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

In the Matter of	)	
	)	
Expanding Flexible Use of the 3.7 to 4.2 GHz Band	)	GN Docket No. 18-122
	)	
Petition for Rulemaking to Amend and Modernize Parts 25 and 101 of the Commission's Rules to Authorize and Facilitate the Deployment of Licensed Point-to-Multipoint Fixed Wireless Broadband Service in the 3.7-4.2 GHz Band	)	RM-11791
	)	
Fixed Wireless Communications Coalition, Inc., Request for Modified Coordination Procedures in Band Shared Between the Fixed Service and the Fixed Satellite Service	)	RM-11778

COMMENTS OF THE C-BAND ALLIANCE

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COMMENTS OF THE C-BAND ALLIANCE

I. INTRODUCTION AND SUMMARY.

The C-Band Alliance has provided rigorous economic analysis,[1] detailed implementation plans,[2] and numerous technical filings[3] to demonstrate that its proposal provides the fastest, most efficient path to reallocate a portion of the 3.7-4.2 GHz band ("C-Band") while protecting the

[1] *See* Coleman Bazelon, *Maximizing the Value of the C-Band: Comments on the FCC's NPRM to Transition C-Band Spectrum to Terrestrial Uses*, The Brattle Group, filed as Appendix A to Joint Comments of Intel Corporation, Intelsat License LLC, and SES Americom, Inc. (filed Oct. 29, 2018); Reply Declaration of Jeffrey A. Eisenach, Ph.D., filed as attachment to Reply Comments of the C-Band Alliance (filed Dec. 7, 2018) ("*CBA NPRM Reply*"). Unless otherwise noted, all filings were made in GN Docket No. 18-122.

[2] *See C-Band Alliance Transition Implementation Process*, C-Band Alliance ("*Transition Implementation Process*"), filed as attachment to Letter from Jennifer D. Hindin, Counsel for the C-Band Alliance, to Marlene H. Dortch, Secretary, FCC (filed Apr. 9, 2019).

[3] *See* Comments of the C-Band Alliance, at 9 (filed Oct. 29, 2018) ("*CBA NPRM Comments*"); Technical Annex, *CBA NPRM Reply*; *Further Technical Statement*, C-Band Alliance ("*Further Technical* Statement"), filed as attachment to Letter from Jennifer Hindin, Counsel for the C-Band Alliance, to Marlene H. Dortch, Secretary, FCC (filed Mar. 4, 2019).

incumbent content distribution services upon which nearly 120 million American households rely.[4] The C-Band Alliance appreciates the opportunity to submit comments in response to the Commission's July 19 Public Notice.[5]

First, the Public Notice seeks comment on the ACA Connects Coalition proposal[6] to repurpose up to 370 MHz of C-Band spectrum through a "multi-step, Commission-driven transition process."[7] Short on details and long on unsubstantiated promises, the Coalition proposal relies upon faulty assumptions to grossly underestimate the complexity of transitioning content delivery mechanisms in the C-Band and the time it would take to do so.

The devil is in the Coalition's complete lack of details. It fails to articulate a plan for designing, testing, implementing, and managing the individual fiber networks contemplated by its proposal, or to appreciate that each of those steps takes time, particularly when every programmer has its own unique network requirements. The Coalition also misunderstands the satellite/transponder environment and the steps and timing required to smoothly transition satellite content to fiber. Were the Coalition to account for these necessary elements, its transition timeline would balloon well beyond the 18 months contemplated by its proposal, and indeed beyond the 36 months it will take to reallocate C-Band spectrum pursuant to the C-Band Alliance's proposal.[8]

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[4] Moreover, in stark contrast to other proposals, the C-Band Alliance's proposal is minimally disruptive to the current content distribution ecosystem, which translates to greater clearing certainty because successful implementation is more likely.

[5] *Wireless Telecommunications Bureau, International Bureau, Office of Engineering and Technology, and Office of Economics and Analytics Seek Focused Additional Comments in 3.7-4.2 GHZ Band Proceeding*, Public Notice, DA 19-678 (rel. July 19, 2019) ("*Public Notice*").

[6] *See* Letter from ACA Connects, CCA, and Charter, to Marlene H. Dortch, Secretary, FCC (filed July 2, 2019) ("*ACA Connects Coalition Proposal*").

[7] *Public Notice*, at 2.

[8] Assuming the Coalition's plan is technically feasible, the timeline for changing the status quo throughout CONUS will take an extended period of time given the complexities involved. *See The Challenges for Replacing C-Band Satellite with Fiber*, C-Band Alliance ("*CBA Fiber*

And as if that were not enough, there is an additional reason not to adopt the Coalition's proposal—the proposal's vague auction scheme would violate the law.[9] In short, unlike the proposal put forth by the C-Band Alliance, the half-baked Coalition proposal provides insufficient details on how it will accomplish the gargantuan task of rearchitecting nearly the entire continental U.S. content distribution ecosystem within an 18-month timeframe. Moreover, unlike in the C-Band Alliance's proposal, there is no one entity in the Coalition's proposal that internalizes the relevant costs and benefits of keeping incumbent users whole while expeditiously enabling use of the C-Band for terrestrial 5G services. The Commission must reject the Coalition's proposal.

Second, the Public Notice seeks comment on a new study regarding point-to-multipoint ("P2MP") deployment in the C-Band.[10] As a technical matter, the new study fails to account for aggregate interference from all terrestrial sources (*i.e.*, terrestrial mobile and P2MP) to incumbent earth stations. As a practical matter, overwhelming record evidence from diverse industries agree that allowing new, standalone P2MP service in the C-Band would encumber future terrestrial mobile deployments and unnecessarily complicate and impede the repacking of satellite services. The Commission must reject standalone P2MP in the C-Band.

Presentation"), filed as attachment to Letter from Jennifer Hindin to Marlene H. Dortch, Secretary, FCC (filed July 2, 2019).

[9] *See* Comments of the C-Band Alliance at 15–21 (filed July 3, 2019) ("*CBA Legal Rights PN Comments*"); Reply Comments of the C-Band Alliance at 3–7 (filed July 18, 2019) ("*CBA Legal Rights PN Reply*").

[10] Prof. Jeffrey H. Reed, *et al*., *3.7 GHz FSS and Fixed Wireless Access Co-channel Coexistence Study*, Reed Engineering ("*Reed Study*"), filed as attachment to Letter from Wireless Internet Service Providers Association, Google LLC, and Microsoft Corp. to Marlene H. Dortch, Secretary, FCC (filed July 15, 2019).

Finally, the Public Notice seeks comment on AT&T's filing proposing changes to the C-Band Alliance's technical criteria, including an alternative flexible use licensing approach.[11] The C-Band Alliance appreciates AT&T's thoughtful feedback on its proposed approach. While some of AT&T's observations have merit, the centerpiece of AT&T's filing—the concept of a three-tiered band plan with "unrestricted licenses"[12]—will not protect FSS earth stations from harmful interference caused by 5G operations. Moreover, contrary to its claims, AT&T's licensing approach would not eliminate the need for a 20 MHz guard band between new terrestrial flexible use operations and repacked satellite services. Accordingly, the Commission should reject AT&T's proposed unrestricted license approach.

AT&T also raised some technical points related to the C-Band Alliance's proposed technical rules. The C-Band Alliance has studied these points and, after also engaging in productive dialogue with AT&T's technical experts, concluded that a number of them are valid. Consequently, the C-Band Alliance proposes herein modifications to certain of its proposed technical rules.

II. THE ACA CONNECTS COALITION PROPOSAL RELIES ON FAULTY ASSUMPTIONS AND GREATLY UNDERESTIMATES THE COMPLEXITY OF, AND TIME INVOLVED IN, REPLACING THE CURRENT U.S. CONTENT DISTRIBUTION ARCHITECTURE.

The ACA Connects Coalition has proposed a complex, inchoate, and time-consuming "plan" for repurposing a portion of the C-Band that relies on transitioning certain FSS earth station operations to fiber.[13] To say that the proposal is light on details is an understatement. For example,

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[11] Letter from Henry Hultquist, Vice President Federal Regulatory, AT&T Services, Inc., to Marlene H. Dortch, Secretary, FCC (filed May 23, 2019) ("*AT&T Ex Parte*").

[12] *Id.* at 4-5.

