Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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

Comments of TechFreedom

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October 31, 2022

Summary

In-space Servicing, Assembly, and Manufacturing (ISAM) represents the next great space race for humanity. Gone are the days when, to launch a satellite into outer space, it took a minimum of three years to develop, manifest for launch, and receive the necessary federal authorizations, all costing many millions. Today, you can literally go from the back of a napkin to launch and deployment in a few months and for less than $500,000. This will only accelerate in the era of the SpaceX Starship, where 100-ton payloads can be launched on a regular, rapid cadence. This will utterly transform how space systems are designed, reducing the time to launch from years to mere weeks. This *NOI* is timely.

The *NOI* fails to ask the fundamental question, however, of what statutory role the FCC has in this ecosystem. We think its jurisdiction is far narrower than portrayed in the *NOI* and based on comments already in the record by members of Congress, others agree. Further, the FCC lacks the necessary expertise to regulate *operations* in space. Other government agencies have been tasked with guiding the emergence of these new industries, and the FCC risks widespread discord if it proceeds without interagency coordination.

What the FCC does have is a vital role in identifying spectrum, encouraging radio engineering development, and adopting flexible regulatory systems that do not stifle the accelerating rate of development of these markets. This burgeoning market demands new approaches to spectrum, and entirely new approaches to licensing regimes. Get it right, and the United States will cement its dominance in commercial space for the next century. Get it wrong, and we will see the greatest brain drain in human history, as U.S. industry moves overseas to seek out regulatory regimes that are flexible and speedy enough to meet market demands. The stakes are that high.

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TechFreedom hereby files these Comments in response to the *Notice of Inquiry*, issued August 5, 2022, in the above-referenced proceedings seeking comment on the FCC's role in establishing rules related to in-space servicing, assembly, and manufacturing ("ISAM").[1] In response, TechFreedom submits:

I. About TechFreedom

TechFreedom is a nonprofit think tank dedicated to promoting the progress of technology that improves the human condition. To this end, we seek to advance public policy that makes experimentation, entrepreneurship, and investment possible, and thus unleashes the ultimate resource: human ingenuity. Wherever possible, we seek to empower users to make their own choices online and elsewhere.

[1] *Space Innovation; Facilitating Capabilities for In-Space Servicing, Assembly, and Manufacturing, Notice of Inquiry*, FCC 22-66 (released Aug. 8, 2022) ("NOI"). The *NOI* was published in the Federal Register on September 14, 2022. 87 Fed. Reg. 56365 (Sept. 14, 2022). The Federal Register Notice set the comment date as October 31, 2022, and reply comment date of November 18, 2022. These comments are timely filed.

TechFreedom and undersigned counsel have a long history advocating for innovative uses of outer space.[2] The instant proceeding sits at the intersection of spectrum policy and space law, a place we've inhabited for decades. We are uniquely suited to provide commentary in proceeding, especially some of the key principles espoused in the *NOI.*

II. A Notice of Inquiry Is the Proper Starting Point

TechFreedom has long urged the FCC not to issue an NPRM in the "asking questions" stage of a proceeding. So we applaud the Commission for issuing this NOI rather than jumping directly to an NPRM.[3] Whatever discretion the Commission enjoys under the Administrative Procedure Act[4] to configure its rulemaking process, the longstanding

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[2] *See, e.g., Reopening the American Frontier: Exploring How the Outer Space Treaty Will Impact American Commerce and Settlement in Space, Before the Senate Comm. on Commerce, Sci., & Transp. Subcomm. on Space, Sci., and Competitiveness*, 115th Cong. (2017) (written testimony of James E. Dunstan & Berin Szoka), https://www.commerce.senate.gov/services/files/A9AD88B2-9636-4291-A5B0-38BC0FF6DA90, video of hearing available at https://www.commerce.senate.gov/2017/5/reopening-the-american-frontier-exploringhow-the-outer-space-treaty-will-impact-american-commerce-and-settlement-in-space; *Artemis Accords: One Small Step for NASA, Not So Giant a Leap for Space Law*, TECHFREEDOM (May 15, 2020), https://techfreedom.org/artemis-accords-one-small-step-for-nasa-not-so-giant-a-leap-for-space-law/; *Revived National Space Council Could Mean Space Policy Rethink*, TECHFREEDOM (July 7, 2017), https://techfreedom.org/revived-national-spacecouncil-mean-space-policy-rethink/; J. Dunstan, "*Space Trash:" Lessons Learned (and Ignored) from Space Law and Government*, 39 J. OF SPACE L. 23 (2013).

[3] *See* TechFreedom, Comments on the Infrastructure Investment and Jobs Act: Prevention and Elimination of Digital Discrimination, GN Docket No. 22-69 (May 16, 2022), https://techfreedom.org/wp-content/uploads/2022/05/TechFreedom-Digital-Discrimination-NOI-Comments.pdf; TechFreedom, Comments on Expanding Flexible Use of the 12.2-12.7 GHz Band, WT Docket No. 20-443 (July 7, 2021), http://techfreedom.org/wp-content/uploads/2021/05/TF-Comments-12-GHz-NPRM-4-7-21.pdf; TechFreedom & The International Center for Law & Economics, Reply Comments on Modernizing the E-rate Program for Schools and Libraries at 4, n.8, WC Docket No. 13-184 (Nov. 7, 2013), http://docs.techfreedom.org/E_Rate_Reply_Comments.pdf ("the FCC should have issued a Notice of Inquiry before issuing this NPRM for precisely this reason—a mistake the FCC all too often makes, frequently putting the Commission in the awkward position of being on the verge of rulemaking without first properly exploring the facts on the ground. This is the worst kind of putting the cart before the horse.").

