Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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

COMMENTS OF INTELSAT LICENSE LLC AND SES AMERICOM, INC.

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Intelsat License LLC ("Intelsat") and SES Americom, Inc. ("SES") hereby submit these joint comments on the above-captioned Notice of Proposed Rulemaking ("NPRM").[1] Intelsat and SES strongly support the Federal Communication Commission's ("FCC" or "Commission") commitment that rules allowing new unlicensed use of the 5.925-7.125 GHz ("6 GHz") band will be designed to ensure that licensed services operating in the band, such as the Fixed-Satellite Service ("FSS"), continue to thrive.[2] To adequately protect critical FSS systems, the Commission must take steps to prevent unlicensed devices in the 6 GHz band from causing harmful interference into licensed FSS uplinks in the band. Only by adopting a limit on the aggregate power at the satellite receiver and employing a robust automated frequency coordination ("AFC") system to implement that limit can the Commission successfully make

[1] *Unlicensed Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Proposed Rulemaking, FCC 18-147 (rel. Oct 24, 2018) (the "NPRM"). The Commission has proposed an Unlicensed National Information Infrastructure ("U-NII") nomenclature for the 6 GHz band, which will be used throughout these comments. The sub-bands are: U-NII-5: 5.925-6.425 GHz; U-NII-6: 6.425-6.525 GHz; U-NII-7: 6.525-6.875 GHz; and U-NII-8: 6.875-7.125 GHz. *See id.* at ¶ 21.

[2] *Id.* at ¶ 1.

6 GHz spectrum available to unlicensed devices while protecting licensed conventional and extended C-band FSS operations from harmful interference.

I. INTRODUCTION AND SUMMARY

Intelsat and SES together operate the overwhelming majority of the C-band satellites that serve the United States, providing a broad range of vital services that enable nationwide distribution of video and audio programming, support communications that are essential to public safety and national security, and represent the only link to remote Alaskan villages. Because these services rely on 6 GHz spectrum, the Commission must ensure that any rules to permit unlicensed devices in these frequencies incorporate robust and enforceable protections for incumbent, licensed FSS networks.

The record before the Commission to date highlights the risks to FSS if unlicensed devices proliferate in the quantities that some parties have predicted. C-band satellites are highly vulnerable to interference due to their large receive beams and the significant attenuation affecting uplink signals that must travel tens of thousands of miles to a space station antenna. Experience in other satellite bands has shown that unlicensed devices operating outdoors in significant numbers can trigger aggregate interference that could disrupt reception of uplink signals, degrading service quality and reliability.

To prevent these harms from affecting the hundreds of millions of Americans who benefit from the C-band satellite infrastructure, the Commission must put in place a limit on aggregate interference before introducing outdoor unlicensed devices in the 6 GHz bands. Specifically, Intelsat and SES propose that the Commission adopt a cap on the aggregate power received at the satellite antenna of -142 dBW per channel.

To implement this limit, the Commission should require its proposed AFC system to monitor and control the power levels unlicensed access points are authorized to use nationwide.

Unlicensed devices operated outdoors must be required to be registered, and no devices should be permitted to be deployed in vehicles of any type, including unmanned aircraft. These measures will allow the Commission to fulfill its commitment to protecting critical incumbent uses of 6 GHz frequencies while opening up the band to unlicensed operations.

II. UNFETTERED DEPLOYMENT OF UNLICENSED DEVICES WILL CAUSE HARMFUL AGGREGATE INTERFERENCE INTO SATELLITE RECEIVERS

The facts do not support the Commission's tentative conclusions that unrestrained unlicensed device deployment in the 6 GHz band would have a negligible effect on FSS operations in the band and that limiting the radiated power of unlicensed devices will suffice to prevent interference into satellite receivers.[3] Geostationary satellite receivers are designed to receive weak signals from earth stations roughly 36,000 kilometers away and "hear" signals from all transmitters within a large footprint—many C-band satellites have receive beams that encompass the entire contiguous United States ("CONUS"). Given the power levels that are currently proposed for unlicensed devices in the U-NII-5 and U-NII-7 bands[4] and their anticipated mass proliferation,[5] the cumulative effect of these devices if used outdoors will eventually cause harmful interference that disrupts reception of earth station signals.[6]

If allowed to occur, this harmful interference would degrade C-band satellite operations, damaging the interests of incumbent FSS customers. As the Commission is well aware, C-band

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3 *Id.* at ¶¶ 24, 55.

4 *Id*. at ¶ 20.

5 *See id*. at ¶¶ 3-7.

