Edison Electric INSTITUTE

Power by Association℠

April 15, 2020

Via Electronic Filing

Marlene H. Dortch, Secretary
Federal Communications Commission
445 Twelfth Street, SW
Washington, DC 20554

Re: Ex Parte Notice: In the Matter of Unlicensed Use of the 6 GHz Band (ET Docket No. 18-295) and In the Matter of Expanding Flexible Use in the Mid-Band Spectrum Between 3.7 and 24 GHz (GN Docket No. 17-183)

Dear Ms. Dortch:

The Edison Electric Institute ("EEI"), American Gas Association ("AGA"), American Public Power Association ("APPA"), American Water Works Association ("AWWA"), National Rural Electric Cooperative Association ("NRECA"), Nuclear Energy Institute ("NEI"), and Utilities Technology Council ("UTC"), each representing their respective critical infrastructure industry ("CII") members, hereby respond to the draft Report and Order and Further Notice of Proposed Rulemaking ("Draft Order") currently on circulation and below request certain changes be made to the text of any final Order so that the formal record of our communications with the Commission, and particularly the Office of Engineering and Technology ("OET"), is complete.[1]

The record here does not support the conclusion in the Draft Order that allowing unlicensed operations without requiring automated frequency coordination ("AFC") for both indoor and outdoor operations poses a low probability of harmful interference to licensed operations in the 6 GHz band. As we have explained throughout this proceeding and shown in our CII User Study, the probability of interference to mission critical licensed communications systems from unlicensed operations to microwave systems in the 6 GHz band is high. As a matter of probability, unlicensed advocates themselves predict the deployment and operation of millions if not billions of unlicensed devices in the band. The combination of this vast number of devices, the bandwidth of their operation, the duty cycle of their transmissions, and that most will not be identifiable or controllable after sale, make harmful interference a virtual certainty.

[1] *Unlicensed Use of the 6 GHz Band*, ET Docket No. 18-295, GN Docket No. 17-183, Report and Order and Further Notice of Proposed Rulemaking, FCC-CIRC2004-01 (rel. Apr. 2, 2020) (*Draft Order*).

The magnitude of the risk from this interference cannot be overstated. Without AFC for low power indoor operations, and with no realistic ability to locate and request termination of any one device or a cluster of devices causing a network outage, these devices will cause interference to public safety and CII licensed networks, the safety of life, health and property of emergency personnel, utility companies, and other critical infrastructure industries, which in turn can lead to power outages, wildfires, and other potential disasters. Accordingly, the failure to require AFC for indoor unlicensed operations in the Draft Order poses an unacceptable risk to licensed mission critical communications systems and the underlying essential and life-saving services that they help to support.

Instead, the Commission should (1) adopt a robust AFC for unlicensed low power indoor operations, as well as standard power outdoor unlicensed operations; (2) require thorough market testing of unlicensed low power devices under real-world conditions before such devices can be marketed and operated; (3) require the formation a multi-stakeholder group structured with proactive participation by OET and open eligibility and representation from all the incumbent licensed stakeholders in the band to ensure the development of technical capabilities and processes to remediate and rectify harmful interference; and (4) revisit and revise its rules if harmful interference is not prevented from occurring.

The text of the Draft Order unduly minimizes our recent technical study and related submissions in the docket. Specifically, paragraph 138 of the Draft Order not only dismisses our January 13, 2020, Study on the "Impact of Proposed Wi-Fi Operations on Microwave Links At 6 GHz" (hereinafter, the "CII User Study" or "Study"),[2] it fails to appropriately acknowledge our subsequent participation though numerous technical dialogues with OET, as well as our comprehensive technical submissions clarifying, responding to criticisms, and defending the Study.[3] Below we recap our recent technical submissions and request that the Commission revise the Draft Order to fully reflect our responses to the four critiques identified in paragraph 138.

