

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of )
Space Innovation ) IB Docket No. 22-271
Facilitating Capabilities for In-space Servicing, ) IB Docket No. 22-272
Assembly, and Manufacturing )

NOTICE OF PROPOSED RULEMAKING

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By the Commission: Chairwoman Rosenworcel issuing a statement.

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I. INTRODUCTION

1. Today, we continue our efforts to promote United States leadership in space by adopting this Notice of Proposed Rulemaking (NPRM) to propose a new framework for licensing space stations engaged in in-space servicing, assembly, and manufacturing (ISAM). Space capabilities are expanding, opening novel economic and scientific opportunities, and providing new tools for sustainable use of space. Effective and efficient use of radiofrequency communications will enable these new capabilities and the rules proposed today are designed to facilitate and support their growth. This NPRM reflects the input of commenters from the Commission’s Notice of Inquiry (NOI) on ISAM,<sup>1</sup> which sought comment

<sup>1</sup> Space Innovation; Facilitating Capabilities for In-space servicing, assembly and manufacturing, Notice of Inquiry, 37 FCC Rcd 10022 (2022) (ISAM NOI).

regarding where the industry is today, how the Commission can best support its sustainable development, and what tangible economic and societal benefits may result from these capabilities. Taking these comments into account, we propose to create a new framework to license ISAM space stations, thereby supporting the development of these novel space activities. As the ISAM industry continues to develop, we envision taking additional steps as needed to foster innovation and growth in this field.

## II. BACKGROUND

2. ISAM refers to a set of capabilities used on-orbit, on the surface of space objects and celestial bodies, and in transit between these regimes. The “servicing” aspect of ISAM includes activities such as the in-space inspection, life extension, repair, refueling, or alteration of a spacecraft after its initial launch, which includes but is not limited to: visually acquire, rendezvous and/or proximity operations, docking, berthing, relocation, upgrading, repositioning, undocking, unberthing, release and departure, reuse, orbit transport and transfer, and timely debris collection and removal.<sup>2</sup> These activities typically include the process of maneuvering close to and operating in the near vicinity of the “client” spacecraft,<sup>3</sup> a set of activities often referred to as rendezvous and proximity operations (RPO). The term “servicing” is also used to describe transport of a spacecraft from one orbit to another, as well as debris collection and removal. “Assembly” refers to the construction of a space system using pre-manufactured components, and “manufacturing” is the transformation of raw or recycled materials into components, products, or infrastructure in space.<sup>4</sup>

3. On August 5, 2022, the Commission adopted the *ISAM NOI*.<sup>5</sup> It sought comment on spectrum needs and allocations;<sup>6</sup> licensing processes in general<sup>7</sup> and specifically for satellite servicing operations,<sup>8</sup> assembly, manufacturing, and other activities;<sup>9</sup> and international licensing considerations.<sup>10</sup> Twenty-four comments were filed by ISAM operators, satellite operators, industry groups, and

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<sup>2</sup> See National Science and Technology Council, *In-Space Servicing, Assembly, and Manufacturing Interagency Working Group, In-Space Servicing, Assembly, and Manufacturing National Strategy* at 6 (April 2022), <https://www.whitehouse.gov/wp-content/uploads/2022/04/04-2022-ISAM-National-Strategy-Final.pdf> (ISAM National Strategy); see also the In-Space Servicing, Assembly, and Manufacturing Interagency Working Group, *National In-Space Servicing, Assembly, and Manufacturing Implementation Plan* at 5 (2022), <https://www.whitehouse.gov/wp-content/uploads/2022/12/NATIONAL-ISAM-IMPLEMENTATION-PLAN.pdf> (ISAM National Implementation Plan).

<sup>3</sup> Throughout this NPRM, we use the terms “space station,” “satellite,” and “spacecraft.” “Space station” is defined in the Commission’s rules as “[a] station” located on an object which is beyond, is intended to go beyond, or has been beyond, the major portion of the Earth’s atmosphere.” 47 CFR §§ 2.1, 25.103. This is consistent with terminology used by the International Telecommunication Union (ITU). ITU Radio Regulations (R.R.) 1.64. The Commission’s rules define “satellite” as “[a] body which revolves around another body of preponderant mass, and which has a motion primarily and permanently determined by the force of attraction of that other body.” 47 CFR § 2.1. In this NPRM we use the term “satellite” to refer only to artificial satellites. The Commission’s rules define “spacecraft” as “[a] man-made vehicle which is intended to go beyond the major portion of the Earth’s atmosphere.” 47 CFR §§ 2.1, 25.103. These terms are used interchangeably in this NPRM, but we observe that “satellite” and “spacecraft” are more broadly defined than “space station.”

<sup>4</sup> ISAM National Strategy at 6.

<sup>5</sup> See generally *ISAM NOI*, 37 FCC Rcd 10022.

<sup>6</sup> *Id.* at 10026-28, paras. 11-15.

<sup>7</sup> *Id.* at 10028-30, paras. 16-22.

<sup>8</sup> *Id.* at 10030-31, para. 23.

<sup>9</sup> *Id.* at 10031, para. 24.

<sup>10</sup> *Id.* at 10031, paras. 25-26.

government agencies, ten parties filed reply comments, and a number of parties also submitted *ex parte* filings on the record.<sup>11</sup>

4. *Prior Actions Involving ISAM Activities.* While many commercial ISAM activities are still at an early stage, the Commission, in coordination with NTIA where operations were in frequency bands shared with the federal government, has issued licenses for space stations conducting several types of ISAM activities, including the following: licensing of SpaceLogistics, LLC's (SpaceLogistics) Mission Extension Vehicle-1 (MEV-1)<sup>12</sup> and Mission Extension Vehicle-2 (MEV-2);<sup>13</sup> granting an experimental license to SpaceIce to investigate freeze-casting, a processing technique used to create a wide range of materials like ceramics, metals, polymers, and composites, among others,<sup>14</sup> in the microgravity environment;<sup>15</sup> authorizing U.S. earth station communications to support Astroscale Ltd.'s ELSA-d testing of spacecraft capabilities for orbital debris removal;<sup>16</sup> and granting an experimental license to NanoRacks LLC for communications to demonstrate metal-cutting in space.<sup>17</sup>

5. Topics related to ISAM capabilities have also been raised in other Commission rulemaking proceedings. In the ongoing rulemaking to update the orbital debris rules, *Mitigation of Orbital Debris in the New Space Age*, the Commission sought comment on a variety of rule changes,

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<sup>11</sup> See Appendix C for a list of all parties who filed comments, reply comments, and *ex parte* submissions to the ISAM NOI.

<sup>12</sup> See *Space Logistics LLC*, ICFS File No. SAT-LOA-20170224-00021 (granted-in-part Dec. 5, 2017) (MEV-1 License) (granting authority for SpaceLogistics to construct, deploy, and conduct telemetry, tracking, and command (TT&C) operations with the MEV-1 as it (1) is deployed from the launch vehicle; engages in orbit-raising maneuvers and conducts post-launch system verification tests; (2) raises its orbit above the geostationary orbital arc; (3) and performs RPO and docking with the Intelsat-901 space station); ICFS File Nos. SAT-LOA-20170224-00021, SAT-AMD-20190207-00008 (granted June 20, 2019) (granting authority for TT&C operations with the combined vehicle stack of the MEV-1 and Intelsat-901 after RPO and docking while in geostationary orbit (GSO), and during relocation above the GSO arc and undocking) (MEV-1 License). MEV-1 completed its first successful docking operation in February 2020. See Space Logistics, Northrop Grumman, <https://www.northropgrumman.com/space/space-logistics-services/> (last visited Jun. 1, 2022).

<sup>13</sup> See *Space Logistics LLC*, ICFS File No. SAT-LOA-20191210-00144 (granted Mar. 20, 2020) (MEV-2 License) (granting authority to construct and deploy the MEV-2, and conduct TT&C operations with the MEV-2 as it is deployed from the launch vehicle, engages in orbit-raising maneuvers, and conducts various post-launch system verification tests, performs RPO with the Intelsat spacecraft IS-1002, operates in a combined vehicle stack in geosynchronous transfer orbit with IS-1002 for an expected five years, and subsequently undocks). MEV-2 successfully docked with IS-1002 in April 2021. See *MEV-2 Servicer Successfully Docks to Live Intelsat Satellite*, <https://spacenews.com/mev-2-servicer-successfully-docks-to-live-intelsat-satellite/> (last visited Jun. 14, 2022).

<sup>14</sup> See Freeze-Casting, <http://www.freezecasting.net/freezecast.html> (last visited Jan. 16, 2024).

<sup>15</sup> See *SpaceIce Application*, ELS File No. 0985-EX-CN-2019 (granted Oct. 8, 2020).

<sup>16</sup> See *Denali 20020*, ICFS File No. SES-STA-20200113-00043 (granted Nov. 17, 2021) (granting special temporary authority to provide TT&C support for Astroscale's demonstration of RPO, capture, and deorbit); see also *Viasat, Inc.*, ICFS File No. SES-STA-20200117-00055 (granted Mar. 19, 2021); see also *University of Miami – CSTARs*, ICFS File No. SES-STA-20200811-00859 (granted Nov. 17, 2021); see also Letter from Karl A. Kensinger, Acting Chief, Satellite Division, International Bureau, FCC, to Darryl White, Denali 20020, et. al., ICFS File Nos. SES-STA-20200113-00043, SES-STA-20200117-00055, SES-STA-20200811-00859 (dated Sept. 29, 2020) (request for information regarding the Astroscale ELSA-d spacecraft mission, to support request for earth station authorization). The ELSA-d spacecraft was licensed by the United Kingdom, and the spacecraft consists of two components, a "client" and "servicer," interacting with each other to complete an orbital maneuver demonstration. See *Astroscale's ELSA-d Successfully Demonstrates Repeated Magnetic Capture*, Astroscale (Aug. 25, 2021), <https://astroscale.com/astroscales-elsa-d-successfully-demonstrates-repeated-magnetic-capture/>.

<sup>17</sup> See *NanoRacks, LLC Application*, ELS File Nos. 0022-EX-ST-2021 (granted May 28, 2021), 1328-EX-ST-2021 (granted Nov. 15, 2021) (NanoRacks Mars Outpost experiment).

including, for example, whether we should update rules specifically to address RPO.<sup>18</sup> The Commission ultimately adopted a requirement that space station applicants disclose whether a space station is capable of, or will be, performing proximity operations, noting that this disclosure would identify situations where such operations are planned and provide a vehicle for further review of those operations.<sup>19</sup> At the time, the Commission noted the evolving and developing nature of RPO and accordingly found that adoption of more specific technical or operational requirements would be premature.<sup>20</sup> The Commission also sought comment on the role of spacecraft retrieval, also referred to as active debris removal (ADR), as a debris mitigation strategy in certain circumstances and concluded that this was also an area where it would be premature to establish more detailed regulations.<sup>21</sup>

6. *State of the ISAM Industry.* The ISAM NOI sought information on the state of the industry for ISAM operations.<sup>22</sup> Astroscale notes that more than 102 companies have undertaken ISAM projects or research, that 18 of those have either partially or fully operational ISAM capabilities, and that 40 expect to be ready within the next 5 years.<sup>23</sup> Operators describe their specific work developing servicing spacecraft,<sup>24</sup> orbital transfer vehicles (OTVs),<sup>25</sup> life extension vehicles,<sup>26</sup> end-of-life servicing spacecraft,<sup>27</sup> refueling depots,<sup>28</sup> space situational awareness spacecraft,<sup>29</sup> commercial inhabitable space stations,<sup>30</sup> lunar landers,<sup>31</sup> and spacecraft conducting science experiments and manufacturing in microgravity.<sup>32</sup> While Aerospace Corporation (Aerospace) sees a “chicken and egg” problem regarding a lack of serviceable satellites and a lack of servicers, it notes that SpaceLogistic’s MEVs that operate on vehicles not designed for servicing have significantly reduced this barrier and finds the mix of old and new satellites will expand ISAM servicing opportunities and draw in more satellite and ISAM providers.<sup>33</sup> NTIA highlights two previous successful ISAM-related demonstrations by the Defense Advanced Research Projects Agency (DARPA) and NASA’s Double Asteroid Redirection Test (DART) to support

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<sup>18</sup> *Mitigation of Orbital Debris in the New Space Age*, Notice of Proposed Rulemaking, 33 FCC Rcd 11352, 11375-76, para. 68 (2018) (*Orbital Debris NPRM*).

<sup>19</sup> *Mitigation of Orbital Debris in the New Space Age*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 4156, 4213, para. 123 (2020) (*Orbital Debris R&O and FNPRM*). The rules adopted by the Commission state that applicants must disclose planned proximity operations, if any, and address debris generation that will or may result from the proposed operations, including any planned release of debris, the risk of accidental explosions, the risk of accidental collision, and measures taken to mitigate those risks. *Id.* at Appendix A. *See also Mitigation of Orbital Debris in the New Space Age*, Order on Reconsideration, FCC 24-6 (rel. Jan. 26, 2024) (declining to modify the *Orbital Debris R&O*).

<sup>20</sup> *Orbital Debris R&O and FNPRM*, 35 FCC Rcd at 4213, para. 123.

<sup>21</sup> *Id.* at 4206-07, paras. 106-107.

<sup>22</sup> *See ISAM NOI*, 37 FCC Rcd at 10035, para. 40.

<sup>23</sup> Astroscale Comments at 8-9; *see also* Aerospace Comments at 55.

<sup>24</sup> Aerospace Comments at 54-55; Starfish Space Comments at 4-5; CONFERS Comments at 22.

<sup>25</sup> Spaceflight Comments at 2-3; Atomos June 7, 2023 *Ex Parte* at 3.

<sup>26</sup> Starfish Space Comments at 3; Astroscale Comments at 9, 40-41; Intelsat Comments at 3; Aerospace Comments at 55.

<sup>27</sup> Starfish Space Comments at 3; Astroscale Comments at 9, 40-41.

<sup>28</sup> Orbit Fab Comments at 3, 8; Aerospace Comments at 55.

<sup>29</sup> CONFERS Comments at 22; Astroscale Sept. 14, 2023 *Ex Parte* at 3.

<sup>30</sup> Blue Origin Comments at 1; Siera Space Comments at 1.

<sup>31</sup> Blue Origin Comments at 1; Aerospace Comments at 56.

<sup>32</sup> Sierra Space Comments at 1.

<sup>33</sup> Aerospace Comments at 55, 57, 59.

planetary protection.<sup>34</sup>

### III. DISCUSSION

#### A. Scope of FCC Regulations

7. The NOI queried how the FCC could support ISAM activities, noting that the ISAM National Strategy calls for the U.S. domestic regulatory regime to be updated to facilitate ISAM activities.<sup>35</sup> We issue this NPRM in line with that call, while recognizing that the Commission, with over 50 years of expertise in regulating satellites,<sup>36</sup> is one of several government agencies charged with regulation and oversight of commercial activities in space.<sup>37</sup>

8. Our authority under the Communications Act<sup>38</sup> allows the licensing of ISAM space stations under our existing rules, including rules that consider public interest factors.<sup>39</sup> We expect to continue to rely on the expertise of our fellow agencies as appropriate,<sup>40</sup> and note that our regulations on these issues are evolving in tandem with other government efforts.<sup>41</sup> We also recognize that the United

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<sup>34</sup> NTIA Reply at 1. *See also* NASA's In-space Servicing, Assembly, and Manufacturing (ISAM) State of Play for an overview of current ISAM missions, capabilities, and developments, <https://www.nasa.gov/wp-content/uploads/2023/10/isam-state-of-play-2023.pdf>.