[4] Pub. L. No. 79-404, 60 Stat. 237 (1946) (codified as amended at 5 U.S.C. § 551 et seq.).

pattern—under chairs of both parties—of jumping directly to an NPRM without an NOI often leads to a situation of "ready, fire, aim!"[5] The Commission cannot fully understand the most important, most complex issues without the basic comments to be produced by an NOI. If the Commission attempts to include draft rules in the NPRM, those rules often rest on significant misunderstanding. If, absent sufficient information, the Commission does not include draft rules in the NPRM, it compounds the problem by denying regulated parties an opportunity to provide specific input on specific proposals. Here, an NOI is the proper approach.

III. The FCC Lacks Statutory Authority to Regulate ISAM

Although the *NOI* asks a number of fascinating questions concerning the FCC's role in the future of space operations and the development of a vibrant outer space economy, it fails to ask the fundamental question of whether the FCC has statutory authority to write rules that impact ISAM. This did not escape the notice of several members of Congress, who have already submitted a bipartisan letter in the docket warning the FCC that it may be overstepping its jurisdiction, and in the process, stepping on the toes of other agencies with both greater authority and expertise in this area.[6]

> At the recent meeting of the National Space Council on September 9, 2022, which you attended, Vice President Harris underscored the importance of coordination and collaboration on federal space activities. The Commission's interest in acting alone to regulate orbital debris mitigation, however, poses the potential for creating confusion in an area that has historically been closely coordinated. Within the Federal government, agencies follow U.S. Orbital

[5] *See also FCC Violates Basic Legal Principles in Rush to Regulate Set-Top Boxes*, TECHFREEDOM (Feb. 18, 2016), https://techfreedom.org/fcc-violates-basic-legal-principles-in-rush-to/ ("This is simply the latest example of the FCC abusing the rulemaking process by bypassing the Notice of Inquiry … Every time the FCC does this, it means the gun is already loaded, and 'fact-finding' is a mere formality.").

[6] *See* Letter from Rep. Eddie Bernice Johnson (D-TX), Chairwoman, Committee on Science, Space, and Technology, Rep. Frank Lucas (R-OK), Ranking Member, Committee on Science, Space, and Technology (Sept. 27, 2022).

> Debris Mitigation Standards and Practices, which are developed through coordination within the Federal government and based on scientific and technical research led by the National Aeronautics and Space Administration (NASA). In addition, NASA has been charged with reevaluating those standards and action by the FCC at this time could lead to conflicting U.S. guidelines.[7]

This is not the first time Congress has questioned the ability of the FCC to adopt rules governing space activities.[8] Other agencies have questioned the FCC's jurisdiction over space operations as well, as the Department of Commerce did in 2019.

> It is clear that, given the multiple regulatory schemes across executive branch agencies impacting space commerce generally and orbital debris specifically, commercial space policies must be based on the technical expertise of the whole government. To that end, the [Commerce] Department has contributed to interagency efforts to achieve these shared space policy goals by leading administration efforts to advance space commerce and The President's Space Policy Directives are producing results and increasingly support a thriving space commerce industry in the U.S. As it leads the federal effort to dramatically grow U.S. space commerce, the Department shares the Commission's objective "to ensure continued, safe operations in space and maximize space commerce investments and innovation." Without a collaborative approach across federal agencies and independent authorities this objective cannot be attained.[9]

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[7] *Id.* (footnotes omitted).

[8] *See, e.g.,* Press Release, Committee on Science, Space, & Technology, House Science Committee Leaders Criticize FCC Action On Space Orbital Debris (Apr. 24, 2020), https://science.house.gov/news/press-releases/house-science-committee-leaders-criticize-fcc-action-on-space-orbital-debris, *citing* Letter to FCC Chair Ajit Pai from Rep. Eddie Bernice Johnson (D-TX), Chairwoman, Committee on Science, Space, and Technology, Rep. Frank Lucas (R-OK), Ranking Member, Committee on Science, Space, and Technology (Apr. 15, 2020), https://republicans-science.house.gov/_cache/files/9/d/9d1f5fb3-a6af-4f76-9ba1-2adfe9a78d1e/1EF44C07847DB88C92DA894FDE33EF2E.4.15.2020---fcc-orbital-debris-letter---final-bipartisan-.pdf.

[9] *See* Comments of the United States Department of Commerce in IB Docket No. 18-313, filed Apr. 5, 2019, p. 15 (footnote omitted), at https://www.fcc.gov/ecfs/document/1040509194602/1.

Even the FCC, in the past, has questioned whether its authority to allocate and license frequency use for U.S. companies operating communications satellite systems extended to rules regarding orbital debris.

> With respect to the rules proposed here, the Commission revisits the Commission's discussion in 2004, which addressed the Commission's responsibilities and obligations under the Communications Act of 1934 (the Act). The 2004 Orbital Debris Order specifically referenced the Commission's authority with respect to authorizing radio communications, including the statements in the Act that charge the FCC with encouraging ''the larger and more effective use of radio in the public interest,'' and provide for licensing of radio communications, upon a finding that the ''public convenience, interest, or necessity will be served thereby.'' Did the 2004 order cite all relevant and potential sources of Commission authority in this area? Do the provisions discussed, or other statutory provisions, provide the Commission with requisite legal authority to adopt the rules we propose today?[10]

Yet no such self-reflection exists in the present *NOI.* As we explain below, this critical gating question must be addressed before the Commission moves forward in even proposing ISAM-related regulations.

A. The FCC Lacks Authority Over Many of the Activities Contemplated in the *NOI*

The Commission's lack of analysis of its own jurisdiction is especially troublesome because, unlike its existing orbital debris rules, which apply to specific applications for *hardware* to be launched, the *NOI* contemplates rules that could apply to *activities* to be conducted in outer space, including on the surface of other planets and Celestial Bodies.[11]

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[10] Mitigation of Orbital Debris in the New Space Age, Notice of Proposed Rulemaking, 84 Fed. Reg. 4742, 4744 (Feb. 19, 2019).

[11] *See NOI,* ¶ 2 ("Missions in this category—which can include satellite refueling, inspecting and repairing in-orbit spacecraft, capturing and removing debris, and transforming materials through manufacturing while in space—have the potential to build entire industries, create new jobs, mitigate climate change, and advance our nation's economic, scientific, technological, and national security interests.").

