NATIONAL SPECTRUM MANAGEMENT ASSOCIATION

March 27, 2018

VIA ELECTRONIC FILING

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

Re: GN Docket No. 17-183, *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*
Ex Parte Communication

Dear Ms. Dortch:

The National Spectrum Management Association (NSMA)[1] submits this Ex Parte Communication in support of the Ex Parte Communication filed by the Fixed Wireless Communications Coalition (FWCC) March 13, 2018 in opposition to the study "Frequency Sharing for Radio Local Area Networks in the 6 GHz Band (January 2018),"[2] prepared by RKF Engineering Services, LLC on behalf of Apple Inc., Broadcom Limited, Cisco Systems, Inc., Facebook Inc., Google LLC, Hewlett-Packard Enterprise, Intel Corporation, Microsoft Corporation, MediaTek Inc., and QUALCOMM Incorporated, filed on January 26, 2018.

The RKF study considers a billion unmanaged transmitters into frequency allocations whose spectrum is currently successfully managed. As an organization whose middle name is "Spectrum Management," we have an interest in the spectrum conservation impact of the RKF study. Our organization promotes efficient sharing of spectrum allocated to all services. We believe the RKF study has serious deficiencies, many of which were addressed by the FWCC. We have additional concerns, as we will discuss below, and will estimate the highest power that unconstrained RLANs can operate at without posing a threat of harmful interference to the Fixed Services.

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[1] NSMA is a voluntary association of individuals involved in the spectrum management profession including service providers, manufacturers, frequency coordinators, engineers and consultants. NSMA's goal is to promote rational spectrum policy through consensus views formulated by representatives of diverse segments of the wireless industry.

[2] Letter from Paul Margie, Counsel to Apple Inc., Broadcom Corporation, Facebook, Inc., Hewlett Packard Enterprise, and Microsoft Corporation to Marlene Dortch, Secretary, FCC (filed Jan. 26, 2018) (attachment) (RKF study).

RKF'S QUESTIONABLE ASSUMPTIONS

RKF[3] made incorrect assumptions about Part 74 TV Pickup Broadcast Auxiliary Service (BAS) operations in the 6.425-6.525 GHz and 6.875-7.125 GHz bands. Trucks used for remote at-event electronic news gathering (ENG) have high-gain truncated parabolic reflector transmitting antennas with the transmitting antenna atop a pneumatically operated 30 to 40 foot mast. Many large market TV stations have also installed multiple high-elevation fixed site receiving locations, to make it more likely that no matter where a news event in the TV station's market occurs, an ENG truck will have line of sight to at least one of its fixed ENG receive sites. These fixed ENG receive sites often also employ steerable truncated parabolic reflector receiving antennas, which are remotely steered in real time in both azimuth and elevation, so as to be aimed towards the ENG truck's location. These receiving antennas often employ feed horn-mounted pre-amplifiers, to increase the effective range over which an ENG truck can establish a useable path.

The RKF Engineering study mis-read[4] the ULS data for the fixed ENG sites of TV Pickup stations, assuming that the receiving antenna height obtained from the ULS database is the antenna's height above average terrain (AAT). That is incorrect. The ULS requires TV Pickup stations to report the ground level site elevation of their fixed ENG sites in meters above mean sea level (AMSL), and in another data field the center-of-radiation (C.O.R.) height in meters above ground level (AGL) for the receiving antenna. These two numbers must then be added to get the receiving antenna's C.O.R. height in meters AMSL. Broadcasters go to considerable effort to achieve high AMSL C.O.R. heights by siting on mountain tops, on the roofs of tall buildings, and near the tops of tall TV towers. In other words, RKF should have analyzed the AMSL C.O.R. heights, not the AGL C.O.R. heights (which it mis-identified as AAT heights). Since many fixed ENG receive sites are on mountain tops, their AGL heights are typically modest, but their AMSL heights are substantial, meaning much greater line-of-sight distances.

RKF indicates that dynamic frequency selection (DFS, aka "polite protocol") would be a tool for avoiding interference to incumbent systems[5]. But DFS is only effective if the DFS sensing receiver can detect all of the signals it is trying to protect. A DFS sensing receiver antenna needs to have comparable height, as well as sensitivity, otherwise it becomes a clueless, impolite protocol DFS. A newcomer RLAN system would need to invest in an infrastructure comparable to that used by TV BAS stations for DFS to be an effective mitigation tool. This is unlikely to be the case.

The RKF study makes many assumptions regarding deployed RLAN type and activity[6]. The source of those assumptions was never explained. When analyzing a random process, if the initial conditions (such as RLAN parameters) are not definitively established, a standard practice is to perform a Sensitivity Analysis: Change the initial conditions significantly and reanalyze the

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[3] RKF study, pages 54 through 60.

[4] RKF study, page 55.

[5] RKF study, page 27.