<sup>35</sup> *See ISAM NOI*, 37 FCC Rcd at 10034-35, para. 38; ISAM National Strategy.

<sup>36</sup> The FCC first determined that it could legally authorize non-governmental entities to construct and operate communications satellites for domestic use in 1970. *See Establishment of Domestic Communication-Satellite Facilities by Non-Government Entities*, Report and Order, 22 FCC 2d 86 (1970).

<sup>37</sup> *See, e.g.*, ISAM National Strategy (in which the FCC is one of several departments and agencies on the working group); ISAM National Implementation Plan; *see also* <https://www.nasa.gov/press-release/nasa-creates-in-space-servicing-assembly-manufacturing-consortium> (the FCC is represented on this new consortium, the Consortium for Space Mobility and ISAM Capabilities (COSMIC), which was created to fulfill the White House's Office of Science and Technology Policy ISAM Implementation Plan goals and includes participants across government, academia, and industry). There are also several pending legislative proposals to shift the regulatory framework of commercial space activities. *See, e.g.*, The White House, United States Novel Space Activities Authorization and Supervision Framework (2023), <https://www.whitehouse.gov/wp-content/uploads/2023/12/Novel-Space-Activities-Framework-2023.pdf> (Novel Space Activities Framework); House Committee on Science, Space, and Technology, *Babin and Lucas Introduce Legislation to Modernize Commercial Space Sector*, <https://science.house.gov/2023/11/babin-and-lucas-introduce-legislation-to-modernize-commercial-space-sector>.

<sup>38</sup> *See* 47 U.S.C. §§ 301, 307(a).

<sup>39</sup> *See Mitigation of Orbital Debris, Report and Order*, 19 FCC Rcd 11567, 11575 para. 14 (2004) (*2004 Orbital Debris Order*); *Orbital Debris R&O and FNPRM*, 35 FCC Rcd at 4164, para. 15 ("As the Commission also previously concluded, to the extent that spacecraft are controlled through radiocommunications links, there is a direct connection between the radiocommunications functions we are charged with licensing under the Act and the physical operations of the spacecraft."). Several commenters raise concerns regarding any extension of FCC regulations beyond activities related to radiofrequency communication, for example regulation of manufacturing activities, or to planetary protection. *See* CSF Comments at 1; Relativity Space Comments at 2; CONFERS Comments at 10; TechFreedom Comments at 3-4, 5-6, 8-9; SpaceX Comments at 2-4; Blue Origin Comments at 7. Some commenters note that the Commission has significant experience in licensing and is well-positioned to develop policies and procedures in the ISAM arena, along with other government regulators. *See, e.g.*, Orbit Fab Reply at 7, Lockheed Martin Comments at 13; Viasat Reply at 1-3; Astroscale Comments at 5. *See also*, NTIA Reply at 1 (noting that "[a]s new spectrum allocations, rules, and regulations are being considered, NTIA will continue to work with the FCC and other Federal agencies to develop viable solutions supporting evolving ISAM requirements and incumbent and future Federal operations").

<sup>40</sup> For example, our space station licensing rules contemplate that applicants use NASA's debris assessment software for preparing their orbital debris mitigation plans. *See* 47 CFR § 25.114; *see also Orbital Debris R&O and FNPRM*, 35 FCC Rcd at 4170, para. 29 (recognizing the use of NASA assessment tools, metrics, and methodology).

<sup>41</sup> *See, e.g., Orbital Debris R&O and FNPRM*, 35 FCC Rcd at 4160-61, 4192-94, paras. 7, 79. The Commission

(continued....)

States' regulatory regime for achieving compliance with our obligations under Article VI of the Outer Space Treaty contemplates multiple agencies authorizing and supervising the activities of non-governmental entities in space.<sup>42</sup>

9. *Planetary Protection.* The NOI discussed the issue of planetary protection,<sup>43</sup> given that some recent ISAM-related license applications are focused on lunar activities and beyond.<sup>44</sup> Several commenters suggest the Commission consider working with other agencies on planetary protection issues instead of separately considering or taking action in this proceeding.<sup>45</sup> We plan to continue to support other agencies' efforts to develop and implement planetary protection policies.<sup>46</sup> We tentatively conclude that our proposed licensing framework for ISAM space stations should not include independent review and action from the Commission on applicants' planetary protection plans. We seek comment on how to ensure that applicants work with NASA and other relevant agencies to address planetary protection guidance and policy considerations.<sup>47</sup>

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noted in this Report and Order that Space Policy Directive-3 ("SPD-3") charged NASA, in coordination with other agencies and in consultation with the FCC, to lead efforts to update orbital debris mitigation standard practices (ODMSP) for missions operated or procured by U.S. government agencies and that best practices derived in part from the ODMSP should be incorporated into future rulemaking and licensing actions, and noting that the Commission's orbital debris update was aiming to do just that. *Id.*; see also *2004 Orbital Debris Order*, 19 FCC Rcd at 11609-12, paras. 102-108. Furthermore, the United States Novel Space Activities Authorization and Supervision Framework repeated this call and charged NASA, in consultation with the FCC, with leading the reevaluation process every two years. See *Novel Space Activities Framework*, at 6-7.

<sup>42</sup> See Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, art. 6, Jan. 27, 1967, 18 U.S.T. 2410 610 U.N.T.S. 205 (Outer Space Treaty); *ISAM National Implementation Plan* (identifying various federal agencies to serve as the lead or supporting agency on developing various ISAM-related implementation activities, including tasking the FCC and FAA with exploring policies related to safe post-mission disposal of ISAM space stations to mitigate orbital debris); see also, e.g., Jack Bacon, NASA Orbital Debris Program Office, *NASA & US Government Orbital Debris Mitigation Policies*, (2019) at 14; Daniel Morgan, Cong. Research Serv., R. 45416, *Commercial Space: Federal Regulation, Oversight, and Utilization* (updated November 29, 2018); the U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, § 109, 129 Stat. 704, 708 (2015).

<sup>43</sup> Planetary protection typically encompasses the policies and practices designed to protect celestial bodies from contamination by Earth life and protect the Earth's biosphere from potential contamination from returning spacecraft. See *Outer Space Treaty*, art. 9.

<sup>44</sup> See *ISAM NOI*, 37 FCC Rcd at 100033-35 paras. 34-38; see also, e.g., Intuitive Machines, Grant Stamp, ICFS File Nos. SAT-LOA-20210423-00055 and SAT-AMD-20220510-00049 (granted Oct. 5, 2023); Astrobotic Technology, Inc., ICFS File Nos. SAT-LOA-20210512-00065 and SAT-AMD-20220107-00004; Lockheed Martin, ICFS File No. SAT-LOA-20220218-00020. We also note that the FCC participates in OSTP's planetary protection forward contamination interagency working group. See White House National Space Council, *National Strategy for Planetary Protection at 7* (2020), <https://trumpwhitehouse.archives.gov/wp-content/uploads/2020/12/National-Strategy-for-Planetary-Protection.pdf>.

<sup>45</sup> See, e.g., *Aerospace Comments* at 46-48; *CONFERS Comments* at 13-14; *AIA Comments* at 3.

<sup>46</sup> See, e.g., NASA Office of Safety and Mission Assurance, *Planetary Protection for information, policies, and guidance* <https://sma.nasa.gov/sma-disciplines/planetary-protection>.

<sup>47</sup> We expect that various applications might require planetary protection considerations, such as small spacecraft applications. The Commission has previously ensured that applicants work with other federal agencies to consider planetary protection. See, e.g., ICFS File No. SAT-LOA-20210423-00055, Letter from Karl A. Kensinger, Chief Satellite Division, International Bureau, to John T. Graves, Intuitive Machines, at para 11 (dated Mar. 2, 2022) (requesting that the company describe any coordination with NASA regarding mitigation of contamination of the lunar environment).



## B. Licensing Framework for ISAM Space Stations

10. The NOI sought information on the best approaches to licensing ISAM activities.<sup>48</sup> As discussed in greater detail below, we propose to modify our rules to create a licensing framework specific to ISAM space stations within our part 25 rules for licensing commercial space stations. We also propose to apply our existing orbital debris mitigation requirements to ISAM space stations and to address the spectrum needs of ISAM operators on a case-by-case basis. At the same time, we propose to maintain our part 5 experimental licensing rules as an option for licensing ISAM space stations not providing commercial service.

### 1. Licensing Rules for ISAM Space Stations

11. *Commercial Readiness of ISAM activities.* The NOI sought comment on possible approaches for licensing different types of ISAM operations, including servicing, assembly, manufacturing, and ADR.<sup>49</sup> The record demonstrates that various ISAM operations are developing at different rates.<sup>50</sup> Some commenters recommend that we develop rules specific to categories of ISAM activities that are at a high level of technological readiness, like servicing, while adopting broad performance-based regulations that could apply to categories of ISAM activities that are still developing and could become more common in the future, like assembly and manufacturing.<sup>51</sup> We agree with commenters that communications operations of certain ISAM activities may need to be regulated differently,<sup>52</sup> but do not propose separate rules for different types of ISAM activities at this time. Instead, we propose to move forward by creating a new framework for applications for U.S. authorizations or grants of market access<sup>53</sup> that applies broadly to space stations associated with all activities that fit within the proposed definition of ISAM. This proposed approach will allow applicants for any type of ISAM activity to apply for a U.S. license or market access grant pursuant to these new rules and will provide a framework to support future regulations for specific ISAM activities that may be necessary as the industry develops. We seek comment on whether there are different factors of servicing, assembly, or manufacturing activities that necessitate specific rules or a specific framework at this time.

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<sup>48</sup> *ISAM NOI*, 37 FCC Rcd at 10028-31, paras. 16-26.

<sup>49</sup> *Id.* at 10028-31, paras. 16-26.

<sup>50</sup> Aerospace Comments at 2-3, 49, 65; Starfish Space Comments at 2; *see also* Atomos Comments at 7 (suggesting that with some modifications, part 25 licensing will be appropriate for fully developed and mature ISAM business models); CONFERS Comments at 9, 11 (encouraging the Commission to move forward with rulemaking under part 25 for servicing but suggesting that assembly and manufacturing are not yet developed enough for concrete requirements); *see* AIA Comments at 2 (supporting the continued allowance of allocations pursuant to part 25 and part 5 licenses for ISAM services).

<sup>51</sup> *See* Aerospace Comments at 2-3; 49, 65; U.S. Chamber of Commerce Reply at 3; ULA Comments at 4 (suggesting the Commission's rules "should rely on experience from initial missions instead of attempting to regulate every aspect of the broader ISAM ecosystem from the start"); CSF Comments at 1-2; Astroscale Reply at 6; Spaceflight Comments at 3-4; *see also* Thuraya Comments at 2; Intelsat Comments at 8; SpaceX Comments at 6; Starfish Space Comments at 2; TechFreedom Comments at 16; ULA Comments at 1; CONFERS Comments at 9.

<sup>52</sup> *See* Aerospace Comments at 22-23 (suggesting that servicing missions, which operate by interacting with separate client space stations, should be regulated differently from assembly, manufacturing, or planetary protection missions, which likely do not involve communications between spacecraft).

<sup>53</sup> Satellite operators who file for a license through the FCC are licensees, and operators who have been previously licensed by a foreign regulator who seek access to provide satellite communications in the U.S. market must request U.S.-market access through a petition for declaratory ruling, or if a U.S.-earth station operator files a license application to communicate with the foreign operator. *See, generally, Amendment of the Commission's Regulatory Policies to Allow Non-U.S.-Licensed Satellites to Provide Domestic and International Service in the United States*, IB Docket No. 96-111; Report and Order, 12 FCC Rcd 24094 (1997) for background on the Commission's rules to allow market access grantees to provide satellite services to the U.S. market. Unless indicated otherwise, when we refer to the term license or licensee in this document, we also include market access grants or grantees.

12. *Licensing ISAM Space Stations Through Part 5 and Part 25.* Commenters note that ISAM remains nascent, and it may be five to ten years before the industry generally shifts toward requiring part 25 licensing for commercial space stations (rather than part 5 licensing for experimental space stations, which remains an important licensing avenue for operators as ISAM technology develops).<sup>54</sup> Some commenters suggest updating the part 5 rules “to more readily enable ISAM operations.”<sup>55</sup> Others caution against rule updates to part 5, explaining that “[c]hanging the Part 5 rules would pose an unnecessary drain on FCC resources and take years to complete.”<sup>56</sup> We note that several ISAM space stations have successfully received experimental licenses through the part 5 process,<sup>57</sup> and therefore, we do not propose to modify the part 5 experimental license rules at this time. We propose to continue to utilize both part 5 and part 25 licensing in appropriate circumstances to provide radiofrequency licensing to support ISAM development. and seek comment on this proposal.

13. *Definition of ISAM Space Station.* As an initial matter, we propose to include a definition of “ISAM space station” in section 25.103 of the Commission’s rules.<sup>58</sup> We propose that operators wishing to apply using our proposed framework for ISAM space stations must plan to operate space stations that fit this definition, although space stations that fall within the definition would not be precluded from applying through our regular part 25 rules or through our existing processes for small satellites or small spacecraft. We propose to define “ISAM space station” as follows: “A space station that has the primary purpose of conducting in-space servicing, assembly, and/or manufacturing activities used on-orbit, on the surface of celestial bodies, and/or in transit between these regimes. Servicing activities include but are not limited to in-space inspection, life-extension, repair, refueling, alteration, and orbital transfer of a client space object, including collection and removal of debris on orbit. Assembly activities involve the construction of space systems in space using pre-manufactured components. Manufacturing activities involve the transformation of raw or recycled materials into components, products, or infrastructure in space.” We note that this definition is drawn from the definition of ISAM in the ISAM National Strategy.<sup>59</sup> We seek comment on this proposed definition. Specifically, should we further define “primary purpose” and, if so, how? Are there ISAM activities that would not be included in this definition? Conversely, is this definition so broad that it risks creating confusion as to whether more traditional space stations are included and, if so, how should it be tightened?

14. *Proposed Section 25.126.* In general, we propose to require applicants for authorization for ISAM space stations to comply with the rules of either our regular part 25 licensing process<sup>60</sup> or our streamlined processes for small satellites<sup>61</sup> and small spacecraft,<sup>62</sup> with some exemptions. We note that ISAM technologies are still nascent, and we view our proposed approach to regulating ISAM space stations as iterative, developing with the capabilities and needs of the industry. We believe licensing ISAM space stations under our current rules, including rules for applications for grants of market access

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<sup>54</sup> Aerospace Comments at 2-3, 49, 65; Starfish Space Comments at 2; Atomos Comments at 7-8; CONFERS Comments at 9, 11; Rogue Space Comments at 4; AIA Comments at 2; OneWeb Comments at 3; Orbit Fab Reply at 3; Turion Comments at 7; Astroscale Comments at 26 (suggesting that ISAM operators should remain free to elect to license under part 5 or part 25, as is appropriate for their mission).

