

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

In the Matter of
Streamlining Licensing Procedures for
Small Satellites
IB Docket No. 18-86

NOTICE OF PROPOSED RULEMAKING

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I. INTRODUCTION

1. In this Notice of Proposed Rulemaking (*Notice*), we seek comment on proposed revisions to our rules to facilitate deployment of a class of satellites known colloquially as “small satellites.” These types of satellites, which have relatively short duration missions, have been advancing scientific research and are increasingly being used for commercial endeavors such as gathering Earth observation data. The proposed rules are designed to lower the regulatory burden involved in licensing small satellites and reduce application processing times, while offering protection for critical communication links and enabling efficient use of spectrum for this dynamic sector.

II. BACKGROUND

2. The impetus for this *Notice* is to facilitate the authorization and operations of “small satellites.” Although a wide variety of satellites are being designed and launched as “small satellites,” the Commission has not previously defined this category of space objects. There are a number of ways of describing small satellites. A recent International Telecommunication Union Radiocommunication (ITU-R) Report indicated that satellites weighing less than 500 kilograms (kg) are sometimes referred to as small satellites.¹ The National Aeronautics and Space Administration (NASA) has in some instances described small satellites as satellites having a mass of less than 180 kg.² The ITU-R Report focused on satellites that have a mass of less than 10 kg and identified their typical mission duration as less than three years.³ Such missions have been characterized in other ITU-R documents as “short duration missions.”⁴ Other notable typical characteristics of small satellites include operation in low-Earth orbit (LEO), as well as lower power as compared with traditional satellite systems.⁵ This proceeding seeks to address this category of “small satellites” which we propose to define by seeking comment on a number of particular characteristics.

¹ See International Telecommunication Union, Radiocommunication Sector (ITU-R), Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites, Report SA.2312 (Sept. 2014), <https://www.itu.int/en/ITU-R/space/Documents/R-REP-SA.2312-2014-PDF-E.pdf> (ITU-R Characteristics Report). The ITU-R Report focused on a subset of satellites that have been characterized as “nanosatellites” and “picosatellites.” *Id.* at 2. Nanosatellites typically have a mass of 1-10 kg, and picosatellites typically have a mass of 0.1-1 kg. *Id.* at 3.

² See, e.g., NASA Ames Research Center, Small Spacecraft Technology State of the Art, NASA/TP-2015-216648/REV1 at 1 (Dec. 2015), https://www.nasa.gov/sites/default/files/atoms/files/small_spacecraft_technology_state_of_the_art_2015_tagged.pdf (NASA Small Spacecraft Technology Report) (describing small satellites as spacecraft with a mass of less than 180 kg for purposes of the Report).

³ ITU-R Characteristics Report at 3.

⁴ ITU-R Resolution 659 (WRC-15), Studies to accommodate requirements in the space operation service for non-geostationary satellites with short duration missions (defining “short duration mission” as typically not lasting more than three years).

⁵ ITU-R Characteristics Report at 9.

3. The Commission has authorized small satellites both as commercial operations under Part 25 of the Commission's rules and as experimental operations — including scientific and research missions for purposes of experimentation, product development, and market trials — under Part 5 of the Commission's rules. Some amateur small satellite operations have also been authorized under Part 97 of the Commission's rules. Because of the increasingly commercial nature of small satellite missions, many satellites are not suitable for licensing under the Commission's Part 5 experimental licensing process, and Part 5 licensees cannot obtain interference protection for radiocommunications links. On the other hand, obtaining a Part 25 regular commercial authorization for an NGSO system can be challenging for some small satellite applicants because of the costs and timelines involved, as compared to the overall scope of most small satellite enterprises. The same application and regulatory fees are currently applicable to all NGSO Part 25 applicants and licensees, regardless of the specific characteristics of the system.⁶ In some instances, these fees constitute a large percentage of the cost of the small satellite system, and could even exceed the total cost of a small satellite mission. Part 25 licensees are also subject to a requirement to post an initial surety bond,⁷ which can be challenging for licensees planning small, low-cost systems. Further, under Part 25, most NGSO satellite applications are processed according to a processing round procedure,⁸ which can add to application review time by the Commission and regulatory complexity for applicants. Given some of the challenges presented by the Commission's licensing process to small satellite systems and their promise as a driver of innovation, our goal in this proceeding is to develop a streamlined authorization process within Part 25 that is tailored to small satellites.

A. A New Era of Small Satellites

4. Today the small satellite sector is engaged in a range of activities, from brief research-oriented satellite missions to regularly replenishing commercial satellite constellations operating over a number of years.⁹ While this *Notice* is focused on those missions having short duration, we observe that there appears to have been growth in this sector across the full range of activities. For purposes of this rulemaking we are not proposing to consider non-geostationary orbit (NGSO) FSS constellations that include numerous satellites to be “small satellites,” even if the physical size of each of those satellites could be considered small.¹⁰ We believe that the characteristics proposed below for small satellites applying under the streamlined process, such as an orbital lifetime of five years or less and the ability to share spectrum with existing and future operators in a particular frequency band, will differentiate small satellite systems under consideration in this *Notice* from typical NGSO FSS, MSS, or other systems requiring full-time uninterrupted availability of assigned spectrum. We recognize that NGSO FSS

⁶ See *Amendment of Schedule of Application Fees Set Forth in Sections 1.1102 through 1.1109 of the Commission's Rules*, Order, 31 FCC Rcd 7534 (July 6, 2016) (*2016 Application Fees Order*); Regulatory Fees Fact Sheet, What You Owe – International and Satellite Services Licensees for FY 2017, Public Notice, (Sept. 6, 2017), available at https://apps.fcc.gov/edocs_public/attachmatch/DOC-346552A1.pdf (*2017 Regulatory Fees Fact Sheet*).

⁷ 47 CFR § 25.165(a)(3).

⁸ See 47 CFR § 25.157.

⁹ These replenishing satellite systems consist of satellites that are replaced on a regular basis, as the service continues to be provided. An example of a system in this category is Planet's NGSO system.

¹⁰ For example, some of the planned NGSO FSS systems consist of what could be considered “minisatellites”, with a typical mass between 100 kg and 500 kg. See ITU-R Characteristics Report at 3; see, e.g., Space Exploration Holdings, LLC, International Bureau Filing System (IBFS) File No. SAT-LOA-20161115-00118, Attachment A, Technical Information to Supplement Schedule S, at 54 (stating that a SpaceX satellite will have a vehicle mass of 386 kg). The Commission recently updated its rules applicable to NGSO FSS systems. See *Updates to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order and Further Notice of Proposed Rulemaking, FCC 17-122, 32 FCC Rcd 7809 (2017) (*NGSO FSS R&O*). This proceeding is also not tailored to address the operations of traditional NGSO satellite constellations offering mobile-satellite service (MSS), such as those operated by Iridium LLC, Globalstar, Inc., or ORBCOMM License Corp., more traditional NGSO satellites offering remote sensing operations, or those in the Satellite Digital Audio Radio Service (SDARS), among others.

systems may in part be responsible for some growth indicators discussed below, such as launch vehicle development, but to the extent possible we have sought to exclude those systems from our discussion of trends in this sector.

