

August 16, 2018

**BY ELECTRONIC FILING**

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

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

Dear Ms. Dortch,

On June 22, 2018, Sirius XM responded to a technical study on coexistence in the 6 GHz band performed by RKF Engineering. This study demonstrated that unlicensed devices can share spectrum with licensed incumbents in the 6 GHz band—including Fixed Satellite Service (“FSS”) operators such as Sirius XM—without causing harmful interference.<sup>1</sup> Sirius XM’s latest filing expands on, and in some respects contradicts, its February 22, 2018 letter on the same topic.<sup>2</sup> Far from demonstrating that unlicensed 6 GHz operations will cause harmful interference, Sirius XM’s new revised explanation confirms RKF’s analysis in several respects, as well as our response to Sirius XM’s previous assertions, and fails to provide reasonable alternatives to the study’s conservative assumptions.

**I. SIRIUS XM CONFIRMS THAT ITS SYSTEM IS TYPICAL OF THOSE RKF CONSIDERED IN ITS ANALYSIS IN EVERY RELEVANT RESPECT.**

In Sirius XM’s previous filing, it asserted that RKF’s analysis was unreliable because it “fails to address the very real possibility that significant numbers of terrestrial devices located near the Sirius XM feeder link sites on the ground could introduce interference.”<sup>3</sup> As we explained,<sup>4</sup> this concern misses the mark because it overlooks the fact that Sirius XM’s uplink

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<sup>1</sup> Letter from Karis Hastings, Counsel, Sirius XM Radio Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 17-183 (filed June 22, 2018) (“June 22 Letter”); RKF Engineering Services, *Frequency Sharing for Radio Local Area Networks in the 6 GHz Band* (Jan. 2018) (“RKF Study”), as attached to Letter from Paul Margie, Counsel, Apple Inc., Broadcom Corporation, Facebook, Inc., Hewlett Packard Enterprise, and Microsoft Corporation, to Marlene H. Dortch, Secretary, Federal Communication Commission, GN Docket No. 17-183 (filed Jan. 26, 2018).

<sup>2</sup> Letter from Karis Hastings, Counsel, Sirius XM Radio Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 17-183 (filed Feb. 22, 2018).

<sup>3</sup> *Id.* at 2.

<sup>4</sup> Letter from Paul Margie, Counsel, Apple Inc., Broadcom Inc., Facebook, Inc., Hewlett Packard Enterprise, and Microsoft Corporation, to Marlene H. Dortch, Secretary, Federal

beams cover the entire continental United States. Sirius XM has changed gears in its latest filing, and now makes the opposite argument. It asserts that “[g]iven the large beam coverage, all terrestrial transmitters operating in the 7025-7075 MHz band throughout the United States would cause uplink interference into all four active Sirius XM satellites.”<sup>5</sup> This confirms that the characteristics of Sirius XM’s satellites, and the proper methodology for evaluating potential interference to them, are consistent with the assumptions and conclusions in RKF’s analysis. RKF specifically evaluated FSS satellites with full-CONUS uplink beams and properly found that RLANs do not pose a risk of harmful interference. In doing so, RKF addressed the very aggregate interference question that Sirius XM raises.

Sirius XM also claims that RKF’s analysis did not account for existing sources of terrestrial interference that, according to Sirius XM, are so significant that its system is unable to tolerate *any* additional noise, no matter how faint.<sup>6</sup> The bands RKF considered, however, include far more intensive terrestrial use than the 7025-7075 MHz band. RKF demonstrated that even in this more challenging environment, any added noise from RLAN operations would not cause harmful interference to satellite systems. In fact, the band RKF considered, 5925-6425 MHz, includes approximately 12 times more existing terrestrial links than the band that includes Sirius XM’s feeder links.<sup>7</sup> In this respect as well, therefore, Sirius XM’s latest filing again confirms that its uplink operations are typical of or, in this case, even *less* vulnerable to added terrestrial noise than one with the representative system characteristics RKF analyzed. RKF’s demonstration that any added noise from RLAN devices would be a small fraction of the interference to FSS operations generated by existing terrestrial operations is valid—a conclusion that holds in the 7025-7075 MHz band no less than at 5925-6425 MHz. In addition, RKF concluded that the intensity of any noise that a satellite could receive from FS and other existing terrestrial operations, and noise that could be received from RLAN operations, would vary with the longitude of the satellite. The intensity of these two terrestrial noise sources, it concluded, would likely vary in complementary ways, such that noise from RLAN would be strongest (although still objectively quite weak) exactly when noise from other sources would be weakest, and vice versa, meaning that the maximum total interference from these sources would be virtually unchanged by the introduction of RLAN devices.<sup>8</sup>