<sup>55</sup> Atomos Comments at 8.

<sup>56</sup> Orbit Fab Reply at 3.

<sup>57</sup> See, e.g., *SpaceIce Application*, ELS File No. 0985-EX-CN-2019 (granted Oct. 8, 2020); see also *NanoRacks Mars Outpost experiments* (granted May 28, 2021, and Nov. 15, 2021).

<sup>58</sup> 47 CFR § 25.103.

<sup>59</sup> ISAM National Strategy at 6.

<sup>60</sup> 47 CFR § 25.114.

<sup>61</sup> 47 CFR § 25.122.

<sup>62</sup> 47 CFR § 25.123.



and rules for modifications to operations, and reviewing ISAM applications on a case-by-case basis, will allow us to address the particular needs of ISAM space station operations of different durations and in different orbits.<sup>63</sup> We believe this proposed approach will provide the industry with flexibility while ISAM capabilities develop. We also believe this approach will allow the Commission to continue to develop a record on ISAM while gaining more experience licensing radiofrequency use for ISAM space stations, allowing the Commission to be in the best position to propose additional rule modifications if needed for ISAM space stations in the future. We seek comment on this approach.

15. We propose to create a new section 25.126—Applications for ISAM Space Stations—to aggregate the requirements applicants for ISAM space stations must fulfill and enumerate the exemptions from our typical processes they are entitled to. We believe creating a new rule section specific to ISAM space stations will make the process transparent for the industry, providing applicants for authorization for ISAM space stations one rule section that details the application process and clearly indicates the other rule sections with which applicants must comply. We propose that applicants that fit within our proposed definition of “ISAM space station,” detailed above, would be able to use the proposed framework in section 25.126. We propose that operators of ISAM space stations could apply for both U.S. authorizations and grants of U.S. market access using the proposed framework in this section. We seek comment on this general approach.

16. Specifically, the proposed new section 25.126 would require applicants to submit a comprehensive proposal for Commission evaluation on Form 312, Main Form, and Schedule S, as described in section 25.114(a) through (c), consistent with our regular part 25 licensing and small satellite and small spacecraft licensing requirements.<sup>64</sup> We propose to allow ISAM space station operators to continue to apply under the small satellite and small spacecraft streamlined processes, provided they satisfy all the requirements of each respective process. We propose that ISAM space stations that do not meet the criteria for the small satellite or small spacecraft processes would continue to be subject to the remaining licensing requirements for GSO or NGSO operators under our regular part 25 application process and therefore would be required to provide the information required by our rules with their application.

17. We recognize that radiofrequency operations for ISAM space stations seem more capable of spectrum sharing than other commercial space stations we have authorized under our part 25 rules and generally require shorter durations of intensive communications operations.<sup>65</sup> We therefore propose to exempt all applications for licenses for space stations that fit our proposed definition of ISAM space stations from processing round requirements for NGSO-like operations under section 25.157 and from first-come-first-served requirements for GSO-like operations under section 25.158, provided they certify that operations of the space station(s) will be compatible with existing operations in the authorized frequency bands and submit a narrative description to demonstrate spectrum sharing capabilities are technically possible, and that the operations will not materially constrain future space station entrants from using the authorized frequency band(s).<sup>66</sup> These proposals and exemption criteria would be located in new section 25.126 and the corresponding sections 25.157 and 25.158 would be updated to reflect these exemptions. We tentatively conclude that this licensing framework will allow greater flexibility for ISAM operators looking to operate as a GSO or NGSO space station while protecting future and incumbent satellite operators from interference. We also propose to include a requirement in 25.126 for ISAM operators to provide ICFS file numbers or call signs for any FCC-related applications or grants or a list of ITU filings and UN Registration information for any related space stations not licensed or granted

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<sup>63</sup> See, e.g., 47 CFR § 25.121.

<sup>64</sup> 47 CFR § 25.114(a)-(c); see also 47 CFR §§ 25.122(a), 25.123(a).

<sup>65</sup> See *infra* paras. 33-36 for a detailed discussion of ISAM radiofrequency use.

<sup>66</sup> See *infra* para. 36.

market access by the United States, which we explain in more detail below.<sup>67</sup> We note that our proposal to exempt ISAM operators from our processing round and first-come-first-served queue, given relevant showings, does not modify our obligations to coordinate authorizations with federal operators when spectrum shared by federal and nonfederal users is requested. We seek comment on these proposals. We also seek comment regarding whether other rule changes are necessary to effectuate the proposed approaches discussed above. Commenters should specify which rules and explain the basis for recommending additional revisions.

18. *Surety bonds.* In addition to the exemptions that we propose in 25.126, we also propose to defer the posting of surety bonds by one year after the grant of a license for ISAM operators. This proposal is consistent with our treatment of small satellites and small spacecraft.<sup>68</sup> Spaceflight suggests that the policy objective underlying the Commission's surety bond requirement<sup>69</sup> is to prevent operators from warehousing spectrum for years while failing to follow through on deploying their planned system, but many ISAM operators would meet these objectives without a bond requirement.<sup>70</sup> Spaceflight notes that ISAM space stations are not likely to have exclusive use of spectrum and are likely to be licensed relatively close to launch, and a surety bond would be excessive for many ISAM operators and disproportionate to the cost of developing the space stations.<sup>71</sup> Spaceflight says these considerations match the considerations the Commission relied on when it decided to implement a one-year grace period for filing of a bond for satellites authorized under the streamlined process for small satellites<sup>72</sup> and recommends the Commission adopt a rule allowing ISAM operators to demonstrate they meet the policy objectives of the surety bond requirement in lieu of filing a surety bond. For operators that cannot make such a showing, Spaceflight suggests that the Commission allow ISAM operators one year to file a bond or meet milestone requirements, in line with the rules for streamlined small satellites and small spacecraft.<sup>73</sup> Intelsat also notes that the Commission waived bond and milestone requirements for SpaceLogistics's MEV-1 servicer vehicle because MEV-1 and Intelsat's satellite were treated as one for purposes of the specific operation.<sup>74</sup> While we tentatively conclude that a one-year grace period for surety bonds for ISAM space stations is appropriate, we do not propose to follow Spaceflight's suggestion of allowing operators to demonstrate compliance with policy objectives of the bond requirement.<sup>75</sup> We believe this type of individualized showing can be handled through a waiver request.<sup>76</sup>

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<sup>67</sup> See *infra* paras. 19-21.

<sup>68</sup> See 47 CFR § 25.165(a); *Streamlining Licensing Procedures for Small Satellites, Report and Order*, 34 FCC Rcd 13077, 13112-13, paras. 93-97 (2019) (*Small Satellite R&O*).

<sup>69</sup> In accordance with our rules, the recipient of a space station license or grant of U.S. market access must post a surety bond within 30 days of the date of issuance of the license or grant. Under the rules, a licensee will be in default with respect to the bond if it fails to satisfy certain milestone requirements or surrenders its license before meeting an applicable milestone requirement. The part 25 milestone rules require that a recipient of an initial authorization for an NGSO system must launch 50% of the maximum number of space stations authorized for service, place them in their assigned orbits, and operate them in accordance with the station authorization no later than 6 years after the grant of the authorization. Additionally, the operator must deploy and begin operations with the full system no later than nine years after grant or accept a reduction in its authorized satellites to the number launched and operational at that time. 47 CFR §§ 25.164, 25.165.

<sup>70</sup> Spaceflight Comments at 7.

<sup>71</sup> *Id.* at 8.

<sup>72</sup> *Id.* at 7-8.

<sup>73</sup> *Id.* at 8.

<sup>74</sup> Intelsat Comments at 5.

<sup>75</sup> Spaceflight Comments at 8.

<sup>76</sup> The Commission may waive any rule for good cause shown. 47 CFR § 1.3. Waiver is appropriate where the particular facts make strict compliance inconsistent with the public interest. *Northeast Cellular Tel. Co. v. FCC*,

(continued....)

Specifically, we propose a one-year grace period, during which ISAM space station operators would not have to post a bond. The grace period would begin 30 days after the license is granted, since this is typically when a licensee would have to post the surety bond. If within the one-year grace period, the ISAM operator satisfies the Commission's milestone requirement, then no bond is required. This proposal is similar to the rules regarding surety bond requirements for small satellites and small spacecraft.<sup>77</sup> We seek comment on these proposals.

19. *U.S.-Licensed Servicing and Client Operations.* Starfish Space recommends that client space stations being serviced should not need to obtain a license modification unless the client space station will need to use new or unlicensed frequencies during or following the servicing.<sup>78</sup> For U.S.-licensed client space stations, we tentatively agree with Starfish that cases are limited where client operators should be required to modify authorizations, but we do not propose to set forth specific scenarios in which a client need not obtain a modification. While some ISAM activities, such as inspection or repair, might not result in changes that necessitate a modification, other activities, including orbital transfer or mission extension, could change the client's orbital location, which could alter the parameters of frequency operations and orbital debris mitigation information that was reviewed and authorized by the Commission. As ISAM capabilities are still developing, we tentatively conclude it is in the public interest to assess whether a client space station operator should obtain a license modification on a case-by-case basis, rather than attempt to lay out all possible scenarios that would require modification. We seek comment on this approach.

20. To facilitate review of whether a client space station must seek a modification, we propose to include a requirement in our new proposed section 25.126 for ISAM space station applicants to provide a list of FCC file numbers or call signs for all related space stations, including experimental applications and grants and other applications and grants under part 25. This requirement is similar to the requirement in our streamlined process for small satellites and small spacecraft,<sup>79</sup> but we propose to expand what we consider to be "related" applications and grants in the context of ISAM applications. We propose that related applications and grants would include not only space stations operated by the same operator, but could also include client space stations, space stations that have become debris the applicant seeks to remediate, and other space stations the applicant plans to interact with or collaborate with as part of its operations. We propose to require this information from all applicants that fit within our proposed definition of ISAM space stations, whether the operator is applying under our regular part 25 process or our streamlined processes under sections 25.122 and 25.123. We seek comment on this proposal.

21. *International Servicing and Client Operations.* The NOI asked a number of questions regarding how to license ISAM space stations that may plan to interact with a non-U.S.-licensed space station.<sup>80</sup> When considering U.S.-licensed space stations interacting with non-U.S. client space stations, Blue Origin asserts that the Commission should only seek the name of the client space station, its licensing administration, and associated International Telecommunications Union (ITU) filings because the client is not seeking U.S. market access and so there should be no spectrum management concerns to

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897 F.2d 1164, 1166 (D.C. Cir. 1990). In making this determination, we may take into account considerations of hardship, equity, or more effective implementation of overall policy on an individual basis. *WAIT Radio v. FCC*, 418 F.2d 1153, 1159 (D.C. Cir. 1969), cert. denied, 409 U.S. 1027 (1972); *Northeast Cellular*, 897 F.2d at 1166. Waiver is therefore appropriate if special circumstances warrant a deviation from the general rule, such deviation will serve the public interest, and the waiver does not undermine the validity of the general rule. *NetworkIP, LLC v. FCC*, 548 F.3d 116, 125-28 (D.C. Cir. 2008); *Northeast Cellular*, 897 F.2d at 1166; *WAIT Radio*, 418 F.2d at 1158.

<sup>77</sup> 47 CFR § 25.165(a); see also *Small Satellite R&O*, 34 FCC Rcd at 13112-14, paras. 93-97.

<sup>78</sup> See Starfish Space Comments at 2-3.

<sup>79</sup> 47 CFR §§ 25.122(d)(6), 25.123(c).

<sup>80</sup> *ISAM NOI*, 37 FCC Rcd at 10031, paras. 25-26.

address.<sup>81</sup> Despite this suggestion, we tentatively conclude that spectrum management may be implicated in certain cases when U.S.-licensed space stations interact with or service non-U.S. licensed space stations, given that there may be a wide range of factual scenarios, including servicing for the purpose of altering the location at which a client spacecraft operates or altering other technical characteristics of operations. We also believe sufficient information concerning the proposed operations must be available to ensure that an authorization is in the public interest. For example, a servicing mission that contemplates facilitating client space station operations fundamentally inconsistent with U.S. interests, such as operations that might interfere with other U.S. satellites, should be identified in the authorization process. Likewise, we do not propose to presume that client space station operators are in possession of a license, as Starfish suggests.<sup>82</sup> That approach might, for example, result in the servicing mission facilitating an activity by the client satellite that has not been authorized by the administration to which it is subject. Therefore, for client space stations licensed outside of the United States, both with or without U.S. market access grants, we propose to require that the license applicant provide the client's ITU filings and United Nations (U.N.) registration information, as well as a discussion of regulatory requirements to which the client satellite and its operators are subject, and the status of any regulatory approvals required for the client satellite's participation in the servicing activity. This baseline information may also facilitate any necessary coordination with other U.S. government agencies, such as the State Department. We propose to require this information in our proposed new rules for applications for ISAM space stations to be located in section 25.126. We seek comment on these proposals.

22. *International Coordination.* Aerospace argues that it would be impractical and unreasonable to require an operator to undergo the ITU's seven-year coordination process for frequencies it will use to service a single satellite and will not use once it moves away from that satellite.<sup>83</sup> Aerospace suggests that notifying the Radiocommunications Bureau at the ITU of a commercial ISAM mission would be a prudent alternative and coordination could be accomplished for TT&C operations used throughout the life of an ISAM space station.<sup>84</sup> We recognize the current ITU process poses challenges to ISAM operators, but the ITU Radio Regulations are a treaty by which the United States is bound, and the Commission cannot unilaterally modify what activities and frequencies need to be coordinated with the ITU through a rulemaking process. We therefore propose not to accept Aerospace's suggestion that we simply notify the Radiocommunications Bureau at the ITU of a commercial ISAM mission instead of coordinating in accordance with ITU Radio Regulations. But we do propose, as part of ongoing work on ISAM activities, to continue to coordinate with other federal agencies, including the State Department, to support international servicer-client arrangements. We seek comment on these proposals.

## 2. Orbital Debris Mitigation and ISAM Space Stations

23. The NOI sought comment on orbital debris mitigation concerns specific to ISAM activities in general.<sup>85</sup> Specifically, the Commission sought comment on how ISAM activities might not fit into our current orbital debris mitigation requirements, for example by storing fuel on-orbit rather than using or depleting fuel (refueling depots), or by creating debris as byproducts of servicing or manufacturing activities, and how we might modify our current orbital debris mitigation requirements to

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<sup>81</sup> Blue Origin Comments at 6 (stating that any non-spectrum related concerns can be addressed by the State Department); *see also* Starfish Space Comments at 2 (suggesting the Commission presume client operators are in possession of a relevant license).

<sup>82</sup> Starfish Space Comments at 2.

<sup>83</sup> Aerospace Comments at 22.

<sup>84</sup> *Id.* (noting that additional information about frequency use for individual ISAM missions the spacecraft will perform could be appended to ITU documents coordinating the TT&C operations).

