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July 25, 2019

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street SW
Washington DC 20554

Re: ET Docket No. 18-295, *Unlicensed Use of the 6 GHz Band*
GN Docket No. 17-183, *Expanding Flexible Use in Mid-Band Spectrum*
***Ex Parte* Communication**

Dear Ms. Dortch:

The Fixed Wireless Communications Coalition (FWCC) responds to *ex parte* filings from RLAN proponents dated July 2, 2019 (July 2 filing)[1] and July 5, 2019 (July 5 filing).[2]

These claim to show that outdoor RLAN devices at 14 dBm, and indoor devices at 30 dBm, can operate free of Automatic Frequency Control (AFC) without causing interference to Fixed Service (FS) receivers. In fact, as we have shown in prior filings and reiterate here, uncontrolled RLANs at any useful power will cause harmful interference to the FS.[3]

Both the July 2 and July 5 RLAN filings contain disturbing factual errors and contrary-to-fact assumptions that, in combination, greatly understate the risk of interference from uncontrolled RLANs—and yet, even then, still predict wholly unacceptable levels of interference.

The proponents' study of 152 FS links serving the Los Angeles Department of Water and Power, using a carefully chosen network and demonstrably unrealistic assumptions, still found four links that would "potentially experience degraded performance" due to RLAN interference.[4] This is a showing ***against*** uncontrolled RLANs, not in their favor. The proponents try to save their position with the claim that the interfered-with links are in unpopulated areas unlikely to have uncontrolled RLANs,[5] but this just follows from proponents' choice to study a remotely-located network. The number of degraded links

1 Letter from Apple Inc. *et al*. to Marlene H. Dortch, Secretary, FCC (filed July 2, 2019).

2 Letter from Apple Inc. *et al*. to Marlene H. Dortch, Secretary, FCC (filed July 5, 2019).

3 *See* Reply Comments of the Fixed Wireless Communications Coalition (filed March 18, 2019).

4 July 5 filing at 1 & slide 25.

5 July 5 filing at slide 25.

would be far higher if the study had rested on true-to-fact assumptions, and less remote study locations would have projected far more RLAN interference.

Below, Part A first sets out the FS target requirements. Part B re-explains the RLAN proponents' fundamental error throughout this proceeding. Part C presents and discusses some of the specific errors in the recent filings.

A. TARGET REQUIREMENTS

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RLANs will be unlicensed devices. Their proposed existence appears to violate Section 301 of the Communications Act, whose plain language requires a Commission license for all radio transmitters, with no exceptions.[6]

The D.C. Circuit found the Commission may permit the use of unlicensed devices, notwithstanding Section 301, but only where it finds they present no "significant potential" for harmful interference to licensed operations.[7] To lawfully authorize 6 GHz RLANs, the Commission must find they present no significant potential for harmful interference to FS receivers.

"Harmful interference" is that which "seriously degrades, obstructs, or repeatedly interrupts" a licensed service.[8] Most FS links operate at 99.9999% or 99.999% reliability, allowing for total outages, respectively, of thirty seconds or five minutes per year. RLAN interference that substantially raises these outage times, even as to a few FS receivers, would "seriously degrade[]" the link's operation, constitute harmful interference, and render the RLAN operation unlawful under Section 301.

We have shown in earlier filings that non-AFC RLAN operation at 14 dBm outdoors or 30 dBm indoors will cause harmful interference.[9] Their operation would violate the Communications Act. We do not object to the introduction of RLANs if all devices are under the control of a properly designed AFC.[10]

B. RLAN PROPONENTS' FUNDAMENTAL ERROR

RLAN proponents' claims of non-interference rest on selective assumptions about device location relative to FS antenna main beams, building wall penetration, ground clutter, and other such factors. But even taking the proponents' assumptions as true, at best they show unlikely interference from a single

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6 "No person shall use or operate any apparatus for the transmission of energy or communications or signals by radio … except under and in accordance with this chapter and with a license in that behalf granted under the provisions of this chapter." 47 U.S.C. § 301 (emphasis added).