[13] *See ACA Connects Coalition Proposal*.

it fails to articulate who or what will serve as transitional facilitator; include any details on how the networks will be designed, tested, and implemented in a coordinated manner consistent with customer needs and requirements; discuss how the multitude of individual fiber networks the Coalition envisions will be managed; or address the ongoing operational costs of the proposed fiber networks.[14] Moreover, in a major technical flaw, the proposal demonstrates a misunderstanding of the satellite/transponder environment and the methodical planning necessary to transition satellite content smoothly and without interruption. Indeed, the proposal aptly demonstrates what the C-Band Alliance has long held: it is best positioned to protect customers during any transition of C-Band spectrum for terrestrial flexible use.[15] The Commission should not adopt the Coalition's half-baked, problem-ridden proposal for these reasons alone. Yet there's still another reason for the Commission to reject the Coalition's proposal—it is unlawful.

A. The ACA Connects Coalition fails to articulate a satellite-to-fiber transition plan or a fiber network management plan.

The ACA Connects Coalition ignores—or does not fully appreciate—the complexity involved in transitioning from C-Band satellite to fiber. One does not simply "flip a switch." Instead, among other things, two independent systems (one satellite, and one fiber) will need to operate side-by-side for an extended period of time while fiber services are brought on line, tested, and made ready for commercial use.[16] Who or what will serve as transition facilitator to oversee and manage these systems, and what is the cost of the inevitable delay in selecting such a

[14] Such costs would be in addition to satellite networking fees until remote sites are also connected to fiber.

[15] Significantly, the C-Band Alliance's proposal would retain a greater portion of the status quo such that the businesses of satellite operators and customers are not massively disrupted by a nearly wholesale rearchitecting of the nation's content distribution ecosystem.

[16] *See CBA Fiber Presentation*.

facilitator? The Coalition does not say (and likely does not know). Relatedly, who or what will be responsible for designing, building, testing, and implementing the extensive fiber networks contemplated by the Coalition?[17] Again, the Coalition does not say.

The individual fiber-based distribution networks contemplated by the Coalition will each necessarily encompass three disparate segments—contribution, aggregation, and distribution—each implemented and managed by a multitude of fiber operators (while each requiring coordination to effectively distribute content across the United States).[18] Yet the Coalition makes no mention of how such haphazard networks will be managed.[19] For example, how (and by whom) will network disruptions be addressed to minimize downtime?[20] The Coalition is mum.

[17] At a minimum, network architectures would need to be identified and assessed, and trade studies would need to be done to ensure that all stakeholders' requirements are addressed and met. Once candidate architectures are down-selected, proof-of-concepts would then need to be developed and evaluated. A departure from the current C-Band satellite ecosystem must also account for changes in business models of each stakeholder and the impacts those have on day-to-day operations, budgets, and contractual commitments. The complexity and costs of a fiber distribution network are significantly higher than a satellite network for broadcast-type services such as cable TV programming.

[18] The existing C-Band satellite ecosystem integrates these three segments into a single architecture managed by a limited number of satellite operators.

[19] Additionally, the ACA Connects Coalition fails to adequately address why their proposed architecture is preferred over others. For example, the ACA Connects Coalition proposes an architecture with 42 distributed data centers fed by cable TV networks and distributed to MVPD headends via direct connections. But is this more effective from an implementation, operational, time-to-market, and economic perspective than a centralized approach with "super headends" functioning as redundant and diverse aggregations points interconnected with a multicast terrestrial architecture such as MPLS?

[20] Indeed, before any changes can be made, a rigorous assessment of the reliability of fiber will be necessary to ensure that MVPDs are protected against network outages. Using an average or approximation will likely not be acceptable to the cable TV networks and MVPDs.

B. The ACA Connects Coalition grossly misunderstands the satellite/transponder environment.

Predictably, given that no member entity of the Coalition is a satellite operator, the ACA Connects Coalition fails to grasp the current satellite/transponder environment. As the C-Band Alliance has previously explained, to clear 200 MHz of C-Band spectrum nationwide, every existing C-Band service must be moved out of transponders 1-10 on every satellite located in the North American orbital arc.[21] This includes a significant amount of cable TV networks and a lesser, but still significant, amount of non-cable TV networks and radio channels. Yet the ACA Connects Coalition incorrectly assumes that all satellites covering CONUS are fungible. Satellite distribution is built around a neighborhood concept, especially for cable programming. Cable headends today typically have C-Band antennas pointed at as many as 10 orbital locations (or "neighborhoods") to receive cable TV networks. If the cable TV networks are spread over more than these 10 cable neighborhoods, additional antennas and downlinking equipment will need to be installed at most cable headends in the nation to downlink content from additional orbital locations. Failure to do so would limit programmers' ability to deliver content to their intended audience, thereby reducing consumer choice.

The C-Band Alliance believes that it is critical to maintain cable TV networks within their current neighborhoods in any spectrum reallocation. Expanding cable programming to 24 orbital locations as the ACA Connects Coalition proposal contemplates would require the installation of up to 14 additional antennas at every MVPD headend. Such a deployment would be expensive, time consuming, and in some cases impossible due to the lack of available real estate at the MVPD's facility.

[21] *See Transition Implementation Process*, at 7.

C. The ACA Connects Coalition fails to understand the steps and timing required to smoothly transition satellite content.

The ACA Connects Coalition suggests that the C-Band Alliance will not need to build any new satellites in the 36 months following a Commission order.[22] This statement evidences the Coalition's failure to understand the steps and timing required to smoothly transition satellite content to a new frequency or to a new satellite.[23] Without new satellites, current customers cannot be accommodated if 200 MHz is cleared on the satellites, for several reasons.

First, to transition services from transponders 1-10, a period of "dual illumination" is required to provide earth stations with adequate time to install and test 5G interference filters and then to switch from the original transponder to the new transponder. During the dual illumination period, the same content will be transmitted simultaneously over two transponders, effectively using twice the capacity typically required.

Second, in the case of cable TV networks, some cable neighborhood satellites are nearing end-of-life and are no longer able to support all or a large number of the transponders on the satellites. Therefore, these satellites must be replaced to provide sufficient capacity to clear out services in transponders 1-10. The time period to build, launch and bring into service a satellite is 24 months or more, depending upon the complexity of the satellite and the availability of launch services. An additional 12 months is necessary to repack the services currently provided on transponders 1-10 on all satellites serving CONUS, including transitioning services from original transponders to new transponders above transponder 10, and to install the necessary 5G

[22] *See C-band Spectrum Clearing Plan*, Cartesian, Inc., at 7, filed as attachment to Letter from Pantelis Michalopoulos, Counsel for ACA Connects – America's Communications Association, to Marlene H. Dortch, Secretary, FCC (filed July 18, 2019).

[23] This is particularly surprising considering that the ACA Connects Coalition members all participated in antenna seeding and content transition programs implemented by SES and Intelsat over the last several years.

interference filters on earth stations. Therefore, a 36-month period is necessary for any large-scale repacking of C-Band satellite services.

Third, due to the fact that many cable neighborhood satellites in the North American orbital arc will be virtually 100% utilized post-clearing and preemptible transponders will no longer be available on active satellites to restore satellite services in the event of transponder and/or satellite failure, the members of the C-Band Alliance must employ a new mechanism to protect their customer's services. Therefore, additional satellites that can be brought into service to replace an ailing satellite should a failure occur will need to be placed strategically throughout the orbital arc.

Finally, there is not—as the ACA Connects Coalition incorrectly claims—a surplus of transponders currently not being utilized that could be allocated for repacking, thereby obviating the need for new satellites.[24] The Coalition used public sources to estimate that 36% of C-Band transponders are not being used. Because the Coalition did not have access to private company information, it was not able to account for capacity that is under contract for either restoration services in the event of a transponder or satellite failure, or for occasional use services used for news, sports, and emergencies. Also, public sources focus primarily on readily available information on cable TV networks, but typically do not account for other services such as broadcast TV, data, government, and mobility networks. As such, the ACA Connects Coalition's assumed utilization rate is not accurate.

D. The ACA Connects Coalition proposal cannot be accomplished in 18 months.

The ACA Connects Coalition contemplates clearing 370 MHz of spectrum in urban areas within 18 months. This is impossible. As discussed below, the ACA Connects Coalition fails to

[24] *See id.* at 3.

consider adjacent area MVPDs and the time it will take to design and implement the proposed fiber network.

1. The number of MVPD headends to be fibered in an urban scenario is significant.

The ACA Connects Coalition grossly underestimates the amount of time needed to complete the transition from C-Band to fiber because it fails to consider the actual number of MVPDs that must be fibered to clear an urban area and protect FSS transmissions to remaining earth stations. In developing its 18-month timeline, the Coalition failed to accurately account for wireless interference into MVPDs that are located outside of, but adjacent to, urban areas. If any of these "adjacent area" MVPD headends are susceptible to 5G interference, they also would require fiber connectivity. Otherwise, 5G deployment in the target urban area would be severely restricted or the headends would receive unacceptable interference. Transmissions from wireless base stations do not stop at urban boundaries and can extend tens of kilometers—and even more than 100 kilometers—from the base station within an urban area. As such, a large number of MVPD headends outside of an urban center (depending upon terrain and other obstructions) may need to be connected via fiber in the same timeframe as the target urban area is cleared before terrestrial wireless services can be introduced.