[6] RKF study, pages 12 through 15 and 22 through 26.

situation. If the results don't change much, the specific initial conditions are not critical. If they do, the actual value of the initial conditions must be established with high accuracy. Since the credibility of the RLAN parameters is not established and a Sensitivity Analysis was never performed, we have no idea how the RKF RLAN deployment assumptions influence their outcomes. Nor did the RKF report provide the information we would need to make that analysis ourselves.

RKF appears to base their entire interference analysis on models[7] for path loss which attempt to estimate "average" performance. That concerns us. **Our experience is receiver interference is typically a relatively infrequent line of sight case rather than an "average" clutter dominated result.** That conclusion is echoed by ITU-R[8].

RKF, while it talks about line of sight (LoS) and non-line of sight (NLoS) propagation, inspection of their propagation curves[9] suggests they only considered NLoS propagation. The industry standard approach[10] [11] is to assume LoS propagation to the victim receiver from near the transmitter site until a Break Point (BP) is encountered. Beyond that point, NLoS propagation is predicted. The Break Point estimation is standardized:

$BP = 4\, h_{TX}\, h_{RX} / \lambda$
BP = Break Point = LoS to NLoS transition point
h_{TX} = transmitter height above effective environment height
h_{RX} = receiver height above effective environment height
λ = free space wavelength of radio wave

[7] RKF study, pages 32 through 35.

[8] ITU-R Recommendation F.1706, Protection Criteria for Point-to-Point Fixed Wireless Systems Sharing the Same Frequency Band with Nomadic Wireless Access Systems in the 4 to 6 GHz Range. Geneva: International Telecommunication Union, Radiocommunication Sector, January 2005.

[9] RKF study, page 34, Figure 4-2, and page 35, Figure 4-3, WII Combined Suburban and WII Combined Urban curves.

[10] Nawrocki, M. J., Mischa, D. and Aghvami, A. H., *Understanding UMTS Radio Network Modelling, Planning and Automated Optimization*. West Sussex: John Wiley and Sons, 2006, page 85, eqn. (5.30) and page 254, eqn. (10.45).

[11] Information Society Technologies, WINNER II Channel Models, Report IST-4-207756 WINNER II (D1.1.2 V 1.2), September 30, 2007 (updated February 4, 2008), (https://cept.org/files/8339/winner2%20-%20final%20report.pdf), page 76, notes 2) and 4).

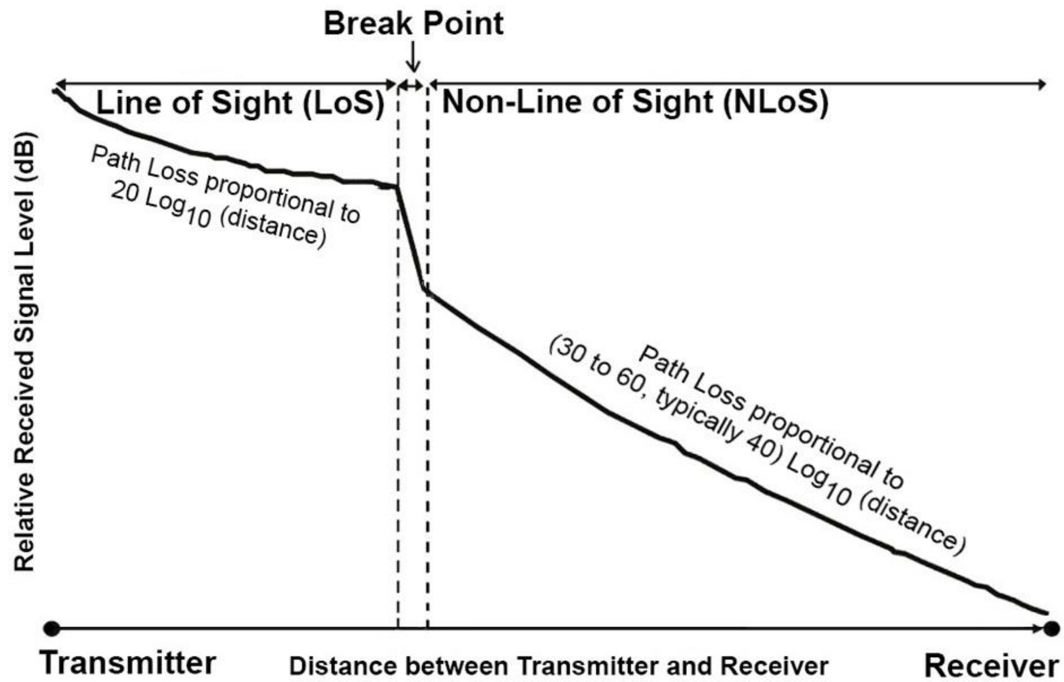

Figure 1 – Path Loss in an Urban or Suburban Environment

The industry assumes LoS propagation is dominant when the transmitter and receiver are close together. It is not clear why RKF apparently did not consider that.

In a highly variable clutter loss environment, an average result is wrong half the time on average. "Average" interference does not represent "actual" interference. Averaging results leads to significantly flawed conclusions. If there are 100 interference paths into a receiver and 99 were blocked and one was free space propagation, RFK would average the results and conclude there is no problem. This is similar to the case of the statistician who drowned trying to cross a river which was only three feet deep "on average". Average and controlling parameters can be quite different.