7 *American Radio Relay League, Inc. v. FCC*, 524 F.3d 227, 234-35 (D.C. Cir. 2008).

8 47 C.F.R. § 2.1. The standard is stricter for radionavigation and other safety services.

9 Reply Comments of the Fixed Wireless Communications Coalition (filed March 18, 2019); Comments of the Fixed Wireless Communications Coalition (filed Feb. 15, 2019).

10 For details on a properly designed AFC, see Reply Comments of the Fixed Wireless Communications Coalition at 19-41 (filed March 18, 2019).

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RLAN at a typical location. The implicit argument: if one RLAN is probably safe, then a lot of RLANs must probably be safe as well.

But this is mathematically wrong for large numbers of RLANs. The proponents expect to deploy 958,062,017 devices.[11] Even when the likelihood of interference from a single device is small—the promised "very limited risk"[12]—the deployment of 958 million devices raises the probability that multiple devices will cause FS interference to an effective certainty. For example, if a single unit has an interference risk of only one in a trillion, a population of 958,062,017 units presents an overall risk of 0.1% —a number that predicts interference into over 90 FS receivers.[13] The claim that uncontrolled RLANs at the proposed power levels present "no real-world risk of harmful interference"[14] is wishful thinking.

The vastly increased risk from large numbers of RLANs is ***not*** due to signal aggregation from multiple devices. Rather, the greatest risk of FS interference comes from a single RLAN in or near the main beam of an FS receiver, with little or no intervening clutter. The RLAN proponents dismiss these instances as "corner cases,"[15] and claim their risk of interference is "extremely low."[16] But even if these cases are rare individually, the calculation above shows the large numbers of projected RLANs make multiple occurrences virtually certain. This is why all RLANs must be under AFC control.

A more recent RLAN filing tellingly asserts that AFC control may be incompatible with "device price points."[17] RLAN proponents knew from the start they would have to fully protect the 6 GHz FS incumbents. We have shown in detail that this requires AFC control over all RLANs.[18] We doubt that AFC functionality, once perfected and rolled out to hundreds of millions of devices, will have much effect on device pricing. But that price increment, whatever it turns out to be, is the cost of unlicensed access to a licensed band that carries critical services.

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11 *Frequency Sharing for Radio Local Area Networks in the 6 GHz Band January 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) (RKF Study).

12 July 2 filing at slide 2.

13 If the probability of one RLAN causing harmful interference is 1 in a trillion (10^{-12}), the probability of one or more of 958,062,017 deployed RLANs causing harmful interference is

$$[1-(1-10^{-12})^{958,062,017}] = 0.00096$$

Multiplying this probability by the 97,000 FS links in the 6 GHz band predicts about 93 interfered-with FS links.

14 July 5 filing at 1.

15 Letter from Paul Margie, Counsel to Apple Inc., *et al*. to Marlene Dortch, Secretary, FCC, in GN Docket No. 17-183 at 2 (dated Jan. 25, 2018).

16 July 2 filing at slide 8.

17 Letter from Paul Margie, Counsel to Apple Inc., *et al*. to Marlene Dortch, Secretary, FCC at 1 (dated July 19, 2019).

18 *E.g.*, Reply Comments of the Fixed Wireless Communications Coalition (filed March 18, 2019); Comments of the Fixed Wireless Communications Coalition (filed Feb. 15, 2019).

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C. ERRORS IN THE RLAN PROPONENTS' JULY 2 AND JULY 5 FILINGS

The proponents' filings contain numerous errors with a property in common: they all act to understate the interference from RLANs into FS receivers. We have responded to several of these in earlier filings. Here the proponents continue to rely on some of the same discredited arguments.

