FOSTERING THE SATELLITE SERVICING INDUSTRY

August 30, 2023

VIA ECFS

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
45 L Street, NE
Washington, D.C. 20554

Subject: *In the Matter of 2023 World Radiocommunication Conference Advisory Committee, IB Docket No. 16-185*

Dear Ms. Dortch:

Through this ex parte letter, CONFERS seeks to provide relevant input from the satellite servicing industry into global preparations for the World Radiocommunication Conference 2023 (WRC-23). CONFERS is an industry-led advocacy organization developing standards and guiding policies for satellite servicing.[1] Since its initiation in 2017, CONFERS has grown to represent over sixty member organizations, mirroring the growth and development of the in-space servicing economy.

Servicing missions are diverse, from satellite refuelers, orbital transfer vehicles, attitude takeover spacecraft, in-space manufacturing, and commercial space stations, to space mobility and logistics operations and space domain awareness. However, servicers categorically face a shared hurdle: introduction of new technology and communication architypes into the existing spectrum environment. Recognizing the crosscutting need for spectrum advocacy, CONFERS initiated an On Orbit Servicing Communications Splinter Group in the summer of 2023 to develop recommendations and standards for on-orbit servicing and satellite-to-satellite communications.[2]

In recognition of the significance of the upcoming WRC-23 and the impact that spectrum access decisions will have on the growth of the servicing industry, CONFERS would presently like to provide four high-level points for consideration on behalf of the in-space servicing community.

ORBITAL TOLERANCES

The WRC-23 Agenda Item 7 Topic A (AI 7(A)) is considering tolerances for certain orbital characteristics of non-GSO (NGSO) space stations in the fixed-satellite (FSS), mobile-satellite

[1] CONFERS was previously known as the Consortium for Execution of Rendezvous and Servicing; the organizational name was modified in December 2022, when CONFERS become a 501(c)(6) entity. *See History*, CONFERS (June, 2023), https://satelliteconfers.org/wp-content/uploads/2023/06/About-CONFERS-FINAL_060223.pdf.

[2] *See About CONFERS,* CONFERS (May 1, 2023), https://satelliteconfers.org/wp-content/uploads/2023/06/About-CONFERS-FINAL_060223.pdf.

(MSS), or broadcasting-satellite (BSS) services.[3] Specifically, AI 7(A) proposals address methods to account for – and potentially limit – differences between orbital values recorded in the Master International Frequency Register (MFIR) and actual deployments of an NGSO system.[4]

CONFERS cautions that blanket institution of "orbital tolerances" for NGSO missions pursuant to AI 7(A) proposals may inadvertently harm the in-space servicing industry. AI 7(A) proposals broadly address NGSO systems using certain FSS and MSS allocations,[5] and in-space servicing missions in these services and allocations would be subject to any adopted orbital tolerances.[6] However, unlike traditional communication satellites, in-space servicing missions intentionally and periodically change orbital parameters to rendezvous with, and provide services to, client spacecraft.[7] Therefore, AI 7(A) proposals that create blanket NGSO orbital tolerances would have outsized impacts for NGSO in-space servicing missions that are designed to move responsively.

CONFERS urges the U.S. to carefully consider how methods for resolving Topic A can be crafted to avoid stifling the emergent in-space servicing industry. For instance, resolution of AI 7(A) could include an exemption period for in-space servicing missions that are in transit from a notified orbit to the orbit of a client spacecraft, similar to conceived exemptions for rephasing periods.[8] Regardless of the ultimate procedural mechanism, it is critical that maneuvering required for satellite servicing does not result in a penalizing decrease in spectrum protection, or suspension or loss of an assignment.[9] Assured spectrum access during servicing, specifically during

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[3] *See* RADIOCOMMUNICATION BUREAU, REPORT OF THE CPM ON TECHNICAL, OPERATIONAL AND REGULATORY/PROCEDURAL MATTERS TO BE CONSIDERED BY THE WORLD RADIOCOMMUNICATION CONFERENCE 2023, ITU-R (Apr. 2023), https://www.itu.int/hub/publication/r-act-cpm-2023/ [*hereinafter* CPM Report].

[4] *See* CPM Report, *supra* note 3, at 780-820; *Office of International Affairs Seeks Comment on Recommendations Approved by the World Radiocommunication Conference Advisory Committee*, IB Docket No. 16-185 at 251-74 (Apr. 12, 2023) [*hereinafter* FCC WAC Recommendations].

