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	)	

COMMENTS OF THE SATELLITE INDUSTRY ASSOCIATION

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October 2, 2017

SUMMARY

The Satellite Industry Association urges the Commission to act with caution in exploring the possibility of expanded terrestrial operations in C-band spectrum. C-band spectrum is critical to satellite services, and disruption of C-band satellite service reliability will have a ripple effect that would negatively impact the delivery of entertainment, sports, news, and weather programming, threaten connectivity in remote areas, and compromise the resiliency of the national communications infrastructure. Ensuring that satellite networks, and the substantial public interest benefits they provide, can continue to thrive and evolve must therefore be an important objective of this proceeding.

The Notice of Inquiry recognizes that satellite networks make extensive use of C-band spectrum to provide valuable services, but does not do justice to the full scope of these offerings. Space stations arrayed at two-degree intervals blanket the U.S. with highly reliable signals, allowing content to be collected from, and distributed to, every state in the union. As a result, C-band satellite capacity plays a central role in video and audio programming contribution and delivery. Satellites provide essential public safety services in areas where terrestrial facilities are unavailable, including supporting telehealth operations and connecting air traffic control sites. Both military and civilian government agencies depend on commercial C-band spacecraft, which provide a global network for the U.S. Army's Intelligence and Security Command and deliver forecasts and warnings from the National Weather Service nationwide. In emergencies and natural disasters, C-band satellites deliver alerts, restore communications capabilities when terrestrial networks are damaged, and serve as a vital source of news information.

This broad variety of services is possible because C-band frequencies are resistant to rain fade and capable of covering large areas, enabling coast-to-coast coverage with high availability.

Content providers can supply the same diverse set of programming across the country, to rural, suburban, and urban areas alike, ensuring that viewers can satisfy their "Game of Thrones" addiction whether they live in Manhattan, New York or Manhattan, Kansas.

By any relevant measure, C-band satellite services represent a clear spectrum policy success story, making intensive use of frequencies to bring value to millions of end customers. Billions of dollars' worth of C-band space station assets have been placed into orbit, and customers and operators have invested tens of millions of dollars in corresponding ground facilities. The resulting infrastructure provides direct or indirect benefits to every U.S. citizen and contributes significantly to the national economy. Technological developments ensure that satellite networks wrest the maximum value from spectrum resources and facilities investments, leading to an exponential growth in what a single transponder can carry.

Commission policies that have served as a catalyst to the development of vibrant C-band satellite operations must remain in effect. The Commission must take steps to prevent unacceptable interference to existing earth station operations, including those using unregistered receive-only antennas, and allow deployment of new earth stations as well. Moreover, the Commission's policy of full-band, full-arc earth station licensing, which has been critical to ensuring that C-band satellite networks can be managed efficiently and can meet customers' needs for reliability and service continuity, must be retained. No party has yet offered an alternative to this framework that would meet the business requirements of satellite networks.

The ubiquity of C-band receive earth stations and their sensitivity to interference make introducing new terrestrial services in the 3.7-4.2 GHz band without disrupting satellite network operations very difficult. Thousands of existing and future earth stations must be protected from unacceptable interference, including receive-only earth stations not currently required to be

registered and whose locations are therefore unknown. Because these earth station antennas must be designed to reliably capture highly attenuated signals from satellites more than 22,000 miles above the equator, they are vulnerable to terrestrial interference. Significant separation distances, ranging from tens to hundreds of kilometers, would be required to ensure that terrestrial signals do not prevent reliable reception of satellite downlinks. The database approach adopted for the 3.55-3.7 GHz band has not yet been tested in those frequencies, which have a limited number of grandfathered earth stations to be protected. It certainly cannot be assumed that a similar approach could effectively prevent interference to the thousands of widely deployed earth stations operating in the 3.7-4.2 GHz band. At a minimum, the Commission should conduct thorough testing and analysis of the effects of expanded terrestrial operations on incumbent services in the C-band.

The challenges created by additional terrestrial use of the C-band uplink frequencies are also significant. In particular, the Commission must develop mechanisms that will ensure that the cumulative emissions from large numbers of terrestrial devices do not create disruptive aggregate interference at the space station antenna. Managing this issue – which will require the Commission to determine how to allocate allowed interference levels among users – will be especially difficult if the Commission permits unlicensed terrestrial operations in this band segment. In addition, the Commission will need to take steps to prevent unauthorized alteration of devices by end users attempting to circumvent operational constraints.

For these reasons, the Commission must ensure that vitally important satellite uses of the C-band spectrum being considered in the Notice of Inquiry are protected in order to preserve the public interest, national security, and economic value of C-band satellite operations.

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The Satellite Industry Association ("SIA")[1] hereby responds to the Commission's Notice of Inquiry in the above-captioned proceeding, which seeks comment on the feasibility of introducing new terrestrial wireless service in spectrum bands between 3.7 GHz and 24 GHz.[2] The NOI focuses on bands used intensively for satellite services that are critical to the nationwide communications infrastructure and support vital national security and public safety programs. Preserving satellite network access to these frequencies is essential to protect existing services and permit continued growth and expansion of operations that benefit every U.S. citizen.

BACKGROUND AND INTRODUCTION

C-band spectrum has been used and shared intensively for decades. Fixed-satellite service ("FSS") operations in the band were not permitted until 1970, and by that time terrestrial

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[1] SIA Executive Members include: The Boeing Company; AT&T Services, Inc.; EchoStar Corporation; Intelsat S.A.; Iridium Communications Inc.; Kratos Defense & Security Solutions; Ligado Networks; Lockheed Martin Corporation; Northrop Grumman Corporation; OneWeb; SES Americom, Inc.; Space Exploration Technologies Corp.; SSL; and ViaSat, Inc. SIA Associate Members include: ABS US Corp.; Analytic Graphics Inc; Artel, LLC; Blue Origin: DigitalGlobe Inc.; DataPath Inc.; DRS Technologies, Inc.; Eutelsat America Corp.; Global Eagle Entertainment; Globecomm; Glowlink Communications Technology, Inc.; Hawkeye360; Hughes; Inmarsat, Inc.; Kymeta Corporation; L-3 Electron Technologies, Inc.; O3b Limited; Panasonic Avionics Corporation; Planet; Semper Fortis Solutions; Spire Global Inc.; TeleCommunication Systems, Inc.; Telesat Canada; TrustComm, Inc.; Ultisat, Inc.; and XTAR, LLC. For more information, visit www.sia.org. These comments are supported by all SIA members except for Ligado, which abstains from participation.

[2] *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").

fixed service ("FS") facilities had already been extensively deployed, causing the Commission to express doubt as to whether satellite requirements could be accommodated in C-band frequencies.[3] Over time, FSS operations were able to gain a substantial foothold, but FS use of the band remained robust. Indeed, the NOI notes that in the late 1980's tens of thousands of FSS earth stations were sharing the 3.7-4.2 GHz band with over 39,000 terrestrial channel assignments.[4]

Gradually, however, many legacy FS links using the 3.7-4.2 GHz frequencies were abandoned, as the common carriers operating those links shifted to using fiber or chose to deploy in other available FS spectrum with more favorable channelization options and in which coordination with FSS operations was not required.[5] As FS use of these frequencies waned, C-band satellite operations moved in to fill the void, expanding their deployment into areas that had previously been foreclosed to them.

This expansion unlocked the unique potential of C-band satellite services. C-band spectrum is resistant to rain fade and allows broad coverage areas, making C-band satellite service ideal for customers such as video content providers that require highly reliable nationwide distribution networks. Demand for such services drove significant investment in both space segment and ground facilities – dozens of satellites with C-band payloads, each

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[3] *See* Comments of the Satellite Industry Association, the Satellite Broadcasting and Communications Association, the World Teleport Association, and the Aerospace Industries Association of America in IB Dkt No. 00-203, *et al.*, filed Jan. 8, 2001 at 18-19 & n.21, *citing Establishment of Domestic Communication-Satellite Facilities by Non-governmental Entities*, 18 RR2d 1631, 1634 (1970) (noting that terrestrial use has "substantially saturated the 4 and 6 GHz bands near several population centers throughout the United States and quite generally in the North-eastern states").

[4] NOI at ¶ 15 & n.24.

[5] *Id*. at ¶ 15.

costing hundreds of millions of dollars, were designed, built, and launched at two-degree intervals across the orbital arc, and thousands of C-band earth stations were deployed across every part of the country.

The Commission's regulatory regime was an essential factor driving this growth. From the beginning of satellite's use of C-band frequencies, the Commission recognized that giving earth station licensees the flexibility to change frequency assignments and antenna pointing to use different transponders and satellites was essential in order to extract the maximum value from the multibillion dollar investment in space segment. That flexibility allowed satellite operators to manage their networks efficiently, remedy interference, and quickly restore service in the event of an outage affecting a single transponder or space station. It also enabled robust competition among space segment providers, competition that was intensified and enhanced when the Commission implemented U.S. trade commitments and allowed foreign-licensed satellites to serve U.S. customers on equal terms with U.S. licensees.[6]

Recognizing the importance of maintaining this flexibility for the continued growth and development of the satellite services business, the Commission has rebuffed demands by FS interests seeking to handcuff satellite network operations by restricting earth stations to use of a limited frequency assignment or segment of the orbital arc. Instead, the Commission reconfirmed the strong public interest benefits of allowing earth stations to access the full band and full arc, "without having to be re-licensed by the Commission, to meet changing operational requirements."[7]

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[6] *Amendment of the Commission's Policies to Allow Non-U.S. Licensed Space Stations providing Domestic and International Service in the United States,* Report & Order, 12 FCC Rcd 24094 (1997) ("*DISCO II*").

