efforts by NCTA and cable operators to identify an alternative licensing approach for CBRS.<sup>83</sup> The county-based licensing framework favored by these cable commenters, however, would have largely the same effects as a PEA-based scheme. As GE described in its comments, counties are much larger than census tracts, on average holding approximately 23 times the population of census tracts and often encompassing thousands of square miles.<sup>84</sup> Thus, county-sized licenses are far too large for geographically targeted CBRS deployments, and the cost of county-based PALs would be well beyond what GE’s industrial and critical-infrastructure customers are willing to spend. OTI states that “[a]s a practical matter, PALs the size of counties would exclude virtually all other small wireless operators and use cases from acquiring interference protection as a cornerstone of a 3.5 GHz deployment,”<sup>85</sup> while WISPA observes that “county-sized licenses, especially in Western states, remain too large for localized deployments that are better suited – and in many cases only suited – for census tract deployment.”<sup>86</sup> County-based PAL licensing would leave licensed CBRS spectrum under the control of large wireless carriers and established broadband operators, similar to the outcome under a PEA-based licensing approach.

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host, or private LTE network that incorporates at least a modest amount of interference-protected bandwidth.” OTI/PK Comments at 32.

<sup>83</sup> See NCTA Comments at 3-6; Comcast Comments at 4-11.

<sup>84</sup> GE Comments at 5 n.4.

<sup>85</sup> OTI/PK Comments at 24.

<sup>86</sup> WISPA Comments at 28.

## V. CENSUS-TRACT LICENSING IS NOT TOO COMPLEX TO IMPLEMENT AND ADMINISTER

Contrary to major carriers' claims, the Commission, SAS developers, and PAL licensees will be able to implement and administer census-tract licensing at 3.5 GHz without difficulty.<sup>87</sup> Concerns regarding the complexity of the existing licensing framework are not valid and should not push the Commission toward PEA-based licensing.

Following the successful Broadcast Incentive Auction earlier this year – likely the most complex spectrum auction ever – the Commission is well positioned to design and execute an auction of census-tract PALs in the CBRS band.<sup>88</sup> As Starry, Inc. points out, “The Commission has decades of experience creating auctions that are tailored to solve a variety of complicated auction problems, and holding an auction with a large number of licenses is very solvable.”<sup>89</sup> GE agrees with Starry that any issues relating to census-tract auction structure “should properly be addressed through the Auction Comment Public Notice and should not drive a policy decision about the license size.”<sup>90</sup>

The experts who have commented on census-tract auctions agree that the Commission can successfully manage a census-tract auction. Paul Milgrom – professor of economics at Stanford University and an advisor on spectrum auctions in the United States and around the world – has previously stated that “[t]he characteristics of the 3.5 GHz spectrum and the FCC’s priority licensing scheme obviate the need for the relatively complex auction designs that have

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<sup>87</sup> See Verizon Comments at 12; AT&T Comments at 5; CTIA Comments at 8; USCC Comments at 4-5.

<sup>88</sup> See generally Public Notice, *Incentive Auction Closing and Channel Reassignment Public Notice*, 32 FCC Rcd 2786 (2017) (DA017-314).

<sup>89</sup> Starry Comments at 7.

<sup>90</sup> *Id.*



been used to sell licenses for other frequencies.”<sup>91</sup> In addition, Verizon’s own economic expert, Dr. Daniel Vincent, in his comments “agree[s] with Professor Paul Milgrom that auctions of license areas that number even as high as 70,000 should be computationally feasible for common auction mechanisms.”<sup>92</sup>

Many commenters also concur that census-tract licensing of PALs will not create undue interference risks or lead to unmanageable challenges for SAS administrators.<sup>93</sup> Developers and future administrators of SAS have made clear that their technologies are fully capable of managing the RF environment resulting from the Commission’s census-tract licensing framework.<sup>94</sup> In its comments, Federated Wireless states that “[n]one of the issues raised in the NPRM affect SAS and ESC functionality and, as a result, the Commission can – and, indeed, should – do all it can to support final certification of SAS administrators and ESC operators by June 30, 2018, whether or not the items under consideration in the NPRM are resolved.”<sup>95</sup>

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<sup>91</sup> Letter from Paul Milgrom, Auctionomics, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 12-354, at 7 (Aug. 8, 2017) (“Milgrom *Ex Parte*”). Milgrom points out that the strong complement and substitute relationships for spectrum licenses in other commercial mobile bands are not a significant consideration in the 3.5 GHz band.

