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

In the Matter of	)	
	)	
Expanding Flexible Use in Mid-Band Spectrum	)	GN Docket No. 17-183
Between 3.7 and 24 GHz	)	

REPLY COMMENTS OF SES AMERICOM, INC.

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SUMMARY

The record before the Commission conclusively demonstrates that C-band satellite networks are integral to the U.S. communications backbone: they play an indispensable role in the delivery of video and audio programming to every state in the union, supply lifeline connectivity to rural areas, distribute information that is critical in emergency situations, restore operability when terrestrial networks are damaged, and enable key national security programs. SES's primary objective in this proceeding is to ensure that it can continue to provide these valuable services to its customers, which rely on SES's substantial investment in C-band space segment and customers' own investment in associated earth station facilities in order to reach U.S. consumers.

C-band satellite service offers capabilities, performance, economic value, and geographic reach that cannot be replicated via other transmission methods. As a result, the suggestion by some terrestrial interests that existing C-band fixed-satellite service ("FSS") uses can simply be switched over to other satellite spectrum or to fiber is completely baseless, reflecting either a lack of understanding of the operational realities and critical role of FSS in the national infrastructure or a determined effort to ignore any facts that conflict with their preferred narrative.

Most significantly, neither other satellite frequency bands nor the nation's fiber network has sufficient capacity and availability to substitute for the dozens of C-band satellites and thousands of ground terminals serving the U.S. today. Cutting satellite access to C-band spectrum would therefore result in loss of service to many users, with the harm falling disproportionately on entities that most heavily rely on C-band satellites, including broadcasters and cable systems in smaller communities beyond the scope of fiber networks. These providers

and ultimately U.S. consumers they serve would be deprived of the diverse content packages they currently receive as well as the opportunity to participate in advanced service offerings like the SES ultra high definition 4K video trial carried over C-band satellites. The effect would be to create a new digital divide between television households in urban areas that would continue to enjoy a full suite of content and services and those in rural areas whose viewing options would be drastically curtailed.

Even setting aside these fundamental issues, there is no possible justification for abandoning C-band space and earth stations that are fully functional and have lengthy useful lives. Billions of dollars have been invested by satellite operators and users in building and deploying the C-band FSS infrastructure, and nullifying this investment would have a devastating economic effect.

The Commission must not underestimate the significant technical obstacles either. Time and again, international study groups have concluded that introducing terrestrial mobile service in spectrum heavily used for satellite networks is impractical. No amount of rhetoric on the part of terrestrial interests will change the laws of physics that dictate the limitations on co-frequency sharing. Indeed, the situation in the U.S. presents especially difficult circumstances because a large proportion of the thousands of C-band receive-only earth stations are unregistered, so the Commission has no information on their locations.

SES emphasized in its comments that it will carefully evaluate any proposed more intensive terrestrial use of C-band spectrum from a perspective of ensuring that SES can continue to use its substantial investment in satellite facilities for the benefit of its customers and their end users. We remain committed to doing so. For example, we are closely reviewing the approach put forth by Intelsat and Intel, although the details of that proposal have not been fleshed out.

SES is open to exploring any approach that meets two essential criteria. First, it must create appropriate financial incentive mechanisms to justify the multibillion dollar costs and significant technical challenges of making a limited portion of the C-band downlink spectrum available for terrestrial 5G operations. Second, it must ensure that SES can continue to deliver high quality services to its customers without the threat of disruptive interference. This balance can only be achieved by opening a limited portion of the 3.7-4.2 GHz band, determined by satellite operators, for new terrestrial operations while maintaining current Commission policies that enable full, ongoing satellite network use of the largest remaining portion of the spectrum.

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SES Americom, Inc. ("SES") submits this reply to the comments of other parties in response to the Notice of Inquiry in the above-captioned proceeding, which requests input regarding possible expanded terrestrial use of spectrum in a broad range of frequencies including the conventional C-band spectrum.[1] SES is a member of the Satellite Industry Association ("SIA") and strongly supports the comments and reply comments filed by SIA.[2] As the SIA submissions and SES's own initial comments[3] make clear, C-band fixed-satellite service ("FSS") operations play a central role in the nation's telecommunications infrastructure by supplying reliable service that blankets the country and fulfills important public interest goals.

In this reply, SES addresses only the 3.7-4.2 GHz conventional C-band downlink spectrum. As discussed herein, SES requires ongoing, robust access to these C-band frequencies in order to continue providing essential capacity used for services that – directly or indirectly – benefit every person in the United States.

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[1] *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, GN Docket No. 17-183 (rel. Aug. 3, 2017) (the "NOI").

[2] Comments of the Satellite Industry Association, GN Docket No. 17-183, filed Oct. 2, 2017 ("SIA Comments"); Reply Comments of the Satellite Industry Association, GN Docket No. 17-183, filed Nov. 15, 2017 ("SIA Reply Comments").

[3] Comments of SES Americom, Inc., GN Docket No. 17-183, filed Oct. 2, 2017 ("SES Comments").

I. C-BAND SATELLITE SERVICE IS AN ESSENTIAL BACKBONE OF THE NATIONAL AND GLOBAL COMMUNICATIONS INFRASTRUCTURE

Since its inception almost fifty years ago, C-band satellite service has developed to play a critical but almost wholly unappreciated part in the U.S. telecommunications ecosystem. Today, C-band satellites are used for everything from providing basic, lifeline connectivity in remote Alaskan bush villages to ensuring that the World Series can be enjoyed by baseball fans wherever they live.

A. C-Band FSS Supports Content Delivery to More Than 100 Million Television Households

Most significantly, C-band satellites enable the collection and subsequent distribution of the video and audio programming enjoyed by virtually every U.S. resident.[4] As major content providers Disney, CBS, Scripps, Time Warner, Fox, and Viacom explain, they depend on C-band FSS "to ensure the reliable distribution of compelling programming to more than 100 million American television households."[5] The American Cable Association emphasizes that virtually all of the nation's multichannel video programming distributors ("MVPDs"), including hundreds of small and mid-sized cable operators, use C-band FSS to obtain programming and distribute it to more than 90 million MVPD households.[6] The National

[4] *See* SIA Comments at 7-9 (detailing the key role of C-band FSS in supplying programming to cable headends, Internet protocol television providers such as AT&T's Uverse offering, direct broadcast satellite networks DIRECTV and DISH, over-the-top distributors, broadcast television affiliates serving the millions of U.S. households that rely on over-the-air broadcast service, and terrestrial and satellite radio service providers).