## **II. RKF CONSERVATIVELY ESTIMATED OUTDOOR USE.**

Sirius XM claims that RKF underestimated future outdoor RLAN use and should have relied on a 5.3% assertion in a CEPT ECC report, rather than the 2% figure RKF adopted. As we

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Communications Commission, GN Docket No. 17-183, at 7-8 (filed Apr. 10, 2018) (“FSS Letter”).

<sup>5</sup> June 22 Letter at 7.

<sup>6</sup> *Id.* at 6-7.

<sup>7</sup> Although this band is wider than the band where Sirius XM’s feeder links operate, it is also used far more intensively on a per-MHz basis, with approximately 4-times more intensive use of spectrum.

<sup>8</sup> RKF Study at 6.

have shown in an earlier filing,<sup>9</sup> the ECC report does not make any claim about the applicability of its 5.3% assumption to other situations and bands, and it is presented without supporting evidence to explain how it was derived. The report merely assumes this rate for the purposes of a calculation unrelated to the 6 GHz band and unrelated to the substance of this proceeding. Much less does that report conclude that this figure is appropriate for the 6 GHz band, or that it would be appropriate to the U.S., rather than European, market.<sup>10</sup>

RKF's 2% outdoor usage rate, by contrast, is supported by multiple empirical studies, and confirmed by our companies' extensive experience with the RLAN device market and typical deployments. And while Sirius XM raises vague concerns about the origins and transparency of the studies on which RKF based its outdoor usage statistics, it provides no reason to think that their results are incorrect.<sup>11</sup> In fact, since RKF published its study, the United States submitted a contribution to the ITU's Working Party 5A that supports—based on three independent sources—an outdoor deployment rate of 2%.<sup>12</sup> Likewise, the CEPT ECC study group SE45 that is undertaking an independent investigation of the technical feasibility of sharing in the 6 GHz band also adopted a 2% outdoor deployment rate for its study input parameters.<sup>13</sup>

In contrast, Sirius XM provides no support for its argument that the Commission should assume higher outdoor deployment rates other than its own speculations about the possibility of outdoor transmitters in the future. Notably, however, the RKF Study, and the studies that it relied on, explicitly considered many of the types of deployments that Sirius XM highlights, such as

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<sup>9</sup> FSS Letter at 3-4.

<sup>10</sup> Sirius XM incorrectly claims that we have “implicitly endorsed” the CEPT ECC report’s 5.3% outdoor deployment assumption. June 22 Letter at 9-10. The discussion it cites only addresses what we describe as a potential “radical increase” of the prevalence of LAA. Letter from Apple Inc., Broadcom Inc., Cisco Systems, Inc., Facebook, Inc., Google LLC, Hewlett Packard Enterprise, Intel Corporation, Microsoft Corporation, Qualcomm Incorporated, and Ruckus Networks, an ARRIS Company, GN Docket No. 17-183, at 7-8 (filed May 14, 2018) (“FS Letter”).

<sup>11</sup> Sirius XM incorrectly claims that the RKF Study does not provide a working link to the *Multi-Operator and Neutral Host Small Cells: Drivers, Architectures, Planning and Regulation* report by 5G Americas and Small Cell Forum. However, both the URL provided in RKF’s footnote, and the clickable link to the report, are correct and functional. RKF Study at 14 n.11. Nevertheless, we reproduce the URL here, for convenience:  
[http://www.5gamericas.org/files/4914/8193/1104/SCF191\\_Multi-operator\\_neutral\\_host\\_small\\_cells.pdf](http://www.5gamericas.org/files/4914/8193/1104/SCF191_Multi-operator_neutral_host_small_cells.pdf).

<sup>12</sup> United States of America, *Technical Characteristics and Operational Requirements of WAS/RLAN in the 5 GHz Frequency Range 2*, Working Document Towards a Preliminary Draft New Report ITU-R M.[RLAN REQ-PAR], Doc. 5A/722-E (May 8, 2018).

