

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)
)
Amendment of the Commission's Rules with) GN Docket No. 12-354
Regard to Commercial Operations in the)
3550-3650 MHz Band)

To: The Commission

REPLY COMMENTS OF THE SATELLITE INDUSTRY ASSOCIATION

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SUMMARY

The record in this proceeding bears out the concerns raised by the Satellite Industry Association (“SIA”) regarding whether introduction of small cells in the 3.5 GHz band would be compatible with current and future satellite operations and would respond to the stated needs of the wireless industry. The comments demonstrate significant disagreement on virtually every aspect of the regulatory framework set forth in the Notice and express doubts about whether the proposals for shared access to the band are feasible, particularly in the near term. Given these material outstanding questions, SIA believes that more study is needed before the Commission could consider proceeding with these proposals. Moreover, the Commission should lift the freeze on new earth stations in the 3.5 GHz band, allowing continued efficient use of this spectrum, while it continues its deliberations.

The lack of unanimity among the parties on the core issues in the Notice serves to reinforce SIA’s argument that the sharing proposals in this band should not be used as a model for other spectrum or in the development of broader U.S. policy. It is simply too early to determine whether shared use by small cells will work and if so, what form it will take. Pending further analysis of these issues, the Commission must take care not to create the impression that the outcome of this rulemaking has been decided, and must certainly not use the proposals in the Notice to shape U.S. positions on spectrum matters in international proceedings.

In weighing further action, the Commission must bear in mind the important satellite services that are currently provided in the 3.5 GHz band and in conventional C-band spectrum. C-band satellites are central to global media distribution and support key Commission objectives, including providing connectivity and advanced telecommunications services to remote areas and providing safety-of-life functions around the world. Untested sharing methodologies cannot be allowed to interfere with these essential services.

The threat to satellite networks must be weighed against the distinct possibility that significant demand for small cell operations in this band will not materialize. Comments from the wireless industry highlight the fact that small cell technology is already being used today in existing licensed and unlicensed spectrum, and cast doubt on the suitability of the 3.5 GHz band for mobile broadband operations. The suggestion of some commenters that this band should be used for long-distance backhaul comports with SIA's proposal that introducing new point-to-point microwave networks for backhaul in this band would meet a demonstrated need and could be implemented easily, given the proven ability of such facilities to share spectrum with FSS.

If the Commission determines that the requirement for new small cells justifies pursuing the proposals in the Notice, it will have to grapple with the complex issues surrounding protection of satellite services. SIA agrees with the Commission that exclusion zones will be needed, but the required separation distance cannot be determined based on the information currently in the record. Enforcement of the exclusion zones using the database approach contemplated in the Notice will also be extremely challenging, requiring the development, testing, and commercial deployment of as yet untried technologies.

In light of these significant concerns, the Commission should abandon its proposal to introduce small cells in the adjacent spectrum at 3650-3700 MHz, which would be disruptive to both FSS and terrestrial users of that band. If it decides to allow small cells in the 3.5 GHz band, the Commission must implement measures to protect satellite operations in conventional and extended C-band spectrum from interference due to out-of-band emissions or overload of a satellite receiver's low noise amplifier. Because SIA has demonstrated that permitting deployment of new earth stations in the 3.5 GHz band will not materially constrain introduction of terrestrial services and will ensure robust use of spectrum, the Commission should lift the earth station freeze.

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The Satellite Industry Association (“SIA”)¹ hereby replies to the comments of other parties in response to the Commission’s Notice of Proposed Rulemaking in the above-captioned proceeding.² SIA’s initial comments demonstrate that the Commission’s proposals to introduce

¹ SIA is a U.S.-based trade association providing worldwide representation of the leading satellite operators, service providers, manufacturers, launch services providers, and ground equipment suppliers. Since its creation more than fifteen years ago, SIA has advocated for the unified voice of the U.S. satellite industry on policy, regulatory, and legislative issues affecting the satellite business.

SIA Executive Members include: Artel, LLC.; The Boeing Company; The DIRECTV Group; EchoStar Satellite Services LLC; Harris CapRock Communications; Hughes Network Systems, LLC; Intelsat, S.A.; Iridium Communications Inc.; Kratos Defense & Security Solutions; LightSquared; Lockheed Martin Corporation.; Northrop Grumman Corporation; Rockwell Collins Government Systems; SES S.A.; and Space Systems/Loral. SIA Associate Members include: AIS Engineering, Inc.; Astrium Services Government, Inc.; ATK Inc.; Cisco; Cobham SATCOM Land Systems; Comtech EF Data Corp.; DRS Technologies, Inc.; Encompass Government Solutions; Eutelsat, Inc.; Globecom Systems, Inc.; Glowlink Communications Technology, Inc.; iDirect Government Technologies; Inmarsat, Inc.; ITT Exelis; Marshall Communications Corporation.; MTN Government Services; NewSat America, Inc.; O3b Networks; Orbital Sciences Corporation; Panasonic Avionics Corporation; Spacecom, Ltd.; Spacenet Inc.; TeleCommunication Systems, Inc.; Telesat Canada; The SI Organization, Inc.; TrustComm, Inc.; Ultisat, Inc.; ViaSat, Inc., and XTAR, LLC. Additional information about SIA can be found at <http://www.sia.org>.

² *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Notice of Proposed Rulemaking and Order, GN Docket No. 12-354, FCC 12-148 (rel. Dec. 12, 2012) (“Notice”).

new terrestrial services in the 3550-3650 MHz band (“3.5 GHz band”) using small cell technology are unsupported by either clear data showing demand for new small cell operations in the band or evidence showing that small cells can share the 3.5 GHz band without harming existing or future C-band Fixed-Satellite Service (“FSS”) operations.³ Other parties echo these concerns.⁴ Accordingly, further study is warranted before the Commission can determine whether use of the 3.5 GHz band for small cells will fulfill stated spectrum needs and is feasible without constraining critical satellite services. Given these unanswered questions, the freeze on new earth stations in the band is unjustified and should be lifted.