[7] *FWCC Request for Declaratory Ruling on Partial-Band Licensing of Earth Stations in the Fixed-Satellite Service,* Notice of Proposed Rulemaking, 15 FCC Rcd 23127, 23145-46, ¶ 40 (2000).

In reliance on this supportive regulatory framework, C-band satellite service has evolved to play an indispensable role in the national and global telecommunications infrastructure. The vast majority of the video programming seen in U.S. homes travels over a C-band satellite at some point, whether the viewer's immediate service comes from a cable operator, Direct Broadcast Satellite ("DBS"), Internet Protocol Television ("IPTV"), or over-the-top ("OTT") provider, or via free to air broadcast television. C-band satellite networks supply basic connectivity to Alaskan bush villages, support missile warning and other national defense capabilities, deliver emergency alerts and weather information critical to public safety, and allow restoration of services when the terrestrial network is damaged or unavailable.

Moreover, the distance insensitivity of satellite communications means that rural and remote areas have access to the same content and features as do densely populated cities. For example, a cable operator in North Dakota can receive the same diverse set of programming channels as one in downtown Cincinnati, and both operators can participate in trials to bring the next generation of ultra high definition service to their customers.

In short, Commission policies have been immensely successful in fostering the C-band satellite industry and contributing to its ability to provide a range of essential services. Preserving the unique value proposition of C-band satellite operations must be a central goal of this proceeding. Although terrestrial interest in C-band spectrum is understandable, the Commission cannot permit any new terrestrial services to imperil satellite operators' ability to continue to meet customer demand for ubiquitous, high-reliability satellite services, both today and in the future. This requires the Commission to ensure that C-band earth stations, including the thousands that are operating on an unregistered basis, are not subjected to unacceptable interference and that new earth stations can be deployed on a protected basis.

Preventing interference to satellite services due to co-frequency, co-coverage terrestrial operations poses significant challenges, especially in the 3.7-4.2 GHz downlink frequencies. Satellite receive antennas are highly sensitive, and signals from a satellite tens of thousands of miles away can easily be overwhelmed by transmissions from much less distant terrestrial facilities. In uplink spectrum, the threat to satellite operations is less severe, but the Commission will still need to develop approaches to mitigate the danger that the cumulative power produced by a large number of terrestrial devices will create unacceptable aggregate interference at the antenna onboard the spacecraft.

The burden must be on prospective new entrants to demonstrate that their operations will not disrupt the critical satellite services being provided in C-band spectrum. The Commission cannot take a "robbing Peter to pay Paul" approach here, undercutting the proven public interest benefits of C-band satellite services to the U.S. economy and communications backbone in order to add further to the significant spectrum already available for terrestrial operations. Instead, the Commission must ensure that C-band satellite services can continue to thrive and grow, and that any new terrestrial services are permitted only to the extent they are compatible with ongoing vibrant use of C-band spectrum by satellite networks.

I. C-BAND SATELLITES DELIVER ESSENTIAL SERVICES TO EVERY PART OF THE NATION WITH EXTREMELY HIGH RELIABILITY

The NOI provides a partial list of services carried by satellites using conventional C-band and adjacent 6 GHz frequencies,[8] but that description falls well short of providing a comprehensive picture of the importance of satellite use of these bands to the national communications ecosystem. As detailed below, this spectrum plays a key role in the delivery of

[8] *See* NOI at ¶¶ 14, 24, & 33.

video and audio programming to consumers nationwide, supports critical public safety and government operations, and supplies basic connectivity where terrestrial infrastructure is lacking or has been damaged. C-band signals are highly resistant to rain fade, making them essential for services – such as video distribution – that require the highest levels of service quality and continuity. The unique propagation characteristics of these bands permit satellite signals to reach every corner of the nation, allowing coverage of rural areas at a cost comparable to that of service in the most densely populated city centers.

A. C-Band Satellite Infrastructure Supports Multiple Critical Industries and Plays a Vital Role in Public Safety and National Security

Although the typical U.S. consumer may be unaware of it, satellite operations in C-band spectrum are an essential element of the core communications services we use every day. For example, although C-band backyard dishes are largely relics of the past, the lion's share of the video programming seen by every household in the country still travels over a C-band satellite link as part of its journey to the viewer. The same is true for the music, news, and sports programming we listen to in our cars and homes. C-band content carriage makes possible the wide variety of channels we take for granted.

Satellite use of the C-band also supports significant government operations, including programs that are relied on by the U.S. Army and Navy to support national defense. In areas where terrestrial services are unavailable or limited, C-band satellites provide basic connectivity, including access to emergency services and potentially life-saving telemedicine links. In short, C-band satellite operations are an underappreciated but essential part of the overall telecommunications infrastructure.

1. C-band Satellites Are Primary Distributors of Video and Audio Content

The largest single use of C-band satellite capacity in the United States is to distribute video and audio programming from content producers to the various service providers who deliver the programming to end users. Regardless of the method by which a household ultimately receives news, entertainment, and sports content, C-band satellites are almost always involved in the distribution chain.

Cable and IPTV headends: C-band antennas deployed at roughly 4800 cable headends receive programming that is distributed to the 52 million U.S. cable television subscribers.[9] A typical cable headend will use at least four individual antennas in order to access programming from the various "cable neighborhoods" – parts of the orbital arc where one or more satellites that carry heavy concentrations of video programming are located.

Internet Protocol Television ("IPTV") uses a similar network model, with headends that receive programming over C-band satellites for distribution to subscribers. IPTV providers serve an additional 9 million subscribers.[10] Combining the cable and IPTV totals, 61 million subscribers, representing more than half the total television households in the U.S., receive programming distributed to headends over C-band satellites.

DBS and OTT: C-band satellites similarly carry content to DIRECTV and Dish, the two U.S. Direct Broadcast Satellite ("DBS") networks. In addition, content providers have noted that they increasingly rely on C-band satellite capacity to distribute content to over-the-top ("OTT")

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[9] *See* https://www.ncta.com/industry-data?share_redirect=/industry-data#colorbox=node-2800.

[10] Verizon has 4.7 million subscribers, *see* http://www.multichannel.com/top-25-mvpds/411157, and the AT&T Uverse service has 4.3 million, *see* AT&T 2016 Annual Report, available at https://investors.att.com/~/media/Files/A/ATT-IR/financial-reports/annual-reports/2016/att-ar2016-completeannualreport.pdf ("AT&T Report") at 16.

distributors, including Sling TV and DirecTV Now.[11] Together, these services reach nearly 35 million households.[12]

Broadcast Television: Most major broadcast television networks also use C-band satellites to distribute programming to their affiliates and owned and operated stations ("O&Os"). Together, the ABC, CBS, and Fox broadcast networks have more than 600 affiliates and O&Os.[13] Reliable distribution of content to these stations is particularly important to the more than 13 million television households that rely on over-the-air broadcast rather than subscribing to a pay television service.[14] Chairman Pai has specifically recognized that "a strong over-the-air broadcast service advances the public interest,"[15] and C-band satellite operations are critical to providing broadcast service.

Terrestrial Radio: C-band satellites are also used to deliver network and syndicated programming to the more than 14,000 radio stations nationwide. For example, CBS, iHeartMedia, National Public Radio ("NPR"), Westwood One, Learfield, Orbital Media Networks ("OMNi"), Premiere Networks, and Skyview Networks all distribute audio content using C-band satellites.

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[11] Letter from The Walt Disney Company, CBS Corporation, Scripps Networks Interactive, Inc., 21st Century Fox, Inc., Time Warner Inc., and Viacom Inc. to Marlene Dortch, Secretary, FCC, RM-11778, filed Jan. 24, 2017, at 1.

[12] AT&T's satellite offerings serve more than 21 million subscribers, *see* AT&T Report at 16, and Dish has 13.7 million subscribers, *see* http://www.multichannel.com/top-25-mvpds/411157.

[13] SIA calculated this total by reviewing broadcast network websites and Commission filings.

[14] SNL Kagan, U.S. Multichannel Industry Benchmarks, 2017 full-year estimates (more than 13 million households rely solely on over-the-air broadcast signals).

[15] Letter of Chairman Ajit Pai, Federal Communications Commission, to The Honorable Frank Pallone, Ranking Member, Committee on Energy and Commerce, U.S. House of Representatives, dated Sept. 15, 2017, at 1.

SDARS: Sirius XM, which provides Satellite Digital Audio Radio Service ("SDARS") to 32 million U.S. subscribers, receives all its third-party generated audio content via C-band satellite links. This includes news programming, live sporting event coverage, and weather reports.