5. For much of the history of the satellite industry, economies of scale, increased capabilities of launch vehicles, and rising global demand for satellite services pushed satellite manufacturers to focus their efforts on designing larger and more powerful satellites.¹¹ In the last 15 years, however, the miniaturization of components and the ability of small satellite developers to capitalize on commercial off-the-shelf equipment has enabled smaller, cheaper satellites to be built and launched into space.¹² In 1999, engineers at California Polytechnic State University and Stanford University developed a small satellite standard known as the “CubeSat” design, with the goal to train students and expose them to real-world engineering practices and design.¹³ The CubeSat is a standardized interface consisting of an approximately 10 cm x 10 cm x 10 cm unit or “U” that can be scaled up to create CubeSats that are 3U (three units) or 12U (12 units) in size, for example.¹⁴ The standardized specification enables CubeSats to be fully enclosed in specially developed deployment mechanisms that can be added to launch vehicles as secondary payloads.¹⁵ The CubeSat specification has been widely adopted even outside the academic community, largely due to low costs and access to launch services, and satellites based on the standard constitute a large percentage of small satellites deployed in recent years. While the advantages of small satellites have ensured their continuing use by universities and research institutions, it has also encouraged the growing number of CubeSat missions that are commercial.¹⁶

6. Commercial sector involvement in all small satellites, not just CubeSats, has increased significantly in recent years. Venture capital firms are investing in small satellite companies, such as those providing Earth imagery.¹⁷ According to one report, the use of small satellites for commercial purposes represents a shift from the practice before 2013, when the majority of small satellites were used for government and academic operations.¹⁸

¹¹ Ram S. Jakhu & Joseph N. Pelton, *Small Satellites and Their Regulation*, 1-2 (Springer 2014).

¹² See, e.g., John Toon, *The Future is Small*, Georgia Tech Research Horizons (Nov. 28, 2015), <http://www.rh.gatech.edu/features/future-small>; Euroconsult, \$22 Billion Market Value for Small Satellites Over Next Ten Years (July 7, 2016), http://www.euroconsult-ec.com/7_July_2016; Jakhu & Pelton, *supra* note 11, at 21-23.

¹³ See National Academies of Sciences, Engineering, and Medicine, *Achieving Science Goals with CubeSats: Thinking Inside the Box*, at 6, 8 (2016), <https://doi.org/10.17226/23503> (National Academies CubeSat Report). See also ITU-R Characteristics Report at 3 (CubeSat design developed “with the goal of easing access to space for the academic community”); CubeSat.org, The CubeSat Program, <http://www.cubesat.org/about/> (last visited Jan. 2, 2018).

¹⁴ See National Academies CubeSat Report at 6.

¹⁵ *Id.* at 6, 8.

¹⁶ See *id.* at 8, 55-59.

¹⁷ Clay Dillow, *Here’s Why Small Satellites Are So Big Right Now*, Fortune (Aug. 4, 2015), <http://fortune.com/2015/08/04/small-satellites-newspace>; Samantha Masunaga, *Trips to Mars won’t make quick money, but venture capitalists are jumping on other space projects*, Los Angeles Times (Oct. 27, 2016), <http://www.latimes.com/business/la-fi-tech-vc-space-20161027-snap-20161027-story.html>; Alex Knapp, *The Space Companies Getting a Boost from Midas List Members*, Forbes (April 8, 2017), <https://www.forbes.com/sites/alexknapp/2017/04/18/the-space-companies-getting-a-boost-from-midas-list-members/#6f0cfed21d19>.

¹⁸ Elizabeth Buchen, *Small Satellite Market Observations* at 4 (2015), <https://digitalcommons.usu.edu/smallsat/2015/all2015/51/> (noting that in 2014, 107 nano/microsatellites were launched, with the commercial operator Planet supplying 93 of the 107 launched).

7. The total number of small satellites, including CubeSats, being deployed annually has increased significantly in recent years. A report by the Satellite Industry Association (SIA) shows a steady increase in CubeSat deployment from 2011, when fewer than 20 CubeSats were launched, to 2015, when 108 CubeSats were launched.¹⁹ Although the SIA report notes that the number of CubeSats launched decreased in 2016 to 55, it attributes this decrease to launch delays.²⁰ When launches are successful, a large number of small satellites can be deployed as part of a single mission. In early 2017, for example, an Indian Space Research Organization launch vehicle deployed over 100 small satellites into orbit in a single launch.²¹ One forecast estimates that between 2017 and 2023, nearly 2,400 satellites with masses ranging between 1 and 50 kg will be launched.²²

8. Small satellites are typically launched as secondary payloads and this limits the choice of launch time and the orbit in which they will be placed. Currently, however, a number of launch vehicles under development are designed to launch small satellites as primary payloads.²³ With the increase in small satellite launches and launch opportunities, the number of small satellites deployed is growing quickly and is predicted to continue to increase in the coming years.

9. The United States continues to be the leader in the number of small satellites launched,²⁴ and in the last several years the Commission has licensed several commercial earth exploration satellite service (EESS)²⁵ constellations that operate using small satellites based on the CubeSat concept.²⁶ These constellations, consisting of a large number of rapidly-replenishing satellites, have been licensed under Part 25 of the Commission's rules. The Commission has also fielded an increasing number of applications from small satellite proponents seeking authorization under the experimental licensing

¹⁹ Satellite Industry Association, State of the Satellite Industry Report at 22 (2017) <http://www.sia.org/wp-content/uploads/2017/07/SIA-SSIR-2017.pdf>.

²⁰ *Id.* See also 2017 Nano/Microsatellite Market Forecast, SpaceWorks at 6 (2017), http://www.spaceworkscommercial.com/wp-content/uploads/2018/01/SpaceWorks_Nano_Microsatellite_Market_Forecast_2017.pdf (2017 Nano/Microsatellite Market Forecast).

²¹ Jeff Foust, *India Sets Record with Launch of 104 Satellites on a Single Rocket*, SpaceNews (February 15, 2017), <http://spacenews.com/india-sets-record-with-launch-of-104-satellites-on-a-single-rocket/>.

²² See 2017 Nano/Microsatellite Market Forecast at 9.

²³ See, e.g., Sarah Scoles, *This New Goldilocks Rocket Is Juuust Right for Small Satellites*, Wired (May 25, 2017) <https://www.wired.com/2017/05/new-goldilocks-rocket-juuust-right-small-satellites/>; Rocket Lab, *Rocket Lab Successfully Makes it to Space* (2017), <https://www.rocketlabusa.com/latest/rocket-lab-successfully-makes-it-to-space-2/>; Alex Knapp, *Successful Launch Of Vector Rocket Is One Giant Leap For The Industry*, Forbes (May 3, 2017), <https://www.forbes.com/sites/alexknapp/2017/05/03/successful-launch-of-vector-space-systems-rocket-is-one-giant-leap-for-the-industry/>.

²⁴ See, e.g., National Academies CubeSat Report at 14 (showing the number of CubeSats launched by the United States and other countries).

²⁵ The 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 in the system concerned; and (4) platform interrogation may be included. This service may include feeder links necessary for its operation. 47 CFR § 2.1; ITU R.R. 1.51.