I. INTRODUCTION

The record in response to the Notice suggests that the Commission’s expectations for small cells in the 3.5 GHz band may be premature at best. The Notice assumes that permitting small cell deployment in this band will meet the stated needs of the wireless industry for additional spectrum.⁵ The Commission recognizes that existing federal and commercial uses, including satellite operations, must be protected,⁶ but suggests that two additional levels of new services can be accommodated, a Priority Access tier consisting of “critical, quality-of-service

³ Comments of the Satellite Industry Association, GN Docket No. 12-354 (“SIA Comments”).

⁴ *See, e.g.*, Comments of Astrium Services Government, Inc., GN Docket No. 12-354 (“ASGI Comments”); Comments of Fox Entertainment Group, Inc., Time Warner Inc., Viacom Inc., and The Walt Disney Company, GN Docket No. 12-354 (“Content Company Comments”); Comments of Harris Corporation, GN Docket No. 12-354 (“Harris Comments”); Comments of the National Association of Broadcasters, GN Docket No. 12-354 (“NAB Comments”); Comments of the National Cable & Telecommunications Association, GN Docket No. 12-354 (“NCTA Comments”); Comments of the Telecommunications Industry Association, GN Docket No. 12-354 (“TIA Comments”).

⁵ Notice at ¶ 156.

⁶ *Id.* at ¶ 65.

dependent users at specific targeted locations,”⁷ and a General Authorized Access (“GAA”) tier that “would be assigned for use by the general public on an opportunistic, non-interfering basis within designated geographic areas.”⁸ In order to manage these varying levels of service protection, the Commission proposes to rely on “a spectrum access system (SAS) incorporating a dynamic database.”⁹

As discussed below, the pleadings here call into question each element of these assumptions. The record reflects significant disagreement, even among terrestrial wireless industry interests, regarding what the 3.5 GHz band should be used for and whether access to this spectrum on a shared basis is even suitable for mobile broadband applications. There are disputes about how terrestrial operations can feasibly share among themselves and with primary services in the band. A number of parties raise concerns regarding whether satellite services can be adequately protected from harmful interference through the proposed SAS, particularly given the undefined and unproven nature of that database system.

In short, fundamental unanswered questions remain before the Commission can decide whether small cell deployment in the 3.5 GHz band on a shared basis is feasible. Accordingly, the Commission should not promote the nascent, untested proposals for sharing of the 3.5 GHz band as part of any U.S. position in international forums on the suitability of this or any other band for terrestrial mobile applications. Furthermore, because the record suggests that resolving all of the disputed issues relating to proposed terrestrial wireless use of the 3.5 GHz band will be a lengthy project, a continued freeze on new FSS earth stations in the band is unjustified.

⁷ *Id.* at ¶ 9.

⁸ *Id.* at ¶ 10.

⁹ *Id.* at ¶ 7.

II. THE RECORD HIGHLIGHTS THE PRELIMINARY NATURE AND LIMITED APPLICABILITY OF THE COMMISSION'S SHARING PROPOSALS

SIA's initial comments caution against any assumption that a sharing framework adopted in the U.S. for the 3.5 GHz band would be appropriate for application to other satellite spectrum or to use of the 3.5 GHz band in other countries.¹⁰ The pleading notes that U.S. restrictions on FSS operations in the 3.5 GHz band have limited earth station deployment domestically in this band segment.¹¹ In contrast, conventional C-band earth stations are ubiquitously deployed in the U.S. and abroad, and both U.S. and foreign-licensed satellite networks use the 3.5 GHz band intensively outside the U.S.¹² As a result, even if the Commission eventually were to develop a workable scenario for sharing the 3.5 GHz band with FSS operations domestically, attempting to superimpose those techniques on bands or in regions where FSS operations are even more widespread would be inappropriate.¹³

For these reasons, the SIA comments emphasize that given the unique characteristics of FSS use of the 3.5 GHz band in the U.S., the Commission's decisions here must apply only domestically, and only to the 3.5 GHz band. In particular, such decisions should not be a factor in developing broader U.S. policy for domestic use of bands above 3.7 GHz nor for international spectrum proceedings, such as WRC-15.¹⁴ The state of the record certainly does not support a U.S. position at WRC-15 that would put forward the entire 3400-4200 MHz band as suitable for mobile broadband services, particularly given the strong U.S. interests in the conventional C-band (3700-4200 MHz). The Content Companies echo this concern in their filing, as their media

¹⁰ SIA Comments at 4-7.

¹¹ *Id.* at 4-5.

¹² *Id.* at 5-6.

¹³ *Id.* at 6.

¹⁴ *Id.* at 6-7.

distribution domestically and internationally depends on satellite networks using C-band frequencies, especially the conventional C-band.¹⁵ The U.S. government also relies heavily on the conventional C-band for secure government networks.¹⁶

Submissions by other parties confirm the wisdom of limiting the scope of any sharing proposals explored here to domestic use of the 3.5 GHz band. As discussed in more detail below, substantial questions remain about the suitability of the 3.5 GHz spectrum for the uses envisioned by the Commission. There is also significant disagreement regarding virtually every aspect of the Commission's regulatory proposals. Several commenters expressly warn that developing and evaluating the types of technology needed to ensure that sharing of the band can occur without harm to existing operations will be a lengthy process, requiring that numerous technical and economic obstacles be overcome.¹⁷

Of course, the feasibility of sharing is inextricably and directly linked to the propagation characteristics and existing service deployments in the 3.5 GHz band.¹⁸ Thus, even if the Commission is able to resolve these matters in connection with its sharing proposal for the 3.5 GHz band in the U.S., there is no reason to believe that a similar approach will work in other bands or in jurisdictions with different usage characteristics. Commenters who suggest that the

¹⁵ Content Companies Comments at 4.

¹⁶ For example, the Navy's CBSP program uses C-band to provide broadband connectivity to ships. See <http://www.intelsatgeneral.com/resources/case-studies/intelsat-general-provides-detailed-look-us-navy%E2%80%99s-cbsp-program>.

¹⁷ See, e.g., Comments of the Consumer Electronics Association, GN Docket No. 12-354 ("CEA Comments") at 3; Comments of Google Inc., GN Docket No. 12-354 ("Google Comments") at 1; Comments of Mobile Future, GN Docket No. 12-354 ("Mobile Future Comments") at 3.