[5] Comments of the Content Companies (the Walt Disney Company, CBS Corporation, Scripps Networks Interactive, Inc., Time Warner Inc., 21st Century Fox, Inc., and Viacom Inc.), GN Docket No. 17-183, filed Oct. 2, 2017 ("Content Company Comments") at 1 & n.2 (citing Nielsen estimates of 118.4 million television homes in the U.S. for the 2016-2017 season).

[6] Comments of the American Cable Association, GN Docket No. 17-183, filed Oct. 2, 2017 ("ACA Comments") at 2.

Association of Broadcasters agrees that "[v]irtually every U.S. television and radio household relies on C-band satellite operations for content distribution in some manner," noting that "[h]undreds of broadcast television stations and thousands of radio stations in the U.S. rely on [C-band] earth stations to receive network and other syndicated programming that these television and radio stations then transmit to viewers and listeners."[7]

Origination of this diverse array of programming is made possible by C-band FSS networks as well. As the Content Companies explain, "the on-site newsgathering and live event audio and video essential to producing breaking news, sports, and other programming also depends upon the C-band, using temporary fixed uplinks to transport video from the field back to studios and on to viewers."[8] NAB notes that "transportable FSS uplink and downlink systems are used for thousands of live events that are broadcast each year," including live news and sports and entertainment events such as the Academy Awards.[9]

In short, regardless of how the final link to a customer's television or radio is made, the vast majority of the underlying news, entertainment, sports, and weather content traverses a C-band satellite network at some point in its path to the end user. Maintaining the performance and reliability of C-band satellite service is therefore crucial to the continued delivery of high quality video and audio services to U.S. consumers.

B. Other Critical Services Depend on C-band Satellite Capacity

The unmatched reliability and ubiquitous coverage of C-band satellites make them ideal for other vital offerings as well. C-band FSS bridges the digital divide for remote areas unserved

[7] Comments of the National Association of Broadcasters, GN Docket No. 17-183, filed Oct. 2, 2017 ("NAB Comments") at 2.

[8] Content Company Comments at 2.

[9] NAB Comments at 3.

or underserved by terrestrial alternatives, supplies U.S. military and civilian agencies with capacity that supports everything from missile defense to air traffic control, is part of the essential distribution chain for emergency alerts, and enables connectivity for ships at sea.[10]

AT&T, for example, explains that in addition to video distribution for its DIRECTV and Uverse video services, C-band satellites play a significant role in the AT&T telecommunications plant. AT&T Alascom uses "a mix of 183 fixed and transportable earth stations to provide basic [public switched telephone network] telecommunications for remote villages in Alaska," interconnectivity that "is essential for the safety and well-being of residents at these locations because it is often the only communications infrastructure available to the local communities."[11] Another Alaskan service provider, General Communication, Inc., describes its use of C-band FSS to "serve customers residing in the most rural and remote areas of the country who rely exclusively on satellite technology for the provision of basic telephone service, medical service, and distance-learning."[12]

GCI also works with the Federal Aviation Administration to "assist pilots in determining local weather conditions throughout the state."[13] Other parties note that the National Environmental Satellite, Data, and Information Service, which operates under the auspices of the National Oceanic and Atmospheric Administration, relies on C-band satellite capacity for

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[10] *See* SIA Comments at 9-14 (describing the role of C-band satellites in serving remote areas, supporting national security and public safety, transmitting emergency information, restoring connectivity when terrestrial networks are damaged, and providing significant maritime services).

[11] Comments of AT&T Services, Inc., GN Docket No. 17-183, filed Oct. 2, 2017 ("AT&T Comments") at 9.

[12] Comments of General Communication, Inc., GN Docket No. 17-183, filed Oct. 2, 2017 ("GCI Comments") at 2-3.

[13] *Id*. at 3.

distribution of weather data.[14] C-band satellite service is used for a variety of military operations as well, including enabling missile warning systems and space surveillance.[15]

NPR relies on the C-band capacity of its Public Radio Satellite System to distribute Emergency Alert System ("EAS") warnings to its interconnected radio stations.[16] Both Sirius XM Radio and iHeartMedia play a similar role, having partnered with the Federal Emergency Management Agency to provide a backup mechanism to distribute EAS alerts, including to state emergency operations centers, and to ensure full, national participation in the system.[17]

C-band satellites are essential to disaster recovery as well. SES provided temporary C-band operations in Puerto Rico that helped to restore Internet connectivity while repairs of the terrestrial infrastructure were taking place.[18] AT&T similarly uses C-band FSS "for circuit restoration in natural disasters, such as efforts undertaken following Hurricanes Harvey and Irma this year."[19]

Both military and civilian ships also rely on C-band satellite communications services. The U.S. Navy's Commercial Broadband Satellite Program provides the sole source of wideband

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[14] Comments of the North American Broadcasters Association, GN Docket No. 17-183, filed Sept. 29, 2017 ("NABA Comments") at 2.

[15] SIA Comments at 10-11.

[16] Comments of National Public Radio, Inc., GN Docket No. 17-183, filed Oct. 2, 2017 ("NPR Comments") at 9.

[17] Comments of Sirius XM Radio Inc., GN Docket No. 17-183, filed Oct. 2, 2017 ("Sirius XM Comments") at 8; Comments of iHeartMedia + Entertainment, Inc., GN Docket No. 17-183, filed Oct. 2, 2017 ("iHeartMedia Comments") at 2.

[18] *See, e.g., SES Americom, Inc.*, File No. SES-STA-20171025-01206, granted Oct. 27, 2017 (authority for C-band earth station in Isabela, Puerto Rico, that allowed a large local employer to resume business operations).

[19] AT&T Comments at 8.

satellite communications for certain types of naval vessels.[20] Moreover, cruise ships, ferries, container ships and other vessels rely on C-band satellite capacity for Internet, voice services for passengers and crew, and map and ship data distribution.[21]

II. SES AND FSS USERS HAVE INVESTED BILLIONS OF DOLLARS TO CREATE AN EFFICIENT, RELIABLE, TECHNOLOGICALLY ADVANCED C-BAND FSS NETWORK THAT IS HEAVILY USED

These capabilities are the product of sustained and substantial commitment of resources in an inherently risky and capital-intensive endeavor with very long investment recovery timelines. SES has worked hard to target its offerings to meet diverse and changing customer requirements and to ensure that usage of both our own and our customers' facilities is efficient and cost-effective. As a result, SES has achieved a high level of capacity utilization. Current Commission policies allowing flexible use of FSS earth stations have been instrumental in facilitating efficient C-band spectrum use.