6 While initial deployments of unlicensed devices may not cause harmful interference, regardless of device characteristics, at a certain deployment level unlicensed devices will cause harmful aggregate interference into satellite receivers.

FSS provides services that are essential to the public interest.[7] The Satellite Industry Association has observed that the C-band satellite backbone delivers:

> services not only enjoyed by American consumers but in many cases critical to their safety and well-being. The media industry as we know it would not exist without the broad coverage, near-perfect reliability, and distance-insensitive pricing of C-band satellite capacity used to distribute video and audio news, weather, sports, entertainment, and religious programming to dense urban centers and small, rural communities alike. The Super Bowl, the Oscars, March Madness and breaking news events arrive in our homes courtesy of nomadic C-band trucks that can be dispatched anywhere to supply a live signal. C-band satellites also provide lifeline connectivity to remote Alaskan villages, deliver emergency alerts, and support critical government operations including air traffic control and broadband communications for U.S. Navy vessels.[8]

Disrupting C-band FSS operations would imperil the continuity and quality of services that supply video programming to 300 million Americans and support industries that contribute more than a trillion dollars annually to the gross domestic product.[9] Given these high stakes, the Commission must take every reasonable step to prevent unlicensed devices from triggering harmful interference to C-band FSS uplink reception.

Contrary to assertions by some parties, the history relating to the U-NII-1 segment underscores the dangers presented by unlicensed operations in the 6 GHz band. The WiFi Alliance has suggested that years of experience in the U-NII-1 frequencies confirm that the rules

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[7] *Id.* at ¶ 12 (conventional C-band satellites provide "content distribution to television and radio broadcasters, including transportable antennas to cover live news and sports events, cable television and small master antenna systems, and backhaul of telephone and data traffic") (footnote omitted). Additionally, many operators, including Intelsat and SES, use extended and conventional C-band for telemetry, tracking, and command ("TT&C") transmissions necessary to ensure safe operation of their spacecraft.

[8] Reply Comments of the Satellite Industry Association, GN Docket No. 18-122, filed Dec. 11, 2018 at i.

[9] *Id.* at 3 & n.6, 9.

for that band are more than sufficient to protect FSS in 6 GHz spectrum,[10] but this assertion ignores recent evidence of the effect of unlicensed devices on the noise floor in the U-NII-1 band. In 1997 the Commission adopted rules opening the U-NII-1 band to unlicensed devices for indoor use only, at a low power.[11] It was not until almost two decades later in 2014 that the Commission allowed devices to operate outdoors at a higher power in U-NII-1 spectrum.[12] The WiFi Alliance's reference to "years of experience" presumably only addresses the time during which U-NII-1 devices were limited to indoor use, as just four years after the Commission permitted outdoor unlicensed operations in the U-NII-1 band, the noise floor over the United States has already increased substantially.[13] Specifically, Globalstar Inc. ("Globalstar") has provided evidence of a dramatic rise in the noise floor of 2 dB from May 2014 to May 2018 over the United States[14] and projects that in three years the aggregate interference will greatly exceed its satellite system's tolerable level.[15]

Globalstar's first-hand example of the effects of aggregate interference from unlicensed devices in a U-NII band highlights what could happen in the 6 GHz band if unlicensed devices are allowed to be deployed without some mechanism to prevent aggregate interference from

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10 *See* NPRM at ¶ 55 & n.129, *citing* Reply Comments of the Wi-Fi Alliance, GN Docket No. 17-183, filed Nov. 15, 2017, at 20.

11 *Amendment of the Commission's Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range*, Report and Order, 12 FCC Rcd 1576 (1997).

12 *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, 29 FCC Rcd 4127 (2014); as amended by *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Erratum, 29 FCC Rcd 11599 (2014).

13 *See Globalstar, Inc. Petition for Notice of Inquiry*, RM-11808, filed May 21, 2018.

14 *Id.* at 11.

15 *Id.* at 13-14.

reaching harmful levels. While Globalstar's system is a low Earth orbit ("LEO") satellite constellation that is much closer to the terrestrial source of aggregate interference than geostationary orbit ("GSO") FSS spacecraft, signals to GSO satellites are weaker on arrival at the satellite receiver, and GSO coverage areas are much larger than those of LEO satellites due to their altitude. These factors make GSO satellite operations similarly susceptible to interference caused by simultaneous transmissions from what could be hundreds of millions of unlicensed devices scattered across CONUS.