<sup>85</sup> *ISAM NOI*, 37 FCC Rcd at 10031-32, paras. 27-28.

account for the additional risks that ISAM operations may pose.<sup>86</sup>

24. At this time, we tentatively conclude to retain the same orbital debris mitigation requirements for ISAM operators as for other space station operators.<sup>87</sup> As stated in the NOI, our orbital debris mitigation requirements apply to all space station operators, including operators of ISAM space stations.<sup>88</sup> We note that our current orbital debris mitigation rules are performance based, in that they require demonstration of results rather than dictating specific methods operators must use to meet those results,<sup>89</sup> and so we propose that we do not need to modify our rules for ISAM communications to accommodate requests in the record for performance-based orbital debris mitigation requirements for ISAM space stations.<sup>90</sup> Our orbital debris mitigation requirements are also based on the United States government's Orbital Debris Mitigation Standard Practices (ODMSP) developed by NASA.<sup>91</sup> We therefore do not propose to modify our orbital debris rules at this time or to require additional orbital debris mitigation showings for ISAM space stations in general. Rather we propose that ISAM operators will either comply with orbital debris requirements under the regular part 25 licensing process,<sup>92</sup> or under the small satellite or small spacecraft processes, if they apply under those streamlined licensing processes.<sup>93</sup> We propose to include a requirement that applicants for ISAM space stations submit the orbital debris mitigation information under the rules of their chosen application process in our proposed new section 25.126, as part of our proposal to clearly lay out the application process for ISAM operators in that section. We also propose to review any applications for ISAM space stations on a case-by-case basis, just as we do with other license applications, to ensure compliance with our orbital debris mitigation requirements. We believe this approach will maximize operator flexibility and therefore allow ISAM technologies and capabilities to develop while allowing the Commission to ensure continued orbital safety for all operators. We seek comment on this proposed approach.

25. *ISAM Activities that May Pose Additional Risks.* We note that commenters suggest that some ISAM activities, such as refueling, life extension, and orbital transfer activities, along with assembly and manufacturing activities, might pose additional risks for creating orbital debris by way of increased risk of accidental explosions, increased risk of release of debris during normal operations, increased risk of collisions, or decreased post-mission disposal reliability, and therefore these space stations must not be held to lesser standards than other operators and must be examined closely by the Commission.<sup>94</sup> We seek comment on whether our current orbital debris mitigation rules are sufficient to protect the orbital environment from these additional risks. Are there additional specific orbital debris

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<sup>86</sup> *Id.* at 10032, para. 28.

<sup>87</sup> *See, e.g.,* Iridium Reply at 4; OneWeb Comments at 3; Aerospace Comments at 27; Orbit Fab Comments at 16.

<sup>88</sup> *ISAM NOI*, 37 FCC Rcd at 10031-32, para. 27.

<sup>89</sup> *See* 47 CFR § 25.114(d)(14).

<sup>90</sup> *See, e.g.,* Aerospace Comments at 2, 64; Starfish Space Comments at 3; Astroscale Comments at 34; Spaceflight Reply at 5-6; CONFERS Comments at 12. We also note that several commenters encourage us to allow the ISAM industry to naturally develop and arrive at best practices regarding orbital debris mitigation. *See, e.g.,* Lockheed Martin Comments at 8; Starfish Space Comments at 2-3; Spaceflight Comments at 6; CONFERS Comments at 12; Astroscale Comments at 32.

<sup>91</sup> *See Orbital Debris R&O and FNPRM*, 35 FCC at 4160-61, para. 7 (noting that SPD-3 charged NASA, in coordination with other agencies and in consultation with the FCC, to lead efforts to update orbital debris mitigation standard practices (ODMSP) for missions operated or procured by U.S. government agencies and that best practices derived in part from the ODMSP should be incorporated into future rulemaking and licensing actions); *see also 2004 Orbital Debris Order*, 19 FCC Rcd at 11609-12, paras. 102-108.

<sup>92</sup> *See* 47 CFR §§ 25.114(d)(14) (informational requirements), 25.283 (end-of-life disposal).

<sup>93</sup> 47 CFR §§ 25.122(c) & (d), 25.123(b) & (c).

<sup>94</sup> Iridium Reply at 4; Aerospace Comments at 27-28, 30, 32-34; Starfish Space Comments at 4; *but see* Orbit Fab Comments at 8; Aerospace Comments at 28-30.

showings we should consider for these activities?

### 3. Orbital Debris Remediation Activities

26. The NOI asked a series of questions to gain information on the state of orbital debris remediation technologies and industry development, including whether and how the Commission should consider ADR as part of an applicant's orbital debris mitigation plan and what actions the Commission could take to promote growth and innovation for ADR.<sup>95</sup> We agree with commenters that ISAM activities can play a role in orbital debris remediation and space sustainability.<sup>96</sup> Aerospace asserts that some ADR technologies, such as tow truck, robotics, and RPO technologies, are at a high level of readiness and reliability, while other technologies, including for capture and stabilization of debris with high spin or tumble rates, are at a much lower level of technological readiness and reliability.<sup>97</sup>

27. We propose that operators engaging in ADR and similar orbital debris remediation activities could seek authorization through the same process for ISAM space stations outlined in this NPRM, including requiring space stations conducting ADR to demonstrate compliance with the Commission's orbital debris rules. We seek comment on this proposal. In particular, we seek comment on whether we should impose additional requirements on applicants for ISAM space stations conducting debris remediation activities to mitigate potential additional risks from these activities.

28. In response to the NOI's queries on whether ADR should be factored into post-mission disposal requirements or otherwise be fostered by Commission action,<sup>98</sup> commenters suggest the Commission make clear that ADR is permitted as a means to demonstrate compliance with the Commission's orbital debris rules and recommend that the Commission encourage all space station operators to include navigational aids and grappling fixtures to assist with potential ADR.<sup>99</sup> We agree that acknowledging third-party services as an option for post-mission disposal will likely further our goals of promoting innovation and growth of ADR and will also likely provide additional flexibility to applicants when considering their end-of-life disposal options. To date, the Commission's rules do not prescribe any particular method of end-of-life disposal of NGSO space stations, and instead the Commission reviews an applicant's orbital debris mitigation plans for such disposals on a case-by-case basis.<sup>100</sup> The Commission has previously stated that it did not intend to dismiss or foreclose direct retrieval as a method of end-of-life disposal and that disposal plans involving direct retrieval would be evaluated if direct retrieval were implemented in the future.<sup>101</sup> As such, we do not propose to modify our rules to list ADR explicitly as a post-mission disposal method. We note that the ODMSP stresses the importance of ensuring that orbital debris remediation activities do not risk creating debris greater than

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<sup>95</sup> *ISAM NOI*, 37 FCC Rcd at 10032-33, paras. 29-30. ADR refers to missions that perform a remediation or removal function for preexisting orbital debris, including defunct satellites, satellite fragments, and material released during normal operations. *Id.*

<sup>96</sup> *See, e.g.*, Astroscale Reply at 7; Aerospace Comments at 34-36; Starfish Space Comments at 4; Orbit Fab Comments at 8-14; Kuiper Reply at 3; CONFERS Comments at 11.

<sup>97</sup> *See* Aerospace Comments at 39; *see also* Astroscale Comments at 6-7 (asserting that initial ISAM market growth will be driven by the servicing elements of ISAM, including active debris removal, as well as life extension services, and end-of-life services).

<sup>98</sup> *ISAM NOI*, 37 FCC Rcd at 10032-33, para. 30.

<sup>99</sup> CONFERS Comments at 12-13; Aerospace Comments at 40, 44-46, 52; OneWeb Comments at 2-3; Starfish Space Comments at 3-4; Relativity Space Comments at 2; Kuiper Reply at 2. Aerospace suggests the Commission only consider ADR as a backup to post-mission disposal plans at this time. Aerospace Comments at 40-42.

<sup>100</sup> *2004 Orbital Debris Order*, 19 FCC Rcd at 11601-02, para. 84 (stating that for NGSO space stations, the Commission intends to examine disclosures of information concerning the end-of-life disposal of NGSO space stations on a case-by-case basis).

<sup>101</sup> *2004 Orbital Debris Order*, 19 FCC Rcd at 11591, para. 60, n.161.

the debris the operation seeks to remediate,<sup>102</sup> and we therefore propose that plans to use ADR for post-mission disposal will continue to be reviewed on a case-by-case basis, including review of the risk of generating debris greater than the debris the operation seeks to remediate and human casualty risk for remediated debris disposed of through atmospheric reentry, along with compliance with our other orbital debris mitigation rules. We believe our proposal to review use of ADR for post-mission disposal on a case-by-case basis is in line with our proposal to review all ISAM space stations, including ISAM space stations conducting ADR activities, on a case-by-case basis and will allow maximum flexibility for operators, thereby fulfilling our goal of promoting growth in the industry. We seek comment on this approach.

29. Additionally, we believe that Aerospace's suggestion that the Commission require ADR plans as a back-up for large constellations' post-mission disposal plans<sup>103</sup> has merit for consideration. In cases of large constellations, as Aerospace points out,<sup>104</sup> numerous defunct satellites could be left in orbit even while meeting our current post-mission disposal requirements. Given that the technology for ADR is still nascent and developing, however, we do not propose to adopt rules on this issue at this time, but we expect to consider this possibility in the future.

30. The NOI asked specifically whether an operator bond associated with removal would be an appropriate mechanism for ensuring ADR.<sup>105</sup> Commenters responding to the NOI present a range of views regarding potential bonds associated with post-mission disposal reliability, from support for the proposal,<sup>106</sup> to requests for further study,<sup>107</sup> to concerns that a bond would chill innovation and be less effective than strong orbital debris mitigation requirements.<sup>108</sup> We agree that further consideration of this issue is warranted, but as we are also continuing to consider post-mission disposal bonds in general in our orbital debris proceeding,<sup>109</sup> we defer this issue as related to ISAM and debris remediation to a later time when we can consider it more fully.

31. Finally, despite the suggestions of some commenters, we defer proposals to modify regulatory and application fees to appropriate regulatory or application fee proceedings in the future.<sup>110</sup>

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<sup>102</sup> U.S. Government Orbital Debris Mitigation Standard Practices, November 2019 Update, at p. 8, Section 5-4. Available at:

[https://orbitaldebris.jsc.nasa.gov/library/usg\\_orbital\\_debris\\_mitigation\\_standard\\_practices\\_november\\_2019.pdf](https://orbitaldebris.jsc.nasa.gov/library/usg_orbital_debris_mitigation_standard_practices_november_2019.pdf) (ODMSP). The ODMSP states: "In developing the mission profile for an active debris removal operation on a debris structure, the program should limit the risk of debris generation as an outcome of the operation. The program should (1) avoid fragmentation of the debris structure, (2) limit the probability of accidental collision, and (3) limit the probability of accidental explosion resulting from the operations. Any planned debris generated as a result of the operations should follow the standard practices for mission-related debris set forth in Objective 1. The operations should be designed for the debris structure to follow applicable post-mission disposal practices set forth in Objective 4."

<sup>103</sup> Aerospace Comments at 42.

<sup>104</sup> *Id.*

<sup>105</sup> *ISAM NOI*, 37 FCC Rcd at 10032-33, para. 30. The NOI also noted that the Commission proposed a bond associated with successful post-mission disposal of a spacecraft in our ongoing orbital debris proceeding, and that a bond to incentivize ADR could potentially be tied to a general bond associated with successful post-mission disposal. *Id.* at 10032-33, para. 30, n. 56.

<sup>106</sup> ALPA Comments at 3.

<sup>107</sup> *See* Aerospace Comments at 43.

<sup>108</sup> *See* Iridium Reply at 6; Aerospace Comments at 43.

<sup>109</sup> *See Orbital Debris R&O and FNPRM*, 35 FCC Rcd at 4245-49, paras. 193-205.

<sup>110</sup> *See e.g.* Astroscale Reply at 8.



The Commission is required by the Communications Act to collect application fees<sup>111</sup> and regulatory fees.<sup>112</sup> The Communications Act provides specific exemptions from application fees<sup>113</sup> and regulatory fees.<sup>114</sup> Moreover, the Commission's authority to waive application fees or regulatory fees is limited to specific instances and the Commission has consistently rejected consideration of waiving such fees for classes of applicants or regulatees.<sup>115</sup> As this proceeding progresses, we will propose any relevant regulatory fee or application fee updates for ISAM space stations as part of future Commission's regulatory and application fee proceedings.

### C. Radiofrequency Spectrum to Support ISAM

32. We tentatively conclude that various communication activities in support of ISAM can potentially operate within several existing service allocations, and we propose to review ISAM operators' requests for frequency use on a case-by-case basis, consistent with our process for reviewing requests for frequency use for small satellites and small spacecraft. We seek comment on these proposals.

33. *Communication Operations and Service Allocations.* ISAM space station operations will require the use of TT&C,<sup>116</sup> as several commenters note.<sup>117</sup> Numerous commenters also explain that ISAM space stations may, at times, require other communications for limited duration, such as video,

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<sup>111</sup> 47 U.S.C. § 158.

<sup>112</sup> 47 U.S.C. §§ 158 and 159; 47 U.S.C. §§ 158 and 159; *2020 Regulatory Fee Reform Order*, 35 FCC Rcd at 4977-4978, paras. 2-3; 47 U.S.C. §§ 159(a) (“shall assess and collect regulatory fees”), 159(b) (“Commission shall assess and collect regulatory fees at such rates as the Commission shall establish in a schedule of regulatory fees that will result in the collection, in each fiscal year, of an amount that can reasonably be expected to equal the amounts described in subsection (a) with respect to such fiscal year.”); *see also* 47 U.S.C. § 156(b).

<sup>113</sup> The application fee exemptions are as follows: “(A) a governmental entity; (B) a nonprofit entity licensed in the Local Government, Police, Fire, Highway Maintenance, Forestry-Conservation, Public Safety, or Special Emergency Radio radio services; or (C) a noncommercial radio station or noncommercial television station.” 47 U.S.C. § 158(d)(1).

<sup>114</sup> The regulatory fee exemptions are as follows: “(A) a governmental entity or nonprofit entity; (B) an amateur radio operator licensee under part 97 of the Commission’s rules (47 CFR part 97); or (C) a noncommercial radio station or noncommercial television station.” 47 U.S.C. § 159(e)(1); 47 CFR § 1.1162. In addition, Congress codified in the RAY BAUM's Act the Commission’s *de minimis* rule through the adoption of new section 9(e)(2). *See FY 2019 Report and Order*, 34 FCC Rcd at 8206-07, paras. 46-47.

<sup>115</sup> 47 U.S.C. § 159A(d)(1); 47 CFR § 1.1166; *Amendment of the Schedule of Applications Fees Set Forth in Sections 1.1102 through 1.1109 of the Commission’s Rules*, FCC 20-116, Notice of Proposed Rulemaking, 36 FCC Rcd. 1618, 1621, 1682-1683, paras. 5, 238, 239 (2020) (reviewing the history of application fee waivers and the Commission’s narrow construction of the statutory waiver authority); *Assessment and Collection of Regulatory Fees for Fiscal Year 2019*, FCC 19-37, Notice of Proposed Rulemaking 34 FCC Rcd. 3272, paras. 33-36 (2019) (reviewing the history of regulatory fee waivers and the Commission’s narrow construction of the statutory waiver authority).