¹⁸ See, e.g., Notice at ¶¶ 19-20 & n. 38 (noting that propagation characteristics are frequency dependent); ¶¶ 22-25 (discussing existing uses of the 3.5 GHz band).

proposals in the Notice can serve as a model to be applied elsewhere¹⁹ ignore this important reality.

Under these circumstances, it would clearly be inappropriate for the Commission to prejudge the outcome of this proceeding and use its own proposed sharing framework set forth in the Notice as a template for developing policies of broader applicability. The Commission must instead be informed by the record in this proceeding on the feasibility of sharing in the 3.5 GHz band, and must not rely on its own proposals here to guide decision making on international spectrum matters.

Unfortunately, there is evidence to suggest that the Commission is putting the cart before the horse and making assumptions about the outcome of the instant rulemaking before the record in the proceeding is even complete. Specifically, a recent Commission white paper includes a table that purports to document bands that the U.S. “has made available for unlicensed use and that can support mobile broadband operations” and lists the 3.5 GHz band as in the “pipeline” for purposes of that table.²⁰ The White Paper acknowledges in a footnote that the 3.5 GHz band is subject to a pending rulemaking proceeding.²¹ However, the document as a whole creates a clear impression that the Commission has already decided on the ultimate disposition of the proposals in the Notice. To the extent that the White Paper is used in international discussions, it could be misconstrued by foreign regulators who may not focus on the document’s fine print, and might

¹⁹ See, e.g., Google Comments at 2; Comments of InterDigital, Inc., GN Docket No. 12-354 (“InterDigital Comments”) at 12.

²⁰ See FCC White Paper, *The Mobile Broadband Spectrum Challenge: International Comparisons* (WTB & OET, Feb. 26, 2013) at 10 & Table 6. The White Paper explains that spectrum is considered to be in the pipeline “if it is not currently available for commercial services but the relevant government has plans to make this spectrum available to providers within the next three years.” *Id.* at 3.

²¹ See *id.* at 18.

be unfamiliar with the distinctions between a bureau-level discussion paper and a Commission-level rulemaking.

The Commission must take precautions to ensure that it does not sow confusion in this manner. The Commission is obligated to weigh the legitimate concerns of all parties in an equitable and unbiased manner as it considers whether to adopt the proposals set forth in the Notice. Pending such a decision, the Commission should not create the impression that it is advocating any position domestically or internationally that assumes that the issues raised in the Notice will be resolved in favor of introducing terrestrial wireless services on a shared basis in the 3.5 GHz band.

III. C-BAND SATELLITE NETWORKS SUPPLY ESSENTIAL SERVICES

Several parties echo SIA's concerns about whether the proposal to introduce small cells in the 3.5 GHz band is compatible with critical satellite services in the conventional and extended C-band.²² The introduction of small cells proposed in the Notice poses a threat to these satellite services due to the possibility of harmful interference from new in-band operations that could adversely affect satellite networks in the 3.5 GHz band and the risk of harmful out-of-band emissions affecting reception of satellite signals in the conventional C-band.

As the SIA comments demonstrate, satellite operations in the 3.5 GHz band support important services for commercial and government users.²³ SIA identifies in its comments more than 60 satellites known to have capacity in this band, representing a substantial sunk

²² The conventional C-band refers to downlink (space-to-Earth) spectrum at 3700-4200 MHz and uplink (Earth-to-space) spectrum at 5925-6425 MHz. The adjacent frequencies, including the 3600-3700 MHz downlink (space-to-Earth) spectrum and 5850-5925 MHz uplink (Earth-to-space) spectrum, are referred to as the extended C-band.

²³ SIA Comments at 10-12.

investment.²⁴ This spectrum allows, among other uses, the provision of safety-of-life functions around the globe.²⁵ In addition, the band is used for telemetry, tracking and control (“TT&C”) to ensure that spacecraft can be operated and maneuvered safely.²⁶

The conventional C-band is characterized by ubiquitously-deployed earth stations in the U.S. and abroad.²⁷ These satellite networks are critical to the broadcast and cable industries and make global media services possible. As the Content Companies note:

All 114 million US television households rely on C-Band operations from 3.7-4.2 GHz in some measure for content distribution Consumers nationwide rely on these services for critical news and information, in addition to their favorite entertainment programming, making reliable and interference-free delivery of this content essential. While other methods of delivery, such as via fiber, supplement satellite delivery in limited circumstances, these alternatives cannot be scaled to provide the same ubiquitous and dependable service to all providers (particularly small providers in rural areas) as does C-band satellite. Further, C-band satellite ensures redundancy and continued signal delivery in circumstances where terrestrial infrastructure may be compromised, such as with weather or other emergency disruptions.²⁸

Similarly, NCTA explains that C-band satellites:

are an essential component of the infrastructure used by the cable industry to distribute programming to the tens of millions of cable customers in the United States. Almost every national cable programming network and many regional networks are uplinked to C-Band FSS satellites

²⁴ *Id.* at Appendix 1.

²⁵ *Id.* at 11-12.

²⁶ *Id.* at 12.

²⁷ *Id.* at 5-6.

²⁸ Content Companies Comments at 2. *See also* NAB Comments at 1-2 (conventional C-band satellites are relied on by broadcast networks and others to distribute programming throughout the U.S.).

and distributed to satellite dishes located at thousands of cable system headends scattered throughout the country.²⁹

In addition to serving as the backbone for programming distribution, the conventional C-band is also used to provide communications links to remote areas in both the U.S. and around the globe where terrestrial infrastructure is limited. For example, C-band satellites enable the provision of both basic connectivity and more advanced services to remote parts of Alaska and to ships at sea.³⁰

The Commission must ensure that untested spectrum sharing approaches are not allowed to disrupt these essential services. Instead, the Commission must “carefully and thoroughly study the interference potential of any proposed wireless deployments” before it moves forward with the proposals outlined in the Notice.³¹ Furthermore, as discussed in Section V below, devising and enforcing measures to safeguard satellite services from harmful interference will be a complicated and time-consuming process that must be completed before new services can be introduced into the 3.5 GHz band.