A. Nineteen SES C-Band Satellites Serve the U.S. Today, with More Being Launched

SES's involvement in C-band satellite operations dates back to 1975, when what was then RCA American Communications, Inc. launched its first domestic communications spacecraft. Today that fleet has grown to more than fifty satellites, of which nineteen have C-band payloads that serve the U.S. Many of these satellites are U.S.-licensed, but a number of critical facilities are foreign-licensed spacecraft that have been granted U.S. market access, including AMC-18 at 104.95° W.L., which carries more than fifty high definition video

[20] *See* SIA Comments at 11.

[21] *See id.* at 13-14.

channels, more than 170 standard definition video channels, and the vast majority of national and regional radio broadcast channels throughout the U.S.

Moreover, to ensure service continuity, SES has new satellites in the pipeline – SES-11 was launched last month to provide C-band replacement service from the nominal 105° W.L. orbital location,[22] and SES-14 is slated for launch in early 2018 to provide follow-on C-band capacity at 47.5° W.L.[23] SES estimates that its total investment in C-band satellite capacity authorized to serve the U.S. is $2.8 billion.

B. SES Is Committed to Innovation to Provide the Highest Service Quality

SES is also pioneering state-of-the-art video service, having introduced a solution for distribution of ultra high definition ("UHD") content in April 2015.[24] As SES noted in its comments, to date 35 MVPDs with roughly 30 million subscribers are participating in an SES trial of 4K UHD video, and several have already initiated service to subscriber homes.[25] The nationwide scope of C-band satellites enables any MVPD to take advantage of the opportunity to take part in the SES trial, and current participants include operators serving a range of communities from Ketchikan, Alaska to downtown Washington, D.C.[26]

C. The SES C-Band Network Is Designed to Maximize User Value and Has a High Utilization Rate

SES has optimized its deployment of C-band satellites to meet the needs of our customers. We have two "cable neighborhoods" with groups of satellites in the western and

[22] *See* https://www.ses.com/our-coverage/satellites/366.

[23] *See* https://www.ses.com/our-coverage/launches.

[24] *See* https://www.ses.com/press-release/ses-and-armstrong-initiate-breakthrough-ultra-hd-trial.

[25] SES Comments at 3.

[26] *See id.*; *see also* http://www.sesnewsletter.com/september/ (listing trial partners that include KPU Telecommunications in Ketchikan, AK, Verizon Fios, and others).

central parts of the orbital arc that carry a large share of the content distributed to cable headends. The central arc neighborhood consists of SES-1 at 101° W.L., SES-3 at 103° W.L., and AMC-18 (soon to be replaced by SES-11) at 104.95° W.L. The western arc neighborhood consists of the AMC-11 satellite at 131° W.L. and the AMC-7 and AMC-10 satellites at 135° W.L.

Over time, SES has shifted many customers to our core center-of-the-arc platform. Many headends have triple-feed antennas that can receive programming from all the satellites in this neighborhood. This capability allows access to multiple satellites for reliability and restoration purposes. As a result, SES's content provider customers can deliver a significant amount of programming over these center of the arc satellites and reach video headends nationwide with a highly reliable signal.

Due to our network design and planning, SES's center-of-the arc cable neighborhood spacecraft are fully loaded, and a number of other SES C-band spacecraft also have high utilization rates. SES does not have sufficient alternative C-band capacity elsewhere in its fleet with the 50-state coverage necessary for video distribution customers to which it could migrate those customers.

D. Users Have Deployed Thousands of C-Band Earth Stations, A Large Proportion of Which Are Unregistered

Complementing the SES investment in C-band space segment, FSS users have purchased and installed ground antennas at thousands of locations across the country. As the NOI recognizes, there are many more receive-only earth stations using the 3.7-4.2 GHz frequencies than there are transmitting antennas in the associated uplink band, 5.925-6.425 GHz. Specifically, the Commission's IBFS database includes only about 1,535 licensees in the 5.925-

6.425 GHz transmit band,[27] as compared to roughly 4,700 in the 3.7-4.2 GHz receive band.[28] Importantly, however, under Commission policies receive-only facilities are subject to a voluntary registration process. The rules specify that these antennas "may be registered with the Commission in order to protect them from interference from terrestrial microwave stations," which have co-primary status in the C-band spectrum.[29]

The record makes clear that a significant portion of the deployed C-band receive-only antennas are not registered, so their numbers and locations are unknown. For example, SIA points out that "cable headends alone account for approximately 4,800 receive antennas – a number that exceeds the combined total for licensed and registered C-band antennas in IBFS."[30] Moreover, a single customer of Intelsat has more than 3,700 unregistered receive-only antennas.[31] The American Cable Association estimates that "as many as ninety percent of its members' roughly 3,000 currently operational receive-only earth stations are unregistered."[32] The North American Broadcasters Association similarly emphasizes that "there is no complete database of receive-only C-band antennas in the U.S. because most of them are not registered."[33]

Thus, there is overwhelming evidence that the number of currently operating C-band receive-only earth stations far exceeds the totals shown in the Commission's database. Indeed, if

[27] NOI at ¶ 24.

[28] *Id*. at ¶ 14.

[29] *Id*. at ¶ 14 n.19, *citing* 47 C.F.R. § 25.131(b).

[30] SIA Comments at 18.

[31] *Id.* at 18 & n.35, *citing* Reply Comments of Intelsat License LLC, RM-11791, filed Aug. 22, 2017, at 3-4.

[32] ACA Comments at 4 n.6.

[33] NABA Comments at 4.

the 90% unregistered ratio reported by ACA is representative, that suggests that the total number of existing receive earth stations is in the tens of thousands, even after making adjustments to account for earth station listings now in IBFS that might be invalid.

Specifically, even if one accepts terrestrial parties' estimates that roughly 30% of IBFS entries are inaccurate,[34] the corrected total should be approximately 3,300 registered earth stations, instead of the 4,700 mentioned in the NOI. If only 10% of receive earth stations are registered, as the ACA data suggests, then the 3,300 number is off by a factor of ten, suggesting that in total roughly 33,000 registered and unregistered receive earth stations are deployed nationwide.

These thousands of facilities are lawfully operating, are used for essential communications services, and represent a substantial equipment investment that must be protected.

E. Earth Station Operators Need Flexibility to Use Multiple Orbital Locations and Frequencies

The record demonstrates that the Commission's full-band, full-arc licensing policy for earth stations facilitates robust spectrum use, maximizing the value derived from both space and ground segment facilities.[35] The policy enhances service reliability, enables competition, simplifies international coordination, and fosters the ability of satellite operators to resolve interference issues.[36]

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[34] *See, e.g.*, Comments of Nokia, GN Docket No. 17-183, filed Oct. 2, 2017 ("Nokia Comments") at 8; Comments of Google LLC and Alphabet Access, GN Docket No. 17-183, filed Oct. 2, 2017 ("Google Comments") at 4-5.