2. C-Band Is Also Used for Video and Audio Content Contribution

C-band satellite facilities also play a significant role in video and audio programming contribution. Many domestic and international news organizations use C-band for satellite news gathering, enabling live coverage of breaking news and sporting events from all across the United States and around the world. For example, PSSI Global Services, which has a fleet of trucks and flyaway antennas, has stated that it relies on occasional use C-band satellite capacity to provide coverage of a broad range of sporting and entertainment events, including NASCAR, major golf tournaments, professional football including the Super Bowl, college football, professional and college basketball, and the Academy Awards.[16] Even when an event venue has a terrestrial link, such as a fiber connection, a satellite truck is typically deployed as well to provide redundancy in case of problems with the terrestrial facility.

3. C-Band Satellites Provide Essential Communications in Remote Areas

C-band satellites are also used to provide essential communications links to remote parts of the United States. In Alaska, General Communication, Inc. ("GCI") relies on C-band satellite services to supply both basic connectivity and more advanced offerings to communities where terrestrial infrastructure is limited or nonexistent.[17] These include:

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[16] *See* Opposition of PSSI Global Services, LLC, RM-11778, filed Jan. 12, 2017, at 2.

[17] Comments of General Communication, Inc., RM-11791, filed Aug. 7, 2017 ("GCI Comments") at 1-11.

- Long distance telephone services that may be a community's only external link, providing the sole means to summon help in an emergency;
- Broadband connections as part of the Commission's "Alaska Plan;"
- Telehealth services to areas underserved by medical professionals; and
- Telecommunications access for libraries and schools that serve over 100,000 patrons.[18]

AT&T's Alascom also uses C-band services to support voice and data backhaul services in remote areas of Alaska. In addition, Alaskan internet service provider OptimERA also has purchased C-band satellite capacity to offer enhanced WiFi and broadband services to meet growing business and consumer demand for faster, more reliable and affordable connectivity in the remote port city of Unalaska and neighboring towns and islands in Southwest Alaska.[19]

4. National Security and Public Safety Services Rely on C-Band Satellites

C-band satellites provide numerous services that play a key role in maintaining national security and enhancing public safety. Military uses of C-band satellite capacity support a wide range of air, land, and sea-based fixed and mobile terminals and applications, enabling services to some of the Defense Department's largest and most important programs as well as making possible a global network to provide national-level missile warning, space surveillance, space control, and satellite command and control. Civilian agencies depend on C-band capacity to provide life-saving services.

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[18] *Id.* at 5-9. *See also* Comments of Competitive Carriers Association, RM-11791, filed Aug. 7, 2017 at 5 ("in Alaska, the 3.7 to 4.2 GHz band is used to facilitate and provide broadband services to areas that would normally not receive such services").

[19] *See* Rural Alaska Benefits from Enhanced WiFi and Broadband Services via Satellite, Press Release, July 20, 2017, available at: https://www.ses.com/press-release/rural-alaska-benefits-enhanced-wifi-and-broadband-services-satellite.

For example, the U.S. Army's Trojan program relies on C-band satellite capacity and has been providing direct support and operational readiness capability to soldiers since 1983. Trojan provides access to a global, end-to-end network, tailored to meet specific U.S. Army Intelligence and Security Command requirements.

The U.S. Navy uses a significant amount of C-band satellite communications as part of its Commercial Broadband Satellite Program ("CBSP"). Among other functions, this program provides the only source of wideband satellite communications to Patrol Coastal ("PCs") and Mine Countermeasure Ships ("MCMs") as well as augmenting and providing diversity for military satellite communications for other ships. The Navy is seeking additional funding to support this program for the coming fiscal year to increase data throughput, reliability, and redundancy.

The National Oceanic and Atmospheric Association ("NOAA") uses commercial C-band satellites for the NOAAPORT network, which distributes weather reports and forecasts, including warnings for the protection of life and property. The system was designed primarily for the National Weather Service, but the data is available to anyone with an appropriate satellite receive antenna and is relied on by both military and civilian agencies.

GCI supports a Federal Aviation Administration ("FAA") program in Alaska that uses C-band satellite capacity to distribute real-time weather camera information to airline pilots. GCI reports that the program has produced an 85 percent reduction in weather-related aviation incidents.[20]

The FAA also uses C-band satellite capacity for the Alaskan Satellite Telecommunications Infrastructure program, which provides links between the main FAA air

[20] GCI Comments at 10.

traffic control center and remote FAA facilities throughout the region.[21] The network relies on C-band earth stations to provide inter-facility communications for air traffic control services supporting commercial aviation.

5. C-Band Satellites Provide Vital Information in Emergencies

The C-band satellite infrastructure supports distribution of emergency information, including in cases when terrestrial facilities are out of service. In addition to using them for programming distribution, NPR relies on C-band satellites to send Emergency Alert System ("EAS") messages known as Emergency Action Notifications ("EANs") to the 1,200 NPR member stations nationwide. Similarly, Sirius XM, which uses the 7025-7075 MHz frequencies to uplink programming and information to its SDARS satellites, not only delivers EAS messages to its subscribers but also serves as a Primary Entry Point ("PEP") station and provides a backup mechanism for distribution of EANs to other PEP stations.

Sirius XM also has taken steps to ensure that important weather information is widely available in emergency situations. For example, during hurricanes Harvey and Irma Sirius XM made The Weather Channel – which is delivered to Sirius XM via C-band satellite – available on a free-to-air basis to all SDARS receivers, regardless of whether they were under an active subscription.[22] This gave listeners access to up-to-date information regarding these dangerous

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[21] *See* http://www.businesswire.com/news/home/20131203005043/en/Harris-CapRock-Awarded-46-Million-FAA-Contract.

[22] *See* http://blog.siriusxm.com/2017/08/25/hear-the-weather-channel-on-siriusxm-during-hurricane-harvey/; http://blog.siriusxm.com/2017/09/07/listen-to-the-weather-channel-on-siriusxm-during-hurricane-irma/.

storms and was especially important in areas where terrestrial television and radio broadcast stations were out of service.[23]

6. Satellite Networks Provide Crucial Restoration and Redundancy

Even where C-band satellite facilities are not the primary transmission method for services, they serve an important role in providing a back-up if issues arise with the terrestrial equipment, including during natural disasters. For example, C-band capacity is already in use to re-establish connectivity in Puerto Rico and other islands in the Caribbean affected by hurricanes Irma and Maria,[24] and discussions are under way to expand C-band recovery service to the U.S. Virgin Islands.[25]

During the 2013 Super Bowl in New Orleans when a power outage halted play, CBS was able to continue broadcasting using a C-band satellite truck equipped with a generator. But for the ability to rely on the C-band transmission capability, the power outage would have interrupted video transmission from the field.

7. C-Band Satellites Supply Significant Maritime Services

C-band satellites provide a way to supply connectivity to ships at sea beyond the reach of terrestrial communications. The Commission has authorized deployment of thousands of C-band earth stations on vessels ("ESVs") to provide video distribution, Internet, and mobile backhaul services. These devices have enabled significant expansion of the communications options

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[23] *See, e.g.*, Communications Status Report for Areas Impacted by Hurricane Irma (PSHSB, Sept. 11, 2017) (listing 8 television stations and 26 radio stations out of service).

[24] *See* http://www.businesswire.com/news/home/20170926005979/en.

[25] In addition, SES donated C-band space segment for distribution of the "Hand in Hand" telethon, which raised $55 million to benefit those affected by hurricanes Harvey and Irma. *See* http://www.billboard.com/articles/news/7972869/hand-hand-telethon-hurricane-relief-final-fundraising-totals.

available to crew members and passengers on U.S. Navy vessels, cruise ships, ferries, barges, and container ships.

For example, C-band satellite service to cruise ships traveling in U.S. territorial and international waters supports corporate network/backbone applications, map and ship data distribution, and passenger voice and internet connectivity. The networks are critical for ship operations and an important component of the passenger experience.

B. The Unique Characteristics of C-Band Spectrum Enable Near-Perfect Reliability and Broad Coverage, Including of Rural and Underserved Areas

The important services discussed above are made possible because the propagation characteristics of C-band spectrum are ideally suited for expansive coverage and resistance to rain fade. As the International Telecommunication Union ("ITU") noted in a 2015 report, in C-band frequencies:

> The low gaseous atmospheric absorption combined with lower attenuation due to rain enables highly reliable space-to-Earth communication links. This, together with the wide coverage beams possible in this band, has led to satellites in this band being an important part of the telecommunications infrastructure in many countries.[26]

The ITU summary reflects the operational realities for C-band satellite customers in the United States. Indeed, at least two dozen satellites with C-band payloads offer service that spans the entirety of the contiguous U.S. ("CONUS"). Satellites in the western portion of the orbital arc can also serve Hawaii and Alaska, while satellites in the eastern arc can cover South America

[26] 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 5.

and Europe in addition to North America. No terrestrial system can match the reach of C-band satellites, which allow transmissions from, and reception of signals at, any point in the country.

Because of these attributes, C-band satellite services meet the requirements of customers whose businesses heavily depend on providing high reliability to users scattered across the country. For example, in explaining their reliance on C-band satellites to distribute video programming, a group of major content providers observed that the satellites permit them to both gather live programming from diverse sites and deliver content packages to broadcasters, cable networks, and other distributors "with near-perfect reliability."[27] Regardless of where a news event is occurring or a sporting event is being staged, a C-band antenna can be dispatched to the site to provide coverage. On the other end, the programming can be received at a broadcast affiliate, cable headend, or DBS or SDARS uplink site with phenomenal signal quality, whether the receive antenna is in the desert Southwest or is being drenched by rain in the Southeast. Other FSS bands do not share these propagation characteristics. As a result, C-band spectrum is highly valued by customers who need extremely high availability service to users over a broad area, such as entities providing real-time distribution of breaking news events or live sports.