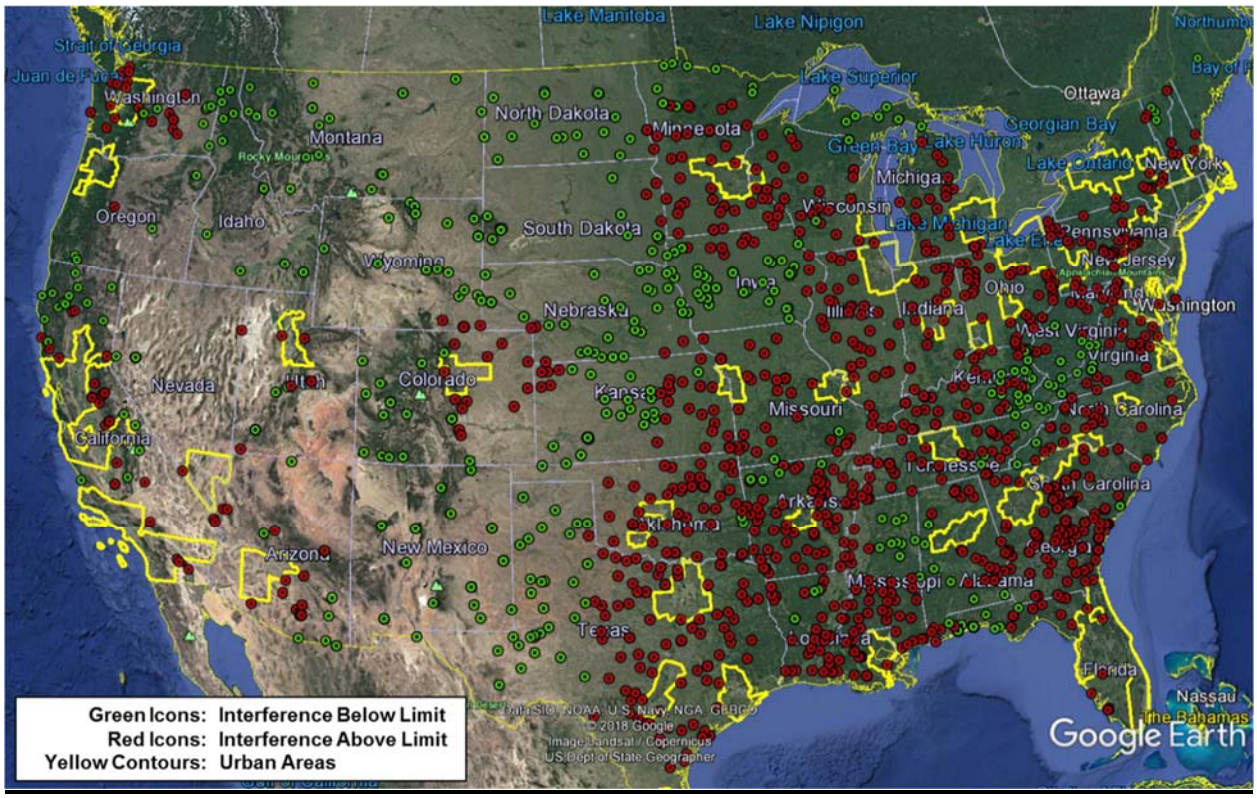
To determine the extent of the problem, the C-Band Alliance engaged NERA Economic Consulting ("NERA") to identify "urban areas" so that the C-Band Alliance could then determine the number of adjacent area MVPD headends that may be subject to interference. NERA identified the counties within each of 49 of the top 50 PEAs[25] that collectively represent approximately 95% of the population within that PEA. The C-Band Alliance considers those counties to be "urban

[25] According to NERA, 63% of the population of CONUS resides in 49 of the top 50 PEAs. The Honolulu PEA is not included as it is not in CONUS.

areas." The C-Band Alliance then performed extensive propagation studies on every MVPD headend location (as specified in IBFS) in the urban areas. These studies considered MVPD headends accessing the 89° W.L. to 139° W.L. satellite arc and utilized the well-known Irregular Terrain Model[26] for determining propagation loss. Because the urban base stations will be operating co-frequency to the receive antennas used by the adjacent area MVPD headends, the maximum aggregate base station in-band emissions ("IBE") measured at the input of the earth station low noise block ("LNB") must not exceed an I/N level of -10 dB, otherwise satellite signal margin will be unacceptably degraded. The results of the C-Band Alliance's analysis are shown in Figure 1 and the underlying assumptions used in the analysis are shown in Figure 2. Using the IBFS database, the C-Band Alliance identified 2,101 MVPD headends, 539 of which are within urban areas and 1,562 of which are outside of urban areas. Of those MVPD headends outside of urban areas, based on the propagation studies, 1,117 must be connected via fiber, as illustrated by the red icons in Figure 1, to ensure that aggregate interference from urban area base stations is below the maximum level accepted at the adjacent area earth station to ensure ongoing FSS operations.

[26] The Irregular Terrain Model, also known as the Longley–Rice model, is a radio propagation model for predicting the attenuation of radio signals for a telecommunication link in the frequency range of 20 MHz to 20 GHz. The C-Band Alliance utilized an integrated modeling software developed by NTIA and incorporated into a broader C-Band Alliance analysis toolset to perform the studies.

Figure 1



As shown in Figure 1, the number of fiber connections needed to replace satellite MVPD content distribution in urban areas is extensive because MVPDs in non-urban areas will need to be connected via fiber as well. Many of these adjacent area MVPDs are located in rural locations which, as the ACA Connection Coalition recognizes,[27] will take longer to connect via fiber than urban areas due to the need to build out fiber facilities. As a result, wireless services within the urban areas will not be able to commence operations until these adjacent area MVPD headends also are fibered.

[27] *ACA Connects Coalition Proposal*, at 4 ("ACA Connects estimates that the transition to fiber can be accomplished within eighteen months in urban areas, within three years in the majority of the remaining areas, and within five years for a few select areas.").

Figure 2

ITM Parameter	Value	Comments
Base Station Height	10	meters
Earth Station Height	3	meters
Dielectric	15	Average ground
Conductivity	0.005	Average ground
Refractivity	301	Continental temperate (average situations)
Frequency	3880	MHz
Climate	5	Continental temperate
Polarization	0	Horizontal
Confidence	0.5	
Reliability	0.001	Probability of interference exceeding limits
Terrain Data	SRTM-1	1 arc-second resolution terrain data

2. Designing, testing, and implementing a network takes time.

The massive change to the C-Band content distribution ecosystem proposed by the ACA Connects Coalition will require a significant amount of time to implement. In addition to the time it will take to physically lay fiber, stakeholder requirements must be evaluated, network architecture must be designed, and responsibility for transitioning to and managing the new network must be assigned. Indeed, the selection of a program manager to oversee the coordinated effort alone will take a substantial amount of time, as will the selection of the implementation and management entities that will be needed even before the first fiber connection is made. Without these up-front activities, any fiber-based alternative to the status quo will be unmanageable and unacceptable to current users. Moreover, agreements will need to be negotiated between cable networks and aggregation points as well as between aggregation points and MVPDs. Topics such as content protection, network outage liability and service credits, blackout management/program substitution for sports content, and much more will need to be considered in the agreements. There likely will not be a "one size fits all" solution.

In addition to these issues, many of the assumptions the ACA Connects Coalition relies upon to support its proposal are faulty. For example, a simple reliance on the FCC's 477 data may over or under predict the actual routes that need to be constructed. Assumptions about the cost of a new fiber build may be reasonable for a national average but low for urban areas. Additionally, while it may be reasonable to assume that 70% or more of IRUs will be available to satisfy the connectivity of content providers to data centers, assuming the same 70% availability for connectivity of earth stations to data centers is unrealistic when there are less than two fiber providers in an area. Moreover, the mix of aerial, buried, and conduit systems will need to be reviewed in conjunction with each MVPD earth station requiring new fiber construction. Factors to accommodate density, terrain, and regional costs also need to be captured, and assumptions about the cost for leased access need to be reviewed.