In order to protect GSO satellite networks, the Commission must establish an upper limit on the per-channel aggregate power level produced by all unlicensed devices in the direction of the satellite receiver, as discussed below. The number of unlicensed devices that can operate simultaneously without harming reception at the GSO satellite antenna is dependent on the operational parameters and utilization characteristics of unlicensed devices, including variables such as duty cycle, deployment density, and antenna patterns. The Commission's proposed rules do not prescribe these operating details, instead specifying only a maximum power for U-NII-5 and U-NII-7 unlicensed devices.[16] As a result, any analysis to predict the potential interference impact of unlicensed devices on geostationary satellite receivers must rely on numerous assumptions regarding unlicensed operational parameters that are necessarily unproven and speculative.

Changing the assumptions used produces significantly different conclusions. Intelsat and SES have participated along with members of the terrestrial wireless industry in recent studies conducted in the European Conference of Postal and Telecommunications Administrations ("CEPT") in response to a mandate from the European Commission to study feasibility and

16 NPRM at ¶¶ 77-81.

identify harmonized technical conditions for unlicensed use in the 5.925-6.425 GHz spectrum for the provision of wireless broadband services. Depending on which set of variables is employed, these analyses have produced a wide range of results, some of which indicate that the FSS protection criteria would be exceeded by unlicensed device deployment representing a fraction of the total numbers predicted in the NPRM. As just one example, the assumed duty cycle for unlicensed operations significantly affects predicted aggregate interference levels at the geostationary arc. Yet there is no reliable way to predict in advance the duty cycles that will be typical for 6 GHz operations. In this proceeding, a report produced by RKF Engineering Solutions, LLC ("RKF") for unlicensed device proponents suggested duty cycles between 0.11% and 0.44% for high activity devices.[17] In contrast, the duty cycle being used in the CEPT proceedings is 1.97%. Simply changing that assumption increases the interference effect of unlicensed devices by more than 10 dB.

Moreover, the RKF Report provides predicted interference levels from unlicensed devices only as of 2025,[18] making no attempt to forecast beyond that date. But there is no reason to expect that the multiplying demand for unlicensed devices discussed in the NPRM[19] will not continue well beyond 2025. If unlicensed device deployment continues to grow at present rates, the cumulative effect of unlicensed devices will eventually trigger harmful aggregate interference at the receiver—well within the lifetimes of current GSO satellites, which typically operate for fifteen years at a minimum.

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17 *See* Frequency Sharing for Radio Local Area Networks in the 6 GHz Band, prepared by RKF Engineering Services, LLC, Attachment to *Ex Parte* Filing of Apple Inc. *et al*., GN Docket No. 17-183, filed Jan. 25, 2018 ("RKF Report") at 12.

18 *Id*. at 11.

19 NPRM at ¶¶ 3-6.

Although the Commission believes that unlicensed use of the 6 GHz band will be compatible with licensed FSS service,[20] to ensure such compatibility the Commission must adopt adequate protection measures to avoid unlawful, harmful interference from unlicensed devices. Intelsat and SES are not proposing that the Commission limit the number of devices or specify acceptable deployment scenarios for unlicensed devices.[21] Instead, the Commission should require that the proposed AFC system limit aggregate power transmitted to the geostationary arc and adopt the mechanisms discussed below to ensure that the aggregate power from unlicensed devices does not increase to a level that results in harmful interference into FSS operations. This approach will confer significant flexibility in the development and use of unlicensed devices while ensuring these devices operate on a non-harmful interference basis *vis-à-vis* licensed FSS operations.

III. THE FCC MUST ADOPT AN AGGREGATE POWER LIMIT TO PREVENT HARMFUL INTERFERENCE INTO SATELLITE RECEIVERS

The Commission emphasizes in the NPRM that all unlicensed devices operate on a non-interference basis.[22] This status requires the Commission to take steps to prevent unlicensed devices from causing harmful interference into licensed services, including FSS. By adopting a maximum limit on the aggregate power at the satellite receiver produced by outdoor unlicensed

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20 *Id*. at ¶ 20.

21 In the NPRM, the Commission asks whether a reduced equivalent isotropically radiated power ("EIRP") above a 30-degree elevation angle or restriction on pointing toward the geostationary arc would be appropriate to constrain interference to satellite operators. *See id.* at ¶¶ 55-56. While such restrictions may slow the onset of harmful aggregate interference to FSS, they would not prevent it. If instead of elevation angle and pointing restrictions the Commission incorporates an aggregate power limit per channel into the AFC system, the FCC would prevent aggregate interference into the FSS while also providing more operational flexibility for unlicensed devices in the 6 GHz band.

