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

COMMENTS OF THE SATELLITE INDUSTRY ASSOCIATION

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SUMMARY

The Satellite Industry Association ("SIA") believes that the proposed introduction of small cells into the 3.5 GHz band raises significant technical and policy issues that must be addressed in order to protect the essential satellite services that are provided in this band. First, before considering changes to the regulatory approach in this band, there must be reliable evidence of demand for *new* small cell spectrum that cannot be met by the licensed and unlicensed bands already available to wireless carriers for this purpose. Second, there must be technical data demonstrating that the proposed small cells can operate without impairing current or future C-band satellite services.

At the outset, SIA emphasizes that the factors relating to satellite use of the 3.5 GHz band in the U.S. are unique and reflect the specific Commission-imposed restrictions on satellite operations in this spectrum. As a result, any measures considered or adopted domestically in this band cannot serve as a template for other spectrum or for treatment of the 3.5 GHz band in other jurisdictions. Most importantly, the development of a regulatory framework for this band should not have any effect on U.S. positions in international spectrum proceedings, such as WRC-15.

SIA urges the Commission to more thoroughly investigate the need for additional spectrum for small cells before it proceeds. The Notice makes clear that small cell deployment is already possible both in licensed wireless spectrum and in unlicensed bands. Prior to concluding that additional spectrum is required, the Commission should examine the extent to which wireless carriers have taken advantage of existing opportunities to deploy small cells.

If the Commission ultimately decides to pursue the introduction of small cells in the 3.5 GHz band, it must take steps to ensure that satellite services throughout the C-band are fully protected. Exclusion zones around earth station sites would be needed to prevent harmful

interference from small cells, and ensuring effective enforcement of the exclusion zones would be critical. However, at this stage, determining the required separation distance between small cells and earth stations is impossible, pending availability of more detailed information about small cell characteristics. Similarly, additional technical data regarding small cells is required before the Commission can develop necessary measures to address the effects of small cell transmissions on earth station receivers in adjacent frequency bands.

In light of the unanswered questions regarding the compatibility of small cells with satellite services and the efficacy of mechanisms to prevent harmful interference, SIA opposes the suggestion in the Notice that the small cell framework should be extended to the 3650-3700 MHz band.

The Commission should lift the freeze on new earth station deployments in the 3.5 GHz band. Contrary to the assumptions in the Notice, the freeze is not needed to preserve a stable spectrum environment. Going forward, the Commission should not alter the primary status of satellite services and should allow introduction of small cells, if at all, only on a secondary basis.

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The Satellite Industry Association ("SIA")[1] hereby responds to the Commission's Public Notice in the above-captioned proceeding, which seeks comment regarding the feasibility of new terrestrial services in the 3550-3650 MHz band ("3.5 GHz band").[2] As discussed below, SIA opposes the introduction of the proposed "Citizens Broadband Service" ("CBS") unless

[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 advocates 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, Inc.; 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.; ATK Inc.; Cisco; Cobham SATCOM Land Systems; Comtech EF Data Corp.; DRS Technologies, Inc.; Encompass Government Solutions; Eutelsat, Inc.; Globecomm 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; TrustComm, Inc.; Ultisat, Inc.; ViaSat, Inc., and XTAR, LLC. In addition to these companies, SIA has also coordinated with Astrium Services Government, Inc. (formerly known as Vizada, Inc.) in developing these comments. 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").

there is clear evidence of a requirement for additional spectrum in which this service can be provided and a demonstration that the new service will not adversely affect existing or future satellite operations in either extended or conventional C-band spectrum.[3]

I. INTRODUCTION

The Notice seeks input regarding whether the 3.5 GHz band, which the National Telecommunications and Information Administration ("NTIA") identified in its "Fast Track Report" for shared federal and non-federal use, is suitable for wireless broadband applications.[4] The Commission's Spectrum Task Force had previously requested comment on whether introduction of terrestrial services in the 3.5 GHz band was feasible, given the need to protect government operations and commercial satellite services from interference.[5] In particular, the Spectrum Task Force Notice observed that both government radar systems and fixed-satellite service ("FSS") networks were deployed in the band and noted that NTIA had proposed excluding terrestrial services in substantial areas along the coastline in order to prevent interference to ship-borne government radars.[6]

In comments responding to the Spectrum Task Force Notice, SIA recommended that compatibility with existing FSS deployments would be enhanced by limiting any new

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[3] 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.

[4] Notice at 2, *citing* NTIA, An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, 4200-4220 MHz, and 4380-4400 MHz Bands (rel. October 2010) ("Fast Track Report"), *available at* http://www.ntia.doc.gov/files/ntia/publications/fasttrackevaluation_11152010.pdf. .

[5] *Spectrum Task Force Requests Information on Frequency Bands Identified by NTIA as Potential Broadband Spectrum*, Public Notice, ET Docket No. 10-123, DA 11-444 (rel. Mar. 8, 2011) ("Spectrum Task Force Notice").