Moreover, unlike terrestrial services, the costs of providing C-band satellite services are distance-insensitive. Adding receive sites to a satellite distribution network does not increase the price of the satellite capacity – once a content provider uplinks its signal to a C-band satellite, it can be received by any number of ground stations anywhere within the footprint of the beam. The purchase and installation of a new receive dish is the only requirement to add locations to the network, and those costs do not vary significantly by location. The C-band satellite network

[27] Letter from The Walt Disney Company, CBS Corporation, Scripps Networks Interactive, Inc., 21st Century Fox, Inc., Univision Communications Inc. and Viacom Inc. to Marlene H. Dortch, Secretary, FCC, GN Docket No. 17-183, filed July 24, 2017, at 2.

ensures that a family-owned regional cable operator in a rural area has access to programming choices comparable to those available in the largest cities.

Smaller operators also are able to participate fully in the latest technological developments. For example, SES is conducting a trial of its 4K platform for ultra high definition ("UHD") video delivery to prepare cable systems to roll out advanced services to consumers. The trial participants include operators in Iowa, North and South Dakota, and Alaska.[28]

The nationwide availability of C-band satellite service is especially significant because while an urban operator may have the option of primarily relying on terrestrial facilities for obtaining programming, such choices almost certainly will not be available to a small-town cable system. Impairing access to C-band satellite service will most seriously disadvantage providers serving customers in "rural, remote, and underserved areas of the country,"[29] contrary to the stated objectives of the NOI.

II. BY ANY REASONABLE METRIC, SATELLITE USE OF C-BAND SPECTRUM IS ROBUST AND EFFICIENT

Allegations that C-band spectrum is underutilized or that demand for C-band satellite service is waning are simply unsupported. The facts show that C-band satellite service is a vibrant contributor to the communications infrastructure and the national economy, indirectly benefitting every American citizen. Moreover, satellite operators and customers alike are driven to continually increase spectrum efficiency.

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[28] *See* https://www.ses.com/press-release/six-more-cable-operators-join-expanding-ses-ultra-hd-trials; https://www.ses.com/press-release/ultra-hd-gains-momentum-us-30-pay-tv-providers-testing-4k-delivery-sess-platform.

[29] NOI at ¶ 6.

A. Satellite Operators Have Invested Tens of Billions of Dollars to Deploy Spacecraft that Provide Unmatched Geographic Reach

The orbital arc above the United States is occupied by dozens of satellites with C-band capacity, each representing an investment of hundreds of millions of dollars. The NOI observes that 48 C-band satellites are currently authorized to serve the U.S.,[30] and new satellites with C-band capacity are being built and deployed as well. In the coming months SES is scheduled to launch two satellites with C-band payloads that are authorized to provide U.S. service – SES-11, which will replace C-band capacity at the nominal 105° W.L. orbital location, and SES-14, which will replace C-band capacity at 47.5° W.L. Intelsat recently filed applications for satellites that will replace C-band capacity at 125° W.L. and 133° W.L.[31] C-band satellites are all required by Commission rules to "employ state-of-the-art full frequency reuse, either through the use of orthogonal polarizations within the same beam and/or the use of spatially independent beams."[32] As a result, the C-band spectrum is reused at each individual orbital location as well as at dozens of positions across the geostationary arc.

Moreover, as discussed above, C-band spectrum characteristics allow extremely large beams, enabling full-CONUS, transatlantic, or transpacific coverage, depending on the satellite's position in the orbital arc. Thus, at any given location in the United States there are multiple satellites – in CONUS locations, at least two dozen – capable of providing service throughout the C-band frequencies and with full spectrum reuse.

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[30] NOI at ¶ 14.

[31] Satellite Policy Branch Information; Space Station Applications Accepted for Filing, Report No. SAT-01259, File No. SAT-LOA-20170524-00079 (Aug. 11, 2017) (Public Notice); Intelsat License LLC Application to Launch Galaxy 15R, File No. SAT-LOA-20170524-00078 (filed May 24, 2017).

[32] 47 C.F.R. § 25.210(f).

No terrestrial network offers anything approaching comparable coverage. Even the most extensively deployed terrestrial mobile systems, for example, have gaps where the density of users is insufficient to justify the costs of building out additional facilities. Indeed, the most stringent Commission build-out requirements for terrestrial wireless networks only require licensees to establish service to 75% of the population of a license area, and many require a much less onerous showing of "substantial service."[33] In contrast, one C-band satellite can cover 100% of the U.S. population, and collectively the four dozen satellites on the Commission's Approved Space Station List blanket the U.S. with C-band coverage many times over.

B. Satellites Communicate with Thousands of Widely Deployed C-Band Earth Stations

These spacecraft serve thousands of earth stations that are ubiquitously deployed throughout the U.S., including an unknown number of receive-only earth stations. As indicated in the NOI, roughly 4,700 C-band earth stations are listed in the Commission's IBFS database, representing a combination of licensed transmit/receive antennas and registered receive-only antennas.[34] Receive-only earth stations, however, are not required to be registered, and the evidence suggests that a large number of C-band users have chosen not to go through the registration process because the benefits of registration do not justify the costs.

For example, as noted above, 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. Intelsat reports that a single user of its C-band capacity for the distribution of religious programming has more than 3,700 unregistered receive-only antennas.[35]

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[33] *See* http://wireless.fcc.gov/licensing/index.htm?job=const_req_by_service.

[34] NOI at ¶ 14.

[35] *See* Reply Comments of Intelsat License LLC, RM-11791, filed Aug. 22, 2017, at 3-4.

Registering a receive-only earth station requires preparation and submission of an application form providing detailed technical information and payment of a fee – currently $435 per station.[36] Under Commission rules, the only value of receive-only registration is that it provides interference protection from later-filed terrestrial fixed service ("FS") operations.[37] As the NOI observes, the number of FS links in the 3.7-4.2 GHz band has dropped substantially in recent decades "as common carriers migrated to fiber or other FS bands that offered more channelization options without the risk of interference disputes with licensed or unlicensed [receive-only] earth stations," such that today FS use of this spectrum "is relatively minimal (119 licenses)."[38]

Given these trends, it is highly unlikely that registering a receive-only earth station will confer any meaningful protection. Registration would not provide protection against any of the remaining legacy FS links already in place, and new FS links are unlikely to be deployed in the 3.7-4.2 GHz band. Under these circumstances, it is not surprising that there appear to be many thousands of unregistered receive-only earth stations in place nationwide.

The total investment in C-band earth station antennas is substantial. SIA estimates that considering current cable headends alone, the sunk cost of these facilities represents roughly $135 million.

C. C-Band Satellite Service Benefits Every U.S. Citizen

The benefits of C-band satellite service cannot be defined based on the number of earth stations in use, but extend broadly to the American public. As discussed above, virtually every

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[36] 47 C.F.R. § 1.1107.

[37] NOI at n.19.

[38] *Id.*, ¶ 15 (footnote omitted).

person who watches television or listens to the radio, whether pursuant to a paid service or free to air, is enjoying programming that traveled over a C-band satellite at some point in its journey to the end user. Moreover, all U.S. citizens share the benefits of the national security, public safety, and disaster recovery roles played by C-band satellites. Furthermore, there is no "digital divide" when it comes to C-band satellite services, which provide truly ubiquitous coverage that permits rural and remote areas to enjoy the same scope and quality of service, and to take advantage of the same technical advances, that are available in urban areas.

D. Technological Advances Have Substantially Increased Throughput

Given the costs of satellite facilities, both operators and customers have strong incentives to maximize the efficiency with which the spectrum is used. The history of video transmission and compression technology highlights this progression. In the early days of analog transmission, one video channel occupied an entire satellite transponder. The shift to digital technology (which required a change-out of equipment at all customer sites over a period of many months) permitted six or seven channels to be carried per transponder. Today, a single transponder can carry 16-20 standard definition channels.

Of course, HD video formats require a higher data rate, decreasing the number of channels that can be carried per transponder, but providing improved picture quality. Ultra HD requires still more capacity per channel.

Going forward, advances in transmission capabilities and compression algorithms will continue to permit more and more data to be delivered using any given C-band transponder. These technological developments have laid the foundation for the explosion in both the number of programming channels offered today and the video quality delivered to viewers. The diversity of content available on current pay television systems – including regional and specialty sports

networks, religious programming, foreign language channels, and so much more – would not be possible without the gains in throughput that have been implemented for C-band satellite service.

E. C-Band Services Contribute Significantly to the National Economy

Finally, the evidence demonstrates that C-band satellite services, and the industries they support, are a significant and critical segment of the U.S. economy. SIA's most recent State of the Satellite Industry Report indicates that the U.S. satellite industry as a whole produced $110.3 billion in revenue in 2016 and employed 211,185 workers in the private sector.[39] SIA estimates that the current annual revenue from C-band satellite services alone is $340 million, with the bulk of that coming from programming distribution and smaller shares attributable to enterprise services, military uses, and mobile backhaul and mobility-related offerings.