While the current FCC orbital debris mitigation requirements might be sustainable under current delegated authority to determine whether a satellite communications system was in the public interest,[12] what is involved in ISAM manifestly is *not* a "satellite communications system." Rather, ISAM is a wide-ranging set of activities that can be conducted outside the atmosphere of the Earth, some, but certainly not all of which, may involve communications satellites.

Given recent court decisions constraining an agency's ability to read in new or expanded authority under its enabling statute,[13] it is highly doubtful that a court would conclude such potentially wide-sweeping rules are authorized under a generalized "public interest" rubric.

> Extraordinary grants of regulatory authority are rarely accomplished through "modest words," "vague terms," or "subtle device[s]." Whitman, 531 U. S., at 468. Nor does Congress typically use oblique or elliptical language to empower an agency to make a "radical or fundamental change" to a statutory scheme. MCI Telecommunications Corp. v. American Telephone & Telegraph Co., 512 U. S. 218, 229 (1994). Agencies have only those powers given to them by Congress, and "enabling legislation" is generally not an "open book to which the agency [may] add pages and change the plot line." E. Gellhorn & P. Verkuil, Controlling Chevron-Based Delegations, 20 Cardozo L. Rev. 989, 1011 (1999). We presume that "Congress intends to make major policy decisions itself, not leave those decisions to agencies." United States Telecom Assn. v. FCC, 855 F. 3d 381, 419 (CADC 2017) (Kavanaugh, J., dissenting from denial of rehearing en banc).[14]

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[12] *See Mitigation of Orbital Debris, IB Docket No. 02-54, Second Report and Order,* 19 FCC Rcd 11567 (2004).

[13] *See* West Virginia v. EPA, 142 S. Ct. 2587, 2022 U.S. LEXIS 3268 (2022); Nat'l Ass'n of Broads. v. FCC, 39 F.4th 817 (D.C. Cir. 2022) (holding that the FCC may not adopt regulations expanding on the specific requirements of Section 317(c)).

[14] *West Virginia v. EPA*, 142 S. Ct. at 2609.

In the same way the Commission couldn't adopt "broadcast flag" requirements for television receivers, similarly here, to the extent that ISAM involves activities not involving communications satellites used to transmit data to and from the Earth, the FCC has no jurisdictional hook to promulgate such rules.[15]

> Great caution is warranted here, because the disputed [] regulations rest on no apparent statutory foundation and thus appear to be ancillary to nothing. Just as the Supreme Court refused to countenance an interpretation of the second prong of the ancillary jurisdiction test that would confer "unbounded" jurisdiction on the Commission, Midwest Video II, 440 U.S. at 706, 99 S.Ct. 1435, we will not construe the first prong in a manner that imposes no meaningful limits on the scope of the FCC's general jurisdictional grant.[16]

This is especially true where the jurisdictional boundaries between agencies are so unclear, and in many cases, overlapping.[17] An agency cannot perceive a gap in inter-agency jurisdiction and simply jump in to fill that gap, especially, where, as here, the President has already assigned the key lead to another agency.

> To ensure safe coordination of space traffic in this future operating environment, and in recognition of the need for DoD to focus on maintaining access to and freedom of action in space, a civil agency should be the focal point for this collision avoidance support service. The Department of Commerce should be that civil agency.
>
> The Secretaries of Commerce and Transportation, in consultation with the Chairman of the FCC, will assess the suitability of incorporating these updated

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[15] *See* American Library Ass'n v. FCC, 406 F.3d 689, 700 (D.C. Cir. 2005) ("The insurmountable hurdle facing the FCC in this case is that the agency's general jurisdictional grant does not encompass the regulation of consumer electronics products that can be used for receipt of wire or radio communication when those devices are not engaged in the process of radio or wire transmission.").

[16] *Id.* at 702–03.

[17] For example, multiple agencies have their own rules regarding orbital debris mitigation. *See, e.g.,* 14 C.F.R. § 417.129 (FAA orbital debris rules for launch and reentry); 15 C.F.R. Part 960, Appendix 1 (NOAA regulations or orbital debris rules for remote sensing licenses); NASA-STD-8719.14A (NASA orbital debris policies for its missions); DoD Directive 3100.10 (Space Policy), 2012 & DoD Instruction 3100.12 (Space Support) (DoD guidelines on orbital debris mitigation).

standards and best practices into their respective licensing processes, as appropriate and consistent with applicable law. [18]

B. The FCC Lacks the Expertise to Declare itself the Federal Space Agency

Further, it is unclear whether the Commission has the expertise necessary to promulgate rules beyond those currently applied to satellite systems. The 2004 Orbital Debris Order relies heavily on the work done by NASA and other expert agencies.[19] Applicants are "encouraged, but not required, to use the NASA safety standard when assessing their debris mitigation plans and preparing these plans for submission to the Commission."[20] Applicants are, however, required to "use the standards established by the NASA guidelines when performing a casualty-risk assessment for the re-entry of space craft into the Earth's atmosphere at the end of life."[21] The NOI itself fails to speak directly to the FCC's expertise in this area, other than citing five licenses (two of which were experimental) issued to entities seeking to engage in ISAM activities.[22] This is in sharp contrast to other

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[18] *See* President's Space Policy Directive 3 (SPD-3) (June 18, 2018), https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/.

[19] *In the Matter of Mitigation of Orbital Debris*, 19 FCC Rcd 11567, ¶¶ 2–6 (2004) (explicit reference to other "experts," to work by NASA (including its orbital debris handbook and software), the White House Office of Science and Technology Policy (OSTP), United States Space Command, the International Telecommunications Union, the Inter-Agency Space Debris Coordination Committee (IADC)), and the United Nations Committee on Peaceful Uses of Outer Space). NASA is cited 21 times in the Order.

[20] *Id.* at ¶ 21.

[21] *Id.* at n. 71.