[6] *Id*. at 3.

terrestrial systems in the 3.5 GHz band to fixed point-to-point microwave links.[7] SIA noted that FSS and microwave links already successfully share the conventional C-band through careful coordination, providing a proven record to support introducing these services in the 3.5 GHz band.[8] SIA argued that new fixed microwave links could supply the need for backhaul capacity to support wireless broadband services.[9]

Wireless industry members also expressed doubts about the potential for terrestrial mobile use of the 3.5 GHz band. These parties suggested that the propagation characteristics of the 3.5 GHz band and the need for large coastal exclusion areas made the band ill-suited for mobile wireless broadband applications.[10]

Notwithstanding this lack of enthusiasm, the Notice here proposes to alter the regulatory framework applicable to the 3.5 GHz band to permit networks of "small cells" to be deployed in this spectrum. The Commission theorizes that the propagation limitations that make the band unattractive for typical wireless broadband network configurations might enhance the ability to use small cells in the band.[11] The Notice states that a report by the President's Council of Advisors on Science and Technology ("PCAST") endorsed both increased use of small cells and more intensive spectrum sharing.[12] The Commission recognizes the need to protect both

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[7] Comments of the Satellite Industry Association, ET Docket No. 10-123 (filed Apr. 22, 2011) ("SIA Spectrum Task Force Comments") at 7-10.
[8] *Id.* at 8.
[9] *Id.*
[10] *See, e.g.*, Comments of AT&T Inc., ET Docket No. 10-123 (filed Apr. 22, 2011) at 7 (the 3.5 GHz band is "likely to be of limited utility for mobile broadband"); Comments of CTIA – The Wireless Association®, ET Docket No. 10-123 (filed Apr. 22, 2011) at 13 (characterizing spectrum above 3 GHz as not useful for mobile broadband).
[11] *See* Notice at 4.
[12] *Id.* at 2, *citing* PCAST, Report to the President: Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth (rel. July 20, 2012) ("PCAST Report), available at: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf .

FSS facilities and military radar services, and seeks comment on using a database system to manage spectrum access and protect against harmful interference to these services.[13]

SIA has serious questions regarding the need for additional spectrum for small cell use and significant concerns about the compatibility of the proposed small cell networks with critical FSS operations in the C-band. The Commission must not move ahead with its small cell proposals in the 3.5 GHz band unless and until there is persuasive evidence that such a plan will meet a clear need and a demonstration that small cell networks can co-exist with FSS in a manner that preserves the current and future availability of C-band spectrum for satellite services.

II. ANY APPROACH TO SHARING DEVELOPED HERE MUST BE LIMITED TO DOMESTIC USE OF THE 3.5 GHZ BAND

As a threshold matter, SIA emphasizes that U.S. FSS operations in the 3.5 GHz band have unique characteristics. As a result, any framework adopted in the U.S. for sharing the 3.5 GHz band between FSS networks and terrestrial wireless systems must be considered as limited to these facts and not as a template that can be applied to other satellite spectrum or to use of the 3.5 GHz band in other countries. In particular, Commission decisions regarding the 3.5 GHz band cannot form the basis for shaping U.S. policy in international spectrum proceedings.

As the Notice recognizes, pursuant to a footnote in the U.S. table of allocations, FSS use of the 3600-3650 MHz band is limited "to international inter-continental systems and is subject to case-by-case electromagnetic compatibility analysis."[14] Because of these Commission-imposed restrictions, only a relatively small number of U.S. earth stations have

[13] *Id.*

[14] Notice at 10, *citing* 47 C.F.R. § 2.106, note US245.

been deployed in the 3.5 GHz band.[15] The overwhelming majority of these earth station sites are located in coastal areas.[16]

In contrast, conventional C-band earth stations are ubiquitously deployed in the U.S. and around the world. The satellite infrastructure in this spectrum serves as the backbone for distribution of media content globally. Programming is distributed over C-band facilities to 6843 cable headends that serve 56.8 million households in the U.S. alone.[17] C-band satellites carry content to DIRECTV and Dish, the two U.S. Direct Broadcast Satellite ("DBS") networks, which serve more than 34 million additional households.[18] Thousands of television and radio stations nationwide also rely on C-band satellites to receive network and syndicated programming to thousands of television and radio stations nationwide. The C-band network plays an important role in media contribution as well, including satellite news gathering and coverage of special events like the Olympics.

C-band spacecraft are also used to provide essential communications links in areas where terrestrial infrastructure is limited, including remote parts of the United States. For example, SIA member SES operates satellites used by the two largest Alaskan telecommunications service providers, AT&T Alaska and GCI, to serve the needs of customers in remote parts of the state for basic voice telecommunications as well as more advanced services, such as Internet connectivity. There are more than 3500 C-band earth stations on vessels ("ESVs"), 680 of them in North America, that provide video distribution, Internet, and

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[15] Notice at 10 & Appendix A (identifying earth stations in 37 cities licensed to receive signals in the 3600-3650 MHz band).
[16] *See id.*
[17] *See* http://www.ncta.com/Statistics.aspx (last visited February 17, 2013).
[18] *See* Leichtman Research Group, Inc., Research Notes 4Q2012 at 1, available at: www.leichtmanresearch.com/research/notes12_2012.pdf.

mobile backhaul services.[19] In addition, C-band satellites are used for critical government networks, including the State Department's Diplomatic Telecommunications Service.

Extended C-band spectrum, including the 3.5 GHz band, is extensively used for satellite services in other countries that do not have limits similar to those in the U.S. For example, Brazil alone has more than 20 million DTH dishes that receive signals in the extended C-band.[20] A number of U.S. content providers use capacity in the extended C-band for distribution of media programming around the globe. Extended C-band frequencies are also relied on to provide backhaul for cellular networks and Internet access in Asia, Africa, and Latin America.

Thus, the limited U.S. FSS deployment in the 3.5 GHz band, with earth stations located in only a few dozen cities that are predominantly clustered along the coasts, stands in stark contrast to both conventional C-band use in the U.S. and use of the 3.5 GHz band abroad. Sharing techniques that may be feasible domestically in the 3.5 GHz band simply will not work in frequency bands where FSS use consists of thousands or even millions of ubiquitous earth stations. As a result, the Commission must conclude that the facts relating to the possibility of introducing a new terrestrial service in the 3.5 GHz band are unique and do not form a basis for such sharing in this band outside the U.S. or in other frequency bands, domestically or abroad.