[35] *See* SIA Comments at 25-34.

[36] *Id.*

The Content Companies, for example, emphasize that their intensive utilization of C-band spectrum for programming delivery "depends on the maintenance of the current full-band, full-arc licensing model."[37] They note that while they "have links established with one or more specific satellites in the geostationary orbital arc over particular frequencies in the C-band, there often is need to use other satellites or frequencies on short notice."[38] Scenarios that require such a change include "in-orbit satellite failures, emergency conditions on the ground (*e.g.*, in the case of a natural disaster), or unexpected interference on frequencies currently in use."[39]

NAB points out that broadcast stations "routinely need to access programming from different network feeds or other sources, which may be on almost any transponder or satellite."[40] The ability to shift among satellites and frequencies allows stations to take advantage of competition and deal with technical issues such as "sun outages," during which a satellite signal is completely unavailable for periods of time because it is overwhelmed by solar radiation.[41]

In short, flexibility on the part of the earth station operator to use multiple frequency segments and communicate with multiple satellites is necessary to ensure efficient operation of FSS networks. An earth station's ability to shift operational parameters is essential to optimize satellite usage and extract the maximum value from the investment in space station facilities. Removing this critical flexibility by limiting each earth station to a specific pointing and frequency segment would be comparable to mandating that an individual smartphone could only

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[37] Content Company Comments at 3.

[38] *Id.*

[39] *Id.* at 3-4.

[40] NAB Comments at 5.

[41] *Id.*

communicate on one channel with a limited subset of base stations. Such an approach would eviscerate, not enhance, spectrum efficiency.

III. C-BAND SATELLITE SERVICE OFFERS UNIQUE ADVANTAGES AND CANNOT BE REPLACED IN OTHER SATELLITE FREQUENCY BANDS OR BY USING FIBER

Suggestions by some terrestrial wireless interests that the existing capabilities of the C-band satellite backbone can readily be replicated, either by using satellite service in other bands or by transitioning to fiber, are wholly groundless. Such commenters substantially underestimate the scope of the problem by ignoring the fact that any proposed substitute transmission methodology would need to duplicate the capacity, functionality, and performance currently provided by dozens of C-band satellites communicating with tens of thousands of receive earth stations scattered across the U.S. Even if an adequate replacement for C-band FSS existed, moreover, abandoning the existing infrastructure would result in the needless loss of billions of dollars of investment in C-band space and ground facilities.

A. C-band Satellites' Reliability Is Unmatched by Ku- or Ka-Band Spacecraft

Claims that Ku- or Ka-band satellites could take over the services carried by C-band satellites are made by a number of commenters associated with the wireless industry,[42] but these arguments ignore several critical facts.

Most significantly, higher spectrum bands cannot provide comparable performance to C-band FSS networks. Satellite services in Ku- and Ka-band frequencies are subject to greater

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[42] *See, e.g.*, Comments of CTIA, GN Docket No. 17-183, filed Oct. 2, 2017 ("CTIA Comments") at 10; Comments of Ericsson, GN Docket No. 17-183, filed Oct. 2, 2017 ("Ericsson Comments") at 7; Nokia Comments at 7; Comments of Verizon, GN Docket No. 17-183, filed Oct. 2, 2017 ("Verizon Comments") at 17.

attenuation due to atmospheric effects – rain, fog, snow, or particulates in the air.[43] As a result, even if it were otherwise possible, shifting from C-band to Ku- or Ka-band satellite services would compromise the reliability essential for nationwide video delivery. As AT&T emphasizes, among satellite spectrum C-band is the optimum choice for video distribution "since signal quality and uptime are critical issues" for those services.[44]

In any event, there is very limited available capacity on Ku- and Ka-band spacecraft. Neither SES nor any other satellite operator has Ku- or Ka-band satellites that are standing vacant and ready to serve as in-orbit spares for C-band FSS networks. Instead, operating satellites equipped with Ku- and Ka-band frequencies were built and launched in response to demand for space segment in that spectrum and are actively used by customers providing a wide range of services, including commercial VSAT networks, aeronautical services, and consumer and enterprise broadband connectivity. Any unused capacity on Ku- and Ka-band spacecraft with U.S. coverage is nowhere near enough to replace the hundreds of C-band transponders that currently serve the U.S. – the ACA calculates that video services alone occupy 308 transponders on 24 C-band satellites.[45]

In addition, many Ka-band satellites are configured with spot beams, which are not well suited for distribution of content on a nationwide basis. For example, CTIA mentions high throughput satellites ("HTS") that use multiple spot beams to increase frequency reuse.[46] SES is very familiar with the HTS approach, as several of its newest satellites are HTS designs.[47] Such

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[43] *See, e.g.,* AT&T Comments at 7; NABA Comments at 2; SIA Comments at 14 & n.26.

[44] AT&T Comments at 7.

[45] ACA Comments at 2.

[46] CTIA Comments at 10.

[47] *See* https://www.ses.com/four-reasons-high-throughput-satellite-will-be-game-changer.

satellites are tailored to achieve certain objectives, including meeting high demands for data services within a small area. However, they are not optimized for delivering a package of programming for reception by MVPDs and broadcast affiliates on a 50-state basis, as each channel would need to be repeated in every spot beam in order to achieve national coverage. Doing so would substantially increase the complexity of content delivery and nullify any spectrum reuse advantage of the spot beam configuration, since the same content – occupying the same bandwidth – would have to be delivered by each beam.

B. Fiber's Limited Reach Would Leave Viewers Outside Urban Areas Unserved

Similarly, the limited scope of terrestrial fiber networks and high costs associated with extending those networks disqualify fiber as a realistic stand-in for C-band satellite service.[48] A significant advantage of C-band FSS for video delivery is that it permits the same wide variety of channels and advanced service offerings available in large metropolitan areas to be received in suburban and rural communities. As discussed above, SES is using C-band capacity for its ultra HD 4K trial, whose participants include many small market MVPDs in addition to providers that serve densely populated urban areas.

Any attempt to force content providers to switch to fiber distribution would eliminate the public interest benefits inherent in the satellite-based system, creating a major gap between the programming options available in large and small communities. Viewers in metropolitan areas where fiber has been deployed might still have access to diverse programming choices and advanced technology, but outside urban areas, those options would immediately disappear,

[48] Parties suggesting that fiber could substitute for C-band FSS include CTIA, Ericsson, Nokia, and T-Mobile. *See* CTIA Comments at 11-12; Ericsson Comments at 7; Nokia Comments at 7; Comments of T-Mobile, GN Docket No. 17-183, filed Oct. 2, 2017 ("T-Mobile Comments") at 14.

producing a deep divide between the haves and the have-nots. This divide would be even more pronounced because in areas without ready access to fiber, there also is limited access to Internet connectivity that would enable other sources of video content such as over-the-top distribution.