<sup>116</sup> TT&C refers to telemetry, tracking, and command (telecommand). Space telemetry is defined as “[t]he use of telemetry for the transmission from a space station of results of measurements made in a spacecraft, including those relating to the functioning of the spacecraft.” 47 CFR § 2.1(c); ITU R.R. No. 1.133. Space tracking is the “determination of the orbit, velocity or instantaneous position of an object in space by means of radiodetermination, excluding primary radar, for the purpose of following the movement of the object.” 47 CFR § 2.1(c); ITU R.R. No. 1.136. Space telecommand is “[t]he use of radiocommunication for the transmission of signals to a space station to initiate, modify or terminate functions of equipment on an associated space object, including the space station.” 47 CFR § 2.1(c); ITU R.R. No. 1.135.

<sup>117</sup> *See, e.g.*, TechFreedom Comments at 14 (suggesting ISAM operations are primarily TT&C related); Aerospace Comments at 8; CONFERS Comments at 4; Turion Space Comments at 2. Aerospace explains that TT&C use will vary depending on the stage of the ISAM mission, from intermittent use at transit to or from a client satellite during a servicing mission to continuous use during RPO, docking, and active stages of servicing, assembly, and manufacturing missions. Aerospace Comments at 8-9, 23.

imaging, location sensing information, other status information, and other data downlink and suggest that TT&C allocations alone will not cover all stages of most ISAM operations.<sup>118</sup> Commenters also raise the need for communications between space stations, such as between a servicing space station and a client or between multiple space stations supporting a common and complex assembly or manufacturing mission,<sup>119</sup> and note that these communications may likely occur at low power given the proximity of the space stations involved.<sup>120</sup> Commenters indicate that ISAM frequency use will need to be agile, changing to communicate with client satellites or to avoid interfering with GSO satellites as an ISAM space station transits close to the GSO arc.<sup>121</sup> NTIA and Aerospace also note that ISAM space stations could utilize relay satellites or satellite networks for data downlink and other communications.<sup>122</sup>

34. Numerous commenters suggest that the space operation service<sup>123</sup> fits well with some aspects of ISAM operations, particularly TT&C needs,<sup>124</sup> but several also note that the space operation bands are already encumbered by federal users<sup>125</sup> and others assert that some communications needs for

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<sup>118</sup> See, e.g., Sierra Space Comments at 2 (noting their LIFE habitat will require rapid data transfer to and from Earth); Aerospace Comments at 9-10, 23 (noting servicing missions will require continuous communications integrity during RPO with client space stations); Atomos Comments at 3 (noting brief periods of need for data during RPO, such as space domain awareness data, navigational scrips, communication between ISAMs and nearby spacecraft for docking, etc.); CONFERS Comments at 3-4 (providing a diagram of “typical” spectrum use by mission stage, although noting the challenge of identifying “typical” spectrum use in such a varied communications profile); NTIA Reply at 2 (noting servicing missions will likely have periodic spikes in spectrum demand in order to downlink video data or to engage in “robust, real-time command and control” and that manufacturing and assembly operations may require longer durations of moderate to high spectrum demand).

<sup>119</sup> See Aerospace Comments at 10-11, 23 (noting that such communication needs may be greater in the future); Atomos Comments at 8 (explaining that sustainable spectrum allocations for ISAM operations will be necessary for ISAM industry growth); Rogue Space Reply at 2 (noting the need for spectrum for radiolocation and radar for communications between spacecraft); AIA Comments at 1 (noting ISAM activities introduce the potential for regular in-space communication between multiple spacecraft, including human tended spacecraft or habitats).

<sup>120</sup> See Aerospace Comments at 11, 23.

<sup>121</sup> *Id.* at 23-24; Starfish Space Comments at 5; see also U.S. Chamber of Commerce Reply (concurring that spectrum allocations will need to be flexible to accommodate the diverse needs of ISAM operations over the lifetime of the spacecraft); AIA Comments at 1 (highlighting ISAM activities will require periods of constant, high bandwidth, low latency communications).

<sup>122</sup> See Aerospace Comments at 24; NTIA Reply at 3-4.

<sup>123</sup> Space Operation Service is “[a] radiocommunication service concerned exclusively with the operation of spacecraft, in particular space tracking, space telemetry, and space telecommand. Note: These functions will normally be provided within the service in which the space station is operating.” 47 CFR § 2.1(c); ITU R.R. No. 1.23.

<sup>124</sup> See, e.g., Aerospace Comments at 12; Orbit Fab Comments at 17-18; Atomos Comments at 3; TechFreedom Comments at 14; Astroscale Comments at 20; Turion Space Comments at 4.

<sup>125</sup> TechFreedom Comments at 14, 16 (noting the Commission’s 2021 space launch frequency Report and Order and that “the bulk of these frequencies are used as part of launch and satellite deployment operations, and with the cadence of launches increasing exponentially over the past decade, more spectrum is needed just for those operations alone”); CONFERS Comments at 6 (noting space operation service is “largely inaccessible in the United States”) at 20-21 (noting that the very limited language in U.S. earth station license grants associated with Astroscale’s ELSA-d mission indicated that long-term non-federal use of the S-band for ISAM missions is highly unlikely); Rogue Space Comments at 6 (noting that “Government operators have made clear in other proceedings that some of the bands allocated for ‘Space Operations’ will not be able to absorb additional ISAM spectrum users”); NTIA Reply Comments at 5-6 (stating that the largest space operations allocations at 2025-2110 MHz and 2200-2290 MHz are only allocated for Federal use or for commercial use limited to launch in the United States, and that these two bands are heavily used today and require extensive coordination even among federal users).

ISAM space stations may not fit in this service.<sup>126</sup> Some suggest that space research service,<sup>127</sup> fixed-satellite service (FSS),<sup>128</sup> mobile-satellite service (MSS), inter-satellite service,<sup>129</sup> or even Earth-exploration satellite service (EESS)<sup>130</sup> allocations, as well as experimental licensing and other flexible options could be construed to allow for certain ISAM operations.<sup>131</sup> The Commission’s rules define service allocations according to the ITU definitions,<sup>132</sup> and we rely on these definitions as we consider requests for frequency authorization as part of our licensing process. We tentatively conclude that various ISAM operations could fit within numerous service allocation definitions. For example, we need not read the definition of space research services, “a radiocommunications service in which spacecraft or other objects in space are used for scientific or technological research purposes,”<sup>133</sup> to be fundamentally at odds with commercial satellite operations given that the plain language of the definition does not exclude commercially-based scientific or technological research operations.<sup>134</sup> Additionally, we propose that the space operation service, which is “concerned exclusively with the operation of spacecraft, in particular

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<sup>126</sup> Atomos Comments at 3; Orbit Fab Reply at 4; Aerospace Comments at 12, 14-16 (noting the space operation service would fit ISAM TT&C needs well, though the definition of the space operation service provides that TT&C should typically occur in frequency bands of the radio service in which the spacecraft normally operates, but currently there is no clearly defined radio service in which ISAM missions normally operate so as to also operate TT&C links); CONFERS Comments at 6 (“The space operation service is not meant for downlinking ISAM payload data.”).

<sup>127</sup> Space Research Service is “[a] radiocommunication service in which spacecraft or other objects in space are used for scientific or technological research purposes.” 47 CFR § 2.1(c); ITU R.R. No. 1.55.

<sup>128</sup> Fixed-satellite service is “[a] radiocommunication service between earth stations at given positions, when one or more satellites are used; the given position may be a specified fixed point or any fixed point within specified areas; in some cases this service includes satellite-to-satellite links, which may also be operated in the inter-satellite service; the fixed-satellite service may also include feeder links for other space radiocommunication services.” 47 CFR § 2.1(c); ITU R.R. No. 1.21.

<sup>129</sup> Inter-satellite service is “[a] radiocommunication service providing links between artificial satellites.” 47 CFR § 2.1(c); ITU R.R. No. 1.22.

<sup>130</sup> EESS is “[a] radiocommunication service between earth stations and one or more space stations, which may include links between space stations, in which: (1) Information relating to the characteristics of the Earth and its natural phenomena, including data relating to the state of the environment, is obtained from active sensors or passive sensors on Earth satellites; (2) Similar information is collected from airborne or Earth-based platforms; (3) Such information may be distributed to earth stations within the system concerned; and (4) Platform interrogation may be included. This service may also include feeder links necessary for its operation.” 47 CFR § 2.1(c); ITU R.R. No. 1.51.

<sup>131</sup> *See, e.g.*, Orbit Fab Comments at 2-3, 17-21 (suggesting use of space operations, space research, FSS, and inter-satellite services, and noting that in-space refueling operations resemble the space operations and space research allocations from a radiofrequency perspective); Astroscale Comments at 24 (urging the Commission to accommodate commercial ISAM missions in current FSS allocations because a large percentage of potential ISAM clients operate in FSS allocations); Aerospace Comments at 12-14 (suggesting use of the space research service, inter-satellite service, FSS, and EESS, along with “experimental licensing or other flexible options”); CONFERS Comments at 6-7 (noting the possibilities of FSS and EESS, but that neither are quite aligned with ISAM operations); Turion Comments at 5-6 (suggesting inter-satellite and fixed-satellite services could fit several different ISAM TT&C and non-TT&C mission activities and suggesting that EESS could house useable spectrum, but noting some distinctions in ISAM operations and typical EESS definitions); NTIA Reply at 4-5 (recognizing that many operators are interested in the space operation service, reiterating that these bands are heavily used by federal agencies and require extensive coordination, suggesting that space research may be appropriate for missions involving scientific or technical research, but asserting that the EESS definition “does not fit ISAM operations”).

<sup>132</sup> *See generally* 47 CFR § 2.1(c).

<sup>133</sup> *Id.*; ITU R.R. No. 1.55.

<sup>134</sup> NTIA Reply at 5 (noting that this allocation “could support early demonstration programs”).

space tracking, space telemetry, and space telecommand,<sup>135</sup> need not be as narrowly construed as some commenters seem to suggest.<sup>136</sup> For example, CONFERS states that the space operation service “is not meant for downlinking ISAM payload data.”<sup>137</sup> However, we tentatively conclude that at least some ISAM operations could fall within the scope of the space operation definition, especially if the data in question is related to “the operation of spacecraft.” At the same time, we note that certain service allocations, such as EESS which is focused on “[i]nformation relating to the characteristics of the Earth and its natural phenomena, including data relating to the state of the environment,”<sup>138</sup> appear to be dedicated to operations that are not typically consistent with ISAM operations.<sup>139</sup>

35. We propose not to limit service allocation designations that might be possible for ISAM operations so long as the requested operations can justifiably fit within the service allocation definition. As such, we propose to continue our current practice of assessing whether an applicant’s proposed ISAM operations fall within the applicant’s desired service allocation(s) on a case-by-case basis. This proposal is consistent with our considerations for small satellites, where we recognized small satellite operators may engage in a variety of operations.<sup>140</sup> Here, we tentatively propose to maintain as much flexibility as possible for ISAM operators to gain authorization for their operations so long as this does not interfere with other radiocommunications and justifiably fits within service allocation definitions. We seek comment on this proposal. We also note that current satellite services offer some flexibility of use and operation. For example, in certain cases, FSS operators are permitted to provide service to earth stations in motion (ESIM). Similarly, a single satellite constellation can be licensed to provide both FSS and MSS.<sup>141</sup> Given the current state of ISAM development, and the variety of communications needs that ISAM operators may have, we believe that continuing to work within available service allocations, with the modifications to the licensing process proposed in this NPRM, can address many of the frequency demands for ISAM in the near term. We seek comment on this approach.

36. *Proposed Exemptions Consistent with Spectrum Sharing Capabilities.* In keeping with our proposal to provide flexibility in considering frequency authorization, we propose to exempt applicants for ISAM space station authorizations from NGSO-like processing rounds<sup>142</sup> and from the GSO-like first-come-first-served queue,<sup>143</sup> which they could otherwise be subject to under our current regular part 25 satellite licensing regime. This proposal is largely consistent with our approach for NGSO small satellites and small spacecraft, which are exempt from processing rounds where spectrum sharing (that is, not materially constraining other operations in the requested frequency band(s)) is shown to be possible.<sup>144</sup> Commenters have indicated that spectrum sharing is likely possible for many aspects of

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<sup>135</sup> 47 CFR § 2.1(c); ITU R.R. No. 1.23

<sup>136</sup> See 47 CFR § 2.1(c); ITU R.R. No. 1.23 (defining space operations service) and 47 CFR § 2.1(c); ITU R.R. No. 1.133 (defining space telemetry); see also CONFERS Comments at 6.

<sup>137</sup> CONFERS Comments at 6.

<sup>138</sup> 47 CFR § 2.1(c); ITU R.R. No. 1.51.

<sup>139</sup> See also NTIA Reply at 5 (“EESS is intended for Earth-centric sensing, and not aligned with imaging artificial resident space objects or performing inspection services as being considered by ISAM operators.”)

<sup>140</sup> *Small Satellite R&O*, 34 FCC Rcd 13077 at paras. 112-14.

<sup>141</sup> See *Single Network Future: Supplemental Coverage from Space*, Notice of Proposed Rulemaking, FCC 23-22, at para. 31 (Mar. 17, 2023).

<sup>142</sup> See 47 CFR § 25.157.

<sup>143</sup> See 47 CFR § 25.158.

<sup>144</sup> See 47 CFR §§ 25.122(d)(6) (requiring applicants for a small satellite license to submit, as part of the application, a description of means by which requested spectrum could be shared with both current and future operators, (e.g., how ephemeris data will be shared, antenna design, earth station geographic locations) thereby not materially constraining other operations in the requested frequency band(s)) and 25.157(i) (allowing NGSO-like applications

(continued....)

ISAM operations as well.<sup>145</sup> However, here we expand our proposal to include an exemption for GSO-like space station processes as well as NGSO because we recognize that ISAM space stations could seek to be authorized as a GSO-like space station,<sup>146</sup> whereas our small satellite process focused on NGSO-only.<sup>147</sup> We tentatively conclude that ISAM-related communications licensing would not require processing rounds for NGSO operators or a first-come-first-served queue for GSO space stations if applicants can demonstrate that the proposed operations are technically able to share spectrum and not materially constrain future use of the band. Specific showings would be laid out in the proposed section 25.126, as described above.<sup>148</sup> We seek comment on this proposal and on any alternate approaches we should consider.

37. *Authorizing Frequency Consistent with Client Space Station Allocations.* We recognize commenters' interest in the possibility of ISAM space stations receiving frequency authorization consistent with a client's authorization, also known as frequency "piggybacking."<sup>149</sup> Under our current rules the MEV-1 and MEV-2 licenses allowed for frequency "piggybacking" with the client satellite for certain frequencies. For example, MEV-1, which is attached to and provides life extension services to the Intelsat 901 satellite, is authorized to provide TT&C consistent with Intelsat 901's licensed frequencies and parameters.<sup>150</sup> NTIA notes that "[o]ne of the more straightforward opportunities for ISAM spectrum access is for ISAM missions servicing [FSS and MSS]" and asserts that those missions could use "the same spectrum used by the 'client' satellite" as was done for the MEV-1.<sup>151</sup> We recognize that such an approach may only be an option for a small portion of ISAM space stations, because the space stations would need to be designed with specific communications capabilities to match operational frequencies of client or partner satellites, and may likely only fit with those providing servicing missions, like life-extension and repair.<sup>152</sup> CONFERS also highlights that the option of relying on client frequencies will not work for operators engaged in debris removal.<sup>153</sup> Given the identified limitations on this model, we do not propose "piggybacking" as an overall solution for ISAM-related frequency authorization; rather we note that this option has been authorized under our existing rules in the past, without requiring a change to our rules.