To evaluate the complexity of fibering MVPD headends, the C-Band Alliance commissioned CostQuest Associates ("CQA")[28] to determine the current status of the affected MVPD headends to determine whether those facilities are "lit" with fiber from two independent networks and, if not, to assess the amount of new fiber that would need to be deployed to provide sufficient fiber connectivity to support 3.5 Gbps of capacity.[29] CQA worked with GeoTel[30] to identify fiber availability for 840 MVPDs (a large subset of MVPD headends within urban areas

[28] CQA is a leading economic network modeling and GIS firm specializing in understanding the cost of deploying fiber networks. CQA designed and implemented the economic network cost model that supported the FCC's National Broadband Plan as well as the economic network cost model that currently defines and supports the FCC's Connect America Fund disbursements. More information on CostQuest is available at: www.costquest.com.

[29] 3.5 Gbps is the approximate amount of capacity needed to allow an MVPD headend to receive over fiber the same amount of cable TV content it receives today over satellite.

[30] GeoTel is the leading provider of telecommunications infrastructure data. More information on GeoTel is available at: www.geo-tel.com.

and those identified in the propagation studies as requiring fiber outside of the urban areas). In the analysis, GeoTel provided the distance to every lit building[31] of a fiber provider within 20 miles of the MVPDs location. From this file, CQA estimates that only 13% of MVPD sites have two or more business fiber providers within 250 feet of the building. Further, more than 37% of the MVPDs will require a fiber build of more than 1 mile and more than 15% will require a fiber build over 15 miles. Figure 3 provides a breakout of the fiber build distance for the two closest fiber providers to each candidate MVPD location.

Figure 3

Mileage Distance Band to Nearest Lit Building of Potential MPLS Provider						
Distance Band (miles)			Count of MVPDs			
Lower		Upper	Closest Provider		Next Closest Provider	
0	to	0.05	261	31%	112	13%
0.05	to	1	413	49%	415	49%
1	to	2.5	73	9%	84	10%
2.5	to	5	36	4%	48	6%
5	to	10	29	3%	33	4%
10	to	15	14	2%	18	2%
15	to	1000	14	2%	130	15%
			840		840	

The C-Band Alliance also asked CQA to estimate the actual cost of new fiber builds. To do so, CQA conducted a study to estimate the cost of building fiber facilities using the FCC's estimates of national average cost per foot[32] along with factors consistent with what the FCC has

[31] Additional fiber strands or open capacity (*i.e.*, wavelengths) on existing fiber strands were assumed to be available at the lit building locations.

[32] Alternative Connect America Cost Model Overview, FCC (Apr. 1, 2015), *available at* https://www.fcc.gov/wcb/ACAM040115.pdf

used in its CACM/ACAM models.[33] Based on this granular analysis, CQA estimates the average cost per new mile of fiber construction to 840 MVPD locations to be almost $85,000 per mile over a 10-year period.[34] Figure 4 provides a summary of the CQA analysis. The rows of the table provide the count of MVPD sites where the maximum distance to the two nearest MPLS providers are within the mileage stated,[35] along with the new fiber mileage requirements and the average cost per mile for the MVPD sites specific to the row.

Figure 4

New Fiber Build to Nearest Two MPLS Providers				
Both Providers Within Miles	Total New Fiber to Both MPLS Providers[36]			
	# MVPDs	Total Fiber Mileage	Ave Cost / Mile	Total Cost
0.05	112	8.36	$95,824	$801,088
1	415	257.18	$87,862	$22,596,475
2.5	84	293.20	$79,676	$23,361,033
5	48	384.94	$80,466	$30,974,672
10	33	541.08	$81,713	$44,213,535
15	18	517.24	$96,486	$49,906,628
1000	130	4,234.60	$84,480	$357,739,427
	840	6,236.60	$84,917	$529,592,860

[33] Such factors include density, terrain, plant mix, and regional cost adjustments.

[34] The 10-year period includes the cost of new construction, maintenance capital spend to replace failed fiber sections, and the operational cost to maintain the fiber.

[35] In looking at the Within Miles column of the table, the reader should consider the value in the row above as the lower bound on the distance. For example, the second row of the table represents distances between 0.05 and 1; the third row represents 1 to 2.5; and so on.

[36] The costs include costs associated with upfront build and NPV of replacement for failures over a 10-year period. This assumes turn up on day one of the system. Any costs associated with planning and staging would be additional.

E. The ACA Connects Coalition proposal is unlawful.

In addition to the numerous flaws discussed above, adoption of the ACA Connects Coalition proposal would run afoul of the Constitution and the Communications Act. The Coalition asserts that the FCC may "facilitate clearance of the C-Band" through "a traditional auction" that would take place after the agency "reallocate[s] the C-Band for terrestrial use" by administrative fiat.[37] However, as the C-Band Alliance has explained in detail, the massive interference that would result from the authorization of new terrestrial mobile operations in the C-Band would wipe out existing FSS service transmissions to CONUS and would constitute an unlawful fundamental change to the authorizations held by the members of the C-Band Alliance.[38] In addition, because the "incentive" payments proposed by the Coalition do not appear to allow the members of the C-Band Alliance to recover the full fair market value of their licensed spectrum and the service transmissions they provide,[39] adopting the proposal would constitute an unlawful taking of their property interests without just compensation.[40]

The ACA Connects Coalition asserts, in the alternative, that the FCC may conduct an "incentive auction" pursuant to 47 U.S.C. § 309(j)(8)(G) in which "satellite operators" may "tender their national shares of in-orbit satellite capacity at progressively declining prices."[41] The Coalition is mistaken. Section 309(j)(8)(G)(ii) expressly provides that "[t]he Commission may

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[37] *ACA Connects Coalition Proposal*, at 5.

[38] *See CBA Legal Rights PN Comments*, at 15–21; *CBA Legal Rights PN Reply*, at 3–7.

[39] *See ACA Connects Coalition Proposal*, at 6.

[40] *See CBA Legal Rights PN Comments*, at 21; *CBA Legal Rights PN Reply*, at 23–24. As the Supreme Court has long made clear, fair market value is measured by the "highest and most profitable use for which the property is adaptable." *Olson v. United States*, 292 U.S. 246, 255 (1934).

[41] *ACA Connects Coalition Proposal*, at 6.

not enter into an agreement for a licensee to relinquish spectrum usage rights in exchange for a share of auction proceeds … unless … at least two *competing* licensees participate in the reverse auction."[42] That situation cannot arise in the C-Band because, as the Commission itself explained, licensed satellite operators "make non-exclusive, non-rivalrous use" of C-Band spectrum.[43] In other words, "satellite licensees [would] not be competing to supply spectrum"[44] in a C-Band incentive auction, resulting in such an auction being unlawful under the Act. Indeed, this specific "legal … problem" was one of the key reasons for initiating this rulemaking in the first place.[45] The proposal advanced by the ACA Connects Coalition would not solve this problem and thus plainly is unlawful.

Moreover, to the extent the ACA Connects Coalition's insistence that "earth station users have no less of a right to the spectrum than satellite operators do" is intended to suggest that the FCC can allow receive-only earth station operators to share proceeds from an incentive auction,[46] that too is incorrect. Section 309(j)(8)(G)(i) authorizes the Commission to share proceeds to "encourage a *licensee* to relinquish voluntarily some or all of its *licensed spectrum usage rights*."[47] Because receive-only earth station operators are not "licensees" within the meaning of Section

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[42] 47 U.S.C. § 309(j)(8)(G)(ii) (emphasis added).

[43] *In re Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, Order & NPRM, 33 FCC Rcd. 6915 ¶ 61 (rel. July 13, 2018) (FCC 18-91) ("*NPRM*"); *see CBA Legal Rights PN Reply*, at 16–18.

[44] NPRM ¶ 61. Nor does the ACA Connects Coalition provide any legal backing for its claim that the Commission could force "winning" satellite operators "to lease capacity on its satellites to an operator not willing to surrender satellite capacity at that price, as necessary to preserve the latter operator's total satellite capacity." *ACA Connects Coalition Proposal*, at 6.

[45] *See* NPRM ¶ 105; *see also id.* ("We seek comment on means of inducing supply competition, such as by bringing in alternative bands as substitutes, both to insure a more competitive and efficient outcome, and to meet the legal requirement of having competing licensees participate in the reverse auction.").

[46] *ACA Connects Coalition Proposal*, at 6.

[47] 47 U.S.C. § 309(j)(8)(G)(i) (emphasis added).

309(j)(8)(G)(i),[48] that provision does not authorize the Commission to share proceeds with receive-only earth station operators.

In any event, even if it were legal (which it is not), the incentive auction proposed by the Coalition lacks critical details. For example, at what spectrum level would bidding begin? How would capacity be cleared when satellite operators continue to transmit via the leasing mechanism proposed by the Coalition?[49] The ACA Connects Coalition's failure to provide these details further reveals that its proposal is neither serious nor a viable alternative to the C-Band Alliance's proposal.