T-Mobile argues that the fiber infrastructure in the U.S. is "robust," citing an estimate indicating that it extends to 273 cities.[49] Even if that estimate is accurate, such coverage represents a tiny fraction of the thousands of cable headends, broadcast affiliates, and other sites currently served by C-band earth stations.

The comments before the Commission make clear, moreover, that many MVPDs or broadcast affiliates in smaller cities and towns will be unable to afford the high cost of extending a fiber facility to reach them. The ACA provides estimates of the one-time and recurring expenses associated with fiber deployment and concludes that for many of its members, these costs would be prohibitive.[50] NAB concurs that in rural areas "it is economically or practically infeasible for small providers to rely on fiber feeds."[51]

An ACA member that operates multiple systems serving largely rural areas in Nebraska and Wyoming makes clear that "fiber is not a feasible option [for programming distribution] due to geography and cost."[52] The member explains that fiber is not available in all of its system operating areas yet and although it now uses fiber for data connectivity in three of its systems, "installation was an expensive, drawn-out and hard-fought battle."[53] Using fiber for

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[49] T-Mobile Comments at 14.

[50] ACA Comments at 16-18.

[51] NAB Comments at 3.

[52] ACA Comments, Exhibit 1, Declaration of William D. Bauer, at 2-3.

[53] *Id*. at 3.

programming "requires double the capacity of data," doubling the expense and difficulty of fiber deployment.[54]

Furthermore, even where it is available, fiber service is not necessarily as reliable as C-band satellite service. Indeed, AT&T notes that "fiber systems can be subject to cable cuts – or 'backhoe fade' – and AT&T has found that C-Band availability therefore often exceeds that of fiber."[55] The ACA observes that to ensure reliability, it is "standard practice to construct an additional fiber line, using a different route to connect to the nearest node, as redundancy in case the primary line suffers damage."[56] Of course, implementing such diversity multiplies the costs associated with fiber yet again.

In short, as NAB observes, fiber "may supplement satellite [content] delivery in some circumstances – but cannot provide reliable service on the same scale as C-band satellite operations."[57] Instead, attempting to shift video distribution to fiber will leave MVPDs and broadcasters in more rural areas cut off and unable to continue to serve their customers.

C. Stranding Investment in C-band FSS Facilities Is Contrary to the Public Interest

Leaving aside these flaws in proposals for replacing C-band FSS with an alternative delivery mechanism, the Commission cannot justify simply abandoning the huge investment in C-band space and ground station facilities. The NOI notes that 48 satellites with C-band capacity are authorized to serve the U.S.,[58] and each of these represents a cost in the hundreds of millions of dollars and has a typical expected lifetime of at least 15 years. SES's C-band fleet

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[54] *Id.*

[55] AT&T Comments at 7.

[56] ACA Comments at 17 n.34.

[57] NAB Comments at 3.

[58] NOI at ¶ 14.

includes the just-launched SES-11 satellite as well as SES-14, which is being launched next year – two spacecraft with the entirety of their useful lives ahead of them.

The associated C-band ground segment consists of more than 1,500 transmitting earth stations and tens of thousands of registered and unregistered receive earth stations, as well as specialized facilities such as teleports with multiple antennas used for Telemetry, Tracking and Control ("TT&C"). SES operates four geographically-diverse TT&C sites in the U.S. alone with multiple C-band antennas at each site to ensure its ability to reliably monitor and control its fleet of spacecraft. Additionally, SES operates TT&C antennas at three other U.S. locations pursuant to agreements with strategic partners who have facilities at those sites. Each teleport represents a significant investment that could range as high as $40 million to $45 million in C-band equipment, depending on the number of antennas deployed at each site. In aggregate, SES estimates that it currently has roughly $160 million to $200 million invested in its C-band TT&C ground network within the United States. As with space stations, ground antennas have a significant equipment life, typically 15-20 years.

Any Commission action to terminate FSS use of C-band spectrum would render billions of dollars of assets unusable, nullifying the investments by satellite operators, cable systems, television and radio broadcast stations, military and civilian government agencies, and many more entities that rely on C-band satellite service. Such a result would be economically devastating and clearly contrary to the public interest. SES agrees with Intelsat that "removing or involuntarily limiting FSS use" of C-band downlink spectrum would not only be bad public policy but could violate the takings clause of the U.S. Constitution.[59]

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[59] Joint Comments of Intelsat License LLC and Intel Corporation, GN Docket No. 17-183, filed Oct. 2, 2017 ("Intelsat/Intel Comments") at 5 n.10.

IV. BECAUSE TERRESTRIAL MOBILE USE IS INCOMPATIBLE WITH C-BAND FSS OPERATIONS, FORCED SHARING WOULD BE A LOSE-LOSE PROPOSITION

Attempting to introduce terrestrial operations on a shared basis with existing, ubiquitously deployed C-band receive earth stations is simply impractical as a technical matter, especially given the large numbers of unregistered earth stations that must be protected. Such an effort would be a lose-lose proposition, as any opportunity for terrestrial service would be extremely limited and would put C-band satellite services at risk of unacceptable levels of interference.

A. The Record Makes Clear that Significant Separation Distances Between Terrestrial Transmitters and FSS Receive Earth Stations Would Be Needed

Ample evidence in the record shows that introducing new terrestrial mobile systems in the 3.7-4.2 GHz band would pose a substantial interference threat to C-band receive earth stations. The SIA Comments describe international studies in which both satellite and terrestrial interests participated that analyzed the possibility of co-existence in these frequencies.[60] The U.S. contributed actively to this process, which resulted in a report concluding that sensitive earth station receivers must be separated from terrestrial mobile base stations by distances ranging from tens of kilometers to more than 100 kilometers in order to prevent disruptive interference.[61] Because such separation distances cannot be maintained if there are ubiquitously-

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[60] SIA Comments at 37-39.