<sup>13</sup> ECC WG SE45, *ECC Report [RLAN6]* § 4.3.3.1, Doc. SE45(18)024A1 (last updated Mar. 19, 2018).

IoT applications.<sup>14</sup> But even if the proliferation Sirius XM predicts actually comes to pass, and exceeds the deployment rates that RKF has already taken into account, this would not support its assertion. The applications that XM Sirius cites are generally lower power, would be used for lower utilization use cases, or are primarily indoor (e.g. Netflix streaming)—and are not the full-power outdoor devices that Sirius XM assumes. Nonetheless, we agree that prediction of future deployments should include a margin for error. That is why RKF *doubled* the most likely outdoor deployment rate that analysts have predicted from 1% (or less) to 2%.<sup>15</sup>

### III. RKF PROPERLY ESTIMATED RLAN AIRTIME UTILIZATION.

Sirius XM argues that RKF underestimated the frequency of RLAN transmissions by overestimating data rates and underestimating utilization. Sirius XM is incorrect on both counts. Critically, Sirius XM ignores the fact that RKF intentionally overestimated actual usage so dramatically that any marginal disagreements about RLAN speeds, HD video bitrate, and similar factors are unlikely to be material. RKF assumed utilization levels equivalent to constant, simultaneous HD video streaming by every man, woman, and child in the United States, *in addition to* constant lower-intensity utilization by another nine devices per person.<sup>16</sup> In fact, if one were to extrapolate from the most recent Cisco VNI report (which provides forecasts through 2021) out to 2025, applying the same 20% compound annual growth rate, this would predict total data consumption, including all fixed and wired communications, of 491.7 GB per person.<sup>17</sup> But RKF assumed a far greater per capita data consumption of 750 GB per person *for RLAN devices alone*.<sup>18</sup> This extremely conservative estimate is likely to more than compensate for any minor disagreements about video encoding efficiency, the effect of congestion, or other issues that Sirius XM raises. But Sirius XM does not acknowledge this fact.

In addition to ignoring RKF's large, conservative margin, Sirius XM also makes incorrect claims about 6 GHz utilization and link speeds. First, Sirius XM contends that RKF overestimated link speeds by ignoring congestion.<sup>19</sup> This is incorrect. RKF correctly found, based on speeds available today in the 5 GHz band, that 6 GHz operations would have an *average* speed of 1 Gbps. This reflects the fact that many devices will likely have substantially higher peak throughputs but will, on average, achieve the lower 1 Gbps speed due to variation in network conditions. Thus, to the extent that speeds will vary due to network conditions and other factors, RKF has already taken these factors into account. Moreover, Sirius XM misstates the relationship between congestion and link speed, apparently confusing physical link speed with

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<sup>14</sup> RKF Study at 14.

<sup>15</sup> *Id.* at 13-14.

<sup>16</sup> *Id.* at 15.

<sup>17</sup> See Cisco, *VNI Forecast Highlights Tool*, [https://www.cisco.com/c/m/en\\_us/solutions/service-provider/vni-forecast-highlights.html](https://www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html) (last visited Aug. 14, 2018).

<sup>18</sup> FS Letter at 4.

<sup>19</sup> June 22 Letter at 10-II.

the throughput experienced by the user. Generally speaking, slowdowns caused by congestion are due to RLAN devices transmitting less frequently in order to more fairly share airtime. But, in the short bursts when a device does transmit, it continues to do so at very high speed. In fact, these high data rates are an important tool to allow RLAN devices to share airtime efficiently—an approach further optimized in the 802.11ax standard likely to be prevalent in 6 GHz RLAN devices.

Second, Sirius XM claims that RKF's prediction of gigabit speeds in the 6 GHz band is unreasonable. But it provides no concrete justification for this claim, other than RKF's statement that gigabit speeds are "not yet ubiquitous" in existing bands.<sup>20</sup> But the fact that gigabit speeds are not yet ubiquitous is entirely consistent with RKF's conclusion. If there are gigabit devices operating today in the 5 GHz band—and there are—then it is reasonable to conclude that the average speed for new devices in a newly opened 6 GHz band will be driven by this latest generation of existing technologies, and will not be driven by previous generations of RLAN devices. Legacy devices will certainly persist in greater numbers in the bands that were available when they were introduced, but a new band will be dominated by the current and future generations of devices. Therefore, gigabit devices need not already be ubiquitous in the 5 GHz band to support RKF's reasonable assumption that they represent the future of the 6 GHz band, where no RLAN devices currently operate.