As it participates in the development of U.S. policy for international spectrum discussions, the Commission must be mindful of the unique circumstances surrounding the 3.5 GHz band. In particular, the Commission must recognize that any decisions it may make or

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[19] Northern Sky Research, Mobile Satellite Services, 8th Edition (Mar. 2012).

[20] *See* The Usage of the 3.4 to 4.2 GHz Spectrum in Region 2, Comisión Interamericana de Telecomunicaciones ("CITEL"), OEA/Ser.L/XVII.4.2, CCP.II-RADIO/doc. 3115/12, 18 October 2012 at 1-2 (the Brazilian Radio and TV Broadcasters Association estimates that 22 million homes receive radio and TV network programming using C-band receive dishes).

consider regarding domestic allocation of the 3.5 GHz band are not a relevant, much less a driving, factor in determining what position the Commission will recommend that the United States take at WRC-15 with respect to the entire 3400-4200 MHz band.

III. THE RECORD RAISES SIGNIFICANT QUESTIONS REGARDING DEMAND FOR NEW SPECTRUM FOR WIRELESS BROADBAND USING SMALL CELLS

The proposals in the Notice for changing the regulatory framework applicable to the 3.5 GHz band are premised on a shortage of available spectrum for commercial broadband uses and "the urgent need to make additional spectrum available while respecting the ongoing spectrum needs of incumbent users."[21] Before it undertakes fundamental changes that will affect existing licensees, however, the Commission must take a hard look at whether the evidence in fact supports a need for additional spectrum that can be met by allowing the introduction of small cells in the 3.5 GHz band.[22]

In SIA's view, the projected shortfall in capacity and bandwidth may not be as significant as the Notice suggests, given the ability of wireless carriers to use a small cell infrastructure today to enhance use of existing spectrum allocations and offload traffic to more efficient wireline alternatives. Before determining that more spectrum for small cell

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[21] Notice at 6.

[22] The Notice cites predictions of substantial increases in demand for wireless broadband capacity, but these all come from sources within the wireless industry and the basis for the estimates is unclear. *See id.* at 6-7. For example, the Commission states that "some experts forecast a need for a thousand-fold increase in wireless capacity by 2020." *Id.* at 3. Yet neither of the reports referenced by the Commission actually provides concrete evidence to support that projection. *See* QUALCOMM, Rising to Meet the 100x Mobile Data Challenge at 2 & 14 (suggesting that the mobile industry is attempting to meet a "1000x challenge" but acknowledging that traffic growth predictions vary and may be subjective); Nokia Siemens Networks, 2020: Beyond 4G Radio Evolution for the Gigabit Experience at 3 (asserting based on "[e]xtrapolations of current growth trends" that mobile networks "need to be prepared to support up to a thousand-fold increase in total mobile broadband traffic by 2020," but providing no underlying data to support that claim). The Commission cannot make policy decisions regarding spectrum reallocation without objective, verifiable data to buttress its actions.

deployments is required, the Commission must thoroughly examine the usage being made of current spectrum allocations for wireless broadband, including for small cell networks.

The Notice cites to existing Wi-Fi deployments as perhaps "the most prevalent example of small cell technology."[23] The Commission states that Wi-Fi has expanded capacity for wireless broadband and carries "an ever-increasing amount of smartphone traffic."[24] A recent article, "Why the Feds Should Promote Wi-Fi Everywhere," observed that:

> By leveraging existing public assets – both unlicensed spectrum and the spider web of federal, state, and local fiber optic backhaul that crisscrosses the nation – it would be relatively inexpensive to blanket most areas with a basic level of wireless connectivity.[25]

Current U.S. wireless licensees have already deployed tens of thousands of Wi-Fi networks in unlicensed spectrum that is available for that purpose today.[26] Furthermore, the Commission is initiating a proceeding today to "substantially increase the amount of unlicensed spectrum available to accelerate the growth and expansion of new Wi-Fi technology."[27] The Notice also explains that in the TV White Spaces proceeding, the Commission has "created a methodology for allowing unlicensed wireless use of vacant TV channels through a dynamic access database."[28]

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[23] Notice at 13.
[24] *Id*.
[25] Michael Calabrese, *Why the Feds Should Promote Wi-Fi Everywhere*, Slate (Feb. 8, 2013), available at http://xrl.us/bofosi.
[26] *Id*. (noting that AT&T operators more than 30,000 Wi-Fi hotspots, and a partnership between Verizon and a consortium of the largest cable companies has built out more than 50,000 Wi-Fi hotspots).
[27] Commission Meeting Agenda, FCC to Hold Open Commission Meeting Wednesday, February 20, 2013 (rel. Feb. 13, 2013), Item 2.
[28] Notice at 14.