²⁶ Operators in this category include the NGSO constellations of Planet, Spire Global, Inc. (Spire), and Terra Bella Technologies, Inc. (Terra Bella) (formerly known as Skybox Imaging, Inc.). See, e.g., International Bureau Filing System (IBFS) File Nos. SAT-MOD-20150802-00053 (Planet), SAT-LOA-20151123-00078 (Spire), SAT-MOD-20150408-00019 (Terra Bella).

process under Part 5 of the Commission's rules.²⁷ Particularly since 2013, the Commission has seen a marked increase in the number of unique small satellite systems seeking to be licensed. Many of these applications are still from universities or other research-oriented organizations with intended short duration missions, but a growing number of others are applications from commercial entities that may plan to transition to licensing under Part 25 of the Commission's rules after completing a technology testing and demonstration phase.²⁸

B. Current Authorization Approach for Small Satellites

10. The Commission currently authorizes small satellites in three ways: (1) as commercial satellite operations under Part 25 of the Commission's rules,²⁹ (2) as experimental operations under Part 5 of the Commission's rules,³⁰ and (3) as amateur service satellite operations under Part 97 of the Commission's rules.³¹

11. Authorization is required prior to launch.³² The ITU Radio Regulations require that no transmitting station may be established or operated by a private person or by any enterprise without a license by or on behalf of the government of the country to which the station in question is subject.³³ The Communications Act of 1934, as amended (the Act) requires the issuance of a license for communications to and from the United States or from any U.S. satellite,³⁴ and provides the Commission with authority to take actions to implement the ITU Radio Regulations.³⁵ Commission licensing is also an important aspect of ensuring that the United States satisfies the treaty obligation for authorization and continuing supervision of the space activities of non-governmental entities.³⁶

12. *Part 25 Satellite Licensing.* The Commission's Part 25 rules are the primary vehicle for satellite authorization and are used to license a wide range of satellite operations, including commercial communication and remote sensing satellites. Applicants must meet the legal, technical, and other

²⁷ Proponents of more than 200 unique systems consisting of one or more satellites have applied for a license through the experimental licensing process since 2009. In 2013, recognizing the increasing number and variety of organizations seeking to participate in the launching of satellites, the Commission issued a public notice with guidance on obtaining licenses for small satellites, including small satellites seeking experimental licenses. *Guidance on Obtaining Licenses for Small Satellites*, Public Notice, DA 13-445, 28 FCC Rcd 2555, 2555 (March 15, 2013) (*Small Satellite Licensing Guidance*).

²⁸ Planet and Spire are two examples of small satellite ventures that have been transitioned from the experimental testing phase to commercial operations. See, e.g., Planet Labs Inc., ELS File No. 0548-EX-PL-2012 (granted Jan. 31, 2013), IBFS File No. SAT-LOA-20130626-00087 (granted Dec. 3, 2013); Spire Global, Inc., ELS File No. 0213-EX-PL-2014 (granted April 25, 2014), IBFS File No. SAT-LOA-20151123-00078 (granted May 18, 2017).

²⁹ See 47 CFR Part 25, Satellite Communications.

³⁰ See 47 CFR Part 5, Experimental Radio Service.

³¹ See 47 CFR Part 97, Amateur Radio Service.

³² This would not include an operator of a satellite authorized by an administration other than the United States, that is seeking to access to the U.S. market under Part 25 of the Commission's rules to communicate with earth stations in the United States. See 47 CFR § 25.137. In that instance, an applicant may file a request to access to the United States market after the satellite or satellites are launched and operational. See 47 CFR § 25.137(c). In addition, satellite operators authorized by an administration other than the United States do not require a Commission authorization if earth station operations are exclusively outside the United States.

³³ ITU Radio Regulations (R.R.), No. 18.1 (2015).

³⁴ 47 U.S.C. § 301(d), (f).

³⁵ 47 U.S.C. § 303(r).

³⁶ 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, adopted Oct. 10, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 (Outer Space Treaty).

qualifications of Part 25, and identify the public interest considerations in support of grant.³⁷ The Commission licenses most NGSO satellites through a processing round procedure, whereby a lead application is placed on public notice, and the public notice establishes a cut-off date for competing NGSO satellite systems entering into the processing round.³⁸ The processing round procedure is intended to facilitate the potential for competitive market entry, under the rationale that NGSO systems generally cannot operate using the same spectrum without causing unacceptable interference to each other.³⁹

13. The Commission has licensed under the Part 25 rules several NGSO constellations utilizing smaller satellites based on the CubeSat concept.⁴⁰ While some waivers have been requested in these applications,⁴¹ many of the Commission's existing NGSO rules have been readily applicable to these types of systems. However, the types of NGSO constellations that have been licensed under Part 25 that use smaller-sized satellites are often large commercial constellations, in some cases envisioned to include hundreds of small satellites deployed more or less continuously over an extended period.⁴² The same procedures may not be suitable for an operator launching fewer small satellites with an intended short duration mission, because of fees and those costs associated with posting a surety bond, as well as the extended timelines associated with a Commission processing round. A processing round may not be necessary for systems that do not require constant spectrum availability, since sharing may be more easily attainable with future systems seeking to use the same spectrum. Some of these factors specific to the application process in Part 25 may explain why the number of Part 25 licenses has not increased appreciably in recent years while the number of individual small satellites licensed by the Commission, particularly through experimental licenses, has increased.⁴³ Additionally, some applicants have filed for licensing under the experimental licensing process and then later transitioned to Part 25 commercial operations, rather than initially filing for a Part 25 license. These factors suggest that some applicants could benefit from an authorization process for regular (rather than experimental) operations that utilizes a process different from the Commission's existing Part 25 NGSO authorization process. Accordingly, in Section III of this *Notice*, we propose a new approach to licensing small satellites that differs from our existing Part 25 process. If adopted, this new approach could enable small satellite operators to obtain licenses for regular operation under a set of rules to be included in Part 25, but through a process better suited to the shorter duration of small satellite operations.⁴⁴

14. *Experimental Licensing.* Experimental operations, including experimental satellite operations, are scientific and research missions for the purposes of experimentation, product

³⁷ See, e.g., 47 CFR § 25.114(d)(6).

³⁸ 47 CFR § 25.157.

³⁹ See *Amendment of the Commission's Space Station Licensing Rules and Policies*, First Report and Order and Further Notice of Proposed Rulemaking, 18 FCC Rcd 10760, 10773, paras. 21-22 (2003) (*Space Station Licensing Reform Order*).

⁴⁰ See, e.g., IBFS File Nos. SAT-MOD-20150802-00053 (Planet modification application to operate up to 600 technically identical NGSO EESS satellites, granted in part and deferred in part, June 15, 2016), SAT-LOA-20151123-00078 (Spire application to operate up to 175 technically identical NGSO satellites, granted in part and deferred in part, June 16, 2016), SAT-MOD-20150408-00019 (Terra Bella modification application to operate up to 13 NGSO EESS satellites, granted in part and deferred in part, June 6, 2016).

⁴¹ For example, applicants have requested waiver of the modified processing round requirements in Section 25.156 and 25.157 of the Commission's rules, discussed *infra* section III.A.2. See 47 CFR §§ 25.156, 25.157.

⁴² See, e.g., IBFS File Nos. SAT-MOD-20150802-00053 (Planet modification application to operate up to 600 technically identical NGSO EESS satellites).

⁴³ As noted *supra*, between 2009 and 2018, proponents of more than 200 unique systems consisting of one or more satellites have applied for an experimental license. Of these proposed systems, approximately 120 have been licensed.