LACK OF TRANSPARENCY

The RKF study lists RLAN operational parameters and discusses their results. Unfortunately, they never spell out any analysis. We are disturbed that the report does not even give the information that would let us attempt to replicate their conclusions – which to us are counter-intuitive. They see no significant interference where we see almost inevitable interference.

EXAMPLES OF SAFE UNMANAGED RLAN OPERATION

We calculate example conditions under which unmanaged RLAN operation could occupy the band with high confidence that interference to existing fixed service (FS) microwave operations would be unlikely. We will consider two cases: 1) The RLAN is constrained to height no greater than 3 meters above ground level and 2) The RLAN's height is unconstrained.

1) We shall first assume the RLAN is constrained to height no greater than 3 meters above

ground level. We accept the RKF assumption[12] that RLANs will not be closer than 30 meters to FS antennas. We also accept RKF's suggestion[13] of the FCC Category A antennas as defining the "typical" FS antenna. We will assume a six foot Category A parabolic antenna (UHX6) and rely on the manufacturer's specifications. We will further assume the microwave path has 3.9 meter clearance[14] above the RLAN 30 meters out from the antenna (3 meter path clearance as recommended by Vigants plus half the antenna diameter). We assume a 35 dBm EIRP RLAN located 30 meters directly in front of the 6 foot antenna and 3.9 meters below the region of maximum sensitivity ("bore sight") of the FS antenna. The distance between the RLAN and the FS receive antenna is 30.3 meters. The look angle (angle off bore sight) to the RLAN from the FS antenna is 7.4 degrees. The FS antenna sidelobe rejection for that angle is 33.3 dB[15]. The bore sight gain is 38.8 dBi. Near field gain reduction is approximately 1 dB[16]. Free space loss is 77.9 dB. We will assume the FS receiver is 30 MHz wide and has a noise figure of 5 dB. The front end noise of the receiver will be -94 dBm[17]. We will accept RKF's recommendation[18] for an interference limit of -6 dB I/N. That infers an acceptable interference value of -100 dBm at the input to the FS receiver. Given these values we may derive the transmit power limit (TPL) for the RLAN.

Allowable Interference = TPL – Free Space Loss + Antenna Bore Sight Gain
- Near Field Loss – Antenna Side Lobe Rejection
-100 dBm = TPL – 77.9 + 38.8 – 1.0 – 33.3
TPL = - 26.6 dBm

This means that the highest RLAN power that can be deployed without risk of harmful interference to the FS is 2.2 microwatts, assuming the RLAN is within 3 meters of ground level.

2) Here we repeat the calculations but shall assume the RLAN has no height restrictions. The situation is exactly the same as 1) except that side lobe rejection does not apply, since the RLAN could be essentially directly in front of the receiver antenna.

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[12] RKF study, page 33.

[13] RKF study, page 29.

[14] Vigants, A., "Space-Diversity Engineering," *Bell System Technical Journal*, page 127, January 1975.

[15] UHX6: ttps://www.commscope.com/catalog/antennas/product_details.aspx?id=31053#, RPE 1729L

[16] Kizer, G., *Digital Microwave Communication*. Hoboken: Wiley and Sons, 2013, page 272, Figure 8.18.

[17] Letter from Cheng-yi Liu and Mitchell Lazarus, Counsel for the Fixed Wireless Communications Coalition, to Marlene Dortch, Secretary, FCC (filed March 13, 2018).

[18] RKF study, pages 5 and 11.

Allowable Interference = TPL – Free Space Loss + Antenna Bore Sight Gain
- Near Field Loss
-100 dBm = TPL – 77.9 + 38.8 – 1.0
TPL = - 59.9 dBm

This means that the highest RLAN power that can safely be deployed is only 1.0 nanowatts, assuming no restrictions on RLAN elevation.

We recommend against using spread spectrum or frequency hopping to reduce interference into a receiver. As long as the frequency shifting is fast compared to the baud rate of the FS radio, the in-band energy into the FS receiver would be reduced on the order of 10 log (30 MHz / 1000 MHZ) = - 15 dB. However, we strongly recommend against this approach. With many emitters the effect of rapid frequency shifting is to raise the overall noise level in the area to a point where the fade margin of conventional radios is seriously degraded. This effect has been observed in several cities in unlicensed bands.

CONCLUSION

We simply cannot agree with the RKF study. They offer no analysis to support their claims. Their apparent reliance on cluttered environment "average" path loss is highly misleading. Our experience (of over 30 years of successful spectrum management) is that line of sight interference, while relatively infrequent, is the dominant limitation to successful receiver performance in a multiple transmitter environment. Our analysis of the RLAN limits that would be low enough to protect the FS is different from the RKF results by many orders of magnitude. The Commission should reject the RKF study.

Respectfully submitted,

/s/ Dave Meyer
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