IV. COMMENTERS QUESTION WHETHER SMALL CELLS IN THE 3.5 GHZ BAND WILL MEET STATED SPECTRUM NEEDS

The SIA comments stress the need to determine whether permitting shared use of the 3.5 GHz band for small cell deployment will satisfy genuine requirements for new spectrum for wireless broadband.³² Unlicensed Wi-Fi capacity already carries a substantial amount of mobile

²⁹ NCTA Comments at 5.

³⁰ SIA Comments at 5-6.

³¹ Content Companies Comments at 3. *See also* NCTA Comments at 5-6 (“the Commission should ensure, through rigorous analysis of technical studies undertaken prior to authorizing the new services, that undesirable technical characteristics resulting from any new operations in the 3.5 GHz band . . . can be appropriately limited, thereby protecting incumbents from harmful interference”).

³² SIA Comments at 7-10.

phone traffic, and wireless carriers can also deploy small cells today in their licensed spectrum.³³

The SIA comments accordingly urge the Commission to assess existing spectrum use first and then decide whether access to additional 3.5 GHz band frequencies for small cells is needed.³⁴

Several other parties also point to use of existing spectrum allocations for small cell networks, including Wi-Fi. For example, both Microsoft and NCTA highlight the fact that a significant portion of traffic is being offloaded today from wireless networks through small cell deployments.³⁵ A coalition of public interest groups emphasizes in its comments the need to distinguish between truly mobile data demand and nomadic demand, noting that:

the rising consumer demand for data on mobile devices, especially smartphones and tablets, is primarily nomadic and can be most efficiently met by offloading data traffic onto wired local area networks (such as home or business Wi-Fi connections), rather than relying on transmission over exclusively-licensed spectrum to more distant carrier-provisioned infrastructure.³⁶

Importantly, these parties do not identify any obstacles to increasing use of small cell technology in existing licensed and unlicensed spectrum allocations. Thus, it does not appear that, taking into account the additional spectrum already being considered for unlicensed small

³³ *Id.* at 8-9.

³⁴ *Id.* at 9-10.

³⁵ Comments of Microsoft Corporation, GN Docket No. 12-354 (“Microsoft Comments”) at 6 (“Wi-Fi carries more than half of all data traffic on laptops, tablets, and smartphones”); NCTA Comments at 7 (“Wi-Fi now carries more Internet traffic to consumers’ smartphones, tablets, laptops, and PCs than licensed wireless and wired connections combined”) (footnote omitted).

³⁶ Comments of Open Technology Institute at the New America Foundation, Consumer Federation of America, Public Knowledge, and Free Press, GN Docket No. 12-354 (“Public Interest Comments”) at 10.

cell networks,³⁷ making the 3.5 GHz band available for small cell deployment would fill a specific need.

To the contrary, representatives of the wireless industry state that the 3.5 GHz band ultimately is not suitable for mobile broadband service.³⁸ Several commenters highlight the lengthy time frames that will be required to research, develop, test, and deploy the technologies needed to move to a dynamic access model as proposed in the Notice for the 3.5 GHz band.³⁹ In addition, PCIA points to the required infrastructure necessary to support small cells.⁴⁰ These parties question whether, given the propagation characteristics of the spectrum and the need to

³⁷ See SIA Comments at 8 (citing pending proceedings to increase the amount of spectrum available for unlicensed wireless use).

³⁸ See, e.g., Comments of AT&T, GN Docket No. 12-354 (“AT&T Comments”) at 3 (repeating its prior statements that the 3.5 GHz band is likely to be of only limited utility for mobile broadband); Comments of CTIA – The Wireless Association®, GN Docket No. 12-354 (“CTIA Comments”) at 1 (the 3.5 GHz band “is not below 3 GHz and therefore is not suitable at this time for *mobile* broadband”) (emphasis in original). See also Mobile Future Comments at 3 (the spectrum below 3 GHz is “best suited for mobile broadband services”) and 8 (“at best, the 3.5 GHz band will only be a small part of a much more complex approach that includes the reallocation of spectrum below 3 GHz over the short- and intermediate-terms for exclusive commercial use”); TIA Comments at 2 (reiterating TIA’s view that sharing the 3.5 GHz band with Department of Defense and FSS incumbents “may be impractical in a mobile environment”).

³⁹ See CEA Comments at 3 (“the dynamic access model the Commission proposes for the 3.5 GHz band is a long-term solution” given the need for further research, development, and testing); Google Comments at 1 (noting the “significant technical and economic obstacles” to making the 3.5 GHz band commercially viable); Mobile Future Comments at 5 (the “technical challenges associated with developing and deploying a technology-driven system for sharing spectrum are substantial” and resolving them will take significant Commission time and resources).

⁴⁰ Comments of PCIA – The Wireless Infrastructure Association and The DAS Forum, GN Docket No. 12-354 (“PCIA Comments”) at 7 (the assumption in the Notice that small cells can be deployed relatively easily by service providers, businesses, and consumers “does not take into account the complex permitting and compliance issues that accompany the deployment of supporting infrastructure for small cells, including elements such as wired backhaul and power”).

protect existing services, the 3.5 GHz band will prove to be useful for mobile operations and warn of the possibility that the band will have low usage and adoption rates.⁴¹

Commenters also suggest that the Commission's proposal for a three-tiered access scheme with opportunistic use is "overly complex"⁴² and "will prevent the 3.5 GHz Band from being used as efficiently as possible."⁴³ The record reflects deep disagreement regarding every aspect of the Commission's proposal for variable levels of access, with a number of parties arguing that a two-tiered system with exclusive licensing of secondary users would be preferable to the three-tiered system put forth in the Notice.⁴⁴ Even among parties supporting the three-tiered system, there is discord regarding what entities should be eligible for priority access.⁴⁵

Several parties suggest alternatives to deployment of small cells in the 3.5 GHz band. When the Commission first proposed allowing shared use of the 3.5 GHz spectrum, SIA advocated for co-primary use of the band by microwave links to support backhaul requirements

⁴¹ TIA Comments at 4 (without concrete data regarding expected use of the 3.5 GHz band by Priority Access and General Access tiers, "both tiers seem likely to follow the low usage and low adoption of other bands above 3 GHz which are already allocated for uses similar to the proposed plan such as the 3650 MHz band").