⁴⁴ See *infra* Section III.A.

development, and market trials.⁴⁵ Section 5.3 of the Commission's rules specifies the scope of permitted operations to include, among other activities, technical demonstrations of equipment or techniques, experimentation under contractual agreement with the United States Government, and communications essential to a research project.⁴⁶ Unlike Part 25 licenses, which are typically valid for 15 years, experimental licenses are granted for either two or five years,⁴⁷ and experimental Special Temporary Authorizations are valid for a six-month period from the date of grant and are renewable.⁴⁸ All experimental licenses are granted on a non-interference basis.⁴⁹ Accordingly, an experimental license is more limited than a Part 25 authorization and cannot serve as the regulatory vehicle for regular commercial operations using the requested frequencies. An applicant for an experimental license should be the party that ultimately controls decisions about the satellite's mission objectives, design, construction, deployment, and operations of the satellite once in orbit.⁵⁰ In many cases experimental license applicants are not limited to universities or research institutions, but also include commercial ventures seeking to test equipment for developmental purposes. All non-Federal⁵¹ applicants for experimental licenses must submit license applications through the Commission's Office of Engineering and Technology (OET) Experimental Licensing System (ELS), including technical information associated with proposed operations.⁵² The Commission's rules also require that applicants for an experimental authorization involving a new satellite or satellite system submit a description of the design and operational strategies that will be used to mitigate orbital debris.⁵³

15. A satellite licensed under the Commission's rules for experimental operations is distinguishable from an "experimental station" as defined in the ITU Radio Regulations. Section 5.3 of

⁴⁵ 47 CFR § 5.1(b).

⁴⁶ 47 CFR § 5.3(a), (d), (e). The Commission's rules also define an "experimental station" as "[a] station utilizing radio waves in experiments with a view to the development of science or technique." 47 CFR § 5.5.

⁴⁷ 47 CFR § 5.71(a).

⁴⁸ 47 CFR §§ 5.54(a)(2), 5.61(a)(1).

⁴⁹ 47 CFR § 5.84 ("Operation of an experimental radio station is permitted only on the condition that harmful interference is not caused to any station operating in accordance with the Table of Frequency Allocation . . .").

⁵⁰ *Small Satellite Licensing Guidance*, 28 FCC Rcd at 2557.

⁵¹ With respect to Federal operations, the National Telecommunications and Information Administration Manual of Regulations and Procedures for Federal Radio Frequency Management (NTIA Manual) provides relevant guidelines, including guidelines concerning control of such operations. See NTIA Manual at section 8.2.17 (May 2013 ed., with Sept. 2015 rev.), available at <http://www.ntia.doc.gov/osmhome/redbook/redbook.html>. In some instances, small satellite proponents that have taken part in a Federal agency program or have been involved with a Federal agency in some capacity may still be considered non-Federal for purposes of the satellite authorization. See *id.* If a station is not a Federal station, the small satellite applicant is required to follow the Commission's licensing procedures.

⁵² OET Experimental Licensing System, <https://apps.fcc.gov/oetcf/els/index.cfm>. The required technical information includes the following: frequency, power, emission characteristics, latitude and longitude coordinates of the launch site or test operations; proposed launch schedule including launch date, requested grant date and any other critical dates relevant to the licenses; an overview of the proposed testing; a 24 hour contact for interference issues; a description of the anticipated orbital parameters or range of orbital parameters (altitude, inclination) in which the satellite will operate; and a list of any earth stations with which the satellite will communicate. See 47 CFR § 5.59. If the applicant is also requesting a license to operate an earth station, it should provide the frequency, power, emission characteristics, and latitude and longitude information for the earth station as part of its application. *Id.* If the applicant is planning to communicate with an earth station licensed to another entity, or operate outside the United States, its territories and possessions, then the technical parameters should be included in an exhibit to the application for reference purposes only.

⁵³ 47 CFR § 5.64(b).

the Commission's rules lists a number of operations that may be considered for experimental licensing,⁵⁴ but the ITU definition is limited to a "station utilizing radio waves in experiments with a view to the development of science or technology."⁵⁵ The ITU has clarified that experimental stations, as defined by the ITU Radio Regulations, are meant to be used for experiments using radio waves, not for communicating the results of experiments using radio waves.⁵⁶ Consequently, the ITU definition is more limiting than the definition of experimental operations in the Commission's rules, and most experimental licenses issued by the Commission are not associated with experimental stations within the meaning of the ITU Radio Regulations.

16. *Amateur Satellites.* The amateur-satellite service, as a subset of the amateur service, is reserved for communications made for the purpose of self-training, intercommunication between amateur stations, or technical investigations carried out by amateurs.⁵⁷ Rules regulating the operations of the amateur radio service are contained within Part 97 of the Commission's rules.⁵⁸ Section 97.113(a)(3) of the Commission's rules, 47 CFR § 97.113(a)(3), prohibits "communications in which the station licensee or control operator has a pecuniary interest, including communications on behalf of an employer."⁵⁹ Such restrictions on operations in the amateur service are generally consistent with the ITU Radio Regulations and the domestic and international understanding of the purpose of the amateur service.⁶⁰ Because the type of operations that qualify as amateur are narrowly defined, an amateur satellite authorization will not be appropriate for many small satellite operations. In seeking Commission approval of amateur-satellite operations,⁶¹ the amateur-satellite control operator must submit a pre-launch notification to the Commission, specifically to the International Bureau, not later than 30 days after the date of launch vehicle determination, but no later than 90 days before integration of the satellite into the launch vehicle.⁶² Applicants must submit to the Commission a draft "Appendix 4" notification for submission to the ITU;⁶³ early coordination with the International Amateur Radio Union (IARU) is also strongly encouraged, and must be completed and documented by submitting a letter from the IARU before materials will be submitted to the ITU.⁶⁴ The notification to the Commission must also include a description of the design

⁵⁴ See 47 CFR § 5.3.

⁵⁵ ITU R.R. No. 1.98.

⁵⁶ Rep. ITU-R SA.2438-0, at 9.

⁵⁷ See 47 CFR § 97.3(a)(2)-(4).

⁵⁸ See generally 47 CFR Part 97.

⁵⁹ 47 CFR § 97.113(a)(3).

⁶⁰ ITU-R, Current practice and procedures for notifying space networks currently applicable to nanosatellites and picosatellites, Report SA.2348-0 at 8 (2015), https://www.itu.int/en/ITU-R/space/Documents/R-REP-SA_2348-2015-PDF-E.pdf (ITU-R Notifying Space Networks Report); ITU R.R. No. 1.56.

⁶¹ See 47 CFR §§ 97.103, 97.105. For more information about how to obtain an amateur operator license, see: <http://wireless.fcc.gov/services/index.htm?job=service+home&id=amateur>.

⁶² 47 CFR § 97.207(g).

⁶³ 47 CFR § 97.207(g)(1). The rule states that the pre-space notification must specify, among other things, the information required by Appendix 4 and Resolution No. 642 of the ITU Radio Regulations. *Id.*; see ITU R.R. Appendix 4; ITU R.R. Resolution 642. See also discussion *infra* Section II.D.

⁶⁴ *Small Satellite Licensing Guidance*, 28 FCC Rcd at 2557. "The IARU will only coordinate a non-amateur satellite if an administration directs in writing that it be operated in an amateur-satellite band under an experimental or other non-amateur license." IARU, "IARU Aligns Satellite Coordination Guidelines with ITU WRC-15 Decisions," June 30, 2017, <http://www.iaru.org/news--events/iaru-aligns-satellite-coordination-guidelines-with-itu-wrc-15-decisions>.

and operational strategies that will be used to mitigate orbital debris.⁶⁵ Commission staff may also request a document describing the mission of the satellite, in order to facilitate review and verify eligibility for operations in the amateur service. These documents are evaluated and, if they meet ITU requirements and raise no issues as to whether operations are in the public interest, the ITU filing is transmitted to the ITU and the orbital debris mitigation plan and any mission description are included in the Commission's Universal Licensing System (ULS) file for the amateur control operator for the satellite. Once materials are submitted to the ITU and placed in the ULS, the satellite is considered "documented" under the Commission's rules and is authorized to operate as an amateur station.⁶⁶

C. Small Satellite Frequency Use

17. To date, the majority of non-governmental small satellite operations in the United States have been authorized through the experimental process under Part 5 of the Commission's rules on a non-interference, unprotected basis and with limited license terms.⁶⁷ Non-interference, unprotected operations may be acceptable for some satellite operations, but for other types of operations, and particularly for satellite mission critical functions such as telemetry, tracking, and command (TT&C), it can be important that satellite links have some level of interference protection.