1. Misuse of fade margin

Between sundown and sunup, multipath fading causes FS signal strength at the receiver to fluctuate downward, typically by tens of dB. To maintain reliable communication through fades, FS designers build in a signal reserve called fade margin. RLAN proponents repeatedly make the false claim that FS receivers have "substantial excess design margin" that will protect FS links against RLAN interference.[19] This is wrong. FS designers evaluate the climate, path length, and other specifics for each individual link, so as to build in the minimum fade margin needed to maintain the rated reliability for that link. Because fade margin is expensive, designers provide no more than necessary. Design margin is not "excess" margin. ***There is no excess fade margin.***

Any RLAN interference that encroaches on fade margin will reduce FS reliability by raising the likelihood of outages during fades. FS fade margin is not a public resource.

Proponents offer the misleading statement that "mobile operations are expected to be highly uncorrelated with these [deep] fading occurrences."[20] "Uncorrelated" just means that deep fades and RLAN interference can randomly occur at the same time, which in turn means that RLANs can randomly cause FS outages.

2. Misuse of diversity antennas

Another technique for countering fades is the installation of a diversity antenna: a second receive antenna higher or lower on the same tower, operating at the same frequency. Fades tend to occur in vertical layers, so when the main antenna experiences a deep fade, the diversity antenna may have better reception.

The recent filings incorrectly imply that a diversity antenna will protect the link against RLAN interference.[21] But no one puts in a diversity antenna unless it is essential to maintain reliability through fades. They are expensive to buy and install, and in monthly tower fees. RLAN interference is similar into both antennas; and interference into a diversity antenna is still interference that threatens link reliability. The diversity antenna does not immunize the link against RLAN interference, but rather helps to ensure that the link maintains its reliability through atmospheric fades. RLAN interference will impair its effectiveness and threaten that reliability.

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19 July filing at 2; *see also* July 5 filing at 1 (similar).

20 July 2 filing at slide 7.

21 July 5 filing at 2 & slides 10, 16, 25, 28.

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3. Wrong reliability target

RLAN proponents base their present interference calculations on 99.99% FS reliability.[22] As explained in Part A, above, most 6 GHz FS systems operate at 99.999% or 99.9999%—a fact that proponents acknowledged earlier,[23] but now choose to ignore. A degraded reliability criterion can easily produce an estimate of "excess" fade margin: a 6 GHz path designed for 99.999% or 99.9999% requires 10 or 20 dB more fade margin, respectively, than a path designed for 99.99%. Again, there is no such thing as excess fade margin.

Proponents try to defend the 99.99% criterion by saying, "This assumption thus provides greater protection than what many of these FS links are designed to achieve."[24] They offer no support for the unlikely notion that a critical service utility would intentionally design a system to be less than 99.99% reliable, allowing more than 52 minutes of outage per year. This is not credible. Safety-of-life applications require 99.9999% reliability, and most other 6 GHz links are designed for 99.999%. Interference calculations that arbitrarily drop the reliability of critical-service fixed links to only 99.99% can have catastrophic consequences.

4. Wrong interference calculation

The RLAN proponents initially, and correctly, assessed interference into FS receivers using an I/N criterion,[25] but now improperly shift to a C/N standard for follow-up calculations.[26]

I/N is preferable—and universally used—because it measures only the amount of increase to the victim receiver's front-end noise. It does not require information on the service being provided, the path, radio equipment characteristics, or customer reliability requirements.

In contrast, C/N must be re-evaluated for each individual FS receiver. Among other shortcomings, its use requires knowledge of the receive signal level, which can be estimated only approximately from ULS data. It also requires knowing the receiver threshold, which is not available in ULS and needs detailed vendor data. The receiver fade margin varies by type of modulation and receiver design, and depends on forward error correction, noise figure, detector design, radio coupling losses, and feeder (typically waveguide) losses. None of this is in ULS. Errors in estimating these factors will cause errors in the estimated link margin, and hence errors in the predicted effects of interference.

Further, a suitable criterion of goodness for C/N will be different for every receiver and customer implementation. Setting it requires knowing the customer's reliability requirements, plus the customer's

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22 July 5 filing at 2 n.3 & slide 15.

23 RKF Study at 6, 27, 45, 50, 52-54.

24 July 5 filing at 2.

25 RKF Study at 5 n.5 ("To avoid interference to FS receivers in the 6 GHz band, the I/N threshold should not exceed -6 dB.")