[61] *Id.* at 38, *citing* Sharing studies between International Mobile Telecommunication-Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands in the WRC study cycle leading to WRC-15, Report ITU-R S.2368-0 (06/2015), available at: https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-S.2368-2015-PDF-E.pdf ("Report ITU-R S.2368") at 31. For the U.S. contribution to this report, *see* In-band and adjacent band compatibility studies between IMT-Advanced systems and fixed satellite service receive earth stations operating in the C-band, submitted by the United States of

deployed earth stations whose individual locations are not known, the report determined that sharing between terrestrial mobile networks and FSS is not feasible in the same geographical area.[62] These theoretical findings are consistent with empirical evidence derived from real-world experience, such as the incident in Hong Kong when field trials of terrestrial service resulted in television signals serving 300 million households throughout Asia being knocked off the air.[63]

A number of other commenters confirm the need for substantial separation distances to protect C-band receive earth stations. Frequency coordination firm Comsearch, for example, observes that prior studies have shown that "the required stand-off distance to protect a co-frequency C-band earth station can be significant."[64] Comsearch goes on to note that in the 3.65 GHz band, the Commission considered the potential for interference to grandfathered earth stations within a 150-kilometer radius.[65]

Ericsson submits a technical analysis that likewise concludes that separation distances needed to protect C-band receive earth stations from interference due to terrestrial mobile

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America to ITU Radiocommunication Joint Task Group 4-5-6-7, Document 4-5-6-7/336-E, dated October 11, 2013, available at https://www.itu.int/md/R12-JTG4567-C-0336/en.

[62] Report ITU-R S.2368 at 32.

[63] SIA Comments at 39, *citing* International Associations of the Satellite Communications Industry, Position Paper on Interference in C-band by Terrestrial Wireless Applications to Satellite Applications at 1-3, ITU Workshop on Market Mechanisms for Spectrum Management (2007), available at: http://www.itu.int/osg/spu/stn/spectrum/workshop_proceedings/Background_Papers_Final/C-band%20Interference%20-%20Global%20Position%20Paper%20for%20ITU%20%20%20%20%20%20spectrum%20workshop.pdf.

[64] Comments of Comsearch, GN Docket No. 17-183, filed Oct. 2, 2017 ("Comsearch Comments") at 3.

[65] *Id.*; *see also* SIA Comments at 37-38 and n.73 (acknowledging that in the 3.65 GHz decision the Commission viewed a circularly shaped 150-kilometer protection zone as conservative and accordingly permitted new terrestrial operations within the zone, but only upon successful coordination with grandfathered earth stations).

operations would be large. Specifically, Ericsson's assessment determines that even under the best circumstances, avoiding co-channel interference to an FSS receive earth station requires a separation distance greater than 30 kilometers.[66] With more typical earth station operating parameters and with the greater levels of protection that high-reliability C band links require, the required separation distances cited by Ericsson increase to between 50 and 70 kilometers.[67]

Further, the Commission must also ensure that FSS reception is protected from adjacent band interference caused by mobile base stations operating in frequency bands immediately adjacent to those used by FSS receive earth stations. SES is concerned about both the potential for overload of FSS receivers and interference from out-of-band emissions from terrestrial transmitters. These risks must be addressed to prevent disruption of satellite services, especially if higher terrestrial transmit power levels are considered as compared to those allowed in 3.55-3.70 GHz.

B. Protecting FSS Earth Stations Will Leave Virtually No Opportunity for Terrestrial Use

Implementing such separation distances around existing C-band receive earth stations would leave very limited areas in which new terrestrial services could deploy. In the following maps depicting the contiguous United States ("CONUS"), Alaska, and Hawaii, SES has plotted 30-kilometer and 70-kilometer exclusion zones, corresponding to the best-case and worst-case calculations made by Ericsson, around the C-band receive stations listed in the IBFS database as of last week. Note that the scale varies among the maps – the scale for each map is indicated by the longitudinal markings shown.

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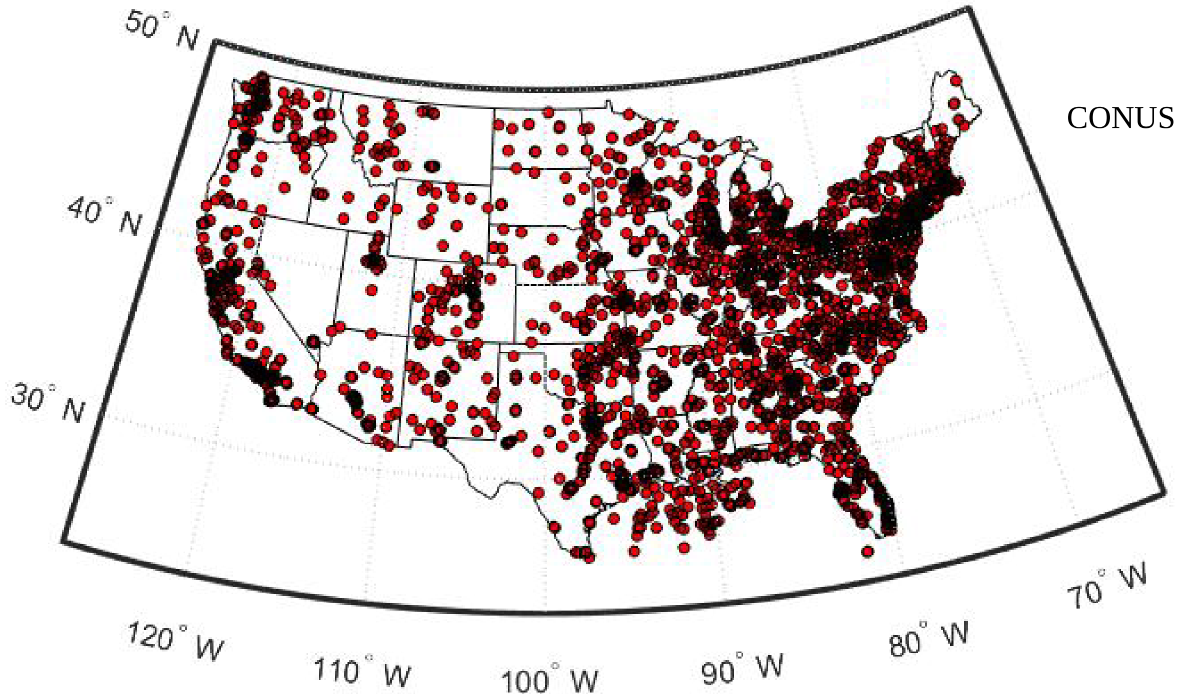
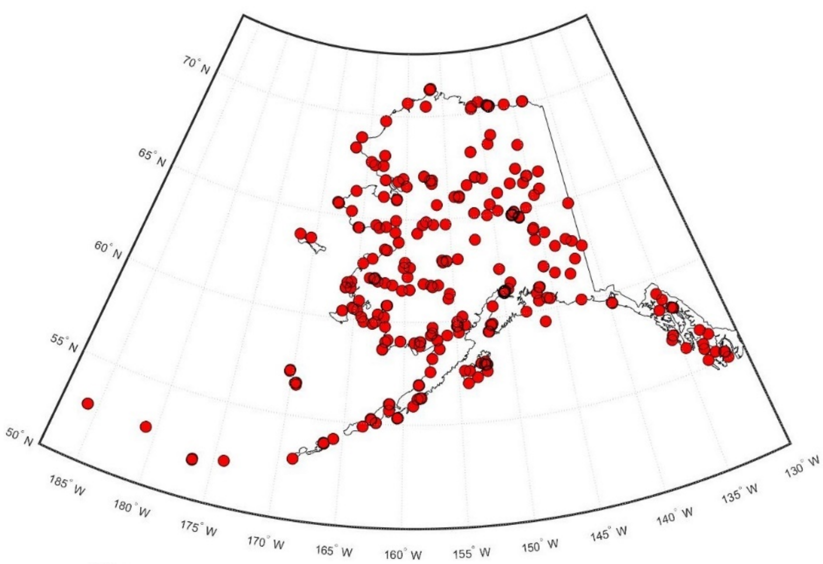
[66] Ericsson Comments at 8 and Attachment A at 1.