In addition to these spectrum allocations for unlicensed use, wireless carriers can use their existing licensed spectrum to deploy small cell networks to expand available capacity.[29] The Notice cites a report from the Small Cell Forum predicting a significant increase in carrier expenditures on small cell equipment over the next five years.[30] This trend must be taken into account in the Commission's analysis, as wireless carriers must certainly invest in more efficient use of their licensed spectrum through small cell deployments before it is appropriate to consider allocating new spectrum for small cell use.[31]

The Commission acknowledges these opportunities for small cell use that already exist in unlicensed and licensed spectrum.[32] However, the Notice does not demonstrate a need for additional spectrum for small cell deployments beyond what is now or soon will be available. Nor does the Notice explore the reasons that may have constrained deployment of small cells in licensed wireless spectrum to date.[33] Finally, the Commission fails to consider whether material demand for additional small cell spectrum will exist outside the exclusion zones that will be needed to protect government radar networks and existing satellite services. Before proposing to

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[29] *See, e.g.*, The Femto Forum, Regulatory Aspects of Femtocells – Second Edition (March 2011) at 4 ("By operating in licensed spectrum licensed to the service provider, femtocells allow operators to provide assured quality of service to customers over the air, free from harmful interference but making efficient use of their spectrum.").

[30] Notice at 13, *citing* Small Cell Forum, Small cells – what's the big idea? Femtocells are expanding beyond the home (Feb. 15, 2012) at 4.

[31] SIA questions the extent to which the small cell model contemplated in the Notice seems to permit the wireless carriers to outsource the costs of expanding wireless broadband infrastructure to their customers instead of bearing those costs themselves.

[32] Notice at 12-15.

[33] At one point, there were predictions that WiMAX would be the next big development for wireless broadband, and in fact the NTIA Fast Track Report used WiMAX characteristics in analyzing possible use of the 3.5 GHz band. *See* Notice at 8 & n.31, *citing* Fast Track Report at 2-1 to 2-7. More recently, however, enthusiasm for WiMAX has declined, with some commentators going so far as to announce that "WiMAX is dead." *See* Craig Mathias, Nearpoints (Aug. 9, 2011) ("Actually, WiMAX has been dead for years but with Clearwire moving to LTE it's finally time for the funeral.").

encumber other services such as FSS that have a proven spectrum requirement, the Commission should investigate whether, once conversion of existing networks to a small cell architecture is taken into account, there is unmet demand for additional new small cell spectrum.

In sum, permitting small cells to be introduced in the 3.5 GHz band should not even be considered unless it is clear that after wireless carriers convert their existing networks to expand capacity through the deployment of small cells, a material capacity shortfall will remain. The Commission should investigate whether additional small cell spectrum is needed before proceeding with the regulatory changes proposed in the Notice.

IV. THE COMMISSION SHOULD NOT ALLOW SMALL CELLS IN THE 3.5 GHz BAND UNLESS IT IS CLEAR THEY WILL NOT CONSTRAIN EXISTING OR FUTURE SATELLITE OPERATIONS

If the Commission does ultimately conclude that more spectrum for small cells is needed in addition to the current allocations available for licensed and unlicensed small cell deployments, it must then determine whether introduction of small cells in the 3.5 GHz band is compatible with primary services in the band. The Commission should only consider permitting small cell deployment in the 3.5 GHz band if it is demonstrated that satellite services will be protected now and in the future.

A. Satellite Networks Use the 3.5 GHz Band for Critical Services

Satellite networks use the 3.5 GHz band today to satisfy the demands of military, commercial and government customers. SIA member companies and others operate space stations and associated ground networks that provide both communications services, including services used for safety of life connectivity and emergency response, and telemetry, tracking and

control ("TT&C") functions within this portion of the extended C-band.[34] A list of known satellites operating in this band is attached as Appendix 1 hereto.

For example, Inmarsat uses the 3600-3700 MHz band to provide feeder links for its global fleet of L-band MSS satellites.[35] These feeder links support many critical safety-of-life functions by supplying basic connectivity in remote areas enabling rapid restoration of communications after natural disasters. Inmarsat's satellite network has played and continues to play a critical role supporting U.S. government agencies' activities in the United States and abroad. It also provides essential services to non-governmental agencies such as Télécoms Sans Frontières ("TSF") and the American Red Cross, as well as international news organizations in response to global disasters. For example, in the past several months, Inmarsat-sponsored TSF teams have set up an emergency satellite communications center in Timbuktu, Mali,[36] deployed mobile satellite services to aid the victims of Typhoon Bopha in the Philippines,[37] and responded to the worst-hit region of Guatemala following a 7.5-magnitude earthquake.[38] Inmarsat received the International Telecommunications Union ("ITU") Humanitarian Award for Lifesaving in

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[34] *See* SIA Spectrum Task Force Comments at 3-7.

[35] Inmarsat distributors such as Astrium Services Government, Inc. (formerly Vizada, Inc.) also hold Commission licenses for extended C-band operations.

[36] *See* TSF set up emergency satcoms in Timbuktu (Feb. 5, 2013), available at: http://www.inmarsat.com/corporate/media-centre/newsroom/tsf-set-up-emergency-satcoms-in-timbuktu.

[37] *See* TSF deployed as Typhoon Bopha strikes the Philippines (Dec. 5, 2012), available at: http://www.inmarsat.com/corporate/media-centre/newsroom/tsf-rapidly-deployed-mobile-satellite-services-to-help-the-victims-of-typhoon-bopha-as-it-swept-through-the-philippines.

[38] *See* TSF deploys to Guatemala after 7.5-magnitude earthquake (Nov. 8, 2012), available at: http://www.inmarsat.com/corporate/media-centre/newsroom/tsf-deploys-to-guatemala-after-7.5-magnitude-earthquake.

recognition of the company's commitment to supporting emergency relief efforts around the globe.[39]

Extended C-band frequencies including the 3.5 GHz band are also used to provide FSS to customers in the U.S. and abroad. Services being provided include end-to-end communications solutions to military, commercial and government customers. For example, typical FSS applications in this spectrum include IP trunking to expand retail Internet services in developing nations and other underserved regions, international video distribution for U.S. programmers, government communications, international private lines, and distribution of the Defense Department's American Forces Radio and Television Service.