⁴² Comments of Competitive Carriers Association, GN Docket No. 12-354 ("Competitive Carriers Comments") at 3; Comments of T-Mobile USA, Inc., GN Docket No. 12-354 ("T-Mobile Comments") at 6.

⁴³ T-Mobile Comments at 6.

⁴⁴ *See, e.g.*, Comments of Nokia Siemens Networks US LLC, GN Docket No. 12-354 ("Nokia Comments") at 20; Comments of QUALCOMM Incorporated, GN Docket No. 12-354 ("Qualcomm Comments") at 9.

⁴⁵ *See, e.g.*, AT&T Comments at 7 (commercial wireless carriers should be eligible for Priority Access); CEA Comments at 5 (all users should be eligible for Priority Access); Comments of Great River Energy, GN Docket No. 12-354 ("GRE Comments") at 3 (Priority Access Tier should be available to critical users such as utilities); NCTA Comments at 12 (cable operators should be allowed to register Wi-Fi hotspots for use in the Priority Access tier).

for wireless traffic.⁴⁶ A number of commenters here support use of the 3.5 GHz band for backhaul.⁴⁷ As SIA previously explained, there is a well-established methodology that permits FSS earth stations to share spectrum with point-to-point microwave networks, and those networks could be used to provide new long-distance backhaul services in the 3.5 GHz band.⁴⁸

In short, the record reinforces SIA's concern that the Commission's proposals to introduce small cells in the 3.5 GHz band are not based on evidence of actual need for additional spectrum for this purpose. Instead, the comments highlight the fundamental disagreement among interested parties regarding whether the Commission's proposals for shared use of the 3.5 GHz band are feasible at all, especially in the near term.

V. THE COMMENTS EMPHASIZE THE COMPLEXITY OF PROTECTING C-BAND SATELLITE SERVICES FROM INTERFERENCE

Even assuming that the Commission concludes that allocating additional spectrum for small cell deployment in the 3.5 GHz band is justified, it must also determine whether such services can feasibly share spectrum with primary services using the band. The record

⁴⁶ Comments of the Satellite Industry Association, ET Docket No. 10-123 (filed Apr. 22, 2011) ("SIA Spectrum Task Force Comments") at 7-10.

⁴⁷ See AT&T Comments at 6 (small cells "could play a role in increasing backhaul capabilities for broadband providers"); T-Mobile Comments at 5 (noting significant growth in backhaul requirements and suggesting the 3.5 GHz band may be used to supply backhaul capacity); Comments of WiMAX Forum, GN Docket No. 12-354 ("WiMAX Forum Comments") at 5-6 (backhaul spectrum is a critical element of the small-cell deployment scenario).

⁴⁸ SIA Spectrum Task Force Comments at 8. In contrast, some parties suggest that the Commission should authorize non-line-of-sight ("NLOS") backhaul in the 3.5 GHz band. See Comments of Alcatel-Lucent, GN Docket No. 12-354 ("Alcatel-Lucent Comments") at 8 (urging the Commission to allow 3.5 GHz to be used for short range NLOS backhaul); Comments of Tarana Wireless, GN Docket No. 12-354 ("Tarana Comments") at 3 (a portion of the 3.5 GHz spectrum, which can support NLOS backhaul, should be allocated for wireless backhaul). SIA does not believe that NLOS systems are point-to-point networks, in which case sharing with FSS under the existing framework will not be feasible.

emphasizes the need to ensure that important satellite services will be protected under any sharing scenario being considered by the Commission.

A. More Information Is Needed to Determine Appropriate Separation Distances for Protection of Satellite Receivers

Recognizing the need to ensure that any potential terrestrial services introduced do not interfere with satellite operations, the Notice seeks comment on the establishment of exclusion zones around FSS earth station sites, using the 150 km zone size established in the 3650-3700 MHz band as a starting point.⁴⁹ As the comments of SIA and other parties make clear, however, determining the necessary separation distance to prevent interference requires detailed information regarding small cell characteristics – information that is not in the Notice and about which there is no consensus in the record.⁵⁰ Comsearch, which has extensive experience in handling coordination of earth stations with terrestrial users, emphasizes that “further study is needed to determine the extent of the protection zones considering the respective types of equipment involved, actual operating parameters, and typical use cases.”⁵¹

SIA and other commenters also emphasize the need to address aggregate interference from multiple small cells deployed in a small area.⁵² Vanu warns that absent effective access

⁴⁹ Notice at ¶ 124.

⁵⁰ SIA Comments at 13-15; Comments of Comsearch, GN Docket No. 12-354 (“Comsearch Comments”) at 9; Content Companies Comments at 3; NAB Comments, Engineering Statement at 3.

⁵¹ Comsearch Comments at 9.

⁵² SIA Comments at 14; Alcatel-Lucent Comments at 14 (further study is needed on technical issues, including the “aggregate interference caused by low power small cells in configurations of various density”); Motorola Comments at 7 (protection of primary systems requires consideration of aggregate levels of interference); Comments of Pierre de Vries, GN Docket No. 12-354 (“Pierre de Vries Comments”) at 12 (research suggests that “aggregate interference from many secondary devices can be an issue” for primary networks).

control, “more and more GAA devices could be introduced into the band, and they would work quite well” but “could create crippling interference to the incumbent” operations.⁵³

Unfortunately, there is no agreement in the record regarding the factors that are central to assessing separation distances. For example, a key parameter needed to determine exclusion zone size is the EIRP and EIRP density at which small cells will be allowed to operate.⁵⁴ The comments, however, contain a broad range of suggestions for power levels, and some parties advocate a high level of flexibility on power levels.⁵⁵ Absent information regarding what power and power density levels small cells will be allowed to use, it is impossible even to begin calculating an appropriate separation distance to protect incumbents. Similarly, SIA’s comments note that limiting small cells to indoor locations would correspond to a smaller separation distance.⁵⁶ However, most commenters addressing the issue oppose restricting small cell operations in the 3.5 GHz band to indoor sites.⁵⁷

Furthermore, several comments relating to separation distances needed to protect FSS receivers make unwarranted and incorrect assumptions about the way satellite networks actually

⁵³ Comments of Vanu, Inc., GN Docket No. 12-354 (“Vanu Comments”) at 4.