18. A variety of frequency bands have been used for, or requested for use by, the types of operations frequently thought of as "small satellite" operations,⁶⁸ both on a conforming and non-conforming basis with respect to the allocations in the United States Table of Frequency Allocations (U.S. Table). Frequency bands sought for use by small satellite operators for downlinks or uplinks⁶⁹ have included: 137-138 MHz, 144-146 MHz, 148-150.05 MHz, 399.9-400.05 MHz, 401-403 MHz, 435-438 MHz, 449.75-450.25 MHz, 460-470 MHz, 902-928 MHz, 2020-2025 MHz, 2025-2110 MHz, 2390-2400 MHz, 2400-2450 MHz, 5830-5850 MHz, 8025-8400 MHz, and 25.5-27 GHz. The majority of these bands have been authorized by the Commission for one or more small satellite(s) or systems, either on an experimental basis under Part 5 or under Part 25 of the Commission's rules. These authorizations have generally been for short duration missions and episodic uses, such that actual use of any of these bands by small satellites in any given area has been limited to a relatively small percentage of time. In some instances, use of these frequency bands has been subject to coordination with Federal users through the U.S. Department of Commerce's National Telecommunications and Information Administration (NTIA) inter-agency coordination process.⁷⁰

D. ITU Notification for Small Satellites⁷¹

19. In addition to the Commission authorization process for small satellites, any frequency assignments of a transmitting station and to its associated receiving earth stations must be notified to the

⁶⁵ 47 CFR § 97.207(g)(1).

⁶⁶ See 47 CFR § 97.5(a)(3). There is no formal grant document. In response to a need for amateur satellite operators to provide proof to launch providers that operations are duly authorized, staff have begun to provide the space station licensee an email indicating that the satellite is "documented." This email is also entered into the FCC ULS file of the licensee.

⁶⁷ See 47 CFR §§ 5.71(a), 5.84.

⁶⁸ As noted *supra*, we do not consider large NGSO constellations providing FSS to be "small satellites" for purposes of this *Notice*.

⁶⁹ As discussed in more detail *infra*, small satellite operators have also sought to communicate via inter-satellite links with the Globalstar and Iridium systems in bands allocated to the MSS.

⁷⁰ See *infra* Section III.B.2.

⁷¹ Although the focus of this section is on the ITU process for small satellites, other international legal obligations, such as registration with the United Nations, apply to small satellites as well. For additional guidance on these obligations, the United Nations Office for Outer Space Affairs released an informational document addressing the international legal regime relating to space activities and space objects. See generally United Nations, Committee on the Peaceful Uses of Outer Space, "Guidance on Space Object Registration and Frequency Management for

ITU Radiocommunication Bureau (BR)⁷² if the station is: (1) capable of causing harmful interference; (2) used for international radiocommunication; (3) subject to coordination procedure of Article 9 of the ITU Radio Regulations; (4) seeking to obtain international recognition; or (5) is a non-conforming assignment seeking to be recorded into the Master International Frequency Register (MIFR) for information purposes only.⁷³ In general, small satellites, including satellites using frequencies in the amateur-satellite service and those authorized through the Commission's experimental licensing process, are not exempt from the ITU notification process.⁷⁴ The specific procedures for notification vary based on frequency band, depending on whether the frequency band is subject to coordination procedures under Article 9, Section II, but generally involve the submissions of technical characteristics as specified in Appendix 4 of the ITU Radio Regulations. For assignments not subject to Article 9, Section II procedures, the notifying administration⁷⁵ for the small satellite operations is required to send to the BR the Appendix 4 information in the form of an advance publication information (API).⁷⁶ This includes information such as the frequency range and orbital parameters of the station, and may often encompass broader frequency ranges and orbital parameters than those with which the satellite will ultimately operate.⁷⁷ Next, the BR publishes the relevant API/A special section in a BR International Frequency Information Circular (IFIC) for space services.⁷⁸ If any administration believes that the assignment has the potential to affect assignments under its responsibility, it has the right to comment within four months of publication of the proposed assignment.⁷⁹ The administration that filed the API may also submit the required notification data to the BR at the same time, but it will be considered received by the BR no earlier than six months from the date of publication of the API/A. The notification information includes the specific relevant information listed in Appendix 4, such as exact frequency assignments and antenna diagrams.⁸⁰ The BR

(Continued from previous page) _____

Small and Very Small Satellites," April 2015, http://www.unoosa.org/documents/pdf/psa/bsti/2015_Handout-on-Small-SatellitesE.pdf (UNOOSA Small Satellite Guidance).

⁷² The BR is the executive arm of the Radiocommunication Sector of the ITU. Its responsibilities include recording and registering frequency assignments and orbital characteristics of space services, and maintaining the Master International Frequency Register (MIFR). See <http://www.itu.int/net/ITU-R/index.asp?category=information&rlink=br&lang=en>.

⁷³ BR-SSD e-Learning Center, Frequency Registration for Small Satellite Missions, at 5, available at http://www.itu.int/en/ITU-R/space/elearning/presentations/ITU_SSD_030.pdf; see ITU R.R. No. 11.2.

⁷⁴ ITU-R Notifying Space Networks Report at 7. We note, however, that frequency assignments for stations in the amateur service and earth stations in the amateur-satellite service are not required to be notified to the BR under Article 11 of the Radio Regulations. ITU R.R. No. 11.14. See also UNOOSA Small Satellite Guidance at 11-17.

⁷⁵ Filings must be made through a country's administration to the BR, not directly by the satellite operator. The BR cannot accept satellite network filings directly from universities, for example. See ITU-R Notifying Space Networks Report at 5.

⁷⁶ The recent 2015 ITU World Radiocommunication Conference (WRC-15) decided to eliminate the requirement for API submissions for frequency assignments of satellite systems subject to coordination under Article 9, Section II of the ITU Radio Regulations. See WRC-15 Final Acts, Resolution COM5/3 (WRC-15), available at <http://www.itu.int/pub/R-ACT-WRC.12-2015/en>. Many small satellites and satellite systems, however, are not subject to the coordination procedure of Article 9, Section II of the ITU Radio Regulations, and so the API requirement will continue to apply. See ITU R.R. Art. 9, §§ IA, II.

⁷⁷ See ITU-R Notifying Space Networks Report at 11, 12.

⁷⁸ See *id.* at 3.

⁷⁹ *Id.*; ITU R.R. No. 9.3. Comments will be published by the BR in API/B special sections, and "[t]hereafter, both administrations shall endeavor to cooperate in joint efforts to resolve any difficulties, with the assistance of the BR if so requested by either of the parties, and shall exchange any additional relevant information that may be available." ITU-R Notifying Space Networks Report at 3.