1. *"Even though [the CII Study] incorporates specific access point behavior into the simulation, including activity factor, transmit speed, and availability of other Wi-Fi bands, it also made certain assumptions that significantly detract from its value. For*

[2] Roberson & Associates, LLC, *Impact of Proposed Wi-Fi Operations on Microwave Links at 6 GHz* (2019) (*CII User Study*). *See also* Letter from EEI, AGA, APPA, AWWA, NRECA, NEI, and UTC to Marlene H. Dortch, Secretary, FCC Docket Nos. 18-295, 17-183 (Jan. 13, 2020) (*CII Letter*).

[3] Letter from EEI to Marlene H. Dortch, Secretary, FCC Docket Nos. 18-295, 17-183 (Mar. 30, 2020); Letter from EEI and UTC to Marlene H. Dortch, Secretary, FCC Docket Nos. 18-295, 17-183 (Mar. 30, 2020); Letter from EEI, NRECA, AGA, UTC, APPA, NEI and AWWA to Marlene H. Dortch, Secretary, FCC Docket Nos. 18-295, 17-183 (Feb. 7, 2020); Letter from EEI, UTC and APPA to Marlene H. Dortch, Secretary, FCC Docket Nos. 18-295, 17-183 (Jan. 24, 2020); Letter from EEI to Marlene H. Dortch, Secretary, FCC Docket Nos. 18-295, 17-183 (Dec. 11, 2019); Letter from EEI, UTC, AGA, API, AWWA, AAR, APPA, IAFC, GWTCA, NRECA, NEI and 58 other individual industry stakeholders to Marlene H. Dortch, Secretary, FCC Docket Nos. 18-295, 17-183 (Nov. 18, 2019); Letter from EEI, UTC, NRECA, APPA, and AWWA to Marlene H. Dortch, Secretary, FCC Docket Nos. 18-295, 17-183 (May. 17, 2020); EEI, UTC, NRECA, APPA, API and AWWA Reply Comments, FCC Docket Nos. 18-295, 17-183 (Mar. 18, 2019); EEI, UTC, NRECA, APPA, API and AWWA Comments, FCC Docket Nos. 18-295, 17-183 (Feb. 15, 2019).

example, [the CII study] assumes both outdoor operations and power levels that we do not allow for low-power indoor operations."

This critique reflects a misunderstanding of the design of the CII User Study. As we clarified in our March 20, 2020, submission, outdoor operations were properly factored into the CII User Study completely separately from indoor operations, and at RLAN power levels appropriate for their respective operations, in order to provide an accurate comparative analysis to respond to the submissions of the Wi-Fi advocates.[4] Specifically in our submission, we explained the following points:

- The Study calculated interference from indoor RLANs and outdoor RLANs separately so that the effect of each could be independently evaluated. As a result, the conclusions of the Study regarding indoor operations are based on the same parameters used in the Draft Order – namely uncontrolled operations without antenna gain operating at 30 dBm EIRP (or lower) power levels, as described in more detail in the following point below. Accordingly, the conclusions of the CII User Study regarding the impact of indoor unlicensed operations are entirely applicable and valid with respect to the potential interference from indoor unlicensed operations that would be permitted by the rules in the Draft Order. Indoor unlicensed operations without AFC will cause interference far in excess of the -6 dB receiver threshold of licensed microwave systems in the 6 GHz band, as shown in the CII User Study.
- Indoor devices are considered in the Study at a reduced power level compared to outdoor and at power spectral density ("PSD") levels that are less than or equal to those proposed by the FCC, with no transmit antenna gain.[5] The CII User Study includes antenna gain or attenuation of the victim microwave receivers as a function of the elevation angle.[6] The results showed that interference to the 2,325 microwave licensed systems in the nine-county Houston metropolitan area in excess of the desired I/N limit of -6 dB will occur (separately) from either indoor or outdoor RLANs if AFC is not used, and in particular, interference will occur from indoor RLANs without AFC even if outdoor RLANs are controlled so that their interference is avoided.

The CII User Study therefore properly calculated outdoor interference separately from indoor interference. We request that our response on this issue be reflected in the text of the final Order.