The industries that rely on C-band satellite services also produce substantial revenues. The U.S. cable industry generated $57.7 billion in residential video revenue in 2016[40] and accounted for 2.6 million direct and indirect jobs according to NCTA.[41] The U.S. DBS market generated $39.7 billion in revenue in 2016,[42] and the broadcast television industry accounted for

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[39] SIA 2017 State of the Satellite Industry Report, available at http://www.sia.org/wp-content/uploads/2017/07/SIA-SSIR-2017.pdf ("SIA Report") at 6, 31.

[40] *See* http://variety.com/2016/biz/news/cable-tv-revenue-decline-broadband-cord-cutting-1201836417/.

[41] *See* https://www.ncta.com/industry-data?share_redirect=/industry-data#colorbox=node-2790.

[42] SIA Report at 12.

$28.4 billion in revenues.[43] Terrestrial radio revenues were $14.1 billion in 2016,[44] with SDARS representing an additional $5 billion.[45]

In short, C-band satellite operations have a ripple effect, enabling other services that employ millions of Americans and are significant drivers of the U.S. economy.

III. REGULATORY POLICIES THAT ENABLE VITAL C-BAND SATELLITE OPERATIONS MUST BE RETAINED

In order to ensure that C-band satellite networks are able to continue providing these critical services, Commission rules and policies must protect existing satellite operations, allow continued growth and expansion of C-band deployments, and preserve the flexibility on which C-band satellite systems rely.

A. Receive-Only C-Band Earth Stations Must Be Protected

As discussed above, the record demonstrates that there are thousands of receive-only earth stations that have not been registered under the current C-band spectrum sharing regime. Specifically, the only benefit conferred by registration – protection from interference due to new FS links – is of little or no value given the small and diminishing number of FS facilities remaining in the 3.7-4.2 GHz band.

Before the Commission can reasonably consider whether introducing new fixed or mobile terrestrial services on a shared basis is feasible in this band, it will need a clear picture of the existing receive-only antenna deployments. Moreover, the Commission must provide a mechanism for operators of such antennas to obtain ongoing protection of their investment in C-

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[43] *See* http://www.fiercecable.com/broadcasting/local-tv-stations-revenue-totaled-28-4-billion-2016-bia-kelsey-says.

[44] *See* http://www.biakelsey.com/digital-revenues-u-s-radio-industry-continue-rise-ota-numbers-remain-steady-14-1-b-2016-according-new-biakelsey-report/.

[45] *See* SIA Report at 12.

band ground facilities. These entities have made the choice not to register their earth stations to date because the significant costs of registration far outweigh any benefits under the existing regulatory framework. Prior to adopting any changes in that framework, the Commission must give receive-only antenna owners the opportunity to decide if potential changes in the sharing environment justify a different choice.

In particular, the argument by the Broadband Access Coalition ("BAC") that unregistered receive-only earth stations "are not relevant" to the Commission's analysis of potential added uses of the C-band downlink spectrum[46] must be rejected. Operators of unregistered receive-only earth stations are incumbent users of primary FSS systems in full conformance with Commission rules, which make clear that registration of such stations is voluntary.[47] In effect, the BAC is claiming that its proposed point-to-multipoint operations in C-band spectrum, which are not permissible under existing Commission rules, should not only be authorized but should be able to leap-frog currently permitted users, gaining superior status to – and the right to interfere with – lawful incumbent receive-only satellite operations. Such a result would clearly be contrary to the public interest.

SIA understands that many receive-only earth station operators are deterred from registering their antennas because of the complexity of the necessary forms and the costs of completing the registration process, including the need for a coordination report and payment of the per station FCC filing fee of $435. To encourage the development of a complete and accurate record regarding the number and positions of receive-only earth stations, the Commission may want to streamline the registration procedures and waive the registration fee, in

[46] Reply Comments of the Broadband Access Coalition, RM-11791, filed Aug. 22, 2017, ("BAC Reply") at 20 n.67.

[47] *See* 47 C.F.R. § 25.131(b).

part or in whole. In addition, particularly for entities with large numbers of receive-only dishes, such as the Intelsat customer with 3,700 antennas, preparing and submitting registration requests will be a lengthy process. The Commission should ensure that there is adequate time for receive-only antenna owners to complete the registration process before any changes in the spectrum sharing framework take effect.

The Commission cannot make evidence-based assessments regarding the difficult sharing issues presented in the NOI unless it has access to reliable information regarding the deployed base of receive-only facilities. Easing the registration process for incumbent receive-only earth station operators will give the Commission this essential information. Moreover, allowing those operators to cement their rights to protection vis-à-vis potential new terrestrial services is necessary to avoid disruption of the valuable services delivered today to C-band receive-only satellite earth stations.

B. The Commission Must Allow for Deployment of New C-Band Earth Stations

In addition to preserving the rights held by operators of existing earth stations, the Commission must ensure that C-band satellite networks can continue to grow and evolve. As discussed above, C-band satellite service remains in high demand, particularly for businesses like content contribution and distribution that require extremely high levels of availability and nationwide coverage. Use of existing C-band satellites is robust, and new satellites with C-band capacity are being constructed and launched.

In short, the C-band satellite services market is dynamic, not static, and the regulatory framework must take into account the need for earth station deployments to expand and change. C-band system operators must be able to add sites to existing networks and add networks in response to customer demand as well as to introduce new service offerings. To permit continued

vital uses of the sunk investment in C-band satellite capacity, Commission rules must guarantee reasonable and reliable ongoing access to C-band spectrum for satellite users, including the ability to add earth stations in the C-band uplink and downlink frequencies.

C. Full-Band, Full-Arc Earth Station Licensing Policies Must Be Retained

As SIA has previously demonstrated, the requests for elimination of the Commission policy in favor of full-band, full-arc licensing of earth stations filed by the Fixed Wireless Communications Coalition ("FWCC")[48] and the BAC[49] must be rejected.[50] The record in those proceedings makes clear that the policy is necessary to ensure that satellite networks can be managed efficiently, and no viable alternative that would meet the needs of the satellite industry has been put forward.

1. Flexible Spectrum Access Is Essential for C-Band Satellite Operations

The Commission explained in 2000 that:

> Our full-band licensing policy promotes important operational objectives in the FSS, in particular by providing earth station licensees the needed flexibility to change transponders or satellites on short notice, and without having to be re-licensed by the Commission, to meet changing operational requirements. . . . Many satellite earth stations employ multiple antennas and regularly communicate with a constantly changing mix of FSS satellites, both domestic and foreign. This type of operation requires access over a wide range of orbital arc and frequencies. . . . In sum, our full-band licensing policy provides all earth station operators the ability to conform to the constraints placed on the satellite operators and the flexibility to change channels to access available

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[48] Petition for Rulemaking, Fixed Wireless Communications Coalition, Inc., RM-11778, filed Oct. 11, 2016 ("FWCC Petition").

[49] Petition for Rulemaking of the Broadband Access Coalition, RM-11791, filed June 21, 2017 ("BAC Petition").

[50] *See* Petition to Dismiss or Deny of the Satellite Industry Association, RM-11778, filed Jan. 9, 2017; Reply of the Satellite Industry Association, RM-11778, filed Jan. 24, 2017; Opposition of the Satellite Industry Association, RM-11791, filed Aug. 7, 2017; Reply of the Satellite Industry Association, RM-11791, filed Aug. 22, 2017.

> transponder capacity within a satellite network and available capacity on other satellite networks.[51]

This description remains equally valid today. Full-band, full-arc earth station licensing is critical to deriving the maximum value from the multibillion-dollar investment of satellite operators and their customers in C-band facilities and to exploiting the propagation characteristics of C-band spectrum. The flexibility afforded by this Commission policy has played an essential role in the evolution of the C-band satellite services marketplace. As SIA has shown, C-band satellite networks are uniquely well-suited to meeting the needs of customers like content providers who require very reliable service nationwide. Constraining the ability of an earth station operator to reorient its earth station or change to a different C-band segment would nullify this critical advantage and deprive C-band satellite users of the benefits they relied on in designing and deploying their networks.

Full-band, full-arc earth station licensing is a necessity in a broad variety of situations:

Service restoration in the event of a satellite or transponder outage: When a transponder or whole satellite fails, the only way to prevent damaging, long-term disruption of service is to quickly switch to another transponder or satellite, which will necessarily involve a change in antenna orientation, frequency segment, or both. Content providers purchase protected service on C-band satellites, meaning that in the event of an outage affecting the primary transponder or satellite, they are guaranteed replacement capacity on another transponder or spacecraft. In some cases, the protection agreement specifies to which other satellite the user will be changed in the

[51] *FWCC Request for Declaratory Ruling on Partial-Band Licensing of Earth Stations in the Fixed-Satellite Service,* Notice of Proposed Rulemaking, 15 FCC Rcd 23127, 23145-46, ¶ 40 (2000).

event of an outage; in others, the satellite operator has the discretion to choose the restoration capacity.