⁸⁰ See ITU R.R. Appendix 4.

will then publish this information in the Part I-S publication of the BR IFIC.⁸¹ This constitutes an acknowledgement of receipt.⁸² Finally, when the examination leads to a favorable finding, the BR will publish the result of its technical and regulatory examinations and findings in a Part II-S publication of the BR IFIC, which results in international recognition and recording of the satellite's frequency assignments in the MIFR.⁸³ We also note that for small satellite systems seeking frequency assignments in bands subject to the coordination procedures in Article 9, Section II of the Radio Regulations, the procedures are somewhat different, involving submission of Appendix 4 information in the form of a coordination request (CR/C) and a formal examination by the BR for identifying potentially affected administrations, but also involving publication.⁸⁴

20. In some instances, the Commission has submitted filings to the ITU on behalf of small satellite applicants whose operations conform with an existing frequency allocation in the International Table of Frequency Allocations (International Table).⁸⁵ In other instances, the Commission has authorized small satellite operations that are non-conforming to the ITU Radio Regulations, under ITU R.R. No. 4.4, subject to the condition that the operations shall not cause harmful interference to, and shall not claim protection from harmful interference caused by, a station operating in accordance with the ITU Radio Regulations.⁸⁶ In both cases applicants are subject to the cost recovery provisions of section 25.111 of the Commission's rules.⁸⁷

III. DISCUSSION

A. Streamlined Process for Small Satellites

21. The Commission has found that many small satellites are launched not as part of large constellations, but as part of small-scale operations consisting of a single satellite or only a few satellites. As noted, existing Part 25 rules governing NGSO-like⁸⁸ systems are not necessarily tailored to address such small-scale operations and may present challenges for small satellite applicants and licensees. We propose to establish a set of streamlined application and processing rules for commercial NGSO small

⁸¹ International Telecommunication Union Radio Communication Bureau, "ITU BR Registration Tutorial for the potential amateur satellite builders", at 2, available at <http://www.itu.int/en/ITU-R/space/AmateurDoc/ARS-tutorial.pdf>. The BR IFIC Space Services is a service publication published every two weeks by the BR, in accordance with Nos. 20.1-20.6 and No. 20.15 of the Radio Regulations, containing information on the frequency assignments to space stations, Earth stations or radio astronomy stations submitted by administrations to the BR for recording in the MIFR. See <http://www.itu.int/pub/R-SP-LN.IS/en>

⁸² *Id.*

⁸³ *Id.*

⁸⁴ See, e.g., ITU R.R. No. 9.21.

⁸⁵ The International Table is subdivided into the Region 1 Table, the Region 2 Table, and the Region 3 Table. For the allocation of frequencies, the ITU has divided the world into three Regions. The United States and most of its insular areas are in ITU Region 2, which is generally North America and South America. The International Table is included in the Commission's rules for informational purposes only. See 47 CFR §§ 2.104(a), (b); 2.105(a), nn.2, 3; 2.106, International Footnotes, 2.106, footnote 5.337. See 47 CFR § 2.104(b) for the ITU's official definitions and map of the Regions.

⁸⁶ ITU R.R. No. 4.4.

⁸⁷ See 47 CFR § 25.111. For more information on the ITU's cost recovery policy, see Radiocommunication Bureau Circular Letter CR/245 (Oct. 2005), available at <https://www.itu.int/md/R00-CR-CIR-0245/en>.

⁸⁸ "NGSO-like" is term used in the Commission's rules to describe systems which are either (1) NGSO satellite systems or (2) GSO mobile satellite service (MSS) satellite systems that communicate with earth stations using non-directional antennas. See 47 CFR § 25.157(a).

satellites meeting certain criteria.⁸⁹ As described below, it appears that satellites with the characteristics outlined in this *Notice* could be authorized on a more streamlined basis, both from a radiofrequency (RF) interference and orbital debris mitigation perspective, than satellites that we have typically licensed under the existing Part 25 rules. Accordingly, we propose an approach for authorizing this new category of satellites that we believe will make the process more accessible, decrease processing time for applications, limit regulatory burdens borne by applicants, and offer protection for critical communication links, while promoting orbital debris mitigation and efficient use of spectrum. Our objective is to develop an alternative arrangement for authorizing small satellites that is more efficient for both applicants and the Commission and that better reflects the unique nature of small satellite deployment than the existing authorization regimes.

22. A primary goal of this proceeding is to better tailor the Commission's regulatory process to small satellites.⁹⁰ Currently, an application for an NGSO satellite system under Part 25 of the Commission's rules requires the applicant to submit an FCC Form 312, Main Form and Schedule S, along with exhibits as described in section 25.114 of the Commission's rules.⁹¹ NGSO systems are also subject to frequency-band and service-specific requirements.⁹² NGSO satellite applications are processed according to a processing round procedure.⁹³ NGSO satellites that complete the processing round procedure are subject to certain milestones for completing system deployment, and a bond requirement,⁹⁴ as well as operational requirements that may be frequency-band or service-specific. Under the proposed streamlined small satellite process, applicants would not be subject to processing round procedures, although certain other requirements would continue to apply, as described below. Ideally, this new process would decrease the time spent by some NGSO applicants in submitting applications, as well as Commission staff time in processing applications, commensurate with the short mission lifetimes of many small satellites. While this proposed process would still include several of the requirements in section 25.114 of the Commission's rules,⁹⁵ we envision that the small satellite process will be set forth in its own section of Part 25 to enable small satellite applicants seeking to use this process to clearly understand the applicable procedures and technical requirements.

23. Under our existing rules, entities may file a petition for a declaratory ruling to access the U.S. market using a non-U.S.-licensed space station.⁹⁶ Although we at some points use the term "license" in this *Notice*, we anticipate that the same basic processes for obtaining authorization for small satellite operations will also be available to proponents of foreign-licensed satellites seeking U.S. market access via declaratory ruling.⁹⁷ Accordingly, we do not propose rule changes that would limit the streamlined process to applicants seeking a U.S. license. We seek comment on this approach.

⁸⁹ As an example of another jurisdiction considering processes specific to small satellites, we note that the United Kingdom is considering a new process for CubeSat authorizations. UK Space Agency, *Draft Cubesat regulation recommendations*, <https://www.gov.uk/guidance/apply-for-a-license-under-the-outer-space-act-1986>, (2015).

⁹⁰ See National Academies CubeSat Report at 6-9 (characterizing the Commission's "regular" satellite process as time-consuming and potentially expensive).

⁹¹ See 47 CFR § 25.114. This includes information regarding the applicant's orbital debris mitigation plan. 47 CFR § 25.114(d)(14).

⁹² See, e.g., 47 CFR § 25.145 (licensing provisions for FSS satellites in the 20/30 GHz bands); 47 CFR § 25.146 (licensing and operating rules for NGSO FSS in the 10.7-14.5 GHz bands).

⁹³ See 47 CFR § 25.157; *Space Station Licensing Reform Order*, 18 FCC Rcd at 10782-83, para. 48. For further discussion, see *infra* Section III.A.2.

⁹⁴ See 47 CFR §§ 25.164, 25.165.

⁹⁵ 47 CFR § 25.114.

⁹⁶ See 47 CFR § 25.137.

⁹⁷ See 47 CFR § 25.137(d).

24. In the following part of the Discussion, we break down our proposals for streamlined small satellite licensing process into five subsections. First, we propose a list of eligibility criteria for applying for a Part 25 license under the streamlined process. Second, we propose an approach for processing these applications. Third, we propose procedural requirements applicants would need to meet. Fourth, we outline proposed revisions to the bond requirement for the new process, and fifth, we seek comment on technical rules.