In addition, the 3.5 GHz band is used for critical TT&C transmissions essential for safe spacecraft operations.[40] Reliable reception of these signals must be protected in order to allow operators to track and monitor the status of in-orbit satellites' position, health and operational characteristics. Disruption of these signals could mean loss of control over a given satellite and increased risk of collision with other space objects.

FSS networks in the 3.5 GHz band represent a substantial long-term investment in satellite capacity and associated ground equipment. The Commission must ensure that investment is not stranded as a result of any actions taken to promote small cell deployment.

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[39] *See* Inmarsat presented with inaugural ITU humanitarian award (Oct. 22, 2012), available at: http://www.inmarsat.com/corporate/media-centre/press-releases/inmarsat-presented-with-inaugural-itu-humanitarian-award.

[40] *See, e.g.*, Intelsat North America LLC, File No. SAT-A/O-2009122300151, call sign S2804, grant-stamped Apr. 2, 2010, Attachment at ¶ 6 (authorizing the Intelsat 25 satellite to conduct telemetry at 3630 MHz); Inmarsat Hawaii Inc., File No. SES-MOD-20091105-01419, call sign KA25 (granted Jan. 26, 2010), Section B, Particulars of Operations (authorizing use of 3625-3700 MHz for "Test/TTC&M").

B. Exclusion Zones Will Be Necessary to Prevent Harmful Interference to FSS

As the Commission recognizes, protection of FSS as an "Incumbent Access User" is appropriate if the Commission pursues introduction of small cells in the 3.5 GHz band.[41] In order to ensure that new services do not adversely affect licensed FSS earth stations, the Commission will need to establish exclusion zones.[42]

The separation distance between an earth station and a small cell installment that is necessary to prevent harmful interference to FSS signal reception will depend on multiple factors. The characteristics of the small cell base station and mobile station transmissions, such as power, bandwidth and antenna gain, must be taken into account. Setting lower EIRP and EIRP density limits for small cells would, of course, decrease the separation distance needed to protect FSS earth stations.

The specific locations of the small cell base station and mobile station transmitters must also be known, including whether the equipment is indoors or outdoors and the height above ground level of each antenna. As with lowering the EIRP limits, restricting small cells to indoor locations would also correspond to a reduced separation distance. However, SIA recognizes that imposing an indoor-only limitation would not permit all the usage scenarios for small cells that the Commission currently envisions,[43] and it would also make enforcement of exclusion zone boundaries more difficult. Furthermore, the additional propagation attenuation resulting from small cells located indoors is difficult to determine because it depends on a number of factors, including the construction and design of the building in which the small cell is

[41] Notice at 24-25.
[42] *Id*. at 42.
[43] *See id*. at 44.

deployed. Such variables cannot be reliably predicted and incorporated into a separation distance analysis.

Because the Notice contemplates deployment of many small cell sites in a given geographic area, the aggregate impact of multiple interfering signals must also be factored into the exclusion zone calculation. Finally, the analysis must reflect data regarding the operational characteristics and physical siting of the protected FSS earth station antenna. A list of the technical parameters that would be needed to evaluate the interference effect of a small cell and determine the appropriate separation distance from FSS earth stations is found in Appendix 2.

The Notice seeks input on a proposed maximum EIRP for small cell operations of 30 dBm.[44] Even assuming that limit is adopted, however, that does not supply sufficient information for SIA to determine the necessary separation distance to protect FSS receive earth stations. In particular, the EIRP density is an important factor in evaluating potential interference, and that cannot be calculated without knowing how across how wide a bandwidth the power will be spread.

The Notice discusses using a 150 km separation distance, which is the size that was adopted for the adjacent 3650-3700 MHz band, as a starting point for exclusion zones in the 3.5 GHz band.[45] Again, without more information about the small cell technical parameters, it is impossible to make a definitive assessment of the adequacy of a particular separation distance. For example, an exclusion zone of approximately 150 km would be prudent to prevent interference from small cells into an earth station if one assumes that the 30 dBm maximum EIRP is spread over a 1 MHz bandwidth, as permitted in the adjacent 3650-3700 MHz band.[46] If

[44] *Id*. at 44.
[45] *Id*. at 42.
[46] *See* 47 C.F.R. § 90.1321(a).

that is the EIRP density limit, then SIA would support use of the 150 km distance. SIA stands ready to perform more detailed analysis of the necessary exclusion zone radius as more information about small cell characteristics becomes available.

In short, even calculating a starting point for separation distances between small cells and receive earth stations requires considerations of multiple factors that have yet to be determined. Furthermore, measures to shrink the size of exclusion zones will inevitably involve trade-offs affecting the desirability of the 3.5 GHz band for small cell deployment. Such trade-offs are a feature of all sharing proposals as each authorized use in a band will constrain other uses to some extent. After determining the area of the United States territory that would be subject to exclusion zones to protect both FSS and radar installations, the Commission should then reassess its tentative conclusion that small cell deployments should be permitted in the 3.5 GHz band and consider whether the benefits of small cells could be better realized in another band.

C. Effective Enforcement of Exclusion Zones Will Be Essential

To ensure that the exclusion zones have the intended effect of preventing harmful interference to satellite operations, the regulatory framework must be set up with clear, practical, and reliable enforcement mechanisms. Unfortunately, the primary approaches to enforcement discussed in the Notice are unproven, creating a significant risk of harm to FSS and government operations.