22 *Id*. at ¶ 13 & n.37, *citing* 47 C.F.R. § 15.5(b).

devices in each U-NII channel, the Commission can make spectrum available to meet demand for innovation and growth of services such as Wi-Fi while meeting its stated objective of protecting "the important base of incumbent users" of existing licensed services.[23]

To ensure continued reliability of essential FSS operations, the Commission should adopt a maximum permissible aggregate interference level from unlicensed 6 GHz devices. There are over 90 GSO satellites operating in the UNII-5 and U-NII-7 bands authorized to serve the United States.[24] The characteristics of these satellites, including antenna gain, receiver noise figure, and coverage—which all play a critical role in the level of interference received at the satellite—vary by satellite and will continue to evolve with future GSO spacecraft. The Commission must ensure that the adopted limit is adequate to protect existing systems but also flexible enough to accommodate future innovation in FSS satellites. Every potentially affected space station in the geostationary arc must be protected, and by selecting a satellite that represents current state-of-the-art performance as a model, a maximum permitted aggregate power level transmitted in the direction of the geostationary arc can be calculated that should protect all satellites.

Intelsat and SES have chosen Intelsat 35e as a benchmark because it is a relatively new satellite that currently operates in the 6 GHz band with a large beam over CONUS. Because of the technical characteristics of Intelsat 35e, it is likely that the satellite would be one of the first affected by aggregate interference from unlicensed use of the 6 GHz band. By setting a maximum aggregate interference level based on the capabilities of one of the most sensitive satellites on orbit, the whole geostationary arc should be protected.

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[23] NPRM at ¶ 2.

[24] The list of satellites authorized to communicate with U.S. earth stations is available from the Commission's website at: https://www.fcc.gov/approved-space-station-list.

Next generation satellites that use the Intelsat Epic^{NG} platform, such as Intelsat 35e, are more susceptible to interference due to higher receiver gain-to-noise-temperature ("G/T") compared to traditional satellite architectures. Therefore, the maximum G/T for Intelsat 35e is used to calculate the level of aggregate interference from unlicensed devices. Contrary to the assumptions made by RKF,[25] spot beams that exhibit higher G/T values should not be disregarded when selecting a G/T value for interference analysis. RKF argues that Intelsat and SES's use of an Intelsat 35e G/T value is unrealistic because spot beams, which have higher G/T values, cover much smaller areas than wider beams and therefore will "capture interference from far fewer devices."[26] While RKF is correct that spot beams do have smaller coverage and higher G/T values than wide beams, RKF grossly underestimates the actual size of C-band spot beams, which are much larger than spot beams in higher frequency bands. In fact, a C-band spot beam on Intelsat 35e is large enough to cover CONUS. Thus, satellites operating in 6 GHz spectrum that rely on spot beams over CONUS will experience interference from a much larger area and have higher G/T levels than RKF's calculations account for.

In order to derive an aggregate power level that will protect satellite receivers, it is necessary to define the required protection level for FSS space station receivers from aggregate interference from unlicensed devices. Protection levels for FSS satellite systems are conventionally defined using an interference to noise ("I/N") ratio, which specifies the level of the interfering signal (I) relative to the system noise level (N). Intelsat and SES are proposing that the Commission adopt an aggregate power limit based on an I/N level of -13.5 dB as the protection criteria in this instance, even though ITU-R recommendations allow significantly

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25 RKF Report at 37.

26 *Ex Parte* Filing of Broadcom Corp. *et al*., GN Docket No. 17-183, filed Apr. 10, 2018 at 3.

more protection.[27] The I/N level proposed by Intelsat and SES is based on significant study in the ITU and derived using a 20% of time probability for which the I/N may be exceeded and reflects the apportionment of interference to the fixed service that also operates in this band. The analysis provided in the table below shows that using the operational parameters of the Intelsat 35e satellite, the aggregate power at the satellite receiver should not exceed -142 dBW in order to meet an I/N of -13.5 dB.

Derivation of Maximum Power at the GSO Satellite Receiver	
Aggregate EIRP from unlicensed devices into 40 MHz FSS carrier (dBW)	19.7
Free space path loss (dB)	199.82
Satellite receive gain for Intelsat 35e (dBi)	39.6
Transponder bandwidth (MHz)	40
Polarization advantage (dB)	1.46
Aggregate interference at the satellite receiver (dBW)	-142
Satellite receiver noise temperature (K)	257
Receiver noise floor (N = KTB)	-128.48
I/N (dB)	-13.5

Intelsat and SES recognize that the proposed aggregate power level limit may provide more protection than the I/N of -13.5 dB to certain satellites whose characteristics make them less susceptible to interference compared with Intelsat 35e. However, the Commission must take into account all operational satellites if it intends to protect existing incumbent services. The

[27] ITU Recommendation S.1432, *Apportionment of the allowable error performance degradations to fixed-satellite service (FSS) hypothetical reference digital paths arising from time invariant interference for systems operating below 30 GHz*, recommends levels of acceptable interference from other FSS systems, other co-primary systems and for all other sources of interference. Since the unlicensed devices do not have a co-primary status and operate on a non-interference/non-protected basis, the 1% limit of increase to satellite system noise applies, and an I/N of -20 dB at the space station receiver is recommended.