1. Characteristics of a Satellite or System Qualifying for Streamlined Processing

25. We propose a series of criteria that would define the types of operations able to qualify for the small satellite process. These criteria are consistent with the goals of enabling faster review of applications by the Commission in order to facilitate the deployment and operation of small satellites that can advance research missions and support services such as the provision of Earth observation data. Under these criteria, many satellites that are currently licensed through the experimental licensing process under Part 5 of the Commission's rules would likely qualify as small satellites and therefore could be subject to the Part 25 streamlined process proposals.

26. We also seek comment on whether there are other criteria not considered below that should be met by satellites applying under this streamlined process. Many proposals in this *Notice* rely on the Commission's current understanding of the characteristics and scope of operations that generally define small satellites; for example, that a small satellite is typically designed to serve its purpose within a limited, relatively short period of time, and that these satellites have more limited frequency use characteristics than more traditional operations licensed under Part 25, including use of narrower bandwidths and ability to share and not preclude other operations in a particular frequency band.⁹⁸ Are these assumptions about the nature of small satellites—and any others reflected in this *Notice*—accurate? Are there any other defining traits of small satellites that we may have overlooked and should be taken into account as we define eligibility for the proposed streamlined process?

a. Number of Spacecraft

27. We propose to limit the number of spacecraft that can be deployed under a Part 25 small satellite license. We propose to license no more than ten satellites under a single small satellite license and seek comment on this approach. This is generally consistent with our experience authorizing small satellites. We anticipate that many small satellite applicants intend only to launch one or a few satellites in total, and this proposal would enable those applicants to proceed in a streamlined manner. We seek comment on this approach and on whether we should consider other factors in determining the number of total satellites that may be specified in any single license under the streamlined process. We note that our proposed process is intended for a limited group of applicants whose operations are small enough in scope that it would not serve the public interest to apply certain of our standard Part 25 procedures. We seek comment on what rules would be necessary to facilitate that goal, including whether it is necessary to adopt limits on the number of applications that can be filed under the proposed streamlined process by an individual small satellite operator or its affiliates.

b. Planned On-Orbit Lifetime

28. For an applicant seeking a license under the streamlined small satellite process, we propose that the applicant must certify that the total on-orbit lifetime is planned to be five years or less, including the time it takes for the satellite(s) to deorbit. The ITU has found that for nanosatellites, such as CubeSats, the typical operational lifetime is between one and three years, although operational lifetimes of five, six, or even ten years are possible for some small satellites. The ITU also recently identified three

⁹⁸ See also *infra* Section III.B.1 for further discussion on frequency use characteristics.

years to be typically the upper limit for what it considers to be “short duration missions.”⁹⁹ Factoring in time for the satellites to deorbit,¹⁰⁰ and that there may be satellites launched at different times under a license, we seek comment on whether five years is an appropriate total on-orbit lifetime for small satellites that would be eligible for the streamlined process. The five-year planned lifetime corresponds to satellite orbits at relatively low altitudes, consistent with other proposals in this *Notice*. For example, all satellites lacking propulsion that are deployed at or below an altitude of 400 km will naturally de-orbit by atmospheric re-entry within five years.¹⁰¹ Should a small satellite that is not designed with a sufficiently short orbital lifespan to result in atmospheric re-entry within five years nevertheless be eligible if it has a capability to maneuver to a lower orbit that would ensure re-entry within five years? Applicants seeking to operate a small satellite for longer than five years would not be eligible for the streamlined process and could seek a license or market access grant under our existing Part 25 NGSO procedures, which provide for longer license terms.¹⁰² We seek comment on this proposal and any other factors to consider in identifying eligible satellites based on orbital lifetime.

c. License Term

29. We propose that the license term for these satellites be five years and that the license term for the satellites covered by each small satellite license would begin once one satellite has been placed into its authorized orbit. We anticipate that most operators would launch and operate all satellites in these small constellations within a short period of time, therefore it would be appropriate to begin the license term once the first satellite has been placed into its authorized orbit. We seek comment on this proposed five-year license term and whether there are other approaches that we should consider in determining what constitutes an appropriate license term, such as limiting license terms to be proportional to the expected satellite operational lifetime. We also ask alternatively whether the license term should begin at the time of grant, given the typically shorter timeline from satellite development to launch for small satellites.

30. *License Extensions and Replacement Satellites.* Given the possibility of seeking additional licenses under the streamlined process, it does not appear necessary or efficient to adopt rules for replacement satellites or expectation of replacement,¹⁰³ or to provide for license extensions.¹⁰⁴ Accordingly, we propose that licenses granted under the streamlined process will be valid only for the original satellite(s) launched and operated by the licensee.¹⁰⁵ We believe that this approach is consistent with the typical technical capabilities of small satellites, which often last no more than a few years in orbit, and also reflects the limited scope of the small satellite process. The possibility of seeking additional licenses as new satellites are launched provides a mechanism to address rapid turnover in

⁹⁹ *Studies to accommodate requirements to study the spectrum in the space operation service for non-geostationary satellites with short duration missions*, International Telecommunication Union, Provisional Final Acts, World Radiocommunication Conference, Resolution 659 (WRC-15).

¹⁰⁰ Many small satellites are deployed in LEO, where they are more susceptible to upper atmospheric perturbations, solar winds, and other factors which can impact the orbit of the satellite and affect the duration of its operations. See NOAA Space Weather Prediction Center, Geomagnetic Storms, <http://www.swpc.noaa.gov/phenomena/geomagnetic-storms>.

¹⁰¹ See *infra*, Section III.A.1.e.

¹⁰² With some exceptions, licenses issued under Part 25 of the Commission’s rules are currently issued for a period of 15 years, although the Commission reserves the right to grant or renew station licenses for less than 15 years. 47 CFR § 25.121(a)(1), (b).

¹⁰³ Part 25 of the Commission’s rules currently provides for space station system replacement authorizations for non-geostationary orbit satellites. See 47 CFR § 25.128(e).

¹⁰⁴ Part 25 of the Commission’s rules generally permit licensees to file for license extensions for spaces stations as license modifications, subject to the requirements of section 25.117. See 47 CFR § 25.117.

¹⁰⁵ Additionally, we do not anticipate that in-orbit spares would be authorized under a small satellite license.

deployment and technology. We seek comment on this approach toward license extensions and replacement spacecraft.