Enforcement of exclusion zones entails significant logistical challenges. The Notice seeks input on whether "spectrum sensing" could be used to allow small cell deployment while protecting FSS operations.[47] The Commission explains that with this approach:

[47] Notice at 42, 47-48.

> prior to initiating a transmission, a device's spectrum sensing mechanism would monitor the available radar or small cell channel in a predefined band. If a signal is detected, the channel associated with that signal would either be vacated and/or flagged as unavailable for use by the small cell device.[48]

The 3.5 GHz band is a downlink band for FSS, however, so earth stations use this spectrum only to receive signals that are transmitted from the satellite throughout a given beam's coverage area. There is no signal from the earth station in this band for the small cell to "sense" in order to determine spectrum usage or pinpoint the location of the earth station. As a result, "spectrum sensing" is not a feasible approach and cannot be used to facilitate small cell sharing with FSS networks.

The Notice implicitly recognizes this obstacle and asks whether a beacon or other signaling technology could be deployed to protect FSS receivers.[49] SIA believes such an approach would very likely be impractical. As a threshold question, the Commission would have to determine what spectrum the beacon or signal would use to transmit. The frequency could not be near or within the 3.5 GHz band, or the beacon would interfere with reception by the very same earth station that the beacon is supposed to identify. Thus, the Commission would need to find different spectrum that would be set aside for this purpose, which does not seem to make sense from a spectrum efficiency standpoint.

The Notice also seeks comment on use of a proposed Spectrum Access System ("SAS") – a database that would manage small cell operations and prioritize usage among the various tiers of 3.5 GHz band services.[50] A database approach to enforcement of protection for FSS is certainly more promising than spectrum sensing. However, the Notice makes clear that

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[48] *Id*. at 47-48.
[49] *See id*. at 48.
[50] *Id*. at 32-36.

numerous important questions remain open regarding how the SAS would actually work. For example, how would a small cell device communicate with the database, especially if the device is itself mobile? How would new earth stations in the 3.5 GHz band be protected from already-deployed small cells? How would the SAS know the sites of small cell base stations, particularly if the Commission allows such base stations to be moved from one location to another?[51] How would the Commission prevent small cell devices from being tampered with to override the requirement to protect incumbent services?[52]

The complexities of enforcement and the risk of interference to FSS networks will be increased if, as proposed, the Commission allows mobile or nomadic terrestrial operations in the 3.5 GHz band. As the Commission recognizes, managing such operations will require that small cell devices be equipped with effective geo-location technology and that they have the ability to communicate in real time with the SAS to know when they are entering an exclusion zone.[53]

SIA members have significant experience with interference resulting from the proliferation of poorly made unlicensed devices, such as radar detectors.[54] Once the interfering devices are deployed, it is very difficult to recall them or halt their use. The Commission must therefore carefully consider and address the requirements for protecting FSS networks in the 3.5 GHz band before it allows widely-deployed small cells.

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[51] *See id*. at 35 (recognizing that reliance on GPS for geo-location may not be feasible, given that the Commission contemplates that most small cells will be located indoors).
[52] *See id*. at 34.
[53] *See id*. at 34-35.
[54] *See Review of Part 15 and other Parts of the Commission's Rules*, First Report and Order, FCC 02-211, 17 FCC Rcd 14063 (2002) (revising Part 15 rules applicable to radar detectors to address interference into VSAT networks, but taking no action with respect to radar detectors already in operation).

D. The Commission Should Not Allow Small Cells in the 3650-3700 MHz Band

Given the myriad issues presented by introduction of small cells and questions regarding their compatibility with satellite operations, SIA strongly opposes the Commission's "supplemental proposal" to extend the framework set forth in the Notice to encompass the 3650-3700 MHz band.[55] Instead, operations in that band should continue to be subject to the existing regulatory scheme.

The Commission has already created a sharing framework in the 3650-3700 MHz band that involves nationwide-licensing of terrestrial fixed wireless operations that must protect grandfathered earth stations operating in that spectrum.[56] The suggestion in the Notice that yet another, seemingly incompatible, terrestrial wireless broadband service should be added to the mix is at best premature. SIA believes that a track record on the operation of small cell devices and their impact on satellite services should first be established over a period of time before the concept is expanded into additional spectrum. Unless and until the Commission resolves the numerous questions regarding the demand for new small cell spectrum and the feasibility of protecting FSS earth stations in the 3.5 GHz band from interference, it should not expose earth stations in an additional frequency band to potential in-band interference from small cells.

E. Adjacent Band Issues Must Be Addressed

The Notice seeks comment on the need for out-of-band emission limits to protect adjacent band operations. SIA emphasizes that adoption and enforcement of appropriate measures to address out-of-band emissions are critical to protect ongoing C-band satellite operations. These operations include earth stations in the 3600-3650 MHz band, the 3650-3700

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[55] Notice at 6, 27-29.

[56] *See id.* at 11-12 & n.56 (discussing the history of introduction of wireless broadband services in the 3650-3700 MHz band).

MHz band, and the conventional C-band at 3700-4200 MHz. The Commission will need to consider potential interference caused by two mechanisms: the unwanted emissions of the small cell transmissions, which fall within the receive band of the FSS earth station; and the overload of the earth station's low noise amplifier due to small cell transmissions (either from a single cell or the aggregated effect of multiple cells) exceeding the overload criterion and causing the receiver to malfunction.