III. THE INTRODUCTION OF POINT-TO-MULTIPOINT SERVICES IN THE C-BAND WOULD UNNECESSARILY COMPLICATE REPURPOSING THE BAND FOR TERRESTRIAL MOBILE.

Like Sisyphus, WISPA, Google, and Microsoft continue to push for the introduction of co-primary wireless point-to-multipoint ("P2MP") services in the C-Band[50] despite overwhelming record evidence demonstrating how P2MP would disrupt critical FSS satellite operations and effectively prevent satellite operators from optimally clearing spectrum for terrestrial 5G services.[51] As the Satellite Industry Association has succinctly stated, "P2MP operations" "would further encumber the C-Band with non-flexible-use services, making it inconsistent with the rapid

[48] *See CBA Legal Rights PN Comments*, at 10–14, 30–32, *CBA Legal Rights PN Reply*, at 11–16.

[49] The Coalition suggests that, to clear spectrum pursuant to an incentive auction, "A satellite operator willing to tender satellite capacity for refarming at a certain price would have to lease capacity on its satellites to an operator not willing to surrender satellite capacity at that price, as necessary to preserve the latter operator's total satellite capacity." *ACA Connects Coalition Proposal*, at 6.

[50] *See, e.g.,* Letter from Wireless Internet Service Providers Association, Google LLC, and Microsoft Corp. to Marlene H. Dortch, Secretary, FCC (filed July 15, 2019) and *Reed Study*.

[51] *See, e.g., CBA NPRM Reply*, at 49, n.180 (collecting comments in opposition).

deployment of 5G in the C-Band and Chairman Pai's 5G FAST Plan."[52] Other commenters agree. For example, Ericsson notes that "[a]uthorizing a dedicated P2MP service in the 3.7-4.2 GHz band would add encumbrances" that could restrict the Commission's ability to repurpose the spectrum.[53] Luken Communications, LLC believes that P2MP coordination would impose operational burdens that could result in "substantial losses of revenue and viewership" and "impact and limit future growth" of the company.[54] Moreover, as the C-Band Alliance has previously stated, claims that P2MP would prove a boon to rural broadband development are unsupported and overstated,[55] and P2MP operators already have a wealth of spectrum available to them, including a substantial amount of mid-band spectrum.[56] In short, the record demonstrates that the cost of introducing the added complexity of accommodating new P2MP operations for current and new C-Band uses greatly outweighs any prospective benefits.[57]

In support of their proposal, WISPA, Google, and Microsoft commissioned a new study that analyzes FSS and fixed wireless P2MP co-channel coexistence in the C-Band.[58] The study suggests that exclusion zones of about 10 kilometers are sufficient to protect most FSS earth stations from harmful interference caused by co-channel P2MP operations.[59] Yet, as the C-Band

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[52] Reply Comments of the Satellite Industry Association, at 3-4 (filed July 18, 2019) ("*SIA Comments*").

[53] Comments of Ericsson, at 17 (filed Oct. 29, 2018); *see also* Comments of CTIA, at 26 (filed Oct. 29, 2018) (dedicated P2MP service would unnecessarily "encumber" the C-Band and "complicate repacking.").

[54] Comments of Luken Communications, LLC, at 5 (filed Oct. 30, 2018).

[55] *CBA NPRM Reply Comments,* at 51.

[56] *SIA Reply Comments*, at 3.

[57] *See, e.g.*, *CBA NPRM Comments*, at 39-51.

[58] *See Reed Study.*

[59] *Id.* at 2.

Alliance proposes in its Further Technical Statement,[60] 150 kilometers should be the outer bound for calculating aggregate RF power spectral density from co-frequency emissions from flexible use base stations to TT&C sites and other earth stations remaining in the 3700-3900 MHz portion of the band. A similar approach is needed for any co-frequency emissions to FSS transmissions anywhere in the 3700-4200 MHz band to ensure that there are no long-range signals that could potentially interfere with FSS earth stations.[61] Furthermore, interference must be considered, in aggregate, from all flexible use base stations and user equipment as well as from all co-frequency P2MP base stations and customer premise equipment. The *Reed Study* does not account for these aggregate interference considerations. Consequently, co-frequency P2MP aggregate interference at every earth station must be sufficiently below the -129 dBm/MHz level suggested in the *Reed Study* to ensure that P2MP does not degrade FSS signals beyond the potential 0.4 dB degradation already caused by flexible use licenses' in-band emissions or out of band emissions. A more appropriate P2MP aggregate co-frequency emissions level is -138 dBm/MHz—an I/N of -20 dB at the output of the earth station LNB.

IV. ASPECTS OF AT&T'S PROPOSAL WOULD FAIL TO ADEQUATELY PROTECT FSS OPERATIONS.

A. Unrestricted terrestrial operations in any portion of the 3.7-4.2 GHz band are not achievable if earth stations are to be protected.

AT&T has proposed, and the Commission has sought comment on, the possibility of establishing a portion of C-Band downlink spectrum for "unrestricted licenses."[62] AT&T lays out a scheme whereby, pursuant to such licenses, terrestrial mobile operators would operate using full

[60] *Further Technical Statement,* at 4.

[61] Further analysis is required to understand the impact of two new uncoordinated terrestrial services within the 3700-4200 MHz band, one of which is co-frequency, on FSS services.

[62] *AT&T Ex Parte,* at 5.

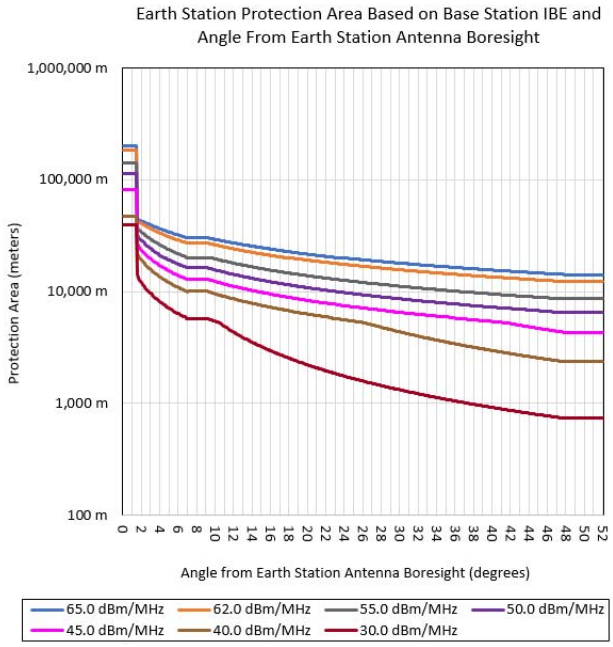
power, defined as the EIRP limits set out in Section 27.50(d) of the Commission's rules,[63] and would not be obligated to coordinate with FSS earth stations or otherwise ensure that earth station operators do not receive harmful interference. Although AT&T's desire to maximize flexibility for future 5G operations is logical from its perspective, unrestricted licenses as AT&T conceives them are simply not possible if FSS earth stations will continue to operate in the upper portion of the C-Band. The reason has to do with fundamental satellite earth station antenna design and the high gain of the antennas at close angular distances from the antenna boresight. As shown in Figure 5 (for a single in-band base station emission) and Figure 6 (for a single out-of-band base station emission), a 5G base station will cause blocking to the FSS earth station even at relatively large separation distances.[64] Thus, to accommodate unrestricted licenses and FSS earth stations in any portion of the C-Band downlink, terrestrial operators would need to vigilantly site 5G base stations to avoid transmitting into an FSS antenna's boresight, thus not providing true unrestricted licenses.

[63] 47 C.F.R. § 27.50(d).

[64] The propagation model used in these figures uses the same assumptions as shown in Figure 2, except that a flat terrain was used rather than the SRTM-1 dataset.