<sup>92</sup> Vincent Comments at 6.

<sup>93</sup> See, e.g., Microsoft Comments at 6; WISPA Comments at 36-38; Cantor Comments at 8.

<sup>94</sup> While SAS developer Sony has observed that census-tract licensing requires somewhat more sophisticated spectrum management than PEA-based assignments, it states that “the difference between the two approaches is minor and entirely manageable with a sufficiently robust database implementation.” Comments of Sony Corporation, GN Docket No. 12-354, at 2 (July 21, 2017).

<sup>95</sup> Federated Wireless Comments at 2. In its comments, Federated Wireless indicates that it has conducted more than thirty technical trials, with important field trials underway with a variety of CBRS stakeholders; it has over 200 CBSDs on the air and connected to its SAS; it is also processing more than 18,000 spectrum grant requests per week. *Id.* at 3.

There is no merit to some carriers' claims that census-tract licensing at 3.5 GHz would result in guard bands or inefficient "buffer zones" at census-tract border areas.<sup>96</sup> As Ruckus points out, "In the 3.5 GHz CBRS band the PAL-to-PAL border protections are dynamically coordinated by the SAS, resulting in virtually no administrative burden to the licensees."<sup>97</sup> Union Pacific further states that "SAS operations protect users from interference based on the actual location and coverage of transmitters, not license boundaries; thus, the complexity and effectiveness of such operations is largely disconnected from PAL boundaries."<sup>98</sup> Because SAS manages interference on a highly granular, device-by-device basis, the size of the PAL license area has virtually no effect on the complexity of SAS activity or licensee protections.<sup>99</sup>

Finally, contrary to the claims of one PEA proponent, the Commission's ULS wireless licensing database is well equipped to manage 500,000 plus PAL licenses in the CBRS band.<sup>100</sup> GE agrees with Microsoft that "[m]odern databases can easily keep track of tens of thousands of licenses, so neither the Commission nor the SAS administrators should be overwhelmed by the auction of census tract licenses."<sup>101</sup> With respect to licensees, the major carriers already manage thousands of wireless licenses, and these companies have existing internal systems that

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<sup>96</sup> See CTIA Comments at 8-9; Verizon Comments at 10; USCC Comments at 6; T-Mobile Comments at 9.

<sup>97</sup> Ruckus Comments at 11.

<sup>98</sup> Union Pacific Comments at 10.

<sup>99</sup> As Google has previously explained, interference protection results from a PAL licensee's actual deployment of one or more CBRS devices ("CBSD"); an SAS protects a PAL licensee's claimed actual service area, which is based on calculations of CBSD signal coverage. Since the protected area is not defined by the PAL's formal boundaries, the abundance of PAL border territory in a census-tract framework will not unduly complicate SAS management of this band. See Comments of Google Inc. and Alphabet Access, GN Docket No. 12-354, at 25 (July 24, 2017).

<sup>100</sup> See Verizon Comments at 12.

<sup>101</sup> Microsoft Comments at 6.

will enable them to administer 3.5 GHz wireless networks covering hundreds or thousands of census tracts.

In any event, an interest in greater administrative convenience does not justify passing up what could be a one-time opportunity in U.S. spectrum policy to boost the industrial, manufacturing, and critical-infrastructure sectors in this country and spark substantial economic growth. Even if census-tract auctions absorb more administrative resources than other licensing alternatives, the enormous economic and public interest benefits of the existing licensing framework at 3.5 GHz far outweigh those additional costs.