2. *As another example, in a dense urban environment like that of the city of Houston, the CII study assumes free space propagation path loss for the first kilometer, and ignores the impact of buildings, trees, terrain, and other obstructions. This assumption ignores real life conditions in Houston, and it is also inconsistent with the TIA TSB-10 F recommendation regarding use of a statistical propagation model that considers different environments such as medium-small city, large city, or suburban. TIA TSB-10*

[4] Letter from EEI, AGA, APPA, AWWA, NRECA, NEI, and UTC to Marlene H. Dortch, Secretary, FCC Docket Nos. 18-295, 17-183 (Mar. 20, 2020).

[5] *See CII User Study* at section 1, paragraph 1: "…low power for ubiquitous indoor installations (0.25 W, 0 dBi antenna)." *See also id.* at section 4.3.1, paragraph 2: "An antenna gain factor is also included; this study will use 0 dBi for indoor RLANs." This is repeated again in section 4.3.3.2.

[6] *See, e.g., id.* at Figure 5.

F is a widely recognized technical standard for sharing between fixed microwave links and other services.

The CII members submitted a Revised Technical Analysis into the record on March 20 and subsequently met with OET on March 26 to discuss their new analysis, and in both instances, this issue was discussed in detail. This revised analysis, as well as our subsequent discussion with OET and our further clarification for the record, are wholly ignored in the Draft Order. Our Revised Technical Analysis refined technical assumptions to more closely reflect "real life conditions" in the greater Houston metropolitan area.

Characterization of the entire nine-county Houston metropolitan area as uniformly "dense urban" in the Draft Order is factually incorrect and reflects a further misunderstanding of the CII User Study's intent to analyze the impact on all the 2,325 FS receivers in the greater metropolitan area. The nine-county Houston metropolitan area is hardly all dense or urban, it actually spans more than 10,000 square miles, almost the size of the entire state of Massachusetts, all the way from Galveston to Liberty and Brazoria counties.

In order to engage in the ongoing dialogue surrounding appropriate path loss models for measuring potential interference, the Revised Technical Analysis incorporated an alternate path loss model that fits the contours and characteristics of the entire Houston metropolitan area.

- The Revised Technical Analysis uses the 3GPP TR-38.901 Rural Macro path loss model, a model that is functionally the same as WINNER II relied on by unlicensed proponents, including for distances less than 1 km. Specifically, TR-38.901 includes both non-line of sight (NLOS) as well as line of sight (free space path loss) components for propagation below 1 km, as does WINNER II. For indoor RLANs, building loss is also always included. TR-38.901was developed for cellular communications modeling and inherently takes into account the impact of buildings, vegetation, and clutter. For these reasons, the criticism that the CII User Study assumes only free space propagation for distances below 1 km is entirely unfounded.
- Unlike WINNER II, TR-38.901 is validated for the relevant frequencies in the 6-7 GHz band, and for antenna heights up to 150 m, while WINNER II has not been validated for these conditions. The CII User Study modeled the Houston Metropolitan Statistical Area, and the average antenna height for victim receivers in the Houston area is 57 meters. Among available standardized path models, TR-38.901 Rural Macro model is the best fit with this antenna height.
- The model labels of "rural" and "urban" are convenient 3GPP labels for simulation studies for receiver sites in rural/suburban or urban conditions. Microwave links that we modeled in Houston are long enough to straddle rural/suburban/urban boundaries so that many of the links have victim receivers in both conditions. In such conditions, the urban receiver is pointed to a transmitter in a rural area, and the rural receiver is pointed to a transmitter in an urban area. In both cases interference originates in both types of neighborhoods. The relevant determinant for selection of a model is therefore the victim frequency band, antenna height, and environment that best represents the nine-county Houston area, and this indicates that the "rural macro" model is the best match for analysis of FS microwave interference in the greater Houston metropolitan area.