[22] *Id.* at ¶ 5. *See also* Separate Statement of Commissioner Geoffrey Starks ("I'm proud of the expertise we've built on space policy issues in this building, including through the number of ISAM missions we've reviewed and approved already.").

federal agencies that have been looking toward, and supporting, ISAM activities for years.[23] And the FCC's short excursion into ISAM activities is dwarfed by the decades of study and development in both the government and private sector.[24] Nowhere is this more apparent than in the *NOI* seeking comment on the FCC's role in reviewing planetary protection plans for ISAM operations.[25]

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[23] *See, e.g., CONFERS to Establish "Rules of the Road" for On-Orbit Servicing of Satellites*, DARPA (Oct. 4, 2017), https://www.darpa.mil/news-events/2017-10-04; *In-space Robotic Servicing Program Moves Forward with New Commercial Partner*, DARPA (Mar. 4, 2020), https://www.darpa.mil/news-events/2020-03-04; *Orbital Construction: DARPA Pursues Plan for Robust Manufacturing in Space*, DARPA (Feb. 5, 2021), https://www.darpa.mil/news-events/2021-02-05; Defense Innovation Unit & Air Force Research Laboratory., *STATE OF THE SPACE INDUSTRIAL BASE 2021: Infrastructure & Services for Economic Growth & National Security*, U.S. SPACE FORCE, (Nov. 2021), https://assets.ctfassets.net/3nanhbfkr0pc/43TeQTAmdYrym5DTDrhjd3/a37eb4fac2bf9add1ab9f71299392043/Space_Industrial_Base_Workshop_2021_Summary_Report_-_Final_15_Nov_2021c.pdf; *Commercial Space Integration into the National Airspace System: Concept of Operations*, FEDERAL AVIATION ADMINISTRATION (2014), https://www.faa.gov/space/airspace_integration/media/Final_CSINAS_ConOps.pdf; *Legislative Status of Civil and Commercial Orbital Safety*, FAA (Sept. 28, 2016), https://www.faa.gov/about/office_org/headquarters_offices/ast/media/4_legislative_status.pdf; *On-Orbit Servicing, Assembly, and Manufacturing 2 (OSAM-2)*, NASA, https://www.nasa.gov/mission_pages/tdm/osam-2.html (last visited Oct. 27, 2022); *NASA Invests in 3D Printing to Enable in-Space Manufacturing* (July 18, 2019), https://builtin.com/3d-printing/nasa-invests-3d-printing-enable-space-manufacturing.

[24] For an excellent cross-section of studies on ISAM possibilities, visit the archives of the Space Studies Institute (SSI) Conference Archives. https://ssi.org/ssi-conference-abstracts/. Beginning in 1975 and through to the 1990s, SSI held biannual conferences on "Space Manufacturing." Undersigned counsel was honored to chair the legal and economic tracks at these conferences during the late 1980s and through the 1990s. SSI itself was founded by luminary Gerard K. O'Neill, who posited in his 1976 book, The High Frontier, "Is a planetary surface the right place for an expanding technological civilization." You can't get more ISAM than that.

[25] *NOI*, ¶ 36. The FCC has virtually no expertise in this area. Does the Commission intend to stand up an entire Bureau to duplicate the efforts of NASA and other agencies who deal with planetary protection? Will applicants for licenses for ISAM operations be faced with paying the cost of the additional FTEs that will have to be employed to undertake this analysis? Will ISAM annual regulatory fees reflect this yet-to-be-acquired expertise? *See NOI*, ¶ 9 (the FCC has yet to begin assessing annual regulatory fees on ISAM operations).

The FCC is at its best, and is accorded the most deference by the courts, when it deals with issue of spectrum and radio frequency interference.[26] It is due far less deference when it embarks on regulations in areas where it lacks a natural expertise.

> The FCC argues that the Commission has "discretion" to exercise "broad authority" over equipment used in connection with radio and wire transmissions, "when the need arises, even if it has not previously regulated in a particular area." FCC Br. at 17. This is an extraordinary proposition. "The [Commission's] position in this case amounts to the bare suggestion that it possesses *plenary* authority to act within a given area simply because Congress has endowed it with *some* authority to act in that area. We categorically reject that suggestion. Agencies owe their capacity to act to the delegation of authority" from Congress. *See Ry. Labor Executives' Ass'n,*29 F.3d at 670. The FCC, like other federal agencies, "literally has no power to act . . . unless and until Congress confers power upon it." *La. Pub. Serv. Comm'n v. FCC,*476 U.S. 355, 374, 106 S.Ct. 1890, 90 L.Ed.2d 369 (1986). In this case, all relevant materials concerning the FCC's jurisdiction — including the words of the Communications Act of 1934, its legislative history, subsequent legislation, relevant case law, and Commission practice — confirm that the FCC has no authority to regulate consumer electronic devices that can be used for receipt of wire or radio communication when those devices are not engaged in the process of radio or wire transmission.[27]

Thus, the FCC should be circumspect in taking this voyage of jurisdictional discovery to develop rules for space operations such as on-orbit servicing, assembling space components, and manufacturing. Instead, it should limit its focus to the one area where it

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[26] *See* EarthLink, Inc. v. FCC, 462 F.3d 1, 12 (D.C. Cir. 2006) ("the Commission's 'predictive judgments about areas' within its 'discretion and expertise are entitled to particularly deferential review, as long as they are reasonable.'). *See generally* Balt. Gas & Elec. Co. v. Nat. Res. Def. Council, Inc., 462 U.S. 87, 103 (1983) (finding that judicial review of agency decision making is most deferential when an agency "is making predictions, within its area of special expertise, at the frontiers of science . . . as opposed to simple findings of fact.").