[5] *See, e.g.,* FCC WAC Recommendations, *supra* note 4, at 259-61 (considering MSS, FSS, and BSS frequency allocations between 10.7 GHz and 51.4 GHz (non-inclusive) to be subject to NGSO orbital tolerances); CPM Report, *supra* note 3, at 780 (of the four methods for resolving this topic, two are specific to NGSO FSS, MSS, and BSS, while the other two are radiocommunication-service agnostic).

[6] In-space servicing missions have not identified a specific radiocommunication service that is appropriate for use, but FSS and MSS are both notable possibilities. *See* Comments of Astroscale U.S. Inc., IB Docket Nos. 22-271 & 22-272 at 20-1 (Oct. 31, 2022) (discussing the fit between in-space servicing, assembly, and manufacturing spectrum use and the FSS); Comments of Atomos Nuclear and Space Corp., IB Docket Nos. 22-271 & 22-272 at 4 (Oct. 31, 2022) (noting the benefit of exploring using of FSS and MSS allocations for in-space servicing use).

[7] *See* Comments of Orbit Fab, Inc., IB Docket Nos. 22-271 & 22-272 at 15 (Oct. 31, 2022) (discussing the need for in-space servicing missions to be flexibly licensed in order to complete missions and services in response to changing objectives and clients).

[8] From the CPM Report, CONFERS understands a "rephasing period" to mean "the period used to reorganize satellites within an orbit after a launch of new satellites in this orbit." *See* CPM Report, *supra* note 3, at 791 (discussing a possible 90-day exemption from allowable orbital tolerances for satellites during rephrasing periods).

[9] For instance, US FCC WAC AI 7(A) View A includes the possibility that a system exceeding orbital tolerances would need to submit modifications, and failure to modify a filing can result in cancelation or suspension of an assignment. *See* FCC WAC Recommendations, *supra* note 4, at 261-63.

rendezvous, proximity and docking operations (RPOD), is critical to spaceflight safety and the success of the in-space servicing industry.[10]

INTER-SATELLITE LINKS

In-space servicing operations require spectrum managers to reimagine "typical" links needed to accomplish space missions. For instance, in-space servicing missions – including those conducting RPOD – can operate either partially or entirely through inter-satellite links.[11] Such inter-satellite links are typically between the servicer spacecraft and a communications constellation;[12] inter-satellite links are differentiated from proximity communications, which operate between a servicer spacecraft and client space object. Use of the inter-satellite service alleviates the need for a ground footprint and can improve mission safety. Inter-satellite links allow communications with a spacecraft during ground station "gaps," thereby decreasing data latency and providing near real-time data transmissions. [13] Use of inter-satellite links may be especially beneficial during RPOD phases of servicing, as consistent and secure links support complex commanding operations of maneuvering spacecraft and high data-rate downlink.

Overall, use of inter-satellite allocations allows servicing missions to decrease their space-to-ground footprint and improve mission operations and safety, especially during RPOD. For these reasons, availability of inter-satellite service allocations, and procedures to receive assignments in

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[10] *See* Comments of the Consortium for the Execution of Rendezvous and Servicing Operations, IB Docket Nos. 22-271 & 22-272 at 5 (Oct. 31, 2022).

[11] ITU-R, Radio Regulations 1.22 (2020) (defining the inter-satellite service). *See, e.g., Atomos Nuclear and Space Corp.,* OET File No. 0911-EX-ST-2023 at Narrative 3-4 (filed Apr. 24, 2023) (application for the Meson spacecraft – a servicing demonstration mission that will rely solely on space-to-space communications through the Inmarsat and Iridium systems for operations uplink and downlink); *Tyvak Nano-Satellite Systems Inc.,* OET File No. 0293-EX-CN-2022 at Narrative 3 (filed Mar. 22, 2022) (noting that the two cubesats making up NASA's CubeSat Proximity Operations and Demonstration (CPOD) mission will use S-band intersatellite links); *see also* Rachel Jewett, *Astroscale's ELSA-M Mission to Use Addvalue Data Relay Service*, VIASATELLITE (Dec. 12, 2022), https://www.satellitetoday.com/technology/2022/12/12/astroscales-elsa-m-mission-to-use-addvalue-data-relay-service/.

[12] Currently, commercial communications operators such as Inmarsat and Viasat offer inter-satellite communications as a service. *See Viasat Real-Time Space Relay,* VIASAT (2023), https://www.viasat.com/space-innovation/space-systems/intersatellite-communications/; *World-First As New Real-Time Link Between Satellites Promises Quicker Delivery of Data and Imagery Across the Globe,* INMARSAT (Nov. 23, 2020), https://www.inmarsat.com/en/news/latest-news/government/2020/world-first-as-new-real-time-link-between-satellites-promises-qu.html.