[67] *Id*., Attachment A at 3.

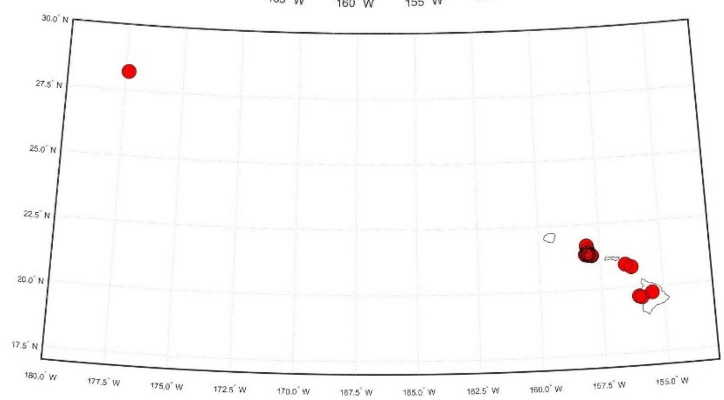
30-Kilometer Zones



CONUS

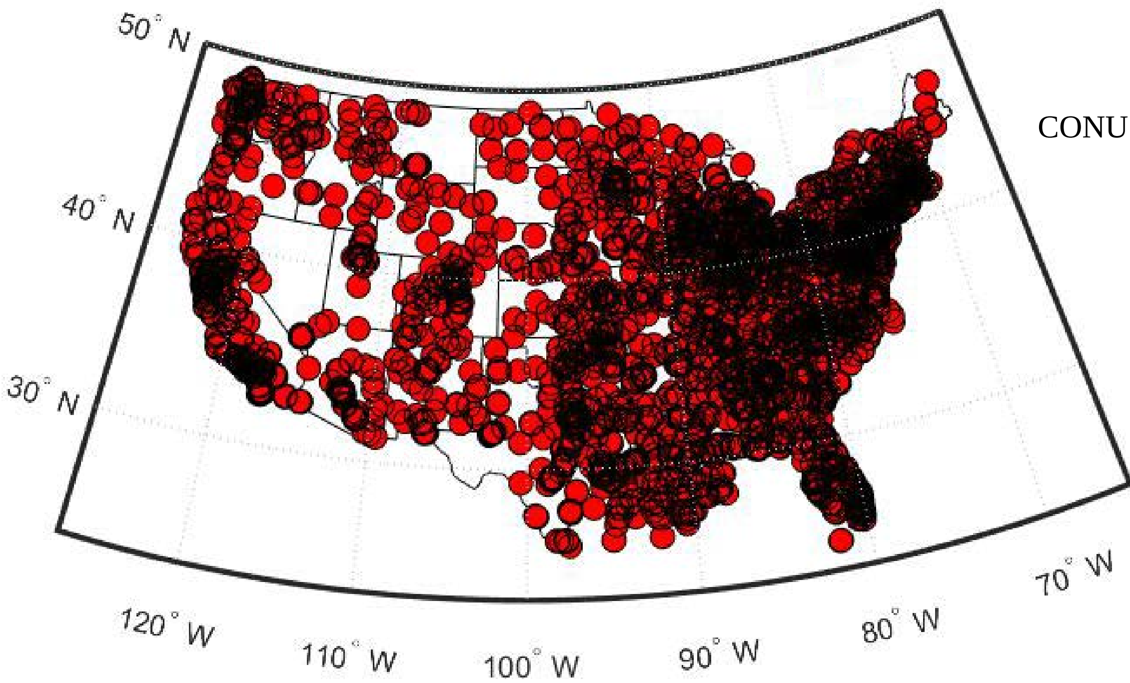


Alaska

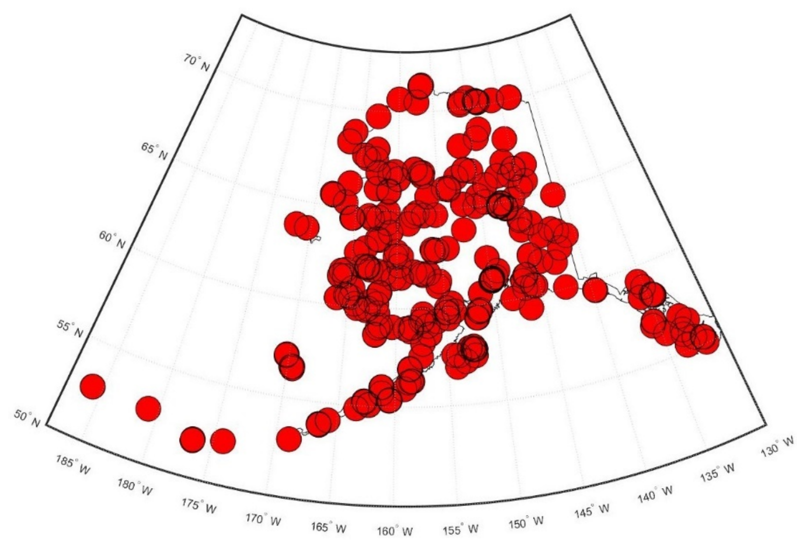


Hawaii and the Midway Atoll

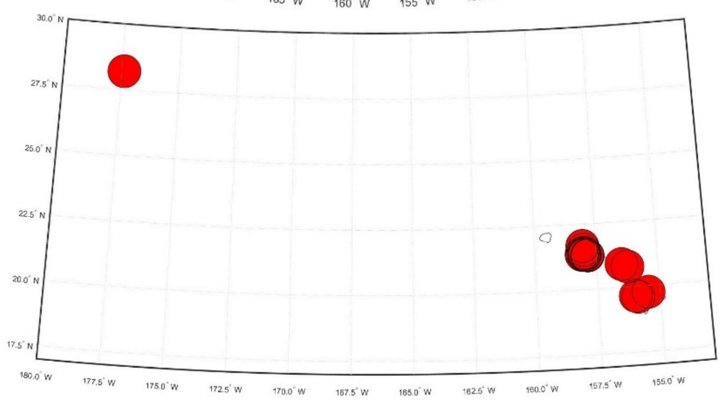
70-Kilometer Zones



CONUS



Alaska



Hawaii and the
Midway Atoll

The 30-kilometer zone maps show that even under the most terrestrial-friendly set of assumptions used by Ericsson, protecting earth stations from disruptive interference would necessitate excluding new terrestrial mobile services from almost all of the eastern half of the United States, along with the west coast and significant other populated regions of CONUS, as well as much of Alaska and Hawaii. The 70-kilometer zone maps show that applying more realistic operating and protection requirements would require exclusion of new terrestrial service in all of CONUS but the least densely populated areas in the western portion, most of Alaska, and all the major Hawaiian Islands except for Kauai.

These maps, however, substantially underrepresent the full population of operating earth stations, which includes thousands of unregistered facilities. Indeed, as discussed above, total earth station deployment could be 33,000 antennas, many times the total depicted here. Thus, once the Commission updates its database to reflect complete and accurate information regarding the full base of receive-only earth stations currently operating, the infeasibility of introducing new terrestrial systems in spectrum that is fully used for C-band FSS will become even more clear.

V. SES IS WILLING TO CONSIDER PROPOSALS FOR TERRESTRIAL MOBILE SERVICE IN C-BAND SPECTRUM PROVIDED OUR ABILITY TO SERVE CUSTOMERS IS MAINTAINED

SES is committed to exploring effective, workable solutions to satisfy the Commission’s desire to accommodate terrestrial 5G services in C-band spectrum while allowing continued provision of high quality, reliable service to customers that depend on C-band FSS. In this regard, SES is reviewing in detail all of the proposals made in the NOI itself and in the responsive pleadings.

As an initial matter, SES strongly supports the proposals in the SIA Reply Comments for immediate Commission action to correct and update its earth station database.[68] The Commission cannot make informed policy decisions regarding C-band spectrum without an accurate understanding of the extent of deployed ground facilities. Accordingly, SES urges the Commission to embark expeditiously on a process to gain information regarding the thousands of currently unregistered C-band receive-only antennas.[69]

As discussed above, claims by some terrestrial interests that the Commission can simply oust FSS from the 3.7-4.2 GHz frequencies and shift current operations to other spectrum or fiber are wholly unrealistic and must be rejected out of hand. Again, neither higher-frequency satellites nor fiber are equivalent replacements to the vast C-band infrastructure. Moreover, services such as content delivery that rely on C-band satellite capacity require nationwide coverage and near-perfect performance, which cannot be provided using other transmission means.

Suggestions that the Commission should employ a database-type approach similar to that adopted for the adjacent 3.6 GHz band[70] also must be dismissed as infeasible. As SIA explains,

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[68] SIA Reply Comments, Section III.B.

[69] In order to expedite assembly of the most critical information regarding unregistered receive earth stations, the Commission may want to initially collect just the location coordinates for each antenna via a simple electronic data entry procedure and with no associated filing fee. Once that preliminary information is in hand, the Commission can move forward with full-scale registration of the antennas, but SES suggests that the Commission revise its registration requirements to reduce barriers to participation. At a minimum, the Commission should waive or significantly reduce the registration filing fee and eliminate the coordination requirement for receive-only earth stations, which serves no meaningful purpose and simply adds needless expense and delay to the registration process.