Figure 5

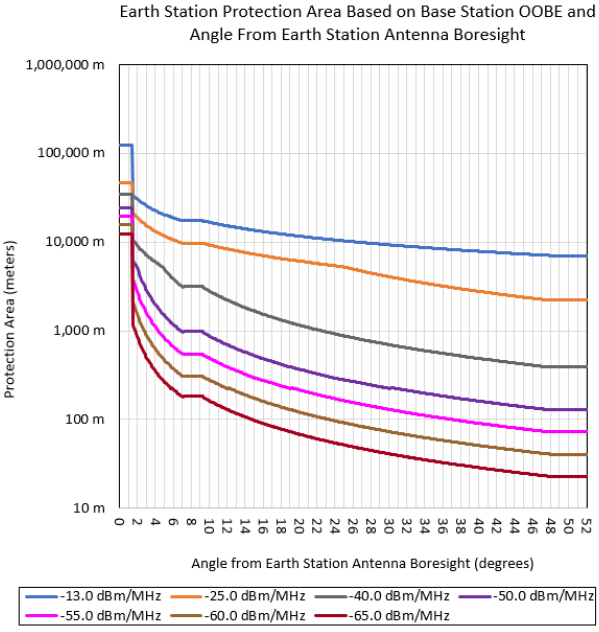
Base Station IBE Interference Into Earth Station



- Single base station example; results will be worse with multiple base stations simultaneously interfering with earth station
- All angles are BS angle to ES antenna boresight
- Based on ITM propagation model with flat terrain; use of actual terrain data will provide smaller protection areas
- -59 dBm maximum earth station allowable emission at LNB input over a 180 MHz bandwidth
- At close proximities, near-field antenna affects need to be considered

Figure 6

Base Station OOBE Interference Into Earth Station



- Single base station example; results will be worse with multiple base stations simultaneously interfering with earth station
- All angles are BS angle to ES antenna boresight
- Based on ITM propagation model with flat terrain; use of actual terrain data will provide smaller protection areas
- OOBE power levels are conductive and assume an 18 dBi base station antenna gain
- At close proximities, near-field antenna affects need to be considered

AT&T suggests that aggregate emissions from multiple base stations do not come into play and provides an example of a 5G base station deployment that mimics current 4G LTE deployments.[65] Because future 5G deployments are likely to be much denser than current 4G LTE deployments, with 5G base stations installed ubiquitously and at low heights, such as on streetlight posts,[66] the aggregate interference FSS earth stations will receive from 5G transmissions could greatly increase. Indeed, the closer 5G base stations are to FSS earth stations, the greater the need to consider aggregated base station emission levels and earth station antenna masks.

B. A guard band in which no terrestrial transmissions will be authorized will continue to be necessary.

AT&T's proposal also seeks to designate "adjacent" spectrum between the unrestricted licensed spectrum and FSS spectrum that could be used for restricted or coordinated terrestrial use.[67] Ultimately, the limits that would have to be imposed on operations in the adjacent spectrum may be so restrictive that it may not be usable for many services and any transmission in the guard band would be at the expense of the flexible use band. To demonstrate this, the C-Band Alliance performed analyses utilizing a new 5G filter mask[68] and introducing a secondary transmission with a 20 MHz bandwidth in the guard band. The C-Band Alliance-proposed maximum aggregate in-band and out-of-band emissions levels at the input of the earth station

[65] *AT&T Ex Parte*.

[66] *See, e.g.*, Sascha Segan, What is 5G?, PC MAGAZINE (Apr. 16, 2019, 10:23 AM EST), https://www.pcmag.com/article/345387/what-is-5g (explaining that mid-band networks will "be pretty dense; probably every third to half-mile").

[67] *AT&T Ex Parte* at 5.

[68] *See* Section V.B.4., *infra*.

LNB of -59 dBm (-81.6 dBm/MHz with a 180 MHz flexible use band) and -128 dBm/MHz, respectively, were maintained. The results are shown in Figure 7.[69]

Figure 7

5G Transmission in Flexible Use Band with Secondary Transmission in Guard Band				
Signal Level at ES Filter Input			Example Scenario Transmission EIRP	
Power Allocated to Guard Band (dBm/MHz)	5G Signal (dBm/MHz)	Guard Band Signal (dBm/MHz)	5G Signal (dBm/MHz)	Guard Band Signal EIRP (dBm/MHz)
None	-16.6	No Signal	65	No Signal
1.0	-17.6	-77.6	64	3.9
2.0	-18.6	-75.1	63	6.5
3.0	-19.6	-73.8	62	7.8
4.0	-20.6	-73.0	61	8.6
5.0	-21.6	-72.4	60	9.1
6.0	-22.6	-72.0	59	9.5
7.0	-23.6	-71.7	58	9.8
8.0	-24.6	-71.5	57	10.0
9.0	-25.6	-71.3	56	10.2

Also shown in Figure 7 is a representative scenario in which the levels at the input of the earth station filter are translated to 5G transmissions in the flexible use band and a secondary transmission in the guard band is located at the same location (same path loss, same earth station antenna gain). A reduction of 9 dB in 5G power from 65 dBm/MHz to 56 dBm/MHz allows for a 10.2 dBm/MHz secondary transmission in the 20 MHz guard band (23.3 dBm absolute power) which is approximately the same power level as a single wireless handset.

[69] The power levels are indicated at the input of the earth station filter and as such the frequency-dependent filter attenuation is added to the values shown.

V. THE RULES PROPOSED BY THE C-BAND ALLIANCE ARE BOTH FLEXIBLE AND PROTECTIVE, BUT FURTHER ENHANCEMENTS CAN BE MADE.

The C-Band Alliance continues to believe that the most effective way to protect FSS earth station antennas and provide flexibility to terrestrial mobile operators is to establish a 20 MHz guard band between terrestrial mobile operations and FSS operations coupled with FSS antenna protection criteria based on received power spectral density ("PSD") limits. However, after further study and productive discussions with AT&T's technical experts, the C-Band Alliance believes that certain of its original proposals can be adjusted to provide increased flexibility to mobile operators without increasing the risk of interference to FSS operations.

A. 20 MHz is the correct size for the guard band and the proposed PSD limits allow for flexibility.

The C-Band Alliance has carefully analyzed the potential for interference into FSS earth stations following the introduction of 5G terrestrial operations in the C-Band and proposed a limited 20 MHz guard band to allow the two disparate services to coexist. This 20 MHz guard band strikes a careful balance—small enough to not significantly detract from the overall amount of C-Band spectrum available to terrestrial mobile operators, but large enough that it will greatly reduce the risk of interference to FSS earth stations.

The aggregate PSD limit proposed by the C-Band Alliance will protect earth stations and allow flexibility across the full band used by mobile operators.[70] As discussed above, AT&T's proposed unrestricted licenses are not technically feasible because—absent exclusion zones—mobile operators will have to continuously assess the impact their deployment scenarios have on

[70] *Further Technical Statement*, at 7. It is important to note that the appropriate aggregate PSD limit will be dependent on the total amount of spectrum reallocated to terrestrial mobile and whether terrestrial operators will be licensed to operate on the same frequencies as FSS in adjacent license areas. An increase in the amount of spectrum reallocated to terrestrial use or an increase in adjacent co-frequency operations would require a decrease in the power spectral density limit.

existing FSS antennas. In contrast, under the rules proposed by the C-Band Alliance, terrestrial operators will not have to interact with earth station operators. Instead, terrestrial operators can establish triggers within their deployment software, whereby they identify the limited scenarios based on terrain or elevation that could require a full assessment of the aggregate PSD level at a particular earth station antenna. If those triggers are not met during the mobile operator's network deployment planning process, then the mobile operator can deploy base stations as it sees fit.

B. Revisions to the C-Band Alliance's proposed rules.

After carefully studying other technical proposals in the record as well as the feedback the C-Band Alliance received on its proposed rules, the C-Band Alliance has determined that some of its original proposals were conservative. Accordingly, the C-Band Alliance has made adjustments to its proposals to provide further flexibility to mobile operators while maintaining interference protections for FSS operations.

1. Antenna elevation angles can be defined by a limited orbital arc.

In its filing, AT&T questioned the C-Band Alliance's proposal to protect FSS earth stations at elevations angles down to 5 degrees.[71] AT&T asserts that "such conservative elevation angle is unnecessary because it implies protection for earth stations to communicate with orbital slots where there are no U.S. authorized C-Band GSO satellites."[72]

The C-Band Alliance's original proposal was based on the legal standard set forth in the Commission's rules. Specifically, section 25.205(a) restricts earth station operators from transmitting at elevation angles less than 5 degrees.[73] In response to AT&T's input, the C-Band

[71] *AT&T Ex Parte*, at 13-14; *see also Further Technical Statement*, at 2.

[72] *AT&T Ex Parte*, at 13.

[73] 47 C.F.R. § 25.205(a) ("Earth station antennas must not transmit at elevation angles less than five degrees, measured from the horizontal plane to the direction of maximum radiation, in a

Alliance has conducted additional analysis and concluded that existing CONUS video and radio services, once repacked as proposed under its transition plan,[74] will be transmitted from satellites located between 89° W.L. and 139° W.L. across the orbital arc. Thus, the C-Band Alliance has revised its proposed rules as reflected in Attachment A.

2. Earth station protection zones can be reduced to the existing one arc second if the filing freeze is temporarily lifted.