26 July 5 filing at 1 & slide 15 *et seq*.

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method of estimating reliability, and all of the parameters necessary to implement that method. Again, none of this is in ULS.

Errors in an uninformed estimate of the factors necessary for a C/N calculation can easily overestimate the FS fade margin by 20 to 30 dB. C/N requires far too much guesswork to be used in protecting critical services.

5. Inappropriate propagation model

A slide heading claims, "VLP devices can coexist with typical FS operations even in line of sight scenarios near the FS receiver,"[27] but the slide content uses line-of-sight calculations only selectively. For the hard cases of an RLAN near the FS receiver boresight (5 and 2 degrees away), the slide instead assumes Winner II NLOS Urban Macro clutter—not free space. But not every RLAN close to the boresight will have NLOS Urban Macro levels of clutter. With no clutter, the estimated I/N values for these cases become +5.7 dB or +11.7 dB respectively, far above the accepted interference objective of -6 dBm.

The same presentation asserts that the vast majority of FS receivers are in rural and barren areas—but the Winner II NLOS Urban Macro path assumes a street-level RLAN among multiple blocks of buildings.[28] The proponents cannot have it both ways. In any event, the law behind unlicensed operations requires protection of all FS receivers, regardless of their locations.

6. Excessive power

Proponents assert that uncontrolled indoor-outdoor devices will be comprised "mostly" of portable devices operating at ranges of less than 3 meters.[29] Yet they seek a power level of 14 dBm (25 mW), far higher than is needed to communicate over 3 meters.

7. Wrong antenna

Proponents picked the UHX6 antenna for their calculations.[30] This antenna is obsolete, was expensive when available, and was only used when necessary in congested environments. Less stringent Category A antennas, such as PAD6, are more common.

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27 July 2 filing at slide 6 (capitalization changed).

28 *WINNER II Channel Models*, IST-4-027756 WINNER II, D1.1.2 V1.2 at ¶ 2.3.9 (Information Society Technologies updated 04/02/2008).

29 July 2 filing at slide 2.

30 July 2 filing at slide 6.

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8. Faulty choice of LADWP system

RLAN proponents' analysis of 152 FS links operated for the Los Angeles Department of Water and Power (LADWP) appears to be intended as a stand-in for FS 6 GHz operations generally—otherwise these links would be of no particular interest. But the LADWP network is atypical: "Vast majority of LADWP FS links are on mountaintops and in uninhabited locations"[31] This choice made it easier for the proponents to dismiss the FS links it projected to receive harmful interference. But the LADWP network is a poor model for FS operations generally.

FS links ultimately connect people, so the end-points of the links tend to be where people are. This is why a map of 6 GHz links (Figure 1) looks very much like a map of U.S. population density. The LADWP facilities may have been a good choice to artificially minimize findings of interference, but they do not represent the risk of RLAN interference into FS facilities nationwide.

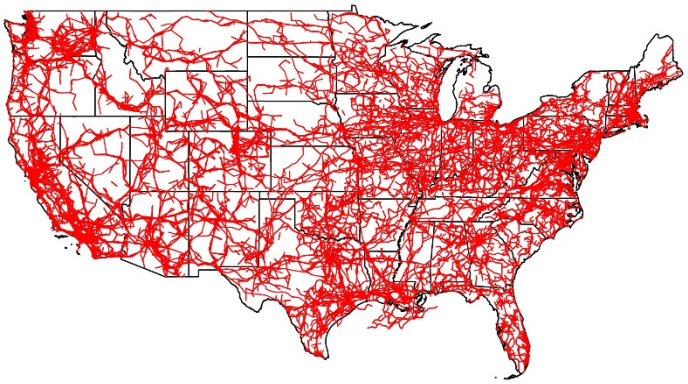

Figure 1: 6 GHz FS links nationwide

CONCLUSION

The only way for the Commission to meet its obligation to protect all FS receivers from harmful interference is to place all RLANs, regardless of power, under AFC control.

Respectfully submitted,

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31 July 5 filing at slide 22.

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