Third, Sirius XM claims that RKF underestimated airtime utilization by underestimating the data rate requirements of HD video. The primary basis for this claim appears to be Netflix's recommendation to consumers that a 5 Mbps internet connection is best for HD video rather than the 4.44 Mbps bitrate that RKF assumed.<sup>21</sup> Netflix's recommendation does not support Sirius XM's argument. To begin with, Sirius XM ignores the fact that RKF very conservatively assumed that every American would stream HD video simultaneously, which more than compensates for any small effects of bitrate assumptions.

Furthermore, Netflix is only one of many HD video providers, each with its own video encoding and compression strategy. Streaming video bitrates also vary depending on the user's device. Sirius XM ignores these facts as well in asserting that Netflix's recommendation is the final word on bitrate for all consumers using all devices. RKF's 4.44 Mbps rate, on the other hand, accounts for these sources of variation by reflecting empirical measurements of actual video traffic, including from Netflix and other providers.<sup>22</sup>

Although it is true that Netflix's 4K streaming requirements are data intensive, only a minority of consumers actually view Netflix's 4K content, as evidenced by the empirically derived 4.44 Mbps rate.<sup>23</sup> Although Sirius XM emphasizes the few users that view 4K content, a

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<sup>20</sup> *Id.* at 10 n.21.

<sup>21</sup> *Id.* at 11-12.

<sup>22</sup> See Hewlett Packard Enterprise, *Video Streaming Airtime Consumption Measurements*, CEPT WGSE PT45, Doc. SE45(18)014 (issued Mar. 8, 2018).

<sup>23</sup> *Id.*

number of viewers presumably also view SD content, contributing to the 4.44 Mbps average. Netflix's current requirements for 4K streaming are also not representative of future demands. As we have explained, compression technologies continue to improve at a rate that roughly keeps pace with increases in consumer demand for video quality. Indeed, compression technologies already exist that could radically reduce the bitrate demands of Netflix's 4K streaming video.<sup>24</sup> Presumably Netflix will implement these technologies, and others, to the extent that future demand for 4K video expands and improved codecs become more widely available. Combined, these facts make RKF's assumption far more reasonable than that of Sirius XM.

Finally, Sirius XM suggests that Cisco's projected increase of streaming video traffic, if extrapolated beyond the end of Cisco's actual projections to 2021, demonstrates that RKF underestimates likely traffic.<sup>25</sup> But, as we have explained, such an extrapolation actually shows that RKF dramatically *overestimated* wireless usage: RKF assumed that consumers will generate RLAN traffic at a rate that is 50% more than a reasonable projection for all North American IP traffic. This is because, regardless of any uncertainty in the precise bitrate or utilization of HD video, RKF compounded its conservative assumptions by assuming that every American would stream HD video constantly.

#### **IV. SIRIUS XM INCORRECTLY PREDICTS THAT THE 6 GHZ BAND WILL BE USED DISPROPORTIONATELY.**

Sirius XM speculates that the 6 GHz band will be more heavily used than the 5 GHz and 2.4 GHz RLAN bands due to the availability of greater bandwidths, undermining RKF's channel usage assumptions.<sup>26</sup> This misunderstands how the radio resource management ("RRM") algorithms of both managed and unmanaged RLAN deployments actually operate. These systems typically treat spectrum as a "pool" and use various criteria to select a specific channel for a specific device. For unmanaged devices, this is often done by a periodic scan of all usable channels to identify the least busy channel for the target channel width desired by the device. Managed deployments with multiple APs generally employ a centralized algorithm that shares knowledge of the local RF usage environment and seek to distribute all channels in the pool across those devices to achieve uniform spectrum utilization. In either case, RRM systems will not systematically prefer 6 GHz over 5 GHz. On the contrary, the availability of additional spectrum in the pool simply makes it possible to deliver wider channels overall by leveraging aggregate capacity of both the 6 GHz and 5 GHz bands. Furthermore, any analysis of the potential aggregate skyward interference received by the Sirius XM satellites must account for the fact that only RLAN devices transmitting in the 7025-7075 MHz range—among the many channels available—will even have the potential to make an incremental contribution to

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<sup>24</sup> See, e.g., Yu Liu, *AVI Beats x264 and libvpx-vp9 in Practical Use Case*, Facebook Code (Apr. 10, 2018), <https://code.facebook.com/posts/253852078523394/avi-beats-x264-andlibvpx-vp9-in-practical-use-case/>.