The ITU and its working groups have clearly established that out-of-band and in-band emissions from terrestrial operations below 3700 MHz can detrimentally impact satellite operations above 3700 MHz.[57] These predictions have been borne out by real-world experience, with significant disruption to satellite services occurring when terrestrial wireless broadband systems have been introduced in C-band spectrum.[58] For example, field trials of terrestrial service in Hong Kong resulted in television signals serving 300 million households being knocked off the air.[59]

As SIA has explained, the specific threat of interference potential from small cells into FSS is impossible to assess without a more concrete understanding of small cell technical characteristics and likely deployment density. Clearly, however, the Commission must proceed

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[57] *See, e.g.*, Report ITU-R M.2109 at 11-32. For a terrestrial wireless micro cell transmitting with an EIRP density of 22 dBm/MHz and using an out-of-band attenuation mask more stringent than the 43-10 $\log_{10}$(P) limit proposed in the Notice, this report determined that distance separations ranging from 8.5-35 kilometers were required, depending on the modulation scheme used by the terrestrial station. *See id.*

[58] *See, e.g.*, International Associations of the Satellite Communications Industry, *Position Paper on Interference in C-band by Terrestrial Wireless Applications to Satellite Applications* at 1-3, ITU Workshop on Market Mechanisms for Spectrum Management (2007), *available at* http://www.itu.int/osg/spu/stn/spectrum/workshop_proceedings/Background_Papers_Final/C-band%20Interference%20-%20Global%20Position%20Paper%20for%20ITU%20%20%20%20%20%20spectrum%20workshop.pdf (visited Feb. 18, 2013).

[59] *See id*. at 2.

very cautiously in order to avoid the harmful interference events that have occurred when C-band terrestrial broadband has been introduced abroad.

In general, a combination of out-of-band emission limits and exclusion areas will be required to protect FSS earth stations which receive on adjacent frequencies to small cell transmissions. The exclusion zone around an earth station with respect to small cells using adjacent frequencies will be smaller than would be the case for co-frequency operations, but an exclusion area will be required nonetheless. The size of the exclusion area and associated out-of-band interference limits on small cell stations will be considered in future SIA pleadings in this rulemaking, once more information is available on planned small cell characteristics. For present purposes, SIA simply notes that given the sensitivity of conventional C-band receivers, the out-of-band emission limit proposed in the Notice[60] may be inadequate and may therefore lead to large exclusion areas, even with respect to adjacent frequency operations.[61]

F. The Commission Should Maintain Flexibility for Future FSS Spectrum Use

Finally, to preserve the flexibility for FSS operations in the future, the Commission should lift the freeze on new earth stations and ensure that only minimal restrictions are imposed on future FSS deployment. Such an approach will prevent stranded investment in

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[60] *See id*. at 44-45.

[61] *See, e.g., Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands, Fixed and Mobile Services in the Mobile Satellite Service Bands at 1525-1559 MHz and 1626.5-1660.5 MHz, 1610-1626.5 MHz and 2483.5-2500 MHz, and 2000-2020 MHz and 2180-2200 MHz, Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz and 2175-2180 MHz Bands*, WT Docket Nos. 12-70 and 04-356 & ET Docket No. 10-142, Report and Order and Order of Proposed Modification, FCC 12-151 (rel. Dec. 17, 2012) at 36-43 (adopting a limit of $70 + \log_{10}(P)$ in order to protect future use of the immediately adjacent spectrum).

existing satellite facilities and is consistent with the Commission's goal of introducing new commercial terrestrial services "without displacing mission-critical incumbent systems."[62]

SIA accordingly urges the Commission not to adopt its proposal to restrict primary FSS use to existing licensed or applied for earth stations.[63] Instead, SIA believes that full primary status for FSS must be preserved with respect to both existing and future earth station deployments. If the Commission determines that additional small cell spectrum is needed and that small cell operations can co-exist with FSS and federal radar networks, it should permit introduction of small cells only on a secondary basis in the 3.5 GHz band.[64]

Retaining full primary status for FSS and designating small cells as secondary will allow FSS use to continue to evolve and grow and is unlikely to materially constrain small cell deployment. As the Notice recognizes, FSS is currently permitted only in the upper half of the 3.5 GHz band.[65] Thus, allowing new FSS earth station deployments would have no effect at all on small cell use of the 3550-3600 MHz portion of the band.

Even in the upper 50 MHz available to the FSS, the impact of expansion on availability of spectrum for small cells would be minimal. As discussed above, the international-only restriction on FSS use of the 3.5 GHz band has limited the number of earth stations licensed in the band, which has remained fairly stable over the years. Only three of the call signs identified in the list of 3.5 GHz band earth stations in Appendix A to the Notice has a

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[62] Notice at 3.
[63] *Id*. at 32.
[64] SIA's proposal for a straightforward primary/secondary designation has the virtue of being clear and consistent with international spectrum allocation terminology. In contrast, the Notice contemplates multiple classes of users in the 3.5 GHz band – Incumbent Access, Priority Access, and General Authorized Access – with varying levels of protections from interference. *See id*. at 4. SIA has serious doubts about the practical workability of these distinctions.
[65] *Id*. at 47.

Commission filing date of 2010 or later.[66] This suggests that future additions of 3.5 GHz band earth stations will be relatively infrequent.

Retaining primary status for FSS is particularly appropriate given the questions discussed above regarding the level of demand for access to the 3.5 GHz band for small cell networks. Preserving the ability of FSS to expand its use of the 3.5 GHz band will ensure robust use of the spectrum if small cells are permitted but do not end up being deployed in any significant numbers.