- Besides the fact that TR-38.901 is the best match for the propagation environment in the nine-county Houston area for the reasons described above, the CII User study contained a separate analysis of the unique propagation characteristics that would impact receivers in Houston's dense urban core. These propagation characteristics include: backscatter (reflection) from multi-story buildings of RLAN interference into CII receivers; direct radiation of RLAN interference into a CII receive antenna sidelobe; direct radiation of RLAN interference into a CII receive antenna backlobe. Interference analyses using these propagation mechanisms characteristic of dense urban areas showed that indoor RLANs in Houston's high-density core would cause CII receivers to experience I/N levels higher that the -6 dB threshold.[7] The criticism that the CII User Study did not take into account the propagation characteristics of dense urban environments with multi-story buildings is unfounded.
- The Draft Order contains the first mention of OET's concern that the model used in the original CII User Study does not follow TIA TSB-10 F, despite the fact that we have remained in open communication with OET since submitting our Study in January. Nevertheless, the assertion that the CII User Study does not follow TSB-10F and utilize a statistical propagation model that considers different environments is inappropriate.
    - TSB-10F provides the basis for the I/N interference criterion of -6 dB used not only in the CII User Study, but also in the interference studies of the unlicensed proponents.
    - As clarified in our March 20 submission,[8] the CII User Study assumptions account for variance in interference calculations. To summarize, the CII User Study relies on the TR-38.901 propagation model and ITU-R building entry loss values that, based on underlying statistical analysis, resolve to average values used to calculate whether the average I/N level experienced by each of the 2325 FS links in the nine-county Houston area exceeds the -6 dB I/N threshold.
    - As described above, the TR-38.901 propagation model was carefully chosen to best reflect the different propagation environments across the greater Houston metropolitan area to facilitate the assessment of the average I/N that would be experienced by all 2325 CII receivers.
    - While TSB-10F is definitive for the interference analysis of microwave links for scenarios such as sharing between one FS link and another, it does not specifically address the scenario of interference from other sources such as RLANs, or aggregate interference from a large number of individual sources that is

[7] *See* CII User Study, Table 12, page 45.
[8] Letter from EEI, AGA, APPA, AWWA, NRECA, NEI, and UTC to Marlene H. Dortch, Secretary, FCC Docket Nos. 18-295, 17-183, 13-14 (Mar. 20, 2020).

characteristic of the 6 GHz scenario.[9] As noted in the March 20 filing, other reports such as ECC Report 302 specifically address this scenario.[10]

We request that our response on this issue be reflected in the text of the final Order.

3. *Without justification, the study assumes that all buildings in the Houston areas are of traditional construction, ignoring the normal mix of traditional and thermally efficient construction expected in a 240 km^2 area. This assumption leads to a significant underestimation of building entry loss.*

The building loss calculations used in both the initial CII User Study and the Revised Technical Analysis are justified and are appropriate given the construction of the greater Houston metropolitan area. While we cannot ascertain from the Draft Order what mix of traditional and thermally efficient construction the Commission deems to be an appropriate assumption, we have previously engaged with other stakeholders on this issue to ensure that the assumptions in our Study are reasonable and supported by real-world data.

- In our previous response to Apple et al.'s comment on this issue, we explained that there is similarly no reason to modify the calculation to account for thermally efficient buildings. Apple, et al. recommend an additional corrective assumption that at least 30% of buildings are thermally efficient. The suggested 30% ratio overstates the prominence of thermally efficient buildings, both residential and commercial, in U.S. metropolitan areas.
- According to the P.2109 standard, older buildings are classified as traditional.[11] Modern thermally efficient buildings using metallized glass and foil backed panels would be classified as "thermally efficient." Notably, the "thermally efficient" label does not pertain to any thermal insulation rating, and in fact metallized glass has no thermal insulation value by itself since metal conducts heat.
- Thermally efficient buildings are further limited to largely only commercial buildings.[12] The prevalence of thermally efficient buildings in a metropolitan area like Houston is thus considerably lower than the 30% proposed by Apple, et al. But even if the CII User Study were adjusted to use 90/10 mix of traditional/thermally

[9] *See* TIA TSB-10F, Section 5: Digital Receiver Interference, at 56 ("The following text assumes the victim and interfering systems are fixed point-to-point systems. . . [other scenarios] are beyond the scope of this recommendation.").