[13] *See* CPM Report, *supra* note 3, at 690 ("By utilizing inter-satellite links to relay data to the ground, data can be made available in near-real time across a much greater portion of the user space station's orbit, enhancing the availability and value of instrument data for low latency applications."); *see also* Comments of Orbit Fab, Inc., *supra* note 7, at 21. *See, e.g.,* Comments of ATLAS Space Operations, Inc., Fleet Space Technologies, HawkEye 360, ICEEYE US, Inc., Lunasonde, Inc., Maxar Technologies Inc., Planet Labs PBC, and Spire Global, Inc., IB Docket No. 16-185 at 9-10 (Apr. 21, 2023) (supporting expansion of inter-satellite links).

those allocations, are critical for the future of in-space servicing. [14] Accordingly, CONFERS supports ongoing work under WRC-23 AI 1.17, and proposed future agenda items, that relate to inter-satellite links and drive adoption of inter-satellite service allocations.[15]

PROXIMITY COMMUNICATIONS

Servicing missions, and other novel space activities, are driving demand for spectrum to support another type of space-to-space use: proximity communications. A current example of space-to-space proximity communications is seen in transmissions with the International Space Station (ISS), where visiting vehicles establish links with the ISS for rendezvous, docking, and departure operations.[16] As servicing missions proliferate, proximity communications to support RPOD will be carried out by, and between, both crewed and uncrewed space systems.[17]

CONFERS urgers the U.S. to lead investigation of what frequencies could readily accommodate space-to-space proximity crosslinks for servicing operations, and drive change to enable these connections. Technologically, proximity communications to crosslink vehicles involved in RPOD nominally require minimal power, and should be readily accommodatable in the existing spectrum sharing regime. For instance, proximity communications could mimic the WiFi unlicensed regime; indeed, WiFi bands can be studied for re-use by space-based proximity communications, as links between vehicles for proximity communications are at power levels unlikely to cause harmful interference to other existing systems and space-based re-use would allow in-space servicing operators to take advantage of COTS WiFi technology.[18] However,

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[14] *See* Comments of Orbit Fab, Inc., *supra* note 7, at 21; Comments of Atomos Nuclear and Space Corp., *supra* note 6, at 4. *See generally* Ellie Xiuqi Wang, Radiocommunications Bureau, *Inter-satellite Links*, ITU (Aug. 2021), https://www.itu.int/en/ITU-R/space/Documents/Inter-Satellite%20Link%20-%20guide%20to%20submission.pdf (presenting on inter-satellite links under the Radio Regulations, Rules of Procedure, and general application processing and common errors).

[15] *See* FCC WAC Recommendations, *supra* note 4, at 142-70 (WAC proposals on AI 1.17); *id.* at 313-32 (NTIA-provided revised AI 1.17 proposal); *id.* at 210-16 (discussing a future agenda item for C-band inter-satellite links); Comments of the Satellite Industry Association, IB Docket No. 16-185 at 16-7(Apr. 21, 2023) (supporting AI 10 consensus proposal for adding inter-satellite service allocations in C-band); *see also* ITU-R, Resolution 812 (WRC-19), *Preliminary Agenda for the 2027 World Radiocommunication Conference* at 2.8 (2019) (listing a proposed WRC-27 agenda item on space-to-space links in L- and S-bands) [*hereinafter* Res.812].

[16] *See, e.g., Space Exploration Technologies Corp.,* OET File No. 1369-EX-ST-2021 at Grant ¶ 11 (granted Sept. 10, 2021) (use of 2203.2 MHz for space-to-space transmissions with the ISS during approach and departure phases); *Northrop Grumman Systems Corporation*, OET File No. 0875-EX-ST-2021 (granted June 28, 2021) (authorizing Cygnus spacecraft communications, including a space-to-space link between the Cygnus spacecraft and ISS during approach and departure).

[17] *See, e.g., Atomos Nuclear and Space Corp.,* OET File No. 0943-EX-ST-2023 at Mission Description 3 (filed Apr. 28, 2023) (noting that the spacecraft Gluon will be equipped with a WiFi antenna for communication with the Meson spacecraft during RPO, with transmissions occurring at spacecraft separation distances of 500 meters or less).