Thus, FSS should continue to enjoy full primary status in the 3.5 GHz band, even if the Commission does decide to allow small cell deployment. To reflect that status, the Commission should lift the freeze on new earth stations.[67] The Notice suggests that the freeze is needed to "preserve the stability of the spectral environment in the 3.5 GHz Band and ensure that opportunities continue to exist for wireless broadband services."[68] But as discussed above, the environment with respect to FSS use of the 3.5 GHz band has in fact been stable for years, with only a few applications for new licenses filed, all at locations close to an existing 3.5 GHz earth station. Thus, freezing FSS deployment serves no legitimate purpose.

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[66] *Id*. at Appendix A (listing call signs E100091 at Kapolei, HI, E100118 at Hagerstown, MD, and E120128 at Brewster, WA).
[67] *Id*. at 49-50.
[68] *Id*. at 49.

V. CONCLUSION

For the reasons set forth herein, SIA urges the Commission to refrain from moving forward with the small cell concept in the 3.5 GHz band absent a conclusive demonstration both that additional spectrum for small cells outside of existing licensed and unlicensed bands will be needed and that the envisioned small cell stations can protect existing and future C-band satellite services.

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Appendix 1: Satellites Operating in All or Parts of 3550-3650 MHz

	Satellite	Orbital Location	Operator
1	ABS-1 (ex LMI-1)	75° E	ABS
2	ABS-3	3° W	ABS
3	Amazonas-1	61° W	Hispamar
4	AMOS 5	17° E	Spacecom
5	Apstar-5 (Telstar 18)	138° E	APT, Telesat
6	Apstar-6	134° E	APT
7	Apstar-1A (Chinasat 5D)	51.5° E	APT
8	Apstar-2R (Telstar 10)	76.5° E	APT
9	Asiasat-3S	105.5° E	Asiasat
10	Asiasat-4	122° E	Asiasat
11	Asiasat-5	100.5° E	Asiasat
12	Atlantic Bird-3	5° W	Eutelsat
13	Brasilsat B3	(moving)	Star One
14	Brasilsat B4	84° W	Star One
15	Brasilsat B2	68° W	Star One
16	Chinasat 6B	115.5°E	Chinasat
17	Eutelsat 10A (W2A)	10° E	Eutelsat
18	Express-A2	103° E	RSCC
19	Inmarsat-2F2	142° W	Inmarsat
20	Inmarsat-2F4	109.0° E	Inmarsat
21	Inmarsat-3F1	64.5° E	Inmarsat
22	Inmarsat-3F2	15.5° W	Inmarsat
23	Inmarsat-3F3	178.0° E	Inmarsat
24	Inmarsat-3F4	54° W	Inmarsat
25	Inmarsat-3F5	25° E	Inmarsat
26	Inmarsat-4F1	143.5° E	Inmarsat
27	Inmarsat-4F2	25° E	Inmarsat
28	Inmarsat-4F3	98° W	Inmarsat
29	Intelsat 10-02	1° W	Intelsat
30	Intelsat 17	66° E	Intelsat
31	Intelsat 22	72° E	Intelsat
32	Intelsat 25	31° W	Intelsat
33	Intelsat 7	69° E	Intelsat
34	Intelsat 28	33° E	Intelsat
35	Intelsat-603	(moving)	Intelsat

	Satellite	Orbital Location	Operator
36	Intelsat-801	29.5° W	Intelsat
37	Intelsat-805	55.5° W	Intelsat
38	Intelsat-901	18° W	Intelsat
39	Intelsat-902	62° E	Intelsat
40	Intelsat-903	34.5° W	Intelsat
41	Intelsat-904	60° E	Intelsat
42	Intelsat-905	24.5° W	Intelsat
43	Intelsat-906	64° E	Intelsat
44	Intelsat-907	27.5° W	Intelsat
45	Mabuhay-1	3° W	ABS
46	Measat-3	91.5° E	Measat
47	NSS-12	57.0° E	SES
48	NSS-5	50.5° E	SES
49	NSS-7	20° W	SES
50	NSS-806	40.5° W	SES
51	NSS-9	177° W	SES
52	SES 4	22° W	SES
53	SES-5	5° E	SES
54	Sinosat-1 (Chinasat-5B)	146° E	Sinosat
55	Star One C1	65° W	Star One
56	Star One C2	70° W	Star One
57	Telkom 1	108° E	PT Telkom
58	Thaicom 5	78.5° E	Thaicom
59	Thuraya-2	43.5° E	Thuraya
60	Thuraya-3	98.5° E	Thuraya
61	Vinasat-1	132.0° E	Vinasat
62	Yamal-201	90.0° E	Gazprom
63	Yamal-202	49.0° E	Gazprom

	U.S.-licensed

Sources:

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SatBeams, http://www.satbeams.com
Company Websites

Appendix 2: Required Information to Assess Small Cell Interference Potential

Broadband wireless transmitters (base station and mobile units)

1) Cell type , *i.e.,* GAA or Priority Access
2) Type of usage, *i.e.,* indoor or outdoor; urban or suburban or rural, etc.
3) Indoor/outdoor cell deployment density; *i.e.,* number of cells within an area
4) Carrier bandwidth
5) Maximum power density of carrier at the input port of the transmitting antenna in dBW
6) Transmitting antenna type, *e.g.* omni-directional, sectoral, etc.
7) Maximum gain of the transmitting antenna
8) Off-axis gain characteristics of the transmitting antenna
9) Transmit antenna beam tilt angle; *e.g.* 2 degrees below horizon
10) Height of the transmitting antenna
11) Frequency reuse pattern – both within one cell and between cells.
12) In-band and out-of-band frequency response characteristics