⁵⁴ See SIA Comments at 13-14.

⁵⁵ See, e.g., Alcatel-Lucent Comments at 4 (the Commission should “not seek to arbitrarily set power limits across the band” because different parameters may be appropriate for different situations); Google Comments at 11-12 (proposing a maximum power of 23 dBm for LTE and Wi-Fi systems and an outdoor power limit of 36 dBm); Harris Comments at 8 (the Commission should adopt a 40 dB power limit for small cell operations to protect incumbent users); Motorola Comments at 6-8 (supporting use of a higher transmit power limit of 20 W EIRP for outdoor operations in less-congested areas). Some commenters that suggest power levels fail to indicate the related bandwidth of operations. As a result, it is impossible to calculate the power density, a necessary element of any separation distance calculation. See SIA Comments at 14.

⁵⁶ SIA Comments at 13-14.

⁵⁷ See, e.g., Alcatel-Lucent Comments at 5-6; Google Comments at 15; GRE Comments at 7; InterDigital Comments at 13; Motorola Comments at 4-5; NCTA Comments at 11; PCIA Comments at 9.

operate. Shared Spectrum assumes that defined exclusion zones can be eliminated altogether if sensing capabilities are deployed,⁵⁸ ignoring the reality that FSS earth stations do not transmit in the 3.5 GHz band and therefore there is no signal a terrestrial device can sense to determine whether an earth station is nearby.⁵⁹ InterDigital suggests that FSS earth stations use only one azimuth,⁶⁰ but in fact, “each earth station can look at multiple satellites across the geostationary arc.”⁶¹ These unsupported assertions reflect a basic misunderstanding of satellite operations and protection requirements.⁶²

Some commenters assert that the SAS database can be relied on to determine separation distances needed to protect FSS receivers based on the individual circumstances of each site.⁶³ As discussed in more detail below, however, the record indicates that the technology needed for implementing a database approach to allowing dynamic spectrum access is not currently

⁵⁸ Comments of Shared Spectrum Company, GN Docket No. 12-354 (“Shared Spectrum Comments”) at 6.

⁵⁹ See SIA Comments at 16; NAB Comments, Engineering Statement at 4.

⁶⁰ InterDigital Comments at 9.

⁶¹ *Wireless Operations in the 3650-3700 MHz Band*, ET Docket No. 04-151, Report and Order and Memorandum Opinion and Order, 20 FCC Rcd 6502 at ¶ 65 (2005).

⁶² Some comments suggest that deploying a fence around an earth station site can adequately protect the receiver from terrestrial interference. Comments of IEEE 802, GN Docket No. 12-354 (“IEEE 802 Comments”) at 2 (referencing a photograph that shows a teleport site surrounded by what appears to be a concrete wall, not a fence); see also Comments of White Space Alliance, GN Docket No. 12-354 (“White Space Alliance Comments”) at 8. However, while many earth station sites are surrounded by fencing, the purpose of the barrier is to exclude people from an area where exposure to radiofrequency energy is possible and for security, not to exclude radio signals. Moreover, primary services in the 3.5 GHz band should not be required to install expensive shielding to guard against interference from secondary services in the same band. See 47 C.F.R. § 2.104(d)(3) (requiring secondary services to protect primary services). SIA also questions the practicality of shielding as a universal solution, given the wide variety of antenna sizes (e.g., some are 30 meters in diameter) and the fact that the shielding could itself block the receiver’s view of the geostationary arc.

⁶³ See, e.g., Comments of IEEE Dynamic Spectrum Access Networks Standards Committee, GN Docket No. 12-354 (“IEEE DySPAN-SC Comments”) at 6; InterDigital Comments at 10; Microsoft Comments at 11; Shared Spectrum Comments at 6.

available. Clearly, the Commission cannot simply trust the protection of critical incumbent services to a database system that has not even been developed, much less tested.

In short, it is simply not possible to define a separation distance for protection of FSS earth stations based on the record here. Any such analysis would have to rely on assumptions regarding small cell operations, given the lack of a wireless industry consensus on the technical issues relevant to separation distance calculations. The SIA comments demonstrate that the 150 km exclusion zone applied in the 3650-3700 MHz zone would be appropriate if the allowed power and power density levels for small cells are consistent with those imposed for operations in the 3650-3700 MHz band.⁶⁴

Thus, the Commission must closely consider the trade-offs between small cell technical characteristics and the associated separation distances needed to protect FSS installations.⁶⁵ Only once the parameters of small cell operations are more completely understood can a realistic analysis of exclusion zones be performed.

B. Significant Questions Remain Concerning Exclusion Zone Enforcement

The record here also reinforces SIA's concerns regarding whether, once exclusion zones are adopted for protection of FSS operations, they can be effectively enforced.⁶⁶ The enforcement mechanisms contemplated in the Notice are unproven and speculative.

As SIA and other commenters observe, spectrum sensing in the 3.5 GHz band is unworkable for protecting FSS, because earth stations only receive signals in those frequencies.⁶⁷ Thus, even assuming that a device equipped with spectrum sensing technology could detect the

⁶⁴ SIA Comments at 14-15.

⁶⁵ *Id.* at 15.

⁶⁶ *See id.* at 15-17.

⁶⁷ *See* SIA Comments at 16; NAB Comments, Engineering Statement at 4.

downlink 3.5 GHz band transmission originating at a satellite tens of thousands of miles away, that would not tell the device whether there was a receive earth station nearby.

One party suggests that beacon technology is being developed that would address this issue, but does not provide any concrete information needed to evaluate the feasibility of this approach.⁶⁸ As SIA's comments suggest, there are a number of unanswered questions regarding whether a beacon or signaling technology could be deployed to protect FSS receivers.⁶⁹ For example, it is unclear how powerful a beacon signal would need to be in order to be received by small cell wireless devices located up to 150 kilometers from the earth station. Similarly, the Notice does not address whether an earth station operator would be required to obtain a Commission license before transmitting the beacon signal, which would be particularly burdensome in the case of receive-only earth stations that currently are not subject to a licensing obligation.