[70] *See, e.g.,* Comsearch Comments at 3; Comments of Federated Wireless, Inc., GN Docket No. 17-183, filed Oct. 2, 2017, at 1; Comments of Motorola Solutions, GN Docket No. 17-183, filed Oct. 2, 2017, at 1.

the database approach has not yet been implemented or tested in the 3.6 GHz spectrum,[71] which is home to just over one hundred grandfathered earth stations, all at known locations.[72] In contrast, thousands or tens of thousands of receive earth stations, most of them unregistered, operate in the 3.7-4.2 GHz band. To state the obvious, a database cannot possibly prevent terrestrial interference to earth stations whose locations are unknown. Leaving that basic problem aside, it is certainly premature to determine that a database developed for the 3.6 GHz spectrum – even if it ultimately proves successful in that band – could effectively manage the vastly different FSS deployment characteristics and associated interference environment in the 3.7-4.2 GHz frequencies.

Intelsat and Intel have submitted a joint proposal that possibly could permit the introduction of new terrestrial use in the C-band downlink spectrum.[73] SES is evaluating how this plan might work in practice. However, SES does not agree that any such approach could apply to the entire 500 MHz C-band downlink allocation, as that would make it impossible for SES to continue supplying nationwide service to content providers that use C-band FSS capacity to deliver programming to more than 100 million U.S. households.

Given high utilization rates, particularly for SES's center-of-the-arc C-band satellites, freeing up even a limited amount of spectrum would be complex, extremely costly, and difficult. Indeed, in order to maintain service to customers in such a scenario, SES would need to deploy more satellites with C-band capacity, at a cost ranging from $150 million to $250 million in capital expenditure per satellite. Addition of those satellites will be paired with a necessary

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[71] SIA Comments at 39-41.

[72] *Id.* at 35 n.68.

[73] Intelsat/Intel Comments at 6-9.

reconfiguration of the associated ground network that will require further significant investments.

A market-based solution may permit satellite operators to undertake the extremely complicated task of assessing how, when and where to shift customer capacity, satellite infrastructure, and associated teleport, TT&C, and customer facilities, and to incur all related costs. SES is open to exploring any approach, but only if it provides adequate financial incentives to warrant incurring the huge expenses (in billions of dollars) and undertaking the complicated logistical efforts needed to make a discrete and limited segment of the 3.7-4.2 GHz band available for terrestrial 5G services.

In order to preserve essential C-band FSS services, SES also requires ongoing, protected access to significant C-band spectrum and the ability to continue supplying nationwide coverage without the threat of disruptive interference. Commission policies that allow C-band FSS operations to thrive and grow must be retained as well. In particular, the Commission must permit new earth stations to be deployed so that SES and others can continue to respond to customer demand and must maintain full-band, full-arc earth station licensing, which provides flexibility essential for efficient, reliable operation of satellite networks.

VI. CONCLUSION

SES reiterates its openness to consideration of approaches for expanding terrestrial use of C-band spectrum but emphasizes that any approach must allow SES to continue to meet its obligations to provide robust, reliable C-band satellite service to users.

Respectfully submitted,

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