Restoring these protected customers, moreover, creates a daisy-chain effect on other users. Specifically, customers without protected status get bumped from the transponder they are using if that transponder is needed to restore service to a protected user. The satellite operator, although it is not contractually obligated to do so, will make every effort to then find a way to restore capacity to the preempted customers as well, often on other frequencies and possibly on other satellites. Full-band, full-arc licensing allows FSS earth stations to make these changes quickly, without having to modify their licenses.

Often a series of earth station antenna repointings is required. For example, when SES's AMC-9 satellite, which had been providing C- and Ku-band service from 83° W.L., failed earlier this year, many of the customers were immediately switched to the adjacent AMC-6 satellite at 85° W.L. SES later requested and received authority to relocate AMC-6 to 83° W.L. to serve as long-term restoration for customers who had been using AMC-9. While AMC-6 was being relocated, a number of customers temporarily took service from the AMC-4 satellite before returning to use of AMC-6 once it arrived at 83° W.L. Thus, these customers changed satellites four times: from AMC-9, to AMC-6, to AMC-4, and then back to AMC-6.

Given that the predominant use of C-band satellites is for video delivery to widely-dispersed cable and IPTV headends, broadcast affiliates, and DBS uplink sites, switching programming distribution to another satellite requires changes to hundreds or thousands of receive dishes. One of SES's C-band customers had used AMC-9 to deliver video programming to more than one hundred affiliates located across the country.[52] In order to recommence

[52] Opposition of SES Americom, Inc., RM-11791, filed Aug. 7, 2017, at 2-3.

service, that customer had to send out to each affiliate personnel who were qualified to repoint the receive antennas at the site.[53]

In short, the restoration of capacity after a satellite experiences a problem is a highly complex undertaking, even under current policies. Any impairment of the ability of customers to repoint their antennas and/or switch to a different segment of C-band spectrum as part of the restoration process would turn a complex undertaking into a virtually impossible one. Specifically, restoration in that scenario would require identification of a revised frequency segment and new antenna pointing that could be used by *all* of a distribution network's receive sites without creating an interference problem at any of the locations. Without full-band, full-arc earth station licensing, the likelihood of finding a frequency and pointing combination that would satisfy every receive site of even a single customer of a failed satellite – much less all of them – would be infinitesimal.

Transitioning to a follow-on satellite: Similar factors affect the process of changing to a follow-on spacecraft when a satellite is nearing its end of life. For example, SES recently moved a number of its terrestrial radio programming customers from the AMC-8 satellite at 139° W.L. to the AMC-18 satellite at the nominal 105° W.L. orbital location. The transition occurred over a five-month period during which the radio networks were available on both spacecraft, allowing stations to make the switch when ready during that period. SES had to work with all the radio networks to designate appropriate follow-on frequencies, taking into account some receivers that even with full-band, full-arc licensing, had coordination-related limitations on what spectrum they could use. More widespread constraints on each receive earth station's flexibility to repoint and shift spectrum usage would have made this process much more difficult, if not impossible.

[53] *See id.*

Redundancy and emergency services when terrestrial alternatives fail or are unavailable: Flexibility is also critical when a satellite link is activated because of an outage affecting the primary terrestrial transmission facility. A natural disaster or other emergency may require rapid initiation of new satellite services, especially if terrestrial communications systems have been damaged.

Moreover, as noted above, standard practice when televising a major news or sporting event is to have a satellite truck available even if the event venue has a fiber connection. The content distributor must be confident that if it needs to switch carriage of the event to satellite, its network of receive antennas will all be able to orient their antennas as necessary and downlink the signal.

Competition among satellite service providers: Full-band, full-arc earth station authority is also necessary to allow C-band satellite users to take advantage of competing sources of space segment capacity. Under existing Commission rules, an earth station with "ALSAT" authority can communicate with any satellite authorized to serve the U.S. Limiting an earth station to only the C-band frequency segment and the antenna pointing currently in use would make it much more difficult – and perhaps even impossible – for the user to switch suppliers, thus seriously limiting competition.

Such an outcome would be contrary to the Commission's long-standing commitment to promoting competition among suppliers of communications services and to the public interest. The Commission has emphasized that its objective is to "foster development of innovative satellite communications services for U.S. consumers through fair and vigorous competition among multiple service providers."[54] Such pro-competitive policies, the Commission has

[54] *DISCO II*, 12 FCC Rcd at 24098, ¶ 6.

observed, "provide users more alternatives in choosing communications providers and services, as well as reduce prices and facilitate technological innovation."[55] Congress has made clear its interest in satellite competition as well, requiring the Commission to analyze and report on competitive market conditions with respect to domestic and international satellite communications services.[56] Eliminating full-band, full-arc licensing of earth stations would make it impossible as a practical matter for satellite service customers to take advantage of the multiple sources of C-band capacity across the country, depriving customers and their end users of the benefits of competition.

Resolving interference issues: Satellite operators routinely take advantage of the ability to move customers to a different transponder, or even to a different satellite, in order to remedy interference issues. The flexibility to make such changes quickly is essential to ensure that the duration of outages or service degradation is limited.

Operator-to-operator coordination: Similarly, moving customers around may be necessary in the context of coordination between satellite operators. Over the course of a satellite's life, a number of events can require modifications to a satellite's frequency assignment plan in order to accommodate new adjacent satellites or changing end user requirements. Earth stations must be able to modify their frequency use accordingly.

Response to shifts in demand and implementation of technological advances: Full-band, full-arc licensing also permits satellite operators to manage overall network operations efficiently by adjusting transponder assignments in response to changing demand. In addition, the

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[55] *Id.* at 24097, ¶ 4.

[56] *See* 47 U.S.C. § 703.

flexibility to change satellites permits satellite service customers to take advantage of developments in spacecraft technology.

Occasional use service: Satellite service customers often use C-band spectrum for short-term purposes such as video contribution/distribution for breaking news stories or major sporting events. These operations rely on transportable antennas that are moved to a location on very short notice – sometimes mere days before the event. Because frequencies for transportable antennas are coordinated just prior to use through an expedited process, the flexibility to access different satellites in any available frequency is critical to their ability to operate. Similarly, the fixed earth station on the receiving end of the transportable antenna's transmission also needs authority to access different satellites in any available frequency.

Thus, existing satellite operations rely heavily on the flexibility provided by full-band, full-arc earth station licensing. This Commission policy has made possible the competitive, agile, reliable provision of satellite services on which customers depend.

2. No Viable Alternative to Full-Band, Full-Arc Licensing Has Been Proposed

The fixed wireless community first challenged the full-band, full-arc earth station licensing policy almost twenty years ago, and after conducting a comprehensive inquiry into the issue, the Commission closed the proceeding with no action. The Commission concluded that the FS interests had presented "no effective solution" to their concerns that adequately took into account the business needs of satellite operators.[57]

The most recent filings of the FWCC and the BAC do nothing to remedy this failing. These parties pay lip service to the importance of protecting incumbent users but without

[57] *FWCC Request for Declaratory Ruling on Partial-Band Licensing of Earth Stations in the Fixed-Satellite Service That Share Terrestrial Spectrum*, Second Report and Order, 17 FCC Rcd 2002, 2007, ¶ 12 (2002).

proposing a regulatory approach to make that protection a reality. As SIA has explained, the FWCC's current set of proposals for changes to the coordination rules for earth stations are substantially similar to those rejected by the Commission previously and are equally incompatible with the business realities of satellite network operations.[58]

The BAC's requested rule changes are similarly unworkable. As discussed above, the BAC inexplicably suggests that the thousands of operating unregistered receive-only earth stations should simply be ignored for purposes of determining where new terrestrial systems could be deployed.[59] Under the BAC's approach, moreover, these authorized, primary, incumbent receive-only earth station operations would have no protection status with respect to new terrestrial point-to-multipoint operations that currently are not even permissible in the 3.7-4.2 GHz band. The result would be a recipe for interference to existing C-band satellite operations that support video and audio programming to the rural and underserved areas whose interests the BAC purports to represent. SIA is confident that any consumers who expressed support for the BAC Petition did so unaware that under the BAC's proposal, they would sacrifice their continued ability to reliably receive television and radio programming to gain the potential for expanded terrestrial broadband service.

Moreover, the BAC assumes without evidence that occasions when a satellite service customer will need to change spacecraft or frequencies will be "rare," focusing only on situations when there is a satellite or transponder outage.[60] The BAC does not even address the myriad

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[58] SIA FWCC Opposition at 18-22; SIA FWCC Reply at 14-19.

[59] BAC Reply at 20 n.67.

[60] *Id.* at 22.

other situations in which the flexibility provided by current Commission policies in favor of full-band, full-arc licensing come into play.

The BAC also downplays the issues associated with satellite facility outages. It alleges that "prolonged" satellite outages are infrequent and that the satellite operator is often able to bring the affected transponder/s or satellite back online.[61] The BAC also suggests that even if the satellite that failed cannot be returned to service, "in many cases replacement satellites often in-orbit spares) are eventually moved into the orbital slot of the malfunctioning satellite."[62]

These statements are both unsupported and irrelevant. The BAC does not mention the fact that within a few months of the AMC-9 anomaly, EchoStar lost contact with EchoStar-3,[63] and the NSS-806 satellite lost nearly a third of its transponders.[64] None of these outages appears to be temporary – plans are under way to retire AMC-9 and EchoStar-3, and SES has moved up the launch of SES-14, the NSS-806 replacement satellite, in order to restore the lost capacity.[65]

More importantly, though, the BAC's suggestion that outage events are "typically time-bounded"[66] reflects the false premise that a shorter outage time means an easier restoration process. In fact, whether a satellite experiencing an anomaly or its replacement is able to recommence service at the affected orbital location in days, months, or years does not matter. As

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[61] *Id.* at 22 & n.70.