Moreover, a number of parties cast doubt on whether spectrum sensing technology would be a workable and cost-effective interference avoidance approach. The Consumer Electronics Association specifically opposes any requirement that 3.5 GHz devices incorporate spectrum sensing as an interference prevention measure given the "nascent state" of spectrum sensing technology.⁷⁰ The Association goes on to note that in the TV White Spaces proceeding, "the Commission ultimately rejected a spectrum-sensing requirement after a thorough and time-consuming examination of the technology."⁷¹ Spectrum Bridge concurs, observing that it "has

⁶⁸ See IEEE 802 Comments at 3.

⁶⁹ SIA Comments at 16.

⁷⁰ CEA Comments at 7.

⁷¹ See *id.* 7-8, citing *Unlicensed Operation in the TV Broadcast Bands*, ET Docket Nos. 04-186; 02-380, Second Memorandum Opinion and Order, 25 FCC Rcd 18661, 18684-85 ¶ 54 (2010).

been repeatedly shown that cost-effectively implementing a sensing technology capable of reliably identifying incumbent operations is marginally feasible, at best.”⁷²

Reliance on the SAS database, rather than spectrum sensing, to enforce exclusion zones raises similar concerns. SIA’s comments point to a number of open issues regarding how the SAS would actually work.⁷³ Other parties emphasize that the technology needed to make database-enabled dynamic spectrum access an effective interference-prevention tool does not yet exist and will be expensive and time-consuming to develop and evaluate. For example, the Consumer Electronics Association states that:

The dynamic access model the Commission proposes for the 3.5 GHz band is a long-term solution. These technologies require additional time to research, develop, test, and deploy prior to adoption on a commercial basis.⁷⁴

Even if these obstacles can be overcome, the SAS will be able to ensure enforcement of exclusion zones to protect satellite services only if reliable geolocation data for small cell equipment is available and tampering with small cell devices can effectively be prevented.⁷⁵ The record does not provide a basis for confidence on these fronts. In fact, a number of commenters question how well geolocation will work, particularly with devices located indoors,⁷⁶ and whether connecting small cell devices to a centralized database will make them vulnerable to

⁷² Comments of Spectrum Bridge, Inc., GN Docket No. 12-354 (“Spectrum Bridge Comments”) at 19.

⁷³ SIA Comments at 16-17.

⁷⁴ CEA Comments at 3. *See also* Google Comments at 1; Mobile Future Comments at 5.

⁷⁵ *See* Notice at ¶¶ 95-97, 100 & 104.

⁷⁶ Comsearch Comments at 11 (additional investigation is needed into the capabilities of geolocation technology, particularly indoors).

hacking or other security breaches.⁷⁷ There is also disagreement regarding whether the Commission should require all 3.5 GHz terrestrial devices to incorporate geolocation technology.⁷⁸

Moreover, widely deployed small cells would still present a significant risk of interference to existing FSS systems even if the SAS is successfully developed and reliable geolocation data is available. For example, unexpected interference could result if the terrain features specific to the propagation path between the small cell transmitter and the receiving earth station are not adequately characterized by the SAS, or if the small cell device is malfunctioning.

The untested nature of these enforcement measures is all the more alarming given the high stakes involved. As InterDigital observes:

The threat posed by a Citizens Broadband device operating outside of the parameters authorized by the SAS is severe, and is made more so by the fact that interfering devices could be extremely difficult to identify and prevent.⁷⁹

The Commission simply cannot take the risk that small cell devices will be allowed to proliferate without adequate mechanisms in place to prevent harmful interference to satellite operations.

⁷⁷ InterDigital Comments at 24 (noting that “end-user modification of devices . . . could cause significant harmful interference to critical communications services”); Comments of KanOkla Communications, Inc., GN Docket No. 12-354 (“KanOkla Comments”) at 4 (expressing serious concerns over the security and reliability of the SAS and the possibility that devices could be targeted by malicious users).

⁷⁸ Compare Comments of Redline Communications, Inc., GN Docket No. 12-354 (“Redline Comments”) at 3 (suggesting that geolocation technology should be required) *with* Google Comments at 17 (only some types of devices should be required to include standalone geolocation capability).

⁷⁹ InterDigital Comments at 24.

C. Small Cells Should Not Be Permitted in the 3650-3700 MHz Band

The SIA comments demonstrate that the Commission should not go forward with its proposal to extend the small cell concept to the 3650-3700 MHz band.⁸⁰ In light of the serious unanswered questions regarding the ability of small cell operations to share spectrum with FSS services, SIA rejects the suggestion that additional FSS spectrum should be encompassed in the Commission's consideration of small cell deployment.

Several parties share SIA's concern that allowing small cell deployment in the 3650-3700 MHz band would result in interference to FSS operations in that band or in adjacent conventional C-band spectrum.⁸¹ For example, NCTA argues that the Notice does not provide sufficient information to evaluate the potential effect of small cell deployment on adjacent conventional C-band operations and urges the Commission to conduct technical studies before making any decisions in this proceeding.⁸²

Commenters who currently provide terrestrial service in the 3650-3700 MHz band also oppose the idea of placing such operations under a different regulatory structure and introducing a new authorized service in this spectrum. KanOkla states that it "strongly opposes the FCC's proposal to migrate 3.65 GHz licensees" to the framework under consideration for the 3.5 GHz band because the "new regulatory regime and the requirement to implement the SAS would result in a significant loss of investment and additional expenses due to the need for costly

⁸⁰ SIA Comments at 18.

⁸¹ *See, e.g.*, NAB Comments at 3-4 (in light of the "complex and difficult to resolve interference issues" relating to the 3.5 GHz band, "the Commission should refrain from expanding its proposal to include the adjacent 3650-3700 MHz band"); TIA Comments at 2 (noting the "potential for adverse impact on incumbent services" if the sharing framework being considered for the 3.5 GHz band is extended to the 3650-3700 MHz band).