38. *Specific Frequency Bands.* The Commission views its regulation of radiofrequency in

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filed pursuant to the procedures described in § 25.122 to be processed without a processing round).

<sup>145</sup> See, e.g., Blue Origin Comments at 3; Thuraya Comments at 3; Atomos *Ex Parte* (June 7, 2023) at 2. See also, Astroscale Comments at 14 (asserting that the ability to downlink at higher bandwidths and resultant high data rates can be juxtaposed with diminished bandwidth requirements when no proximity operations are ongoing).

<sup>146</sup> See, e.g., Space Logistics, LLC Application for Satellite Space Station Authorization, SpaceLogistics, ICFS File No. SAT-LOA-20170224-00021 (filed Feb. 27, 2017) (checking option for "GSO space station" on Form 312).

<sup>147</sup> *Small Satellite R&O*, 34 FCC Rcd at 13107, para. 80.

<sup>148</sup> See *supra*, section III.B, paras. 15-17.

<sup>149</sup> Intelsat Comments at 5 (using the MEV-1 license as an example, Intelsat notes the ISAM servicer vehicle could "piggyback" on certain client's authorizations while the two objects are connected or working together); Atomos June 7, 2023 *Ex Parte* at 2 (suggesting the Commission formalize the process used for the MEV-1 spacecraft).

<sup>150</sup> See, e.g. MEV-1 License at n. 3 ("Space Logistics and Intelsat have coordinated the use of center frequencies at 3944.5 MHz (space-to-Earth), 3955.5 MHz space-to-Earth), 6170.0 MHz (Earth-to-space), and 6180.0 MHz (Earth-to-space) for operations in connection with IS-901. See ICFS File No. SAT-AMD-20190207-00008, Narrative at 2. Space Logistics states, however, that the parties may revise the coordinated frequencies in the future and requests that it be allowed to operate within the full range of the requested TT&C frequency bands, as coordinated with Intelsat. *Id.* This grant reflects such authority.").

<sup>151</sup> NTIA Reply at 3.

<sup>152</sup> See Aerospace Comments at 14; Starfish Space Comments at 5; CONFERS Comments at 8.

<sup>153</sup> CONFERS Comments at 8.

support of ISAM as an iterative process, and we propose to continue case-by-case review of frequency authorization, as opposed to proposing specific frequency bands for ISAM-related communications' use. In doing so, we recognize the benefit of expanding our experience with authorizing communications operations in support of ISAM missions. We believe that creating a process for operators to identify as ISAM space stations will allow the Commission to gather important data and understanding regarding the future spectrum needs of ISAM operators. Additionally, we recognize that operators are already thinking creatively about various frequencies and service allocations that may be able to accommodate ISAM communication needs, as discussed above. Many commenters responding to the NOI are in favor of identifying spectrum<sup>154</sup> to support ISAM operations on a protected basis (e.g. exclusive or co-primary).<sup>155</sup> We also note that the Commission deferred consideration of specific frequency bands that could be used for certain ISAM-related operations, such as RPO, from the Commission's space launch spectrum proceeding.<sup>156</sup> Yet we do not wish to prematurely limit creativity and innovation for ISAM operators, and tentatively conclude that a case-by-case review will allow flexibility at this time<sup>157</sup> as we and other regulating bodies continue to evaluate the spectrum ecosystem holistically.<sup>158</sup> Our proposal to require frequency use authorization on a case-by-case basis is also consistent with our treatment of small satellite and small spacecraft,<sup>159</sup> with the understanding that these operations would be carried out on a non-

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<sup>154</sup> See, e.g., Lockheed Martin Comments at 5 (suggesting ISAM operations will require use of the UHF, S-, C-, X-, and Ka-bands); Orbit Fab Comments at 18-20 (identifying portions of S-band and X-band that would be needed for refueling operations' communications), at 21-22 (identifying potentially suitable allocations in S-band, X-band, 17.8-20.2 GHz, 27.5-30.0 GHz, and LunaNet Bands); Blue Origin Comments (suggests non-federal use of C2V2 S-band for TT&C; suggests finding other bands with at least 100 MHz of bandwidth via multiple 10 MHz channels to facilitate sharing); Kuiper Reply at 6 (noting utility of S-band and X-band, but suggesting that "bands that are not sufficiently resilient to rain and higher path loss and where intensive bandwidth use is already expected, such as the Ka-Band" should not be considered); Aerospace Comments at 15-22 (discussing properties and potential ISAM use of frequency bands within the space operations service, space research service, inter-satellite service, FSS, and EESS allocations); Rogue Space Comments at 5 (noting the Commission has previously permitted the use of X-band for an ISAM mission); Turion Comments 4-6 (suggesting space research service and EESS bands fit typical ISAM mission's TT&C activities).

<sup>155</sup> See, e.g., Thuraya Comments at 2; Atomos Comments at 3; Sierra Space Comments at 2; CSF Comments at 2; SpaceX Comments at 4; Starfish Space Comments at 5; Blue Origin November 17, 2023 *Ex Parte* at 1; Spaceflight Reply at 4; Rogue Space Reply at 1; SpaceX Reply at 2; U.S. Chamber of Commerce Reply at 1; CONFERS Comments at 5; Astroscale September 14, 2023 *Ex Parte*, Exhibit B at 9.

<sup>156</sup> See *Allocation of Spectrum for Non-Federal Space Launch Operations*, Second Report and Order and Further Notice of Proposed Rulemaking, FCC 23-76 (2023) at paras. 167-68.

<sup>157</sup> See SpaceX Reply at 2 (recommending the Commission refrain from selecting specific frequency bands to allocate for ISAM operations, as this could "prematurely limit the development and innovation in this sector"); Starfish Space Comments at 5 (recommending that as a baseline, the Commission not prohibit use by ISAM spacecraft of any frequency bands traditionally used for satellite communications).

<sup>158</sup> See, e.g., The White House, National Spectrum Strategy (2023), [https://www.ntia.gov/sites/default/files/publications/national\\_spectrum\\_strategy\\_final.pdf](https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf), at 4 ("Future demand for spectrum-based services and technologies is expected to grow substantially across many, if not all, of our Nation's commercial sectors... Meanwhile, demand for satellite-based services is exploding, with domestic firms filing license applications for constellations—some with tens of thousands of satellites—to support consumer broadband, in-space assembly and manufacturing, earth observation and imaging, cislunar activities, and a host of other uses."); NTIA Reply at 2 ("NTIA believes some ISAM needs can be met in the near-term within current spectrum allocations and through the use of existing and planned commercial services. Other types of access will require study and could involve changes to domestic and international allocations, radio service definitions, or both. Regardless, NTIA is committed to promoting the development of ISAM."); *Advancing Understanding of Non-Federal Spectrum Usage*, Notice of Inquiry, FCC 23-63, (Aug 4, 2023).

<sup>159</sup> *Small Satellite R&O*, 34 FCC Rcd at 13122, para. 112.

exclusive, shared basis, and would not cause interference to incumbent operators.<sup>160</sup> We therefore do not propose specific bands at this time and seek comment on this proposal.

39. *Less Traditional Spectrum Use.* Finally, we note that innovation in spectrum use may open new pathways for ISAM-related frequency use in the future. Commenters provide a range of examples and suggestions of less traditional spectrum use, such as increased use of inter-satellite links,<sup>161</sup> in-space radar systems to be used during proximity operations,<sup>162</sup> and unlicensed Wi-Fi spectrum for servicer-to-client satellite communications, especially when in close proximity, e.g. during docking activities.<sup>163</sup> These creative suggestions are evidence of the innovative nature of ISAM operations, but we tentatively conclude that these suggestions will require further study or changes at an international level, and we do not propose any changes to our current rules in relation to these novel suggestions.

#### **D. Digital Equity and Inclusion**

40. The NOI sought comment on “any equity-related considerations and benefits (if any) that may be associated with the topics discussed” in the NOI.<sup>164</sup> Aerospace provided several comments addressing digital equity and inclusion in the ISAM industry. Aerospace states, “[m]aintaining satellite connectivity that is both consistent and affordable is becoming more essential to remote regions that include tribal lands and rural areas, as well as urban centers of typically underserved populations disadvantaged by socioeconomic factors.”<sup>165</sup> We agree that promoting growth of the ISAM industry could create a safer and more sustainable space environment, which will allow for more options for broadband service for unserved and underserved areas.

41. Aerospace suggests that to promote digital equity and inclusion in the ISAM industry, the Commission should encourage inclusive business practices through incentive programs, such as reduced or waived regulatory fees and application filing fees for federally recognized small disadvantaged ISAM businesses and reduced or waived fees for debris-mitigating ISAM activities.<sup>166</sup> Aerospace notes that loss of satellite connectivity caused by debris or interference could mean a complete internet blackout for rural and other unserved and underserved areas which lack ground connectivity infrastructure, and therefore the Commission should work to incentivize ISAM activities which mitigate debris.<sup>167</sup> Aerospace is correct to note the importance of satellite connectivity, particularly in unserved and underserved regions, and ISAM activities, particularly servicing capabilities and debris remediation, have the potential to strengthen these networks to better serve these populations. As discussed above, however, we do not propose to reduce or eliminate fees for space stations that adopt ISAM-compatible technology because the Commission is

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<sup>160</sup> *Id.* at 13111-12, paras. 91-92.

<sup>161</sup> *See, e.g.*, Orbit Fab Comments at 21; Atomos Comments at 3-4; Atomos June 7, 2023 *Ex Parte* at 7; CONFERS Comments at 5-6; Rogue Space Comments at 6; *see also* Orbit Fab Reply at 6; Turion Comments at 6-7 (referencing WRC agenda item 1.17).

<sup>162</sup> *See* Rogue Space Reply at 2.

<sup>163</sup> *See, e.g.*, TechFreedom Comments at 19 (noting its use aboard the ISS since 2008); Atomos Comments at 5; CONFERS Comments at 5; Aerospace Comments at 23; Orbit Fab Reply at 5 (noting that unlicensed frequencies, such as the 2.4 GHz and 5 GHz bands, could be suitable for in-space operations without causing terrestrial interference); Atomos June 7, 2023 *Ex Parte* at 2, N.6 (acknowledging that the use of unlicensed Wi-Fi frequencies in space may best be addressed through the ITU, but the Commission could determine through a future NPRM if more immediate steps can be taken).

<sup>164</sup> *ISAM NOI*, 37 FCC Rcd at 10035-36, para. 42.

<sup>165</sup> Aerospace Comments at 1; *see also* Starfish Space Comments at 6 (“Achieving our nation's ambitions in space will require the knowledge, passion and commitment of diverse and talented minds.”).

<sup>166</sup> *See* Aerospace Comments at 61-62.

<sup>167</sup> *Id.* at 63-64.



required to collect application filing and regulatory fees by Congress,<sup>168</sup> and the Commission lacks authority to waive fees for whole categories of payors or to assess fees on factors other than cost of processing filings or regulatory burden.<sup>169</sup>

42. Aerospace also proposes specific regulations for the FCC to consider regarding spectrum which it states would benefit unserved and underrepresented populations.<sup>170</sup> Specifically, Aerospace suggests that the “FCC could propose spectrum sharing schemes that pool spectrum for Small Disadvantaged Businesses developing or supporting ISAM technology dedicated to public interest efforts specific to underserved customers or for use by academia with underrepresented student populations.”<sup>171</sup> We seek additional comment regarding this proposal. Specifically, how might we categorize “small disadvantaged businesses” in this context?<sup>172</sup> Are there other categories of businesses, organizations, or academic institutions that such a program would be appropriate for? More broadly, how would such a program work? What would the benefits and drawbacks be?

43. Finally, Aerospace suggests that the Commission consider regulatory changes to protect educational spectrum as a public good by requiring that educational spectrum licenses only be sold to other educational entities.<sup>173</sup> Aerospace also recommends the Commission limit the number of leasing agreements for spectrum to prevent hoarding of spectrum that could be used for ISAM operations which will benefit unserved and underserved populations, as well as regulations preventing harmful interference to spectrum users from vulnerable groups, such as farmers, coastal fishers, and gulf states during hurricane season, relying on accurate weather data.<sup>174</sup> We view these suggestions to be beyond the scope of this rulemaking, which is focused on developing rules to most effectively license ISAM space stations to nurture growth in the industry and ultimately benefit the public interest, and therefore we do not propose to incorporate Aerospace’s suggestions into our proposed rule changes in this proceeding.

44. ISAM is a nascent industry, and as such, we are seeking additional comments on ways the Commission can continue to incentivize the growth of the ISAM industry through the proposals in this NPRM and beyond. Furthermore, as part of our continuing effort to advance digital equity for all,<sup>175</sup> including people of color, people with disabilities, persons who live in rural or tribal areas, and others who are or have been historically underserved, marginalized, or adversely affected by persistent poverty or inequality, we continue to invite comment on any equity-related considerations<sup>176</sup> raised by the

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<sup>168</sup> 47 U.S.C. §§ 158 and 159.

<sup>169</sup> *Id.*

<sup>170</sup> *See* Aerospace Comments at 62.

<sup>171</sup> *Id.*

<sup>172</sup> We recognize the Small Business Administration has regulations and programs for small disadvantaged businesses in the federal contracting space. *See, e.g.*, 13 CFR § 124.1001; *see also* <https://www.sba.gov/federal-contracting/contracting-assistance-programs/small-disadvantaged-business#id-program-eligibility>.

<sup>173</sup> *See* Aerospace Comments at 62-63. Aerospace also recommends the Commission restrict use of proprietary tools used with educational spectrum to promote accessibility, open access, and interoperability. *Id.* at 63.

<sup>174</sup> *Id.* at 63.

<sup>175</sup> Section 1 of the Communications Act provides that the FCC “regulat[es] interstate and foreign commerce in communication by wire and radio so as to make [such service] available, so far as possible, to all the people of the United States, without discrimination on the basis of race, color, religion, national origin, or sex.” 47 U.S.C. § 151.

<sup>176</sup> The term “equity” is used here consistent with Executive Order 13985 as the “consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment, such as Black, Latino, and Indigenous and Native American persons, Asian Americans and Pacific Islanders and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality.” *See* Exec. Order No. 13985, 86 Fed. Reg. 7009,

(continued....)

proposals made in this NPRM. Specifically, we continue to seek comment on how the topics discussed and any related proposals may promote or inhibit advances in diversity, equity, inclusion, and accessibility, as well as the scope of the Commission's relevant legal authority.

#### IV. PROCEDURAL MATTERS

##### A. *Ex Parte* Rules - Permit-But-Disclose

45. This proceeding shall be treated as a "permit-but-disclose" proceeding in accordance with the Commission's *ex parte* rules.<sup>177</sup> Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter's written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with section 1.1206(b). In proceedings governed by section 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (e.g., .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules.