## **VI. CONCLUSION**

For all of the reasons described in these Reply Comments, GE again urges the Commission to retain census-tract licensing in the 3.5 GHz band. Census-tract licensing will encourage a broad range of parties to develop dynamic, diverse uses of the CBRS band. Under the current framework, the IIoT will thrive in this band and trigger rapid growth in the U.S. industrial, manufacturing, and critical-infrastructure sectors, already critical engines of productivity for the U.S. economy. Far from being the typical spectrum “tug of war” between competing telecommunications stakeholders, this proceeding thus has the unique potential to elevate a crucial part of the U.S. economy. The Commission should not forego this rare

opportunity in U.S. economic and spectrum policy merely so it can fashion another standard commercial band for already-dominant wireless carriers.

Respectfully submitted,

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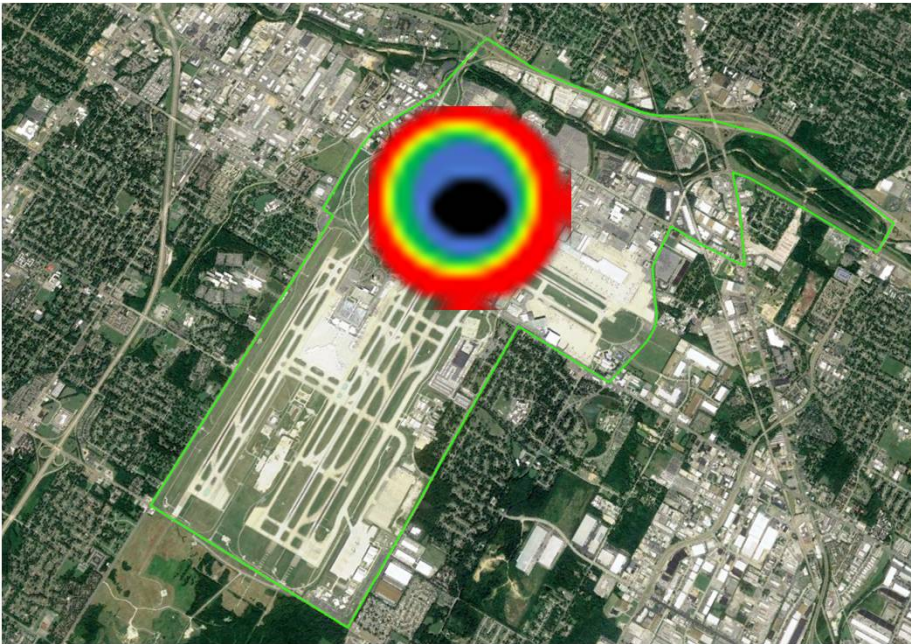
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January 29, 2018

## **Exhibit A**

## Private LTE Network Aircraft Operations and Maintenance

Defined coverage of an outdoor Category B CBSD private LTE network deployment for aircraft operations and maintenance services and support at an airport compared to the census tract containing the network (Green). The deployment site is approximately 2.4 km across.