AT&T also questioned the C-Band Alliance's proposal to establish a 150-meter radius protection zone around each earth station within which future mobile operators would be required to assume that there is an antenna that must be protected.[75] The C-Band Alliance's objectives behind this proposal were twofold: (a) allow earth station operators the flexibility to move existing antennas or install new antennas in the future and (b) account for the likelihood that some earth station operators registered a single antenna rather than all of the antennas within their antenna farm. However, having now studied the issue further, the C-Band Alliance believes that these two objectives can be accomplished by maintaining the flexibility of existing FCC Rule 25.118 and opening a limited filing window to improve the accuracy of the receive-only earth station registration data in IBFS.[76] Doing so would minimize the size of necessary FSS antenna protection zones and allow for more robust terrestrial mobile service.

Section 25.118 of the Commission's rules allows earth station operators to move antennas operating in shared bands up to one arc second in latitude or longitude (*i.e.*, 30 meters in latitude and 20-28 meters in longitude depending upon location in CONUS) from the originally authorized

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frequency band shared with terrestrial radio services or in a frequency band with an allocation to space services operating in both the Earth-to-space and space-to-Earth directions….").

[74] *See generally Transition Implementation Process*.

[75] *AT&T Ex Parte*, at 11.

[76] 47 C.F.R. § 25.118.

earth station coordinates without obtaining a new authorization. However, for this rule to provide the same level of protection to existing operations as the originally proposed exclusion zone, earth station registrants should be given an opportunity via a limited filing window to make additional filings or modify existing registrations to reflect their actual antenna counts.

As detailed in its July 15, 2019 filing, the C-Band Alliance has undertaken extensive analysis of existing IBFS earth station registration data and determined that about two times the number of C-Band antennas exist in the field compared to what IBFS reflects.[77] A limited filing window would allow registrants to improve the accuracy of the IBFS data while maintaining the flexibility that Rule 25.118 provides earth station operators to adapt their operations. These steps would relieve terrestrial mobile operators from having to assume a 150-meter radius protection zone around all earth stations and lead to more fulsome operations, while at the same time ensuring that all antennas in a multi-antenna site are protected.

3. The number of TT&C/Gateway locations could be reduced.

AT&T also raises issues with the 150-kilometer radius coordination zones around TT&C/Gateway sites proposed by the C-Band Alliance.[78] The C-Band Alliance continues to believe that a 150-kilometer radius is the appropriate size for the coordination zones given the critical import of TT&C operations. However, to lessen the potential for impairments on C-Band spectrum that these coordination zones could cause, while maintaining our ability to protect our customers' ongoing services, the C-Band Alliance has committed to reducing TT&C/Gateway

[77] *See* Letter from Jennifer D. Hindin, Counsel for the C-Band Alliance, to Marlene H. Dortch, Secretary, FCC (filed July 15, 2019) (including *FCC Presentation on Registered Earth Station Data Analysis* as attachment).

[78] *AT&T Ex Parte*, at 5.

locations to four.[79] Furthermore, the C-Band Alliance hereby makes the additional commitment to site these four "grandfathered" locations away from metropolitan areas so as to further reduce any wireless spectrum impairments.[80] TT&C operations must be located *somewhere*, and the locations currently under consideration by the members of the C-Band Alliance should significantly reduce, if not alleviate altogether, AT&T's concerns about "significant repercussions for the communities in and around" TT&C coordination zones.[81]

4. Improved FSS filter masks could increase flexibility.

The C-Band Alliance has, for more than 12 months, worked on continuous improvements of to its FSS antenna filter, which is designed to reject 5G in-band interference into FSS antennas. Dozens of prototype filters have been developed, tested, and demonstrated to the current user community.[82] With each successive prototype, higher levels of 5G in-band emissions attenuation has been attained over the levels previously proposed by the CBA.[83] Figure 8 shows actual prototype filter performance from two separate manufacturers.

[79] *Transition Implementation Process*, at 10.

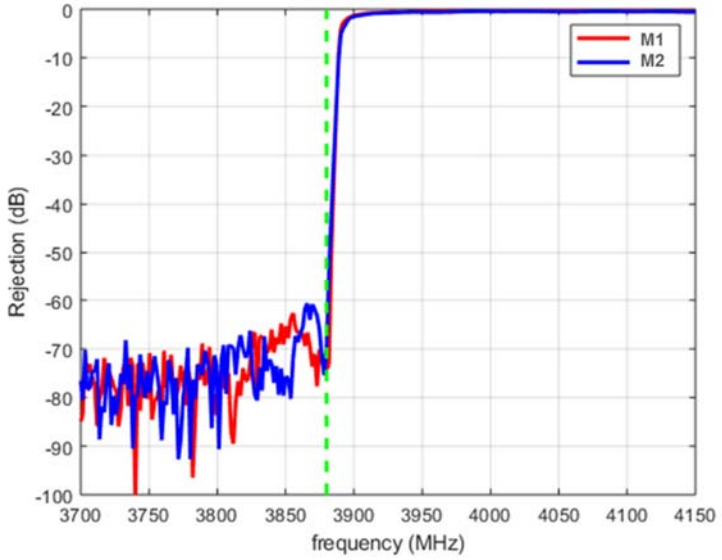
[80] For example, SES is considering siting its two TT&C locations in Brewster, WA and Hawley, PA. According to the U.S. Census Bureau, Brewster and Hawley have populations of 2,364 and 1,162, respectively. *See* American Fact Finder, https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

[81] *AT&T Ex Parte*, at 5.

[82] Indeed, it was due in part to advancements in filtering technology that allowed the C-Band Alliance to reduce its proposed guard band to 20 MHz from the originally-proposed 50 MHz. *See Transition Implementation Process*, at 3.

[83] *CBA NPRM Reply*, Technical Annex, at 3.

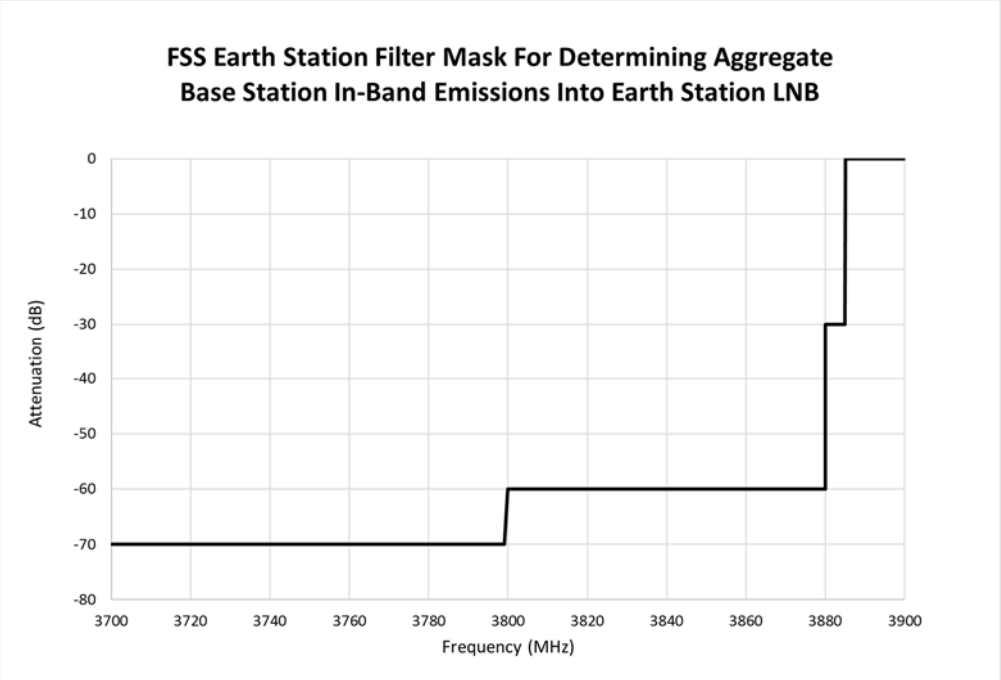
Figure 8



Based on the prototypes, the C-Band Alliance has determined that the FSS antenna filter mask can be significantly improved, which will allow 5G base stations to be built closer to FSS earth stations and operate nearer to the FSS antenna boresight. The CBA proposes the following definition of the FSS earth station filter mask, as also illustrated in Figure 9:

From 3700 to 100 MHz below FSS band edge	-70 dB
From 100 MHz below lower FSS band edge to 20 MHz below lower FSS band edge	-60 dB
From 20 MHz below lower FSS band edge to 15 MHz below lower FSS band edge	-30 dB
From 15 MHz below lower FSS band edge to lower FSS band edge	0 dB

Figure 9



5. Maximum 5G base station and user equipment out-of-band emission levels could be less restrictive.

AT&T and wireless equipment manufacturers have expressed concerns on the record that the C-Band Alliance-proposed out of band emissions ("OOBE") limits on base stations and user equipment[84] are overly restrictive.[85] Others have expressed concern to the C-Band Alliance that our proposed levels do not comply with existing 3GPP band n77 levels, thus requiring specialized

[84] The C-Band Alliance previously proposed maximum aggregate base station OOBE levels that would be acceptable to prevent significant degradation of FSS signals. These levels are measured at the input of the earth station antenna LNB taking into account a reference earth station antenna mask and 5G rejection filter mask. The C-Band Alliance has also proposed that each wireless operator be responsible for calculating its aggregate base station OOBE and ensuring that that level does not exceed the limit established in the proposed rules. In addition, the C-Band Alliance has proposed that, in the case of multiple wireless providers operating within 40 km of any earth station, the minimum acceptable OOBE levels must be reduced for each operator to account for the potential increase in OOBE levels from co-frequency out-of-band emissions falling within the FSS band. *See CBA NPRM Reply*, Technical Annex.