[18] *See* Comments of the Aerospace Corporation, IB Docket Nos. 22-271 & 22-272 at 23 (Oct. 31, 2022); Comments of Atomos Nuclear and Space Corp., *supra* note 6, at 5. CONFERS notes that WiFi frequencies are just one candidate for proximity communications; future action should consider additional appropriate bands.

regarding space objects that are crewed or may become crewed, the U.S. should carefully consider their need for interference protection measures during proximity communications due to safety of life implications.[19]

Overall, the FCC should support timely action to enable proximity space-to-space communications that support in-space servicing. CONFERS notes the opportunity to drive studies for space-to-space proximity communications as a WRC-27 agenda item may already exist. Specifically, per Resolution 812 (WRC-19), the WRC-27 is invited to study technical and operational matters for MSS space-to-space links in various frequency bands.[20] Accordingly, CONFERS urges the FCC to support this proposed agenda item and incorporate studies that would facilitate development of the space-based proximity communications regime.

LUNAR SPECTRUM

Finally, the upcoming WRC is an opportunity for the U.S. to advocate for mindful construction of spectrum infrastructure as humanity pushes, once more, to the moon. Over the next ten years, there will be rising commercial demand for spectrum in the lunar region; either for commercial purposes, or so commercial companies can provide contracted services to the government.[21] Notably, a non-negligible driver of demand for commercial lunar radiocommunications will be space-to-space links. Space-to-space links support docking or berthing of lunar infrastructure, as with the ISS, and RPOD operations in lunar orbits can limit risk by using inter-satellite links to decrease data latency, just as in low-Earth orbits currently.

CONFERS supports U.S. submission of a proposal for a WRC-27 agenda item to study spectrum for communications operations in the lunar domain that includes space-to-space links.[22] In this vein, CONFERS notes the important and ongoing work of NASA and the LunaNet initiative to specify the communications infrastructure in the lunar environment.[23] CONFERS encourages the FCC to ensure that future lunar spectrum regimes are interoperable with existing Earth-centric spectrum, so as not to place unnecessary burdens on commercial operators. For instance, refueling satellites may operate in both lunar and LEO orbits. Distinct spectrum regimes for these two orbits

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[19] For crewed space objects, protected bands that meet the range and data requirements for command and control, audio/video feeds, and relative navigation are the minimum criteria for proximity links.

[20] *See* FCC WAC Recommendations, *supra* note 4, at 206; Res.812, *supra* note 15, at 2.8. The definition of MSS includes communication between space stations. *See* ITU-R, Radio Regulations, Art. 1.25 (2020).

[21] *See Lockheed Martin Corp.,* IBFS File No. SAT-LOA-20230215-00060 (filed Mar. 15, 2023) (application to launch and operate lunar radiocommunication infrastructure); Jeff Foust, *Lockheed Martin Subsidiary to Offer Commercial Lunar Communications and Navigation Services*, SpaceNews (Mar. 29, 2023), https://spacenews.com/lockheed-martin-subsidiary-to-offer-commercial-lunar-communications-and-navigation-services/ (Lockheed is creating Cresent Space Services LLC, to operate a Parsec service providing lunar communications or navigation services).

[22] FCC WAC Recommendations, *supra* note 4, at 238-48.

[23] See *LunaNet Overview*, Presented to NESC Unique Science from the Moon in the Artemis Era Workshop by James Schier, Chief Architect (June 7-9, 2022).

would imply duplicative communications systems, adding unnecessary economic costs to servicing missions.

Overall, spectrum studies for lunar radiocommunications can build a complete picture by cohesively considering links between objects in lunar orbit, on the lunar surface, and between regimes. CONFERS urges the FCC to ensure that a proposed future agenda item directs studies on point-to-point communications for systems in lunar orbit, and prioritizes radiofrequencies that ensure interoperability with existing Earth-centric spectrum regulations.[24]

CONCLUSION

The upcoming WRC-23 is a monumental opportunity to responsively and constructively meet the growing spectrum demand for in-space servicing missions. To summarize, CONFERS:

- Urges the FCC and U.S. to think critically about how Agenda Item 7 Topic A proposals can adopt exemptions or be otherwise resolved to avoid inhibiting movement of in-space satellite servicing missions and compliant spectrum use;
- Supports work under Agenda Item 1.17, and proposed future Agenda Items, that expand inter-satellite service allocations and create assignment procedures;
- Notes the demand for proximity space-to-space communications, and emphasizes that the FCC and U.S. should take current action – provisionally, as already provider for under Resolution 812 – to investigate and establish a regime for proximity communications;
- Asks the FCC and U.S. to ensure future agenda items on lunar communications include, especially, studies of point-to-point systems within lunar orbit, point-to-multipoint on the lunar surface, and measures to enable interoperability with existing Earth-centric spectrum allocations.

Thank you for the opportunity to comment and highlight issues that are vital to the radiocommunication success of the in-space servicing industry.

Respectfully submitted,

Brian K. Lagana
Executive Director

[24] FCC WAC Recommendations, *supra* note 4, at 238-48.