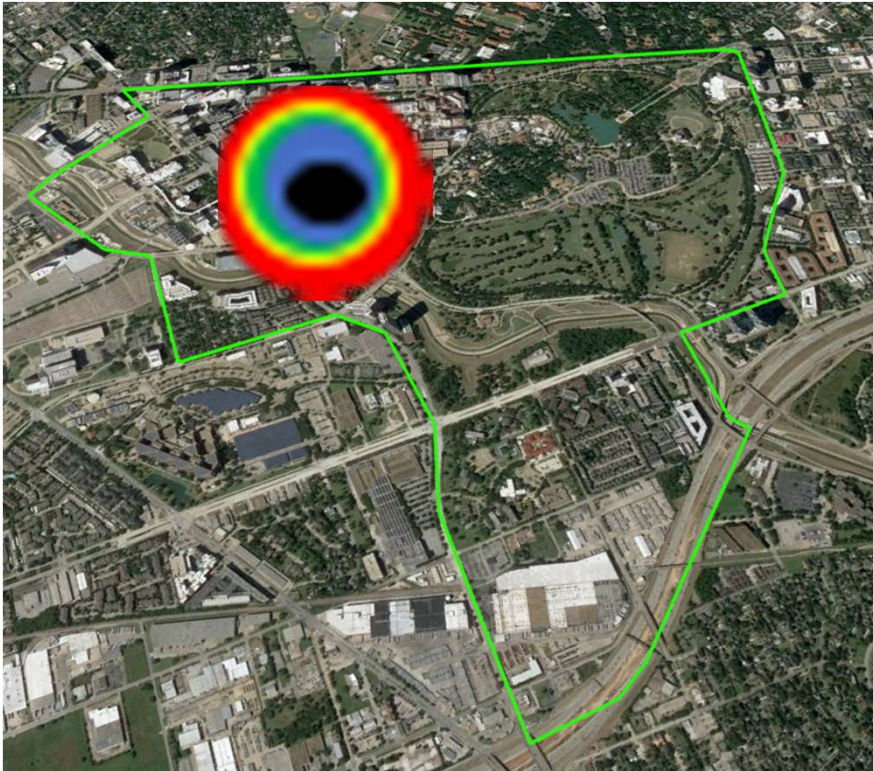
Comparison of the census tract containing the private LTE network at the airport (Green) to PEA (Red), which includes the entire city and the surrounding area





## Private LTE Network Hospital

Defined coverage of an indoor Category A CBSD private LTE network deployment at a hospital compared to the census tract containing the network (Green). The deployment site is approximately 1 km across.



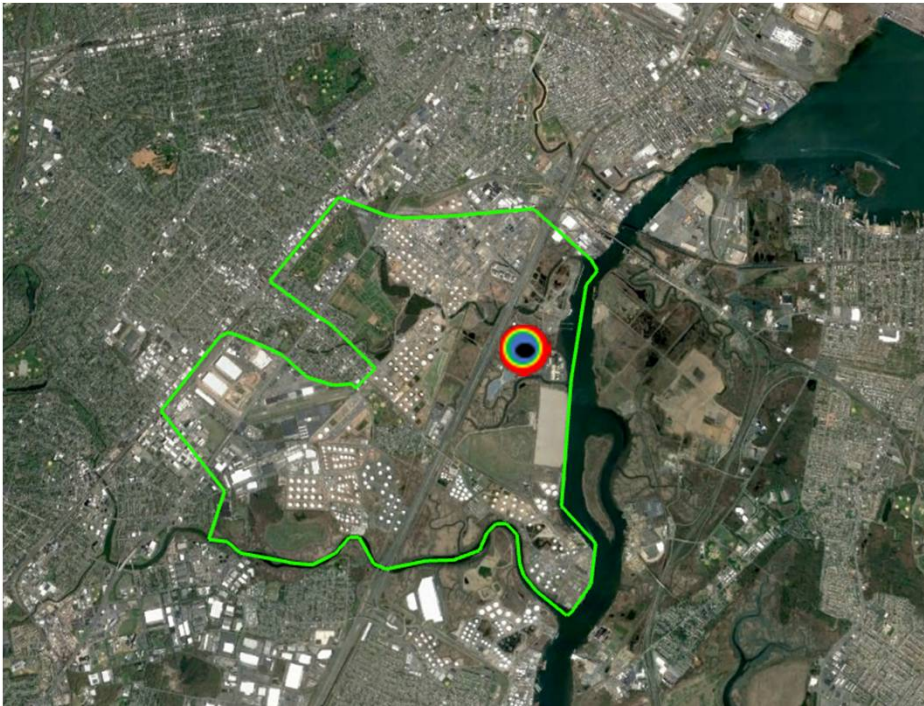
Comparison of the census tract containing the hospital private LTE network (Green) to PEA (Red), which includes the entire city and the surrounding area.





## Private LTE Network Power Utility

Defined coverage of an outdoor Category B CBSD private LTE network deployment at a utility service provider compared to the census tract containing the network (Green). The deployment site is about 1 km across.



Comparison of the census tract containing the private LTE network for the utility service provider (Green) to PEA (Red), which includes the entire city and the surrounding areas.