##### B. Filing Requirements—Comments and Replies

46. *Filing Comments.* Pursuant to sections 1.415 and 1.419 of the Commission's rules, 47 CFR §§ 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS). See *Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- *Electronic Filers.* Comments may be filed electronically using the Internet by accessing the ECFS: <http://apps.fcc.gov/ecfs>.
- *Paper Filers.* Parties who choose to file by paper must file an original and one copy of each filing.
  - Filings can be sent by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.
  - Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9050 Junction Drive, Annapolis Junction, MD 20701. U.S. Postal Service first-class, Express, and Priority mail must be addressed to 45 L Street NE Washington, DC 20554.
  - Effective March 19, 2020, and until further notice, the Commission no longer accepts any hand or messenger delivered filings. This is a temporary measure taken to help protect the health and safety of individuals, and to mitigate the transmission of COVID-19. See *FCC Announces Closure of FCC Headquarters Open Window and*

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Executive Order on Advancing Racial Equity and Support for Underserved Communities Through the Federal Government (January 20, 2021).

<sup>177</sup> 47 CFR § 1.1200 *et seq.*

Change in Hand-Delivery Policy, Public Notice, DA 20-304 (March 19, 2020).  
<https://www.fcc.gov/document/fcc-closes-headquarters-open-window-and-changes-hand-delivery-policy>.

- *Persons with Disabilities.* To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to [fcc504@fcc.gov](mailto:fcc504@fcc.gov) or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (TTY).

### C. Initial Regulatory Flexibility Act Analysis

47. The Regulatory Flexibility Act of 1980, as amended (RFA),<sup>178</sup> requires that an agency prepare a regulatory flexibility analysis for notice and comment rulemakings, unless the agency certifies that “the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities.”<sup>179</sup> Accordingly, the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) concerning the possible impact of the rule changes contained in this *NPRM* on small entities. The IRFA is set forth in Appendix B. Written public comments are requested on the IRFA. Comments must be filed by the deadlines for comments on the *NPRM* indicated on the first page of this document and must have a separate and distinct heading designating them as responses to the IRFA.

### D. Initial Paperwork Reduction Act Analysis

48. This document contains proposed new or modified information collection requirements. The Commission, as part of its continuing effort to reduce paperwork burdens, invites the general public and the Office of Management and Budget (OMB) to comment on the information collection requirements contained in this document, as required by the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. In addition, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. § 3506(c)(4)), we seek specific comment on how we might further reduce the information collection burden for small business concerns with fewer than 25 employees.

### E. Providing Accountability Through Transparency Act

49. Consistent with the Providing Accountability Through Transparency Act, Public Law 118-9, a summary of this document will be available on <https://www.fcc.gov/proposed-rulemakings>.<sup>180</sup>

### F. Further Information

50. For additional information on this proceeding, contact Jameyanne Fuller, Space Bureau, Satellite Programs and Policy Division at 202-418-0945 or at [Jameyanne.Fuller@fcc.gov](mailto:Jameyanne.Fuller@fcc.gov).

## V. ORDERING CLAUSES

51. Accordingly, IT IS ORDERED that, pursuant to sections 4(i), 301, 302(a), 303(e), 303(f), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 301, 302(a), 303(e), 303(f), and 303(r), this Notice of Proposed Rulemaking IS ADOPTED.

52. IT IS FURTHER ORDERED that, the Commission’s Office of the Secretary, Reference Information Center SHALL SEND a copy of this *Notice of Proposed Rulemaking*, including the Initial Regulatory Flexibility Act Analysis, to the Chief Counsel for Advocacy of the Small Business Administration, and shall cause it to be published in the Federal Register.

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<sup>178</sup> 5 U.S.C. §§ 601–612. The RFA has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

<sup>179</sup> 5 U.S.C. § 605(b).

<sup>180</sup> 5 U.S.C. § 553(b)(4). The Providing Accountability Through Transparency Act, Pub. L. No. 118-9 (2023), amended section 553(b) of the Administrative Procedure Act.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch  
Secretary

**APPENDIX A**  
**Proposed Rules**

For the reasons discussed in the document, the Federal Communications Commission proposes to amend title 47 of the Code of Federal Regulations, part 25, as follows:

**PART 25 – SATELLITE COMMUNICATIONS**

1. The authority citation for part 25 continues to read as follows:

**Authority:** 47 U.S.C. 154, 301, 302, 303, 307, 309, 310, 319, 332, 605, and 721, unless otherwise noted.

2. Amend § 25.103 by adding a definition for “ISAM Space station” in alphabetical order to read as follows:

**§ 25.103 Definitions.**

\* \* \* \* \*

*ISAM Space station.* A space station which has the primary purpose of conducting in-space servicing, assembly, and/or manufacturing activities used on-orbit, on the surface of celestial bodies, and/or in transit between these regimes and which are supported by radiofrequency operations. Servicing activities include but are not limited to in-space inspection, life extension, repair, refueling, alteration, and orbital transfer of a client space object, including collection and removal of debris on orbit. Assembly activities involve the construction of space systems in space using pre-manufactured components. Manufacturing activities involve the transformation of raw or recycled materials into components, products, or infrastructure in space. ISAM space stations are eligible for authorization under the application process described in § 25.126.

\* \* \* \* \*

3. Add § 25.126, to read as follows:

**§ 25.126 Applications for ISAM Space stations.**

(a) This section shall only apply to applicants for ISAM space stations as defined in § 25.103. Applicants seeking authorization for ISAM space stations must submit a comprehensive proposal for Commission evaluation on FCC Form 312, Main Form and Schedule S, as described in § 25.114(a) through (c), together with the information required in § 25.114(d)(14) or, if the applicant is seeking authorization under the streamlined processes for small satellites or small spacecraft, the information required in § 25.122(c) and (d) or § 25.123(b) and (c).

(b) Applicants for ISAM space stations will not be placed in a processing round for NGSO-like operations under § 25.157 or placed in a queue for GSO-like operations under § 25.158, provided:

(1) the applicant certifies that operations of the space station(s) will be compatible with existing operations in the authorized frequency band(s) and will not materially constrain future space station entrants from using the authorized frequency band(s); and

(2) the applicant submits a narrative description of means by which requested spectrum could be shared with both current and future operators, (e.g., how ephemeris data will be shared, antenna design, earth station geographic locations) thereby not materially constraining other operations in the requested frequency band(s).

(c) Applicants for ISAM space stations must also provide the following:

(1) A list of the FCC file numbers or call signs for any applications or Commission grants related to the proposed operations (e.g., experimental license grants, other space station or earth station applications or grants), including but not limited to client space stations, space stations that have become debris the applicant seeks to remediate, and other space stations the applicant plans to interact with or collaborate with as part of its operations.

(2) A list of the International Telecommunications Union filings and United Nations Registration information for any space stations not licensed or granted market access by the United States that are related to the proposed operations, including but not limited to client space stations, space stations that have become debris the applicant seeks to remediate, and other space stations the applicant plans to interact with or collaborate with as part of its operations.

(3) For all related space stations included under paragraph (c)(2) of this section, a narrative description of the regulatory requirements to which these related space stations are subject and the status of licenses of these related space stations.

\* \* \* \* \*

4. Amend § 25.137, by revising paragraph (b) to read as follows:

**§ 25.137 Requests for U.S. market access through non-U.S.-licensed space stations.**

\* \* \* \* \*

(b) Any request pursuant to paragraph (a) of this section must be filed electronically through the International Communications Filing System and must include an exhibit providing legal and technical information for the non-U.S.-licensed space station of the kind that § 25.114 or § 25.122 or § 25.123 or § 25.126 would require in a license application for that space station, including but not limited to, information required to complete Schedule S. An applicant may satisfy this requirement by cross-referencing a pending application containing the requisite information or by citing a prior grant of authority to communicate via the space station in question in the same frequency bands to provide the same type of service.

\* \* \* \* \*

5. Amend § 25.157, by revising paragraph (i) to read as follows:

**§ 25.157 Consideration of applications for NGSO-like satellite operation.**

\* \* \* \* \*

(i) For consideration of license applications filed pursuant to the procedures described in § 25.122, § 25.123, or § 25.126 the application will be processed and granted in accordance with §§ 25.150 through 25.156, taking into consideration the information provided by the applicant under § 25.122(d), § 25.123(c), or § 25.126(b) but without a processing round as described in this section and without a queue as described in § 25.158.

6. Amend § 25.158, by revising paragraph (a)(2) to read as follows:

**§ 25.158 Consideration of applications for GSO-like satellite operation.**

(a) \* \* \*

(2) The procedures prescribed in this section do not apply to an application for authority to launch and operate an ISAM space station that meets the relevant criteria in § 25.126(b). The procedures prescribed in this section also do not apply to an application for authority to launch and operate a replacement space station that meets the relevant criteria in § 25.165(e)(1) and (e)(2) and that will be launched before the space station to be replaced is retired from service or reasonable time after the loss of a space station during launch or due to premature failure in orbit.

\* \* \* \* \*

7. Amend § 25.165 by revising the introductory text in paragraph (a) to read as follows:

**§ 25.165 Surety bonds.**

(a) For all space station licenses issued after September 20, 2004, other than licenses for SDARS space stations, space stations licensed in accordance with § 25.122, § 25.123, or § 25.126, and replacement

space stations as defined in paragraph (e) of this section, the licensee must post a bond within 30 days of the grant of its license. Space stations licensed in accordance with § 25.122, § 25.123, or § 25.126 must post a bond within one year plus 30 days of the grant of the license. Failure to post a bond will render the license null and void automatically.

\* \* \* \* \*



## APPENDIX B

### Initial Regulatory Flexibility Analysis

1. As required by the Regulatory Flexibility Act (RFA),<sup>1</sup> the Commission has prepared this Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities by the policies and rules proposed in the Notice of Proposed Rulemaking (*NPRM*). The Commission requests written public comments on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines provided on the first page of the *NPRM*. The Commission will send a copy of the *NPRM*, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).<sup>2</sup> In addition, the *NPRM* and IRFA (or summaries thereof) will be published in the Federal Register.<sup>3</sup>

#### A. Need for, and Objectives of, the Proposed Rules

2. The Commission advances the leadership role of the United States in space with a new framework for licensing space stations engaged in in-space servicing, assembly, and manufacturing, known as (ISAM), proposed in the *NRPM*. The *NPRM* reflects comments the Commission received in response to a Notice of Inquiry on ISAM (*ISAM NOI*), which requested comment on the current state of the industry, how the Commission can best support the sustainable development of the industry, and what tangible economic and societal benefits can result from the expansion of capabilities facilitating the sustainable use of space.<sup>4</sup> The Commission seeks comment on several proposals relating to changes to the Commission's rules and policies for radiofrequency communication to foster the advancement of in-space servicing, assembly, and manufacturing (ISAM) operations. The Commission believes effective radiofrequency communications will enable expansion of capabilities for space use and has proposed rules designed to facilitate and support growth.

3. The licensing framework rules the Commission proposed in the *NPRM* would accommodate authorization under part 25 of the Commission's rules for commercial space stations engaged in ISAM operations. Adoption of the proposed changes would modify 47 CFR Part 25 of the Commission's rules to make communication authorization for ISAM missions more accessible while promoting efficient use of spectrum. The ability of ISAM space station operators to apply under the existing small satellite and small spacecraft streamlined processes would be available to ISAM space station operators that meet the requisite requirements for the applicable process. Licensing under part 5 of the Commission's experimental licensing will also continue to be an option for licensing ISAM space stations that do not provide commercial service. The Commission's proposed approach in the *NPRM* to license ISAM space stations under its current rules, and to review ISAM applications on a case-by-case basis, will provide the industry with flexibility while ISAM capabilities develop, and will enable the Commission to continue developing a record on ISAM while gaining further experience licensing radiofrequency use for ISAM space stations.

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<sup>1</sup> 5 U.S.C. § 603. The RFA, 5 U.S.C. §§ 601-612 has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 847 (1996).

<sup>2</sup> 5 U.S.C. § 603(a).

<sup>3</sup> *Id.* § 603(a).

<sup>4</sup> *Space Innovation; Facilitating Capabilities for In-space servicing, Assembly and Manufacturing, Notice of Inquiry*, 37 FCC Rcd 10022 (2022) (*ISAM NOI*). The Commission received initial comments from 24 ISAM operators, satellite operators, industry groups, and government agencies; reply comments from 10 parties; and ex parte filings on the record from several parties.

**B. Legal Basis**

4. The proposed action is authorized under sections 4(i), 301, 302(a), 303(e), 303(f), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 301, 302(a), 303(e), 303(f), and 303(r).

**C. Description and Estimate of the Number of Small Entities to Which the Proposed Rules will Apply**

5. The RFA directs agencies to provide a description of, and where feasible, an estimate of the number of small entities that may be affected by the proposed rules and policies, if adopted.<sup>5</sup> The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”<sup>6</sup> In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.<sup>7</sup> A “small business concern” is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.<sup>8</sup>

6. *Satellite Telecommunications.* This industry comprises firms “primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.”<sup>9</sup> Satellite telecommunications service providers include satellite and earth station operators. The SBA small business size standard for this industry classifies a business with \$38.5 million or less in annual receipts as small.<sup>10</sup> U.S. Census Bureau data for 2017 show that 275 firms in this industry operated for the entire year.<sup>11</sup> Of this number, 242 firms had revenue of less than \$25 million.<sup>12</sup> Additionally, based on Commission data in the 2022 Universal Service Monitoring Report, as of December 31, 2021, there were 65 providers that reported they were engaged in the provision of satellite telecommunications services.<sup>13</sup> Of these providers, the Commission estimates that approximately 42 providers have 1,500 or fewer employees.<sup>14</sup> Consequently, using the SBA’s small business size standard, a little more than half of these providers can be considered small entities.

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<sup>5</sup> 5 U.S.C. § 603(b)(3).

<sup>6</sup> 5 U.S.C. § 601(6).

<sup>7</sup> 5 U.S.C. § 601(3) (incorporating by reference the definition of “small-business concern” in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies “unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.”

<sup>8</sup> 15 U.S.C. § 632.

<sup>9</sup> See U.S. Census Bureau, *2017 NAICS Definition, “517410 Satellite Telecommunications,”* <https://www.census.gov/naics/?input=517410&year=2017&details=517410>.

<sup>10</sup> See 13 CFR § 121.201, NAICS Code 517410.

<sup>11</sup> See U.S. Census Bureau, *2017 Economic Census of the United States, Selected Sectors: Sales, Value of Shipments, or Revenue Size of Firms for the U.S.: 2017*, Table ID: EC1700SIZEREVFIRM, NAICS Code 517410, <https://data.census.gov/cedsci/table?y=2017&n=517410&tid=ECNSIZE2017.EC1700SIZEREVFIRM&hidePreview=false>.

<sup>12</sup> *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard. We also note that according to the U.S. Census Bureau glossary, the terms receipts and revenues are used interchangeably, see [https://www.census.gov/glossary/#term\\_ReceiptsRevenueServices](https://www.census.gov/glossary/#term_ReceiptsRevenueServices).

<sup>13</sup> Federal-State Joint Board on Universal Service, Universal Service Monitoring Report at 26, Table 1.12 (2022), <https://docs.fcc.gov/public/attachments/DOC-391070A1.pdf>.