[27] Library Ass'n. v. FCC, 406 F.3d 689, 708 (D.C. Cir. 2005). *See also* John Blevins, *Jurisdiction as Competition Promotion: A Unified Theory of the FCC's Ancillary Jurisdiction*, 36 FLA. ST. U. L. REV. (2009). https://ir.law.fsu.edu/lr/vol36/iss4/1 (Courts have given the FCC less deference when the FCC acts to promote other goals, such as social ones).

does have clear jurisdiction, spectrum allocation and spectrum licensing associated with ISAM activities.[28]

IV. The Commission Will Play a Vital Role in Providing Spectrum for ISAM

Notwithstanding our serious concerns of overreach expressed above, we agree completely with the *NOI* when it discusses the role of the FCC in identifying spectrum needed for ISAM and licensing users for that spectrum.

> We seek comment on Commission actions that can address the needs of ISAM activities, including whether there are any regulatory changes the Commission should consider to facilitate ISAM. For example, we ask questions about spectrum needs for ISAM missions, as well as whether there are clarification of or changes to our licensing processes that would support these types of missions.[29]

As we discuss below, an entirely new approach to spectrum for ISAM should be explored in this proceeding and beyond. Far from trying to pigeonhole ISAM into existing licensing structures, the Commission should begin with a "white sheet of paper" to develop a spectrum regime for ISAM, indeed for all future commercial activities in space, that is flexible, speedy, and economical. This includes, by way of example, the provisioning of the licensing of the regulated spectrum use of a spacecraft before and after a servicing mission, where in that mission a Ku band transponder will be replaced with a Ka transponder. At this time there is no regulatory framework for an efficient servicing mission of this type.

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[28] The one area of ISAM where there is a stronger jurisdictional hook is in the satellite servicing sector. There, FCC authorizations will be required to allow for the replacement of older transponders with newer technologies, possibly in different frequency bands, with possibly upgraded intrasatellite communications capabilities. As discussed more fully below, however, if such operations are subject to the lethargy of the existing regulatory regime, this market may be stifled and never develop. This proceeding should explore approaches to reusing existing on-orbit hardware under a more flexibly licensing construct.

[29] *NOI*, ¶ 10.

In this regard, the *NOI* asks for comments on the "'typical' spectrum usage for ISAM missions."[30] First, we would note that the use of the term "missions" itself is a potential misnomer and could instantly lead the Commission down regulatory rabbit holes that are not helpful.[31] "Missions" connote things like rocket launches and satellite deployments. Many aspects of ISAM, in contrast, don't look like "missions," but rather involve long-term operations. A commercial space station assembling satellite pieces to create large structures can hardly be characterized as a "mission." A system that is able to deorbit multiple pieces of space debris isn't on a "mission," its purpose is to efficiently and economically clean up orbits.[32] In either case, if the entity is required to go back to the Commission and obtain a new license for any change in operations (né "mission"), it would never be able to accomplish its goals, but rather would be stuck in an endless bureaucratic "no go" loop of waiting for FCC authority to continue its business operations. This is especially the case for operations whereby a communications capability is swapped for a newer one. This is intrinsically an operations-based construct.

TechFreedom therefore urges the Commission *not* to adopt a mission-based approach to spectrum allocation and licensing. Instead, the Commission should consider

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[30] *NOI*, ¶ 12. We would note that the use of the term "missions" itself (used some 88 times in the *NOI*) can itself be a dangerous and misused term.

[31] The term "missions" is used some 88 times in the *NOI.*

[32] *See, e.g.,* J. Pearson et. al., *Space Test of LEO Debris Removal*, 1st IAA Conference on Space Situational Awareness (ICSSA) Orlando, FL, USA, 13-15 (Nov. 2017), http://www.star-tech-inc.com/papers/Space_Test_of_LEO_Debris_Removal.pdf (proposal to use an electrodynamic tether to remove multiple pieces of large debris from LEO at a probable cost of $500 per kilogram removed).

licensing on the concept of "operations" and define the spectrum needs and regulatory approach in that way.

Similarly, a "facilities-based" approach to licensing ISAM activities may also be a non-starter. As the *NOI* notes:

> Given the Commission's "facilities-based" approach to licensing, we also seek comment on characteristics of ISAM activities and relevant considerations affecting Commission licensing that might be addressed through part 25 of the Commission's rules. What are the challenges, if any, presented by current Commission processes for missions of variable duration or missions exhibiting evolving characteristics?[33]

Given the variability in the types of operations encompassed by ISAM, licensing "facilities," let alone licensing "missions," may lead to unnecessary complications, including the need to constantly amend a frequency license every time the activity licensed changes. If the end-result of this proceeding is a regulatory rotisserie where operators are constantly before the FCC seeking amendments to authorizations, this market may never develop, or at least not within the United States.

A. The Commission Should Reject Prior Arbitrary Distinctions in ISAM Spectrum Allocation and Licensing

The *NOI* falls into the trap of trying to fit future ISAM operations into the existing construct of spectrum allocation and licensing. The existing regime (especially licensing) exists to minimize interference in Earth-to-Space, Space-to-Earth, and in very limited cases, Space-to-Space, communications. The communications path is the *sine qua non* of the license, and the ultimate product is the content contained in the communications transmission.[34] In

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[33] *Id.* at ¶ 18.

[34] Because the value of satellite communications licenses exists in delivering highly reliable and intact data streams, those pathways must be as free from interference as possible.

contrast, spectrum for ISAM is necessary to carry out operations in space, not deliver communications from one point to another. Spectrum for ISAM operations, by and large are at their core telemetry, tracking, and command (TT&C) uses.[35] The licenses have virtually nothing to do with getting the content of a communications stream back to Earth (other than possibly wanting to bring down visual information teleoperations or for documenting ISAM operations). As such, we agree generally that most ISAM operations should be treated as "space operations services."[36] But even that narrow casting of ISAM operations may have unintended consequences, and the FCC should be open, consistent with ITU regulations,[37] to a new definition that is less constraining than "space operations service."