[62] *Id.*

[63] *See* http://spacenews.com/echostar-loses-contact-with-echostar-3-while-changing-orbit/.

[64] *See* http://www.satellitetoday.com/telecom/2017/08/01/ses-reports-second-satellite-malfunction-july/.

[65] *See* http://spacenews.com/ses-flips-spacex-arianespace-launches-to-speed-nss-806-replacement/. Even with the accelerated launch schedule, SES-14 will not be in service until mid-2018 – because it is an all-electric propulsion spacecraft, orbit raising following launch will take four to six months.

[66] BAC Reply at 22 n.70.

soon as an outage occurs, protected users will immediately need to be shifted to alternate capacity, setting off a ripple effect in which other customers are preempted. At such time as service at the original orbital location is restored and customers are moved back, the same set of steps has to occur again. At each stage of this process, customers need to have the ability to quickly change frequencies and repoint their antennas.

The BAC also suggests that in cases where changes to the satellite or frequency used are needed, they could be accommodated by requiring any point-to-multipoint system in the vicinity of an earth station to switch to another part of the band.[67] But the BAC does not explain how, in a time-critical situation requiring immediate restoration of capacity to a protected satellite user, all the point-to-multipoint systems in the vicinity of all the satellite user's hundreds or thousands of receive terminals would even be notified of the immediate need to clear frequencies, much less be able to determine available alternative frequencies and implement the switch.

In short, in the two decades since the issue was first raised, neither the terrestrial community nor the Commission has developed an alternative to full-band, full-arc earth station licensing that would accommodate the legitimate business requirements of satellite networks. The facts make clear that eliminating the policy would disrupt the framework on which satellite operators and customers have relied in investing billions of dollars in C-band satellite network facilities.

IV. THE UBIQUITY AND SENSITIVITY OF C-BAND RECEIVE EARTH STATIONS MAKE SHARING OF THE 3.7-4.2 GHz SPECTRUM WITH ADDITIONAL TERRESTRIAL SERVICES EXTREMELY DIFFICULT

The practical and technical realities of C-band satellite usage and the experience in other countries suggest that introducing new terrestrial services in the 3.7-4.2 GHz downlink

[67] *Id*. at 23.

frequencies in the U.S. without significantly harming incumbent satellite operations will be very challenging. At a minimum, before the Commission makes any determination about expanding terrestrial use of the band, thorough testing and analysis should be conducted of the impact of such added terrestrial operations on incumbent services.

A. Thousands of Highly Sensitive Existing and Future Earth Stations Must Be Protected

As a threshold matter, the sheer number of receive earth stations that would need to be protected from harmful interference due to additional terrestrial transmitters must be considered. As discussed above, this number includes not only the thousands of licensed and registered earth stations reflected in the IBFS database, but many thousands more that are unregistered and whose locations are therefore unknown. The total earth station population in the 3.7-4.2 GHz band is exponentially higher than the earth station numbers in other bands in which the Commission has decided to permit expanded terrestrial operations. For example, fewer than 110 individual earth stations are authorized to receive signals in in the 3.6-3.65 GHz and 3.65-3.7 GHz band segments covered by the small cells proceeding.[68]

The 3.7-4.2 GHz receive earth stations are also scattered nationwide, with locations in every state and territory, in urban, suburban, and rural areas. A single communications provider in Alaska, GCI, has stated that it has over 130 C-band sites in the state, many of them with multiple antennas.[69] Again, this ubiquitous distribution contrasts starkly with the situation in the

[68] In the 3.65-3.7 GHz band, the list of grandfathered earth stations included 86 call signs. *See Wireless Operations in the 3650-3700 MHz Band*, Report and Order and Memorandum Opinion and Order, 20 FCC Rcd 6502 (2005) (the "*3.65 GHz Order*") at Appendix E. Many of the earth stations authorized to operate in the 3.6-3.65 GHz band are on the list of grandfathered 3.65-3.7 GHz band facilities, but based on a review of the Commission's IBFS database, there are roughly 20 additional call signs with 3.6-3.65 GHz authority.

[69] *See* GCI BAC Comments at 7.

3.6-3.7 GHz band, in which the installed base of earth stations is limited to just 48 cities in 16 states, Guam and Puerto Rico.

Neither the number nor the nationwide deployment of receive earth stations is surprising given the specific characteristics of C-band spectrum. As SIA has shown, C-band frequencies are uniquely suited for the point-to-multipoint delivery of programming across extremely wide areas. In order to extract the maximum value from these attributes, a content distributor will want to ensure that its signal can be downlinked anywhere by every one of its customers.

Moreover, each of the thousands of widely-dispersed C-band receive antennas is of necessity highly sensitive. Signals from geostationary satellites located more than 22,000 miles above the earth become attenuated over that long distance and are relatively weak when they reach the ground, particularly in comparison to the typical strength of a terrestrial signal. As a result, satellite downlinks are very vulnerable to interference from terrestrial transmitters.

Indeed, the same "favorable propagation characteristics"[70] that make the C-band spectrum attractive to prospective terrestrial users magnify the difficulties of preventing terrestrial interference to receive earth stations. In its filings, for example, the FWCC has emphasized that 3.7-4.2 GHz frequencies are suited for longer fixed service path lengths than are higher spectrum bands available to microwave operators, noting that the average path length in the 3.7-4.2 GHz band is 45.4 kilometers.[71] Of course, a fixed service signal strong enough to close a link at that distance can also create interference to sensitive satellite receivers within a significant area.

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[70] NOI at ¶ 6.

[71] *See* Reply Comments of the Fixed Wireless Communications Coalition, RM-11778, filed Jan. 24, 2017 at 12.

In turn, greater interference to receive earth stations would undermine the critical value of C-band spectrum for FSS users. Extremely high signal reliability is essential to C-band satellite service customers. Any change in the spectrum sharing environment that compromised reliability would deprive satellite customers of a key benefit of their investment in C-band satellite capacity.

B. Significant Separation Distances from Terrestrial Transmitters Will Be Required to Protect FSS Receive Earth Stations

The evidence clearly demonstrates that regardless of the type of terrestrial service being considered in the 3.7-4.2 GHz band, substantial separation distances would be necessary in order to prevent interference to co-frequency FSS receive earth stations. Given the number and distribution of earth stations that must be protected, it is likely that only very limited, very remote areas of the United States would be outside the required protection zones.

In the context of the FWCC Petition, for example, fixed service interests have stated that, depending on how directly an FS transmitter is pointing toward an earth station receiver, the required separation distance is between 40 miles (64 kilometers) and 120 miles (193 kilometers) or more.[72] For the point-to-multipoint operations proposed in the BAC Petition, depending on the antenna directivity and the deployment geometry, required separation distances ranging from around 38 kilometers to greater than 100 kilometers would be needed between the transmitting stations and the receiving FSS earth station in order to avoid co-channel interference into the

[72] Letter of George Kizer, President, TeleVision, Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, RM-11778, filed Jan. 8, 2017, at 3.

FSS earth station. When the Commission introduced terrestrial services in the 3.65-3.7 GHz band, it adopted a protection distance of 150 kilometers.[73]

As for terrestrial mobile services, in-depth examination by the ITU has shown that International Mobile Telecommunications ("IMT") services cannot be feasibly introduced in C-band spectrum in areas where FSS facilities are widely deployed and in active use. Empirical data reinforce the results of these analyses.

The most recent studies regarding the ability of "IMT-Advanced" stations to share with C-band downlinks are summarized in Report ITU-R S.2368. The Report demonstrates that it is impractical for FSS networks to share C-band downlink spectrum with IMT. In particular, the studies showed that separation distances ranging from tens of kilometers to greater than 100 kilometers would be needed between transmitting IMT stations and receiving earth stations in order to avoid interference into the earth station from in-band, co-channel IMT signals.[74] The Report concluded that:

> The sharing between IMT-Advanced and FSS is feasible only when FSS earth stations are at known, specific locations, and deployment of IMT-Advanced is limited to the areas outside of the minimum required separation distances for each azimuth to protect these specific FSS earth stations. In this case, the FSS protection criteria should be used to determine the necessary separation distances to ensure protection of the existing and planned FSS earth stations.
>
> When FSS earth stations are deployed in a typical ubiquitous manner or with no individual licensing, sharing between IMT-Advanced and FSS is not feasible in the same geographical area since no minimum separation distance can be guaranteed.[75]

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[73] *See 3.65 GHz Order*, 20 FCC Rcd at 6524-27. Because the Commission viewed the circular 150-kilometers zones as conservative, it allowed terrestrial operations within the protection zones if coordinated with earth station operators. *See id.* at 6524, ¶ 60.

[74] Report ITU-R S.2368 at 31.

[75] *Id.* at 32.