<sup>25</sup> June 22 Letter at 11-12.

<sup>26</sup> *Id.* at 12.

aggregate interference. Therefore, actual RLAN deployments are inconsistent with Sirius XM's assumptions.

## **V. SIRIUS XM'S CALCULATIONS ARE FUNDAMENTALLY FLAWED.**

Sirius XM repurposes RKF's analysis to attempt to demonstrate that 6 GHz RLAN devices would cause harmful interference. In doing so, Sirius XM assumes that all of their flawed assumptions discussed above hold true. As we have explained, however, those assumptions are highly unrealistic, and at times based on clear mistakes, making it unreasonable to rely on Sirius XM's calculations. But even if these assumptions were somehow valid, Sirius XM's analysis would still be badly flawed.

Sirius XM attempts to calculate how many 1 W devices it would take to generate the amount of energy into FSS receivers that RKF predicted. It then applies its flawed assumptions about activity levels and outdoor use to come up with a new estimate of how many devices would be transmitting simultaneously, in an effort to show that the latter number is much larger than the former.

But in so doing, Sirius XM attempts to layer on several additional unrealistic assumptions, above and beyond those described above.

- First, Sirius XM makes the wildly erroneous assumption that all simultaneously transmitting devices will transmit towards a Sirius XM satellite at a power level of 1 W. Although RKF assumed that outdoor RLAN devices would be limited to 1 W at elevation angles above 30 degrees, RKF's analysis properly reflects the fact that RLAN operations—including outdoor devices—will transmit at a range of power levels depending on the type of device and the use case.
- In addition, actual antenna patterns typically achieve peak power levels in a limited number of locations, rather than radiating at the maximum allowable levels in all directions.<sup>27</sup> Thus, the average radiated power towards a given satellite is likely to be significantly lower than 1 W, even for a nominally 1 W device.
- Moreover, Sirius XM appears not to have considered any shadowing or clutter loss in its analysis, instead assuming only free-space path loss. Although earth-to-space transmissions typically exhibit less path loss than terrestrial communications, and free-space assumptions may be appropriate for certain cases to ensure a significant and conservative margin, it is plainly inappropriate to assume free-space conditions in every direction, at all elevation angles, and under all conditions. Indeed, although SES and Intelsat criticized RKF's choice of propagation model, even they

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<sup>27</sup> RKF Study at 19-23.

acknowledged, in advocating for the use of the ITU-R P.452-16 model, that a simplistic free-space assumption is inappropriate.<sup>28</sup>

Added together, these new mistakes at the calculation stage of Sirius XM's analysis amplify the company's earlier incorrect assumptions, rendering its filing unreliable.

### **Conclusion**

We have carefully considered Sirius XM's submission and, notwithstanding its erroneous claims, we re-confirm that the RKF Study considered representative and appropriate FSS system characteristics in assessing the risk of harmful interference to 6 GHz FSS operations. Sirius XM's complaints about the study's conclusion fail because of a series of unjustifiable assumptions and calculation errors. RKF's demonstration that RLAN operations in the 6 GHz band are extremely unlikely to cause harmful interference to the satellite incumbents in that band remains valid.

Respectfully submitted,

Apple Inc.  
Broadcom Inc.  
Cisco Systems, Inc.  
Facebook, Inc.  
Google LLC  
Hewlett Packard Enterprise  
Intel Corporation  
Marvell Technology Group  
Microsoft Corporation  
Qualcomm Incorporated

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<sup>28</sup> Letter from Susan H. Crandall, Associate General Counsel, Intelsat Corporation & Gerry Oberst, President, SES Americom, Inc. to Marlene H. Dortch, Secretary, Federal Communication Commission, GN Docket No. 17-183, at 2 (filed Feb. 23, 2018).