More generally, the Commission should avoid adopting arbitrary distinctions that made sense when talking about communications satellites but have much less relevance for ISAM operations. For example, at paragraph 19, the *NOI* states:

> Under part 25 of the Commission's rules, space stations are categorized as GSO or NGSO, and processed accordingly. In most cases, space stations involved in ISAM activities will likely be NGSO, but in some cases they could be engaged in activities near the GSO arc, or even co-located or attached to a GSO space station. How should these types of spacecraft be categorized for licensing purposes? GSO space station applications are processed on a first-come, first-served basis, associated with particular frequencies and a specific orbital location in the GSO arc, whereas servicing or other similar missions in the GSO arc seem likely to move between orbital locations, and may or may not be engaged in more typical satellite communications services, such as fixed-satellite service. What are the key considerations in categorizing those types of missions as between GSO and NGSO? Are there additional flexibilities that

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[35] *See NOI,* ¶ 13 (We note that in some instances ISAM missions have been supported by communications in the space operations service, which primarily covers telemetry, tracking, and command (TT&C). We seek comment on whether typical usage for ISAM missions could be considered a space operations service as currently defined."). Indeed, in all of the instances of past FCC involvement in ISAM activities, the licenses were predominately for TT&C. *Id.* at nn. 1–5.

[36] *Id.*

[37] *Id.* at ¶ 13.

> should be built into the Commission's procedures to reflect these unique cases? Given the apparent need for flexibility, should spacecraft involved in ISAM missions be treated like NGSO applications in all cases? In such a regime, how should those planning to operate at the GSO arc be treated?[38]

The geostationary orbit (GSO) is one small subset of possible orbits (indeed, places) where ISAM operations may occur. While highly important for satellite communications, GSO may have much less relevance for ISAM, and many of the spectrum rules which treat GSO and NGSO so differently may be entirely unnecessary for ISAM. For example, one example of an ISAM operation might be the assembly of a GSO communications satellite in LEO, which is then ferried to GSO by a tug system that cycles back and forth between LEO and GSO.[39] While the communications satellite itself must be licensed under the FCC's GSO rules, the LEO assembly operation and the tug that cycles back and forth between LEO and GSO should not be subject to multiple licensing regimes, one for operations in LEO, and the other for operations in GSO. Similarly, operations in High Earth Orbit (HEO), well above GSO, and areas including operations around and on the surface of the Moon, pose virtually zero interference risk to terrestrial operations on Earth. These new types of operations call for new approaches to spectrum allocation and licensing.

Similarly, the distinction between GSO's licensing rules and NGSO processing rounds is completely irrelevant to that cycling tug and should not be applied to licensing its ISAM

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[38] *Id.* at ¶ 19 (footnotes omitted).

[39] *See, e.g.,* Kalina K. Galabova, Architecting a Family of Space Tugs based on Orbital Transfer Mission Scenarios (Feb. 2004) (Master's Thesis, Massachusetts Institute of Technology), http://strategic.mit.edu/docs/SM-7-Galabova-2004.pdf.

operations.[40] Instead, a cohesive set of rules for spectrum allocation and licensing should be adopted throughout Cislunar space (out to approximately 500,000 km from the surface of the Earth).

B. The Commission Should Encourage Research into Innovative Radio Technology for ISAM

Spectrum currently allocated for "space operations" will quickly be exhausted as ISAM activities ramp up.[41] As the *2200 MHz Space Launch Operations Order* recognized, 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.[42] ISAM operations ultimately may require there own set of allocations, given the limited spectrum currently available in the space operations

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[40] *Id.* at ¶ 19 ("NGSO applications, unless they are filed under the small satellite or small spacecraft process, are, absent a rule waiver, assessed as part of a processing round. Is it appropriate to exempt certain types of operations associated with ISAM missions from the Commission's processing round rules, or are their certain types of missions that might be categorized as or facilitate ISAM, such as in-space data relay networks, that would require the type of continuous, active spectrum use the Commission's processing round framework is designed to manage?" (footnotes omitted)).

[41] Five frequency bands are commonly used for communications with and tracking of space launch vehicles: 420-430 MHz, 2025-2110 MHz, 2200-2290 MHz, 2360-2395 MHz, and 5650-5925 MHz. *See Amendment of Part 2 of the Commission's Rules for Federal Earth Stations Communicating with Non-Federal Fixed Satellite Service Space Stations,* ET Docket No. 13-115, Notice of Proposed Rulemaking and Notice of Inquiry, 28 FCC Rcd 6698, 6727-28, 6730, paras. 76, 79, 85 (2013) (*Space NPRM*). An addition 70 MHz was allocated for space launch operations in the 2200-2290 MHz band by *Allocation of Spectrum for Non-Federal Space Launch Operations*, ET Docket 13-115, Report and Order and Further Notice of Proposed Rulemaking, 36 FCC Rcd 7764 (2021) (*2200 MHz Space Launch Operations Order*).

[42] *2200 MHz Space Launch Operations Order*, ¶ 3.

band. If ISAM operations proceed at anything close to predictions,[43] spectrum needs will be great, and will far outstrip the existing allocations for "space operations."

One of the key drivers for expanded spectrum use will be the development of new radios that operate outside the existing bands traditionally used for TT&C, which themselves largely source from legacy defense and NASA systems.[44] As the nascent ISAM industry has developed, most engineers have defaulted to existing off-the-shelf radios in the UHF/VHF, S and X bands. That's because such radios already exist and are highly reliable. They can also be very expensive, because they are a legacy of the same set of systems that have driven the space economy – large, expensive satellite platforms that are rarely launched, and for which cost is not a significant factor. There are some providers of somewhat lower cost TT&C systems,[45] but the FCC should encourage new approaches to lower the cost of next-generation radios, increase their throughputs, and allow for operation in new bands which the Commission may allocate in the future.

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[43] The market for on-orbit serving is predicted to grow from $2.3 million in 2021 to $1.227 billion by 2030. *Space in Orbit Refueling the Market, by Propulsion System, by Application, and by Region Forecast to 2030*, EMERGEN RESEARCH, https://www.emergenresearch.com/industry-report/space-in-orbit-refueling-market (last visited Oct. 27, 2022). BIS Research predicts that the overall market for in-space manufacturing, servicing and transportation will grow by a compound annual growth rate (CAGR) of 17.36% between 2020 and 2030. https://bisresearch.com/industry-report/in-space-manufacturing-servicing-transportation-market.html.