Real-world experience has borne out the ITU study groups' predictions concerning the incompatibility of IMT and FSS networks, with significant disruption to satellite services occurring when terrestrial wireless broadband systems have been introduced in C-band spectrum.[76] As just one example, field trials of terrestrial service in Hong Kong resulted in television signals serving *300 million households* throughout Asia being knocked off the air.[77] Similarly, during testing of the introduction of C-band terrestrial service in Bolivia, satellite signals carrying television channels in Bolivia were interrupted, causing viewers to miss World Cup games.[78]

Avoiding issues of the same magnitude in the U.S. will be possible only if existing and future FSS receive earth stations – including unregistered receive-only antennas – are adequately protected from harmful interference. That, in turn, will require significant buffer zones around each earth station in which terrestrial wireless operations must be prohibited.

C. The Untested CBRS Approach Is Not Suited for the 3.7-4.2 GHz Band

The NOI asks whether "elements of the database-supported authorization framework used for the Citizens Broadband Radio Service in the 3.55-3.7 GHz band" would be appropriate to promote coexistence between incumbent users of the 3.7-4.2 GHz frequencies and potential

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[76] Report ITU-R S.2368 recounts case studies of actual interference to FSS operations occurring in Bangladesh and Brazil. *See id.* at 24-30.

[77] *See* 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.

[78] *See id.* at 3.

expanded terrestrial operations.[79] At this stage, SIA's answer to that question is an unequivocal "no."

The CBRS approach, which contemplates having a number of Commission-approved Spectrum Access System ("SAS") database administrators, has yet to be implemented or tested. The Commission has granted conditional approval to seven entities that have applied to be SAS administrators[80] and has received applications for a second wave of proposals.[81] However, as the December 2016 SAS Notice makes clear, the standards to be applied by the SAS administrators are still being developed, and the prospective administrators will also "be relying on further guidance from the Commission, and NTIA and DoD, to meet certain requirements."[82] Once these steps have been completed, systems must be submitted for testing, which may take a variety of forms, including "testing of protections for incumbent systems."[83] Thus, evaluation of the most fundamental functionality of the SAS database approach and its efficacy in preventing harmful interference to earth stations using the 3.6-3.7 GHz band is still many months away. Validation of the approach in real-world operational conditions, with multiple SAS administrators having to communicate among themselves to manage the various tiers of spectrum users, is even further off.

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[79] NOI at ¶ 22.

[80] *See* Public Notice, Wireless Telecommunications Bureau and Office of Engineering and Technology Conditionally Approve Seven Spectrum Access System Administrators for the 3.5 GHz Band, DA 16-1426 (rel. Dec. 21, 2016) (the "December 2016 SAS Notice").

[81] *See* Public Notice, Wireless Telecommunications Bureau and Office of Engineering and Technology Establish "Second Wave" Deadline for Proposals from Prospective Spectrum Access System (SAS) Administrator(s) and Environmental Sensing Capability (ESC) Operator(s), DA 17-339 (rel. Apr. 7, 2017).

[82] December 2016 SAS Notice at 4.

[83] *Id*. at 5.

More significantly, however, the population of receive earth stations that need to be protected in the 3.7-4.2 GHz band is exponentially greater than in the CBRS frequencies. Given the required separation distances discussed above, a database attempting to determine whether to authorize a terrestrial wireless transmission in the 3.7-4.2 GHz band would need to consider the impact on hundreds or even thousands of C-band receive earth station antennas in the surrounding area. The sheer computing power needed to make each individual go or no-go determination for a terrestrial transmission request – taking into account the full set of relevant technical criteria for each earth station within a radius of tens or hundreds of kilometers in addition to the details regarding any other terrestrial operations in the vicinity – would be staggering. Attempting to make such decisions quickly, in communication with multiple database administrators, would be more challenging still.

These factors make clear that a database approach may never be feasible for protection of the large numbers of active receive earth stations in the 3.7-4.2 GHz band. There is certainly no basis now, when the basic structure and functionalities of the SAS systems are still being developed, for assuming that the CBRS framework for the 3.6-3.7 GHz frequencies could effectively prevent interference in the much more intensively used 3.7-4.2 GHz band.

V. C-BAND UPLINK FREQUENCIES PRESENT A POTENTIALLY MORE PROMISING SHARING ENVIRONMENT IF TECHNICAL ISSUES CAN BE ADEQUATELY MANAGED

The conventional C-band uplink spectrum and adjacent 6.425-7.125 GHz band present a potentially more promising case for sharing with FSS if the aggregate interference at the satellite can be effectively managed. Preventing excessive aggregate interference, however, can be quite challenging, particularly if the Commission contemplates permitting unlicensed devices to use this spectrum.

As the NOI observes, there are about 1,535 earth stations in the conventional C-band uplink spectrum at 5.925-6.425 GHz,[84] materially fewer than in the corresponding downlink spectrum at 3.7-4.2 GHz. In the 6.425-7.075 GHz band, there are fewer still, roughly 65 earth stations.[85] The number of satellites that are authorized for operations in the 6.425-7.075 GHz frequencies is also fairly low, although the listing provided in the NOI is markedly incomplete.[86] The NOI omits both the SES-6 spacecraft, which is authorized to serve the U.S. in the 6.725-6.874 GHz frequencies,[87] and the SES-15 satellite's Wide Area Augmentation System ("WAAS") payload, which has feeder links in the 6628.27-6650.27 MHz and 6679.42-6701.42 MHz bands.[88] Moreover, there is no reference at all to SDARS satellites, which use feeder link frequencies in the 7.025-7.075 GHz range.[89]

The primary interference concern in these FSS uplink frequencies, as discussed in the NOI, is the possibility that the cumulative energy from large numbers of terrestrial transmitters within a satellite's uplink beam would cause harmful aggregate interference at the satellite receiver.[90] SIA has previously discussed the threat of aggregate interference in the context of the Commission's Spectrum Frontiers proceeding.[91] In particular, SIA noted that a variety of

[84] NOI at ¶ 24.

[85] *Id*. at ¶ 33.

[86] *Id*. at ¶ 33 & nn. 52, 53.

[87] *See SES Americom, Inc.*, Call Sign E000696, File No. SES-MFS-20130604-00470, granted Mar. 14, 2014, condition 90120.

[88] *See SES Satellites (Gibraltar) Ltd.*, Call Sign S2951, File No. SAT-MPL-20160718-00063, granted Dec. 14, 2016, Attachment to Grant at 2.

[89] *See, e.g., XM Radio LLC,* Call Sign S2786, File No. SAT-MOD-20130114-00007, granted Mar. 14, 2013.

[90] NOI at ¶ 29.

[91] Comments of the Satellite Industry Association, GN Docket Nos. 14-177 *et al.*, filed Sept. 30, 2016, at 14-16.

measures can be effective in constraining aggregate interference levels, including antenna downtilting, dynamic beamforming, and variable power control, and that environmental factors such as indoor or in-vehicle use can also play a role in managing the interference received at the satellite.[92] SIA also pointed out that the Commission is obligated as a matter of U.S. treaty commitments to ensure that foreign-licensed satellites do not receive harmful interference originating from U.S. terrestrial transmitters.[93]

Unlike in the Spectrum Frontiers proceeding, the NOI contemplates the possibility of authorizing unlicensed devices in satellite uplink spectrum. This significantly complicates aggregate interference management, as the Commission acknowledges. For example, although an indoor-only restriction would help to limit the risk of harmful aggregate interference, it is difficult to see how such a requirement could be enforced with respect to unlicensed devices in the hands of end users. The NOI acknowledges as much, asking for input on how an indoor environment would be defined for purposes of the applicable rules, and how the Commission would prevent users who own the devices from simply taking them outside.[94]

Having unlicensed devices in the hands of end users also creates the risk of unauthorized modification of the devices to circumvent restrictions designed to control aggregate interference effects. The Commission is familiar with this problem from its experience with attempting to address interference to federal weather radar systems in bands used by Unlicensed National Information Infrastructure ("U-NII") devices. Despite ongoing Commission efforts to resolve the interference issues, they persisted over several years. The Commission found that in many

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[92] *Id*. at 15.

[93] *Id*. at 15-16.

[94] NOI at ¶ 29 & n.46.

cases, interference occurred because devices certified for U-NII operations "had been illegally modified and operated at high power levels in elevated locations."[95] To prevent such abuses if it permits unlicensed operations in the C-band uplink spectrum, the Commission will need to take steps to prevent unauthorized modification of the U-NII devices.

Even if the Commission decides to pursue licensed, rather than unlicensed, operations in the 5.925-6.425 GHz and 6.425-7.125 GHz bands, it will still need to develop mechanisms to manage potential harmful aggregate interference to satellite receivers. For example, once it determines an appropriate aggregate interference limit, the Commission will also have to decide how to allocate that total allowance among the terrestrial licensees across the country that are using the spectrum. Moreover, measures will need to be in place to determine which terminals need to be turned off or powered down to correct any harmful interference and to implement those determinations.

[95] *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, ET Docket No. 13-49, 29 FCC Rcd 4127, 4131 (2014).

VI. CONCLUSION

For the reasons set forth above, the Commission must ensure that vitally important satellite uses of the C-band spectrum being considered in the NOI are protected in order to preserve the public interest, national security, and economic value of C-band satellite operations.

Respectfully submitted,

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October 2, 2017