⁸² NCTA Comments at 6.

software and hardware upgrades.”⁸³ Neptuno agrees, arguing that the Commission’s proposal to extend the 3.5 GHz rules to adjacent spectrum “would cripple the ability of Neptuno and others to continue to operate in the 3650-3700 MHz band.”⁸⁴ In contrast, commenters who support extending small cell use to the 3650-3700 MHz band⁸⁵ do not suggest any practical approaches to ensuring that existing FSS or terrestrial services in that spectrum would be protected from small cell interference.

Given the fundamental uncertainty regarding the compatibility of small cell operations with existing services, any expansion of the small cell framework to additional spectrum cannot be justified.

D. Adjacent Band FSS Operations Must Be Protected

The SIA comments emphasize the need to ensure that conventional and extended C-band satellite services are protected from interference resulting from small cell out-of-band emissions.⁸⁶ Adjacent band operations pose multiple threats to satellite service, including potential unwanted emissions from the small cell that are within the FSS earth station receive band and the possible overload of the earth station’s low noise amplifier from small cell

⁸³ KanOkla Comments at 3.

⁸⁴ Comments of Neptuno Media, Inc., GN Docket No. 12-354 (“Neptuno Comments”) at 4.

⁸⁵ *See, e.g.*, Comments of Ericsson, GN Docket No. 12-354 (“Ericsson Comments”) at 14; Google Comments at 13; GRE Comments at 5; InterDigital Comments at 16; Qualcomm Comments at 19.

⁸⁶ SIA Comments at 18-20.

transmissions.⁸⁷ Furthermore, both analysis by the ITU⁸⁸ and real-world examples⁸⁹ confirm that out-of-band emissions can cause major disruptions to FSS networks. A combination of exclusion zones and out-of-band emission limits is necessary to counter these threats and prevent harmful interference.⁹⁰

As the SIA comments make clear, without more information provided by either the Commission or consensus industry filings regarding small cell technical characteristics and deployment density, it is not possible to accurately determine what size separation distance and what out-of-band emission limits are required to protect FSS receivers from adjacent band interference.⁹¹ However, given the sensitivity of earth station receivers, out-of-band emission protections may require more than the $43 + 10 \log (P)$ dB standard used in other spectrum bands.⁹²

Other commenters agree that implementation of a stricter limit on out-of-band emissions will likely be required to ensure protection of existing services. For example, the engineering statement filed with the NAB comments notes that depending on the specific deployment characteristics of small cell facilities, using $43 + 10 \log (P)$ dB as an out-of-band emission limit “would not provide sufficient suppression of emissions to preclude interference to C-band

⁸⁷ *See id.* at 18-19.

⁸⁸ *See id.* at 19, *citing* Report ITU-R M.2109 at 11-32, which showed that out-of-band and in-band emissions from terrestrial operations below 3700 MHz can detrimentally impact satellite operations above 3700 MHz.

⁸⁹ SIA Comments at 19 (describing outage to 300 million television households resulting from a trial of terrestrial service in Hong Kong).

⁹⁰ *See id.* at 20.

⁹¹ *Id.*

⁹² *See id.* at 20 & n.61.

downlink operations in the adjacent 3700-4200 MHz band.”⁹³ In contrast, the parties who support application of the $43 + 10 \log_{10}(P)$ dB limit provide no evidence or analysis to demonstrate that such a limit would adequately protect existing services.⁹⁴

E. The Freeze on New Earth Stations in the 3.5 GHz Band Should Be Lifted

Finally, the SIA comments urge the Commission to maintain primary status for FSS in the 3.5 GHz band and allow continued deployment of earth stations.⁹⁵ Such an approach would not materially constrain deployment of small cells but would ensure that the substantial investment in 3.5 GHz satellite and ground station capacity is not stranded.⁹⁶

A few parties express support for the freeze on new primary earth stations, but do not provide a valid basis for blocking future growth of satellite services in this band.⁹⁷ Microsoft alleges that the freeze is “a necessary step to manage the interference situation.”⁹⁸ In fact, however, the SIA comments demonstrate that because of the international-only restriction that applies to FSS use of the 3.5 GHz band, future earth station deployments in this band are likely to be limited.⁹⁹ Furthermore, if small cell power levels and other technical parameters are defined in a way that reduces the size of necessary exclusion zones surrounding FSS earth

⁹³ NAB Comments, Engineering Statement at 2. See also Harris Comments at 8 (“Only adequate suppression of emissions into the 3.7 to 4.2 GHz FSS band will allow incumbent users to operate in the band.”).

⁹⁴ See, e.g., Tarana Comments at 4-5; Comments of the Utilities Telecom Council, the Edison Electric Institute, and the National Rural Electric Cooperative Association, GN Docket No. 12-354 (“UTC Comments”) at 4-5; WiMAX Forum Comments at 8.

⁹⁵ SIA Comments at 20-22.

⁹⁶ *Id.* at 21.

⁹⁷ See InterDigital Comments at 11; Microsoft Comments at 8; UTC Comments at 19.

⁹⁸ Microsoft Comments at 8. Microsoft’s allegation supports the conclusion that the freeze is a tacit admission that small cells and FSS are incompatible.

⁹⁹ SIA Comments at 21-22.

stations, the impact on availability of spectrum for terrestrial services from allowing new earth stations to be established will be minimized as well.

Lifting the freeze will also ensure robust use of the 3.5 GHz band spectrum. As discussed above, wireless industry members and other commenters express serious doubts concerning the likely demand for small cell deployment in the 3.5 GHz band. TIA refers to “low usage and low adoption of other bands above 3 GHz which are already allocated for uses similar to the proposed plan,” and warns that the 3.5 GHz band could follow the same pattern.¹⁰⁰ Given the limited interest shown by the wireless industry in deploying small cells in the 3.5 GHz band, allowing continued deployment of primary FSS earth stations will promote more efficient use of the spectrum.

¹⁰⁰ TIA Comments at 4.

VI. CONCLUSION

For the reasons expressed in the prior SIA comments and herein, SIA urges the Commission not to move forward with its proposals to introduce small cells in the 3.5 GHz band unless and until it is clear that such a framework would meet a specific spectrum requirement and would not harm satellite services or constrain future deployment of necessary ground infrastructure for satellite networks.

Respectfully submitted,

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