[44] *See* National Telecommunications and Information Administration, Office of Spectrum Management, *The Spectrum Needs of U.S. Space-Based Operations: An Inventory of Current and Projected Uses*, at 31 (July 2021).

[45] *See, e.g.,* ISIS UHF downlink/VHF uplink Full Duplex Transceiver for € 8,500, CUBESATSHOP, https://www.cubesatshop.com/product/isis-uhf-downlink-vhf-uplink-full-duplex-transceiver/ (priced at roughly $8,300); Aphelion CubeSat UHF/VHF Radio for $1,800, CUBESATSHOP, http://www.aphelionorbitals.com/store/cubesat-uhfvhf-radio.

C. The Need for Spectrum Will Require the Commission to Reuse Terrestrial Spectrum on a Non-Interference Basis

Because the existing space operations spectrum is so limited, the Commission should explore spectrum allocations in other bands, including those currently licensed for terrestrial uses, which could be reused on a non-interference basis in space. Cellular telephone is one of the most revolutionary technologies in the history of communications.[46] It was so innovative because, for the first time, the same frequencies could be used over and over again. This is the mindset the Commission will need when approaching ISAM spectrum. What spectrum can be reused in space without interfering with terrestrial uses? Could frequencies below 1700 kHz be used effectively in space because they don't penetrate the ionosphere? Could spectrum above 100 GHz be used in space because of atmospheric absorption? Could ultrawideband and spread-spectrum radio techniques, characterized by much lower power operations, be used to effectively wall off space transmissions from terrestrial uses from an interference standpoint?

For some ISAM operations such as rendezvous and proximity operations (RPO) and satellite servicing communications between satellites, power level requirements might be so low that a myriad of frequencies used in terrestrial operations could also be adapted cheaply for these types of ISAM operations. The Commission should explore the application of

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[46] *See* From the archives: Bill Gourgey, *When 1970s Cellular Technology Made 'Traveling Telephones' More Accessible*, POPULAR SCIENCE (May 5, 2022, 7:00 AM), https://www.popsci.com/technology/cellular-technology-emergence/ ("In 1974, to address pent-up demand, the FCC released more spectrum but insisted that companies find a better way to use it. As [Popular Science Reporter John] Mason explains with geeky precision, cellular technology got its name from its design, deploying short-range transmission towers to divide large regions, like cities, into honeycomb-shaped cells, enabling frequency reuse. More than any other technology, cellular (first conceived in 1948 but not computationally practical until the 1970s) paved the way for the mobile era.").

terrestrial technologies to computing and short-distance communications in space. Rather than building new rad-hardened computers and radios to duplicate these terrestrial operations, the Commission should examine whether space qualified versions of existing terrestrial technologies can be used in space to reduce ISAM operational costs.[47] With ubiquitous space operations and frequent "flights," the demand for radiation hardened electronics is reduced as the "space supply chain" would be robust enough for rapid replacement of failed radios as is common in any terrestrial setting.

The Commission should also explore whether its unlicensed spectrum rules can be adopted for space. Unlicensed Wi-Fi spectrum has been used aboard the International Space Station since 2008.[48] Can highly robust technologies such as Wi-Fi, Bluetooth, and others be used in space without the potential to cause interference to other space users or users on the Earth? No spectrum should be off-limits for ISAM operations if it can be shown that it will not interfere with terrestrial uses, and we encourage the Commission to think creatively when it comes to ISAM spectrum allocations.

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[47] *See, e.g., Dragon's 'Radiation-Tolerant' Design*, AVIATION WEEK NETWORK (Nov. 20, 2012), https://aviationweek.com/dragons-radiation-tolerant-design ("On the space station, some areas are using rad-hardened parts and other parts use COTS parts. Most of the control of the space station occurs through laptop computers which are not radiation hardened.").

[48] *Wi-Fi Enables Next Generation Space Exploration,* WI-FI ALLIANCE, https://www.wi-fi.org/download.php?file=/sites/default/files/private/Wi-Fi_in_Space.pdf ("The ubiquity of Wi-Fi devices has enabled government space agencies around the world to quickly and easily repurpose commercial Wi-Fi products for scientific use. Wi-Fi's legacy of interoperability has ensured Wi-Fi networks and devices can communicate regardless of country or Wi-Fi generation. NASA and international collaborators have harnessed the inherent strengths of Wi-Fi to improve connectivity in space for more than a decade, with more innovation still to come.").

D. The Licensing Regime Must Be Flexible, Quick, and Cost-Effective to Applicants

Gone are the days when, to launch a satellite into outer space, it took a minimum of three years to develop, manifest for launch, and receive the necessary federal authorizations, all costing millions of dollars at each stage. Today, you can literally go from the back of a napkin to launch and deployment in a few months and for less than $500,000.[49] This will only accelerate in the era of the SpaceX Starship, where 100-ton payloads can be launched on a regular, rapid, cadence. This will utterly transform how space systems are designed, reducing the time between manifesting and launch from years and months, and down to weeks. Yet the rules for acquiring federal authorizations (for launch from the FAA and for communications from the FCC), still assume that same minimum three-year period and cost structure.[50] If ISAM is to succeed, that "old school" paradigm must change. Any rules the Commission adopts related to ISAM must accelerate the current processing pace so that innovative ISAM activities can be supported.[51] If applicants must wait months (or even

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[49] *See, e.g., Get Your Own Satellite in Orbit in Just 10 Months*, EUROPEAN SPACE AGENCY (June 18, 2019), https://www.esa.int/Applications/Technology_Transfer/Get_your_own_satellite_in_orbit_in_just_10_months; "A Basic Guide to Nanosatellites," ALEN SPACE, at https://alen.space/basic-guide-nanosatellites/ (last visited Oct. 28, 2022) (satellites can be built with "less than 8 months of development" and for less than € 500,000).