[10] ECC Report 302, *Sharing and Compatibility Studies Related to Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) in the Frequency Band 5925-6425 MHz*, at 23, Table 13 (May 2019).

[11] *See* Compilation of Measurement Data Relating to Building Entry Loss, ITU-R Rec. P.2346 (2019). *See also* Prediction of Building Entry Loss, ITU-R Rec. P.2109 (2019).

[12] A review of windows from vendors such as Pella and Andersen does not show any metallized glass for residential uses and a review of metallized insulation only shows applications for fire resistance and moisture resistance. Metallized glass is also less common in retail environments since merchants with large display windows (e.g., automobile sales rooms and storefronts) intentionally avoid this feature in order to permit outdoor views inside a building.

efficient buildings in the Houston area, the E[BEL] value merely changes from 11.0 to 11.4 dB, which does not alter the conclusions of the initial Study.[13]

We request that our response on this issue be reflected in the text of the final Order.

4. *Among other noteworthy assumptions, the study assumes there is an access point for every man, woman, and child living in the Houston area, each watching a 4K video streaming service. Naturally, such assumptions will lead to substantial errors on the order of tens of decibels.*

The 1 RLAN per PoP density figure used in the CII User Study is technically appropriate, supported by the intent of the Notice of Proposed Rulemaking (NPRM), and consistent with the unlicensed advocates' statements and behavior.

- Wi-Fi advocates acknowledge the explosive demand anticipated for Wi-Fi access across all user groups as their technical study projects 958 million RLAN devices in the 6 GHz band alone, a density of 2.9 RLANs per PoP.[14]
- An RLAN deployment density value approaching 1 RLAN/PoP is well-established in the technical community as representative across a combination of urban and rural areas. The 2019 ECC RLAN Sharing Study utilized an RLAN density for unlicensed spectrum of 0.9 RLAN/PoP.[15] Studies of aggregate interference by the International Telecommunication Union's Radiocommunication Sector (ITU-R) introduced a value of 0.55 RLAN/PoP in 2015.[16] Considering the growth of RLAN deployments since 2015 and the unlicensed industry projection of 2.9 RLANs/PoP cited above, utilizing a value of 1 RLAN/PoP is justified and appropriate. Taking into account the distribution of RLANs across all unlicensed bands, the RLAN deployment density for 6 GHz spectrum utilized in the CII User Study is 0.2 RLAN/PoP (350 MHz / 1720 MHz).
- Even if the RLAN density in the CII User Study were reduced by *half*, to 0.1 RLAN/PoP in the 6 GHz spectrum, the reduction in interference would only by 3 dB, not "tens of decibels" as stated in the Draft Order.[17] A reduction of the interference to the 2325 CII receivers by 3 dB would result in a modest reduction of the number of receivers that experience interference greater than -6 dB I/N, but would not change the conclusion that AFC is required for indoor RLANs.

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[13] Calculated from 11.0 dB / 20.1 dB for traditional / thermally efficient E[BEL] at 6.5 GHz. The formula becomes: -10 log10[0.90 * 10^(-0.1*11.0) + 0.10 * 10^(-0.1*20.1)] = 11.4 dB.

[14] *Frequency Sharing for Radio Local Area Networks in the 6 GHz Band*, (2018) attached to Letter from Paul Margie, Counsel to Apple Inc., et al., to Marlene Dortch, Secretary, FCC, in GN Docket No. 17-183 at 12, Table 3-1 (filed Jan. 26, 2018).

[15] ECC Report 302, *Sharing and Compatibility Studies Related to Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) in the Frequency Band 5925-6425 MHz*, at 23, Table 13 May 2019 (*ECC Report*).