[85] *AT&T Ex Parte*, at 16

equipment for the U.S. market.[86] Furthermore, wireless operators and manufacturers have expressed concerns to the C-Band Alliance that adhering to the C-Band Alliance-proposed OOBE limits will require the replacement of new base station and user equipment if spectrum is cleared in multiple stages.

Having engaged in discussions with the wireless industry, the C-Band Alliance understands that wireless operators have a number of tools at their disposal to manage their networks that can reduce aggregate OOBE from base stations and user equipment to acceptable levels at FSS earth stations. For example, massive MIMO/FD-MIMO systems can force a radiation pattern null in the direction of a nearby FSS earth station, significantly reducing the blocking and OOBE power levels. In addition, 5G base stations can locally enforce lower transmit power levels, and consequently OOBE levels, on attached user equipment in close proximity of an FSS earth station or force user equipment to roam to non-C-Band frequencies when the user equipment is in close proximity of an FSS earth station. The C-Band Alliance further understands that wireless operators can deploy microcells near FSS earth stations, which will result in lower user equipment power levels. The C-Band Alliance understands that each of these network deployment tools can be deployed by wireless operators on a localized, case-by-case basis.

Given the availability of these tools, the C-Band Alliance proposes to modify its previously proposed rules to measure and enforce aggregate base station and user equipment OOBE limits at the input of the earth station LNB when using the FSS earth station reference antenna mask and filter mask as follows:

> -128 dBm/MHz in aggregate for all base stations and user equipment within 40 km of an earth station other than TT&C/Gateway sites. Where multiple wireless licensees exist, the OOBE limit shall be adjusted by -10log10(n2) where n2 is the number of distinct licensees operating within 40 kilometers of the earth station.

[86] Reply Comments of Qualcomm Incorporated, at 2 (filed Dec. 11, 2018).

> -133 dBm/MHz in aggregate for all base stations or user equipment within 150 km of a TT&C/Gateway site. Where multiple wireless licensees exist, the OOBE limit shall be adjusted by -10log10(n2) where n2 is the number of distinct licensees operating within 150 kilometers of the TT&C/Gateway site.

Furthermore, with this new proposal for base station and user equipment OOBE limits at an earth station, the C-Band Alliance does not see the need to specify OOBE masks for both base stations and user equipment beyond that which has been specified by 3GPP for band n77.[87]

VI. CONCLUSION

The C-Band Alliance has proposed an approach to repurposing a portion of the C-Band for terrestrial 5G operations that represents "the whole package," enabling expedited 5G deployment while protecting ongoing delivery of high quality video and audio programming. For the reasons discussed above, the proposals put forth by the ACA Connects Coalition, WISPA and friends, and AT&T all fall short. The Commission should reject those proposals and adopt the C-Band Alliance's market-based approach.

Respectfully submitted,

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August 7, 2019

[87] Table 6.5.2.2-1: NR General spectrum emission mask, ETSI TS 138 101-1 V15.3.0 (2018-10), https://www.etsi.org/deliver/etsi_ts/138100_138199/13810101/15.03.00_60/ts_13810101v150300p.pdf.

Attachment A - Proposed Technical Rules

Below is a revised proposed rule to be incorporated into Part 27 of the Commission's rules.

PART 27 – MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES

Create new Section 27.78 to read as follows:

§ 27.78 Protection of FSS earth stations operating in the 3700-4200 MHz band

(a) Registered FSS earth stations. FSS earth stations eligible for the protections described in this section must meet one of the following criteria:

(1) Hold a valid registration to receive satellite signals within the 3700-4200 MHz band filed no later than October 31, 2018;

(2) Hold a valid registration to receive satellite signals within the 3700-4200 MHz band filed during the open filing period from [date 1] to [date 2];

(3) Hold a registration to receive satellite signals within the 3900-4200 MHz band pursuant to a waiver issued with the approval of all flexible use licensees operating within 40 kilometers of the earth station's registered location; or

(4) Hold a license to transmit that also includes the 3700-4200 MHz band.

(b) The reference earth station antenna pattern to be used to calculate the aggregate RF power spectral density ("APSD") limits in this section is as follows:

$G = 52.6$ dBi	for $0° \leq \phi < 1.5°$
$G = 29 - 25 \log \phi$ dBi	for $1.5° \leq \phi < 7°$
$G = 8$ dBi	for $7° \leq \phi < 9.2°$
$G = 32 - 25 \log \phi$ dBi	for $9.2° \leq \phi < 48°$
$G = -10$ dBi	for $48° \leq \phi \leq 180°$

where ϕ is the off-axis angle from the main beam of the antenna in degrees.

(c) Registered earth stations operating consistent with § 2.106 of this chapter are eligible for the following protection.

(1) *Blocking.* The APSD produced in the flexible use C-Band by all base stations operated by a Flexible Use Licensee and attached user equipment within 40 kilometers of a registered earth station as measured at the output of a reference RF filter and earth station antenna shall not exceed a value of $-59 - 10 \log_{10}(BW_{MHz}) - 10\log_{10}(n1)$ dBm/MHz

where BW is the total amount of C-Band spectrum, in MHz, cleared for flexible use licensees, and

n1 is the number of distinct licensees using the same frequency block in the services areas within 40 kilometers of the earth station.

This value must be met for all elevation angles to any space station from 89 west longitude to 139 west longitude at every registered earth station within CONUS and at any point within one arc second from the registered earth station. The Flexible Use Licensee shall calculate the APSD for the specific frequency band in which it is transmitting, using the reference earth station antenna pattern and a reference RF filter, between the feed-horn and low-noise amplifier or low-noise block downconverter ("LNA/LNB"), with an attenuation as shown below:

Frequency Range	Attenuation
From 3700 to 100 MHz below FSS band edge	-70 dB
From 100 MHz below lower FSS band edge to 20 MHz below lower FSS band edge	-60 dB
From 20 MHz below lower FSS band edge to 15 MHz below lower FSS band edge	-30 dB
From 15 MHz below lower FSS band edge to lower FSS band edge	0 dB

(2) *Out-of-band emissions into FSS.* The APSD produced in the flexible use C-Band by all base stations operated by a Flexible Use Licensee and attached user equipment within 40 kilometers of a registered earth station as measured at the output of a reference RF filter with a 1 dB insertion loss in the passband and earth station antenna shall not exceed the following levels:

for earth stations used for satellite telemetry, tracking and control ("TT&C")

$-133 - 10\log_{10}(n2)$ dBm/MHz

for other earth stations

$-128 - 10\log_{10}(n2)$ dBm/MHz

where n2 is the number of distinct licensees operating within 40 kilometers of the earth station.

These values must be met for all elevation angles to any space station from 89 west longitude to 139 west longitude at every registered earth station within CONUS and at any point within one arc second from the

registered earth station. The Flexible Use Licensee shall calculate the APSD using the reference antenna pattern.

(3) *Co-frequency emissions into FSS earth stations operating in the flexible use C-Band.* The APSD produced in the flexible use C-Band by all base stations operated by a Flexible Use Licensee and attached user equipment within 150 kilometers of a registered earth station authorized to operate in the 3700-3900 MHz band as measured at the output of the earth station antenna shall not exceed the following values

$-133 - 10\log_{10}(n1)$ dBm/MHz

for other earth stations

$-128 - 10\log_{10}(n1)$ dBm/MHz

n1 is the number of distinct Flexible Use Licensees using the same frequency block in the services areas within 150 kilometers of the earth station.

These values must be met for all elevation angles to any space station from 89 west longitude to 139 west longitude at every registered earth station within CONUS and at any point within one arc second from the registered earth station. The earth stations authorized to operate in the flexible use C-Band are: [X]. The Flexible Use Licensee shall calculate the APSD using the reference antenna pattern.