[50] The FCC recognized the need to speed processing times for smaller satellites in 2019. *Streamlining Licensing Procedures for Small Satellites*, 34 FCC Rcd 13077, 13137 (2019) ("Establishes a new, optional licensing and market access process within part 25 for 'small satellites' and 'small spacecraft.' Satellites and systems licensed under this new streamlined process will meet several qualifying criteria, which are consistent with the goals of enabling faster review of applications in order to facilitate the deployment and operation of these systems.").

[51] Supporting ISAM activities is consistent with the current administration's ISAM National Strategy. *See* National Science and Technology Council, In-Space Servicing, Assembly, and Manufacturing Interagency Working Group, In-Space Servicing, Manufacturing, and Assembly National Strategy (Apr. 2022) (ISAM National Strategy), https://www.whitehouse.gov/wp-

years) to get an FCC license, the ISAM activity will fail, either because the applicant is unable to close the business case because of the delay, or more likely, the business opportunity has been swept up by a foreign entity, able to navigate the foreign regulatory maze quicker to capture the business.

Similarly, licensing and regulatory fees must not be so prohibitive that they ruin the business case for an ISAM activity (or, as discussed below, drive it offshore). Especially in the early years of ISAM activities, the business cases will be high-risk, the profit margins tight, and layering on bureaucratic costs may destroy the economic feasibility of a project. As discussed above, the very worst thing the Commission could do is bulk up staff to acquire the necessary expertise to regulate non-communications aspects of ISAM, and then charge applicants back the cost of acquiring that expertise.

V. Failure to Get This Right Will Result in the Most Dramatic "Brain Drain" in Modern Times

The United States won the first space race by putting humans on the Moon, and the spin-off benefits of that race redounded to the benefit of every American.[52] American

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content/uploads/2022/04/04-2022-ISAM-National-Strategy-Final.pdf ("This National Strategy outlines how the United States will support and stimulate the United States Government (USG), academic, and commercial ISAM capability development.").

[52] *See* Jacob Margolis & Christopher Intagliata, *Space Spinoffs: The Technology To Reach The Moon Was Put To Use Back On Earth*, NPR (July 20, 2019), https://www.npr.org/2019/07/20/742379987/space-spinoffs-the-technology-to-reach-the-moon-was-put-to-use-back-on-earth (detailing spin-off technologies developed in the Apollo program that benefits all humans); NASA- Calif. Space. Instit., *Sourcing-and Sustaining-Optimum Financing Space Resources*, SPACE RESOURCES, Vol. 4, Sec. III, (1992), https://space.nss.org/settlement/nasa/spaceresvol4/newspace3.html#:~:text=Compared%20with%20other%20forms%20of,percent%20of%20the%20Federal%20budget ("Compared with other forms of investment, the return is outstanding: A payback of $7 or 8 for every $1 invested over a period of a decade or so has been calculated for the Apollo Program, which at its peak accounted for a mere 4 percent of the Federal budget.").

dominance in launch vehicles was nearly lost because of self-inflicted hysteria about the potential loss of technology that resulted in several decades of ill-founded ITAR regulation.[53] The result was a retreat by the U.S. launch industry, and the introduction of foreign competition, unburdened by similar regulations. A similar dominance by U.S. communications companies has been whittled away by a slow and costly bureaucratic licensing system that has driven many U.S. companies offshore with a concomitant rise of foreign competitors. The FCC is now faced with far more market access petitions than ever before, precisely because those companies can get their authorizations quicker, and cheaper, for a foreign government, and then seek access to the American market by a more streamlined market access petition system.

Is the U.S. approach to ISAM destined to run aground on the same regulatory reef? Will U.S. companies become so frustrated with the processes in the United States that they will simply reform their businesses offshore? That is a very real possibility, and one that should be at the forefront of the discussion in this proceeding. The FCC needs to carefully balance its own regulatory goals against a competitive regulatory ecosystem, where the business will flow to the regime whose economic and regulatory environments are the most conducive to the applicant. When dealing with many ISAM activities, it is manifestly not the case that the U.S. is the go-to forum for licensing because the U.S. market is so necessary to

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[53] *See* American Institute of Aeronautics and Astronautics, *The Impact of Export Controls on the Domestic Aerospace Industry: An AIAA Information Paper*, https://www.aiaa.org/docs/default-source/uploadedfiles/issues-and-advocacy/aeronautics/exportcontrolitarwhitepaper031309v03.pdf?sfvrsn=f6319b39_0 ("ITAR has created an undue trade barrier for US manufactures, who have lost significant market share and their innovative edge. This toll on economic opportunity has been justified in the past as the cost of sound national security. However, recent studies have shed a new light on this issue, and it has become apparent that US export control policies have actually reduced national security.")

close the business case. In many ISAM activities, the connections to the U.S. are not as important.

The effects of the FCC adopting slow, expensive, and burdensome regulations on ISAM will be an instant brain drain of our best and brightest scientific and engineering minds finding a more conducive environment to live out their dreams in space. Businesses move overseas, people move overseas, and the costs to the United States will be staggering. The FCC could adopt the most perfect set of regulations ever conceived, and then end up with few applications being filed, because people simply went elsewhere to get their authorizations.

The stakes could not be larger.

VI. Conclusion

The advent of ISAM is a transformational moment in the history of spaceflight, driven by space entrepreneurs who have thrown off the shackles of government-run space systems and embraced commercial approaches to launching objects into space. The era of "missions" is on the cusp of being transformed into an era of regularized space operations. With the advent of reusable launch vehicles and in-space automated and human tended/operated space platforms, space will transition to an operational arena limited only by the economic viability and the creativity of the companies and governments involved. The era of science fiction is becoming one of science, engineering, and operational reality. It is incumbent upon our government regulatory systems to also transition to this era. TechFreedom is excited about this future and is happy to participate in crafting the right regulatory regime for the next great space race.

Respectfully submitted,

_____/s/_____

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October 31, 2022