Commission must therefore adopt an aggregate power limit at the satellite receiver of -142 dBW per channel in the U-NII-5 and U-NII-7 bands to avoid harmful interference into FSS satellite receivers.[28]

IV. THE AFC MUST BE DESIGNED TO ENSURE UNLICENSED DEVICES DO NOT CAUSE HARMFUL INTERFERENCE INTO LICENSED SERVICES

Intelsat and SES support the Commission's proposal to limit the operations of unlicensed devices in the U-NII-5 and U-NII-7 bands through the use of an AFC system.[29] The NPRM seeks comment on what capabilities should be incorporated into the AFC system.[30] In order to ensure FSS services continue to thrive in the 6 GHz band, the Commission should mandate that all AFC systems be designed to monitor and limit the aggregate interference into FSS receivers to a level of -142 dBW per channel and include a mechanism to mitigate interference caused by outdoor unlicensed devices into licensed services. Additionally, in order to account for FSS beam coverage, the AFC system should be centralized[31] and should include all devices that operate outdoors, regardless of their power level. Further, because the AFC system cannot feasibly monitor mobile operations, the Commission should adopt its proposal to prohibit use of unlicensed access points in moving vehicles, including unmanned aircraft systems. [32]

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[28] If the Commission adopts rules that allow outdoor operations in the U-NII-6 segment, it should also adopt this limit in order to protect FSS operations in that band. *See* NPRM at ¶ 73.

[29] *Id*. at ¶ 22.

[30] *See id.* at Section II.A.1.

[31] Intelsat and SES do not take a position on whether there should be only one AFS system or multiple AFS systems. However, if multiple AFS systems are established, the Commission must require them to share all information to ensure that each the system can accurately calculate the total I/N per channel at the geostationary arc prior to authorizing an unlicensed access point.

[32] *Id.* at ¶¶ 84-85.

In order to ensure that the AFC system can effectively mitigate aggregate interference and that operators of U-NII devices comply with Sections 15.5(b) and (c) of the Commission's rules,[33] registration should be mandatory for all access points operating outdoors,[34] and the AFC system should be required to record the actual frequency being used by each outdoor access point.[35] While ideally an AFC system would prevent harmful interference, it is necessary to make sure any harmful interference caused by unlicensed devices in shared bands is quickly remedied. Without the ability to determine which device is causing unlawful, harmful interference into a licensed service—Fixed Service or FSS—and the ability to contact that device operator, it will be nearly impossible to quickly mitigate harmful interference should it occur.

Additionally, all unlicensed device registration data should be required to be up to date as a condition of operating.[36] Intelsat and SES agree with the Commission that devices should periodically verify the frequency availability because this will ensure that the AFC system can calculate the aggregate power per channel without including devices that are no longer in operation. This would help maximize the use of the 6 GHz band by unlicensed devices while ensuring FSS services are protected.

Finally, if the Commission determines that the AFC system should, to the benefit of unlicensed devices, include information about earth stations operating in the 6 GHz band or an AFC system chooses to include such information voluntarily, the AFC system operator should collect the relevant data from the International Bureau's Filing System ("IBFS"). All

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33 47 C.F.R. § 15.5(b), (c).

34 This requirement should extend to the U-NII-6 band if the Commission adopts rules that allow devices in U-NII-6 to operate outdoors. *See* NPRM at ¶ 74.

35 *Id*. at ¶ 89.

36 *See id.* at ¶¶ 29, 30.

information needed for an AFC system operator to determine whether an unlicensed device may be subject to interference from a licensed earth station can be obtained from public data in IBFS. Further, any labor needed to collect such data could be recouped by AFC system operators in the fees they are permitted to charge for providing registration and channel availability functions.[37]

V. CONCLUSION

For the reasons stated above, the Commission should incorporate robust and enforceable protection for FSS operations into any rules permitting unlicensed devices to operate in the 6 GHz frequencies.

Respectfully submitted,

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[37] *Id*. at ¶ 36.