[16] Annex 11 to Document 5A/1065-E, Working Party 5A Chairman's Report, *PRELIMINARY DRAFT NEW REPORT ITU-R M. [RLAN SHARING 5 150-5 250 MHz] Sharing and Compatibility Studies of WAS/RLAN in the 5 150-5 250 MHz Frequency Range*, at 44, Table A-1, 13 (May 2019) (*ITU-R Sharing Study*).

[17] $10\log_{10}(0.5) = 3$ dB

- The anticipated widespread deployment of Wi-Fi devices in the near term has been acknowledged by industry and Commission leadership alike. Commissioner Michael O'Reilly quoted the Cisco VNI Forecast, which noted that total Internet traffic is expected to triple from 2016 to 2021.[18] Almost 52% of this traffic is expected to be carried by wireless connections.[19]
- Any argument that the RLAN ratio should be limited to one per household is further contradicted by RLAN mesh network products offered for sale today by Google and other vendors.[20] Deployment of mesh networks implies one or more RLAN repeaters in a household, in addition to a "base" unit. Repeaters have the effect of multiplying both the channel utilization and the effective duty cycle necessary to complete a user transaction by the number of hops necessary to reach the client device.
- If anything, the 1 RLAN per PoP figure is likely overly conservative for determining the future real-world impact of shared use. Actual impact of density in the band would likely be even higher because the 1 RLAN per PoP figure solely accounts for RLAN access points; multiple responsive client devices utilizing the RLAN access point at the same time, which certainly will be even more numerous, are not counted at all. Multiple active client devices will increase the RLAN duty cycle as well.
- By contrast, Apple, et al.'s lower market penetration assumption, with a per household RLAN device count instead of the per person calculation used in our CII User Study, contradicts both the stated goals of the NPRM and the best available public forecasting data on RLAN deployment.[21]
- The Draft Order statement that there will not be multi-user streaming in a household is belied by recent COVID-19 "sequester at home" requirements and the concomitant demand for business, educational, and entertainment video streaming.[22]

We request that our response on this issue be reflected in the text of the final Order.

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[18] Statement of Commissioner Michael O'Reilly, attached to *NPRM* at 50.

[19] *Id.*

[20] *See, e.g., Google Wifi – Mesh Wifi Router*, Google, https://store.google.com/us/product/google_wifi_first_gen; *Mesh WiFi: VELOP Home WiFi System*, Linksys, https://www.linksys.com/us/c/whole-home-mesh-wifi/; *Shop eero Home Wi-Fi Systems*, Eero, https://eero.com/shop; *The Best and Latest WiFi | 11AX WiFi 6*, Netgear, https://www.netgear.com/landings/best-wifi/.

[21] *NPRM* at ¶ 2 (emphasizing the FCC's "commitment to preserve and protect the important base of incumbent users in these frequency bands").

[22] A recent report from the Leitchtman Research Group identifies that Comcast reported at the end of March a 38% increase in streaming and web video consumption in response to the coronavirus as well as a 32% increase in overall peak traffic. AT&T reported that core network traffic, which includes business, home broadband and wireless usage, was up 25% on April 2 compared to a similar day at the end of February. Snapchat reported in early April that time spent on video and voice calling had grown by more than 50% from late February to late March. Leichtman Research Group Inc., *Research Notes: Actionable Research on the Broadband, Media & Entertainment Industries* 1Q 2020.

We again ask the Commission to take into account, as reflected in the CII User Study and our follow-on communications, the real-world risk that would result from unlicensed use of the 6 GHz band without interference mitigation, especially to the broad cross-section of the nation's critical infrastructure licensees that depend daily on the 6 GHz band for essential and mission-critical communications. As they were not fully reflected in the text of the Draft Order, we request that our above-described responses and defense to the criticisms be fully reflected in the final Order so as to accurately reflect the CII community's involvement in this proceeding.

Respectfully submitted,

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Dated: April 13, 2020

cc: Office of Chairman Pai
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