<sup>14</sup> *Id.*

7. *All Other Telecommunications*. This industry is comprised of establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation.<sup>15</sup> This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems.<sup>16</sup> Providers of Internet services (e.g. dial-up ISPs) or Voice over Internet Protocol (VoIP) services, via client-supplied telecommunications connections are also included in this industry.<sup>17</sup> The SBA small business size standard for this industry classifies firms with annual receipts of \$35 million or less as small.<sup>18</sup> U.S. Census Bureau data for 2017 show that there were 1,079 firms in this industry that operated for the entire year.<sup>19</sup> Of those firms, 1,039 had revenue of less than \$25 million.<sup>20</sup> Based on this data, the Commission estimates that the majority of “All Other Telecommunications” firms can be considered small.

#### **D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities**

8. The *NPRM* seeks public comment on proposed revisions to the Commission’s rules governing satellite and earth station applications under 47 CFR part 25. Specifically, the *NPRM* proposes and seeks comment on several rule changes that will affect ISAM communications authorization procedures, reporting, recordkeeping, and other compliance requirements for space station operators. The Commission believes the proposed changes would decrease the burden in various regards for small entities that plan to launch and operate ISAM space stations.

9. The *NPRM* proposes to add a new section to the Commission’s rules, section 25.126 Application for ISAM Space Stations, which clarifies application requirements for ISAM space stations in a single section. These proposals include documentation requirements largely consistent with those already established for an applicant under part 25 of the Commission’s rules. In proposed section 25.126(a), applicants that meet the proposed definition of “ISAM space station” are directed to seek authorization and submit the requisite application information and materials either through the Commission’s regular part 25 process or through the streamlined processes for small satellites and small spacecraft. As such, ISAM space station license applicants, including small entities, that also meet the requirements to seek authorization under the Commission’s current streamlined processes for small satellites or small spacecraft will be able to submit the information and certification required in section 25.122 or section 25.123 rather than the regular part 25 authorization process.

10. In the new section 25.126(b), the Commission proposes to exempt small entities and other operators that meet the definition of ISAM space stations from non-geostationary orbit (NGSO) processing rounds and/or the first-come-first-served queue for geostationary orbit (GSO) operators, provided the applicant certifies that the operations of the space station(s) will be compatible with existing operations in the authorized frequency band(s), and submits a narrative to demonstrate spectrum sharing

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<sup>15</sup> See U.S. Census Bureau, *2017 NAICS Definition*, “517919 All Other Telecommunications,” <https://www.census.gov/naics/?input=517919&year=2017&details=517919>.

<sup>16</sup> *Id.*

<sup>17</sup> *Id.*

<sup>18</sup> See 13 CFR § 121.201, NAICS Code 517919 (as of 10/1/22, NAICS Code 517810).

<sup>19</sup> See U.S. Census Bureau, *2017 Economic Census of the United States, Selected Sectors: Sales, Value of Shipments, or Revenue Size of Firms for the U.S.: 2017*, Table ID: EC1700SIZEREVFIRM, NAICS Code 517919, <https://data.census.gov/cedsci/table?y=2017&n=517919&tid=ECNSIZE2017.EC1700SIZEREVFIRM&hidePreview=false>.

<sup>20</sup> *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard. We also note that according to the U.S. Census Bureau glossary, the terms receipts and revenues are used interchangeably, see [https://www.census.gov/glossary/#term\\_ReceiptsRevenueServices](https://www.census.gov/glossary/#term_ReceiptsRevenueServices).

capabilities are technically possible, and that the operations will not materially constrain future space station entrants from using the authorized frequency band(s). While the exemption contains a certification and narrative submission requirement, the proposal is designed to provide more flexibility to small and other operators who may want to operate as a GSO or NGSO space station, while simultaneously providing interference protection for incumbent and future satellite operators. The proposed rule would also reduce the procedural requirements for small entities and other applicants.

11. Pursuant to proposed section 25.126(c), ISAM space station license applicants, including small entities, would need to provide the International Communications Filing System (ICFS) file number for any applications or Commission grants related to proposed operations (e.g., experimental license grants, other space station or earth station applications or grants), including but not limited to client space stations, space stations that have become debris the applicant seeks to remediate, and other space stations the applicant plans to interact with or collaborate with as part of its operations. Additionally, ISAM applicants working with space stations not licensed or granted market access by the United States would need to provide relevant information related to those operations, including International Telecommunication Union (ITU) file numbers and a narrative description. However, since the international-related filing requirements would only pertain to operators working with space stations that are not licensed or granted market access by the United States, the requirement for applicants who do not have such working relationships is largely to provide the appropriate file numbers. Therefore, the Commission does not believe the inclusion of the proposed filing requirements in section 25.126(c) will increase the procedural compliance burdens for small entities.

12. As a mechanism for fostering the growth of the burgeoning ISAM industry the licensing framework proposal includes a one-year grace period for surety bonds for small and other ISM applicants, just as the Commission has done for operators applying through the small satellite and small spacecraft rules. The Commission seeks comment on whether any of the burdens associated with complying with the filing, recordkeeping, and reporting requirements in our proposed licensing framework can be further minimized for small entities. Due to our proposed approach to license ISAM space stations under the Commission's current rules including allowing applicants to seek authorization under the Commission's current streamlined processes for small satellites or small spacecraft, we do not expect that small entities will need to hire professionals to comply with any of the requirements for ISAM space station authorization. With regard to the compliance costs for small entities, at this time the Commission cannot quantify the compliance costs for small entities. We therefore expect the information we received in comments to include cost and benefit analysis data which should help the Commission assess compliance costs. Industry input should also allow the Commission to identify and evaluate additional matters, and burdens relevant to small entities that may result from the proposals and inquiries we make in this proceeding.

**E. Steps Taken to Minimize the Significant Economic Impact on Small Entities, and Significant Alternatives Considered**

13. The RFA requires an agency to describe any significant, specifically small business, alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): “(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rules for such small entities; (3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.”<sup>21</sup>

14. The Commission's consideration of rule revisions to reflect changes and advances in the commercial space industry includes proposals in the licensing framework that would assist in reducing the economic impact for small entities such as exempting ISAM applicants from the surety bond requirement for one year after an ISAM license is granted, and not subjecting applications for ISAM space stations to

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<sup>21</sup> 5 U.S.C. § 603(c)(1)–(c)(4).

NGSO processing round procedures or the GSO operator queue. These proposals are designed to lower the regulatory burden involved in licensing ISAM operations and reduce application processing times, thereby lessening the burden of compliance on small entities with more limited resources than larger entities. The Commission considered not providing these exemptions, which would require ISAM operators, including small entities, applying under the Commission's regular part 25 process to engage in a more lengthy and complex procedural process. ISAM applicants for example, could be placed in a processing round or required to submit requests for waiver, which the Commission believes may have a greater impact on small entities than the *NPRM*'s proposal to exempt ISAM operators from these processes so long as they provide the requisite demonstrations for spectrum sharing. In the formulation of our surety bond requirement proposal, the Commission considered a recommendation that ISAM operators be allowed to demonstrate compliance with the policy objectives of the surety bond requirements in place of filing an actual surety bond.<sup>22</sup> Implementation of this recommendation would introduce additional review into the licensing process on a larger scale than allowing individual applications to demonstrate such showings through a waiver request, which is currently an available avenue for applicants under our general waiver rules, therefore the Commission did not include this in the proposal.

15. Small entities and other operators meeting the proposed definition of an ISAM space station would be required to include some additional information with their application by providing the ICFS file numbers for related applications or grants of authority, if this proposed rule is adopted. This requirement may ultimately lower the impact on small entities and other operators however, since providing the file numbers up front could lower the need for, and costs associated with additional follow-up and review at a later stage of the application process. Similarly, the Commission believes that the proposed requirement for ISAM applicants to provide relevant international filings for related space stations not licensed or granted market access by the United States while creating some additional steps on the front end, will ultimately lead to a smoother review process for small entities and other applicants who may be servicing or partnering with foreign-licensed space stations as part of their operations.

16. Although the Commission ultimately proposed to continue the use of part 5 and 25 rules for the ISAM space station operation licensing framework, we considered various alternatives for the framework proposal. The Commission assessed for example the use of different licensing requirements for different types of ISAM activities. Rather than proposing to adopt different regulatory requirements, we chose to propose a broad licensing framework for space stations that could be applicable to all activities that fall within the proposed definition of ISAM. The proposed licensing framework provides small entities and other ISAM space station applicants with several options to use to apply for authorization. The option available for small entities meeting the process requirements to utilize the Commission's existing streamlined processes for small satellites and small spacecraft as described in the *NPRM* should reduce the impact for these applicants because of the reduced burden of the streamlined processes. Small entities seeking Commission authorization as ISAM space station operators may already have experience, and familiarity with the existing processes, and have cost-effective and efficient internal procedures in place to execute the streamlined processes. To the extent a small entity does not meet the requirements for the streamlined processes for small satellites and small spacecraft and seeks authorization through the regular part 25 process, the proposed exemptions and reduced regulatory burdens discussed above will result in a less arduous and costly approach than would be available in the absence of the new section and other proposed rule changes. Small entities may also benefit from the continuation of the part 5 process as a means of authorization since several ISAM space stations have secured experimental licenses using this process. Similarly, the part 5 process may be of assistance to small entity ISAM applicants with an interest in market trials.

17. In response to the *ISAM NOI*, comments were filed involving spectrum regulation

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<sup>22</sup> Spaceflight Comments at 8.

impacting small disadvantaged businesses.<sup>23</sup> The Commission considered these comments which suggest the Commission propose spectrum sharing arrangements to pool spectrum impacting small disadvantaged businesses that develop, or support ISAM technology targeting underserved customers, or academic institutions with underrepresented student populations,<sup>24</sup> and in the *NPRM* the Commission requested additional comment on this proposal, including how such arrangements would work, and the benefits and drawbacks of such arrangements. The Commission expects to consider this, and other issues discussed herein, as well as the economic impact on, and alternatives for small entities, based on its review of any comments filed in response to the *NPRM* and this IRFA.

**F. Federal Rules that may Duplicate, Overlap, or Conflict with the Proposed Rules**

18. None.

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<sup>23</sup> Aerospace Comments at 62.

<sup>24</sup> *Id.*

**APPENDIX C**  
**List of Commenters to Notice of Inquiry**

**Comments**

Aerospace Corporation  
The Aerospace Industries Association  
The Air Lines Pilot Association, International  
Astroscale U.S.  
Atomos Nuclear and Space Corporation  
Blue Origin  
The Commercial Spaceflight Federation  
Consortium for the Execution of Rendezvous and Servicing Operations  
Intelsat License LLC.  
Lockheed Martin Corporation  
National Telecommunications and Information Administration  
Orbit Fab Inc.  
Relativity Space Inc.  
Rogue Space Systems Corporation  
Siera Space Corporation  
Space Exploration Technologies Corp.  
Spaceflight Inc.  
Starfish Space Inc.  
TechFreedom  
Thuraya Telecommunications Company  
Turion Space Corp.  
United Launch Alliance LLC.  
WorldVu Satellites Limited

**Reply Comments**

Astroscale U.S.  
Iridium Communications Inc.  
Intelsat License LLC.  
Kuiper Systems LLC.  
National Telecommunications and Information Administration  
Orbit Fab Inc.  
Rogue Space Systems Corporation  
Space Exploration Technologies Corp.  
Spaceflight Inc.  
U.S. Chamber of Commerce  
Viasat Inc.

**Ex Parte Filings**

Astroscale U.S.  
Atomos Nuclear and Space Corporation  
Blue Origin  
Satellite Industry Association  
Space Exploration Technologies Corp.  
United Launch Alliance



**STATEMENT OF  
CHAIRWOMAN JESSICA ROSENWORCEL**

Re: ***In the Matter of Space Innovation, IB Docket No. 22-271; Facilitating Capabilities for In-space Servicing, Assembly, and Manufacturing, IB Docket No. 22-272, Notice of Proposed Rulemaking (February 15, 2024)***

In technology 2007 was a big year. In fact, Thomas Friedman wrote a book about it, “Thank You for Being Late,” which drew attention to how the launch of the iPhone, the globalization of social media platforms and the creation of Watson, an early Artificial Intelligence system, all took place during this year. But something else happened in 2007 that deserves attention. There was a game-changing launch at Cape Canaveral called Orbital Express. It was an experiment by the Defense Advanced Research Projects Agency that pioneered a new type of space mission featuring two satellites that would rendezvous in our skies in order to transfer propellant and hardware. The idea was simple—if we can service satellites in orbit we can extend the lifespan of their missions, enhance their capabilities, and reduce their costs.

Fast forward to now. A new space age is here and the ideas behind Orbital Express have taken hold in our skies with in-space servicing, assembly, and manufacturing—or ISAM. Today, ISAM is a growing part of the space economy. It includes a range of in-space activities, from repairing and refueling satellites to assembling whole new systems in space. It can even include systems for the manufacturing of new parts, products, or infrastructure in orbit. Plus, it can help with space sustainability through the development of technologies to capture and remove orbital debris and assist with reuse and recycling of in-orbit systems. On top of that, it has the potential to support new services like space tugs and new products that leverage microgravity to achieve results impossible back on Earth.

I believe our grandest ambitions for space will depend on developing these ISAM capabilities. Because if we want to expand connectivity on Earth, address global climate change, protect our national security, and support human life on the moon and beyond, we will benefit from ISAM systems.

That is why today we are proposing a new framework to license ISAM space stations and ensure they have access to the communications necessary for their effective use. We have developed common sense, flexible rules that provide ISAM operators a clear path forward for their applications for novel use cases so they can develop new services in our skies.

While Orbital Express left orbit over a decade ago, it was an incredible experiment. In fact, this rulemaking might not have been possible without it. It is also incredible to take a look back at Thomas Friedman’s book about 2007. Because if you comb through the index, space gets a single mention. Only one. But the good news is at this agency we clearly see the vast possibilities of the space economy and are taking steps now to support it.

Thank you to the staff who worked on this effort in our Space Innovation docket. From the Space Bureau: Victor Allison, Christina Almonte, Bill Belt, Matias Cava, Steve Duall, Jameyanne Fuller, Jennifer Gilsean, Julie Kearney, Whitney Lohmeyer, Karl Kensinger, Scott Mackoul, Julia Malette, Kerry Murray, Brandon Padgett, Jeanine Poltronieri, Troy Tanner, Patrick Webre, and Merissa Velez. From the Enforcement Bureau: Jeremy Marcus, Ryan McDonald and Victoria Randazzo. From the Office of Communications Business Opportunities: Joycelyn James, Joy Ragsdale and Chana Wilkerson. From the Office of Economics and Analytics: Aleks Yankelevich. From the Office of Engineering and Technology: Jamie Coleman, Michael Ha, Ira Keltz, Nick Oros, Jamison Prime, and Serey Thai. From the Office of the General Counsel: Susan Aaron, Deborah Broderson, David Konczal, Andrea Kelly, Anjali Singh, and Jeff Steinberg. And from the Office of International Affairs: Nese Gundelsberger, Dante Ibarra, and Michele Wu-Bailey.