31. *Applicability to Other Types of Missions.* We also recognize the possibility of commercial lunar missions or other non-Earth-orbiting missions in the future utilizing CubeSats or other small satellite designs.¹⁰⁶ We seek comment on whether the small satellite process proposed here should be available to such missions and, if so, whether certain prerequisites for the small satellite process should apply only to Earth-orbiting satellites. For example, we seek comment on whether applicants for satellites not intended to orbit the Earth could calculate anticipated mission lifetime based on anticipated operational lifetime rather than total on-orbit lifetime, and whether a different license term should be applicable to such missions. We also anticipate that the proposed certification regarding disposal of the satellite through atmospheric re-entry¹⁰⁷ would need to be modified for non-Earth-orbiting satellites, as well as the certification regarding deployment orbit.¹⁰⁸ We seek comment.

d. Maximum Spacecraft Size

32. We tentatively conclude that satellite size, defined either by mass or by volume, should be a criterion for qualifying small satellites for streamlined processing.¹⁰⁹ We recognize that there are a great variety of technologies and designs used for small satellites and seek comment on what the maximum size for small satellites should be, particularly to avoid situations where systems of satellites that would be more appropriately licensed under the standard Part 25 procedures seek to gain some advantage by applying through the small satellite streamlined process described below. We propose a maximum mass of 180 kg for any satellite that would be authorized under the streamlined process.¹¹⁰ NASA has used a maximum mass of 180 kg as one demarcation for the category of small satellites, which can encompass a variety of spacecraft,¹¹¹ and we believe this upper mass should be sufficient to include typical small satellite designs, given the types of applications we have received to date, while allowing for flexibility to accommodate evolving satellite designs. In addition, we anticipate that this maximum mass would preclude systems that are not small satellites from applying under this streamlined process. We seek comment on this proposed limit. Would a greater maximum mass (e.g., 500 kg) or a smaller maximum mass be appropriate for characterizing small satellites? Do other proposed criteria, such as the proposed zero reentry casualty risk criteria discussed below, effectively preclude larger satellites?

e. Deployment Orbit and Maneuverability

33. We propose to require that applicants filing under the new proposed process certify that their proposed satellite will comply with one of several options regarding the deployment orbit and/or maneuverability of the satellite. First, if the applicant intends to deploy the satellite(s) at an orbit below the orbit of the International Space Station (ISS), which is at an altitude of approximately 400 km, the applicant would certify that its satellite will be deployed at that lower-orbit location. Second, if the applicant intends that its satellite(s) will be deployed from the ISS itself, or from a vehicle while that

¹⁰⁶ Development of these types of small satellite missions for non-commercial, scientific purposes has been ongoing. See, e.g., “NASA’s Space Cubes: Small Satellites Provide Big Payoffs,” NASA, Topics, Technology (Sept. 8, 2015), <https://www.nasa.gov/feature/nasa-s-space-cubes-small-satellites-provide-big-payoffs> (describing selection of proposals for interplanetary CubeSat investigations as part of the NASA Small Innovative Missions for Planetary Exploration (SIMPLEX) program).

¹⁰⁷ See *infra* Section III.A.4.h.

¹⁰⁸ See *infra* Section III.A.4.e.

¹⁰⁹ We also propose to specify a minimum size for satellites authorized under this streamlined process, as *discussed infra* Section III.A.4.h. The proposal specifying a minimum size is relevant to trackability of the satellites, and so is discussed in that context.

¹¹⁰ See Appendix A, Proposed Rules, § 25.122.

¹¹¹ See NASA Small Spacecraft Technology Report at 1, 13.

vehicle is docked with the ISS, the applicant would certify that its satellite will be deployed in this manner.¹¹² Although the ISS is currently the only continuously occupied manned spacecraft in LEO, we recognize that China currently operates a spacecraft in LEO below the ISS that is periodically manned, and that other long-term manned spacecraft have been considered for operation in LEO as well.¹¹³ In the event that any such manned spacecraft are located at altitudes below where an applicant intends to operate a small satellite, we propose that the applicant must describe in narrative form the design and operational strategies it will use to avoid collision with manned spacecraft.¹¹⁴ Such strategies could include use of propulsion, reliance on orbits not occupied by manned spacecraft, coordination efforts with manned spacecraft, or other reasonable means of avoiding collision. We seek comment on these proposals.

34. Deployment of satellites lacking maneuvering capabilities above the ISS, to orbits from which they will eventually transit through the ISS altitude band, increase the likelihood that the ISS will need to conduct avoidance maneuvers, potentially disrupting ISS operations.¹¹⁵ For that reason, deployment of satellites without propulsion capabilities above the ISS may not be appropriate for streamlined consideration. We propose as a third option, however, to authorize small satellites under the streamlined process to deploy at altitudes above the ISS if they certify that the satellite(s) have sufficient propulsion capabilities to perform collision avoidance maneuvers and deorbit within the license term proposed above.¹¹⁶ While many small satellites to date have not been equipped with onboard propulsion systems, new technologies are being developed that could provide a means for actively maneuvering.¹¹⁷ We tentatively conclude that more limited maneuvering capabilities, such as those relying primarily on drag, would be insufficient to support deployment at higher altitudes under the streamlined small satellite process, as these methods will likely require closer Commission review, and seek comment on this tentative conclusion. We also seek comment on whether there are any other factors that we should consider in specifying criteria related to orbits under this streamlined process.

f. Operational Debris and Collision Risk

35. Under our current rules, we require Part 25 applicants to state that the satellite operator

¹¹² Such spacecraft have similarly shorter orbital lifetimes. National Aeronautics and Space Administration, *Orbital Debris: Quarterly News*, “A Review of Space Environment Implications of CubeSat Traffic, 2003-2014,” Volume 19, Issue 3, July 2015, at 6, <http://orbitaldebris.jsc.nasa.gov/Quarterly-News/pdfs/ODQNV19i3.pdf> (“An increase in 2014 traffic is mitigated somewhat by the relatively short lifetimes of those CubeSats deployed from the ISS or visiting vehicles.”).

¹¹³ See, e.g., Jeff Foust, *China launches Shenzhou-11 crewed spacecraft*, SpaceNews, Oct. 16, 2016, available at <http://spacenews.com/china-launches-shenzhou-11-crewed-spacecraft/> (noting that China already has a space-based laboratory in LEO that is manned periodically, and that China is engaged in efforts to develop and complete a permanent space station by the early 2020s); Irene Klotz, *China Unveils Space Station Research Plans*, SpaceNews, Nov. 12, 2013, available at <http://spacenews.com/38131china-unveils-space-station-research-plans/> (noting that the planned China Space Station will be located in an orbit ranging from 350-450 km in altitude).

¹¹⁴ See Appendix A, Proposed Rules, § 25.122. An *ex parte* filing recommended that we consider future manned spacecraft and their likely orbits, and require that satellites have a maneuvering capability that is tested and demonstrated. See Alistair Funge, *ex parte* filing, IB Docket No. 18-86 (filed Apr. 3, 2018).

¹¹⁵ See, e.g., The Aerospace Corporation, ELS File No. 0255-EX-CM-2017, Exh. Above ISS Deployment Letter at 2 (filed Nov. 3, 2017) (documentation relating to approval of deployment for two satellites from the Orbital ATK 8 Cygnus Cargo Resupply Vehicle after unberthing from the ISS, stating that the effect to ISS operations has a one percent likelihood of a debris avoidance maneuver per satellite deployed above the ISS).

¹¹⁶ See Appendix A, Proposed Rules, § 25.122.

¹¹⁷ For example, NASA has found that recent improvements in the efficiency of electric propulsion systems and miniaturization of chemical propulsion systems have opened the door to small satellites with significantly greater maneuverability than was previously possible. See NASA Small Spacecraft Technology Report at 37-56.

has assessed and limited the amount of debris released in a planned manner during normal operations.¹¹⁸ Because the release of operational debris may require closer scrutiny and be inconsistent with a streamlined process, we tentatively conclude that the streamlined process should be limited to satellites that release no operational debris in a planned manner during their mission lifetime. As the release of operational debris is extremely rare among all FCC-licensed satellites, including small satellites, we do not consider this limit as unduly constraining on the availability of the streamlined process. We therefore propose that small satellite applicants must certify that their satellite(s) will release no operational debris, and we seek comment on this proposal.¹¹⁹

36. Under current Part 25 requirements, applicants must also include a statement that the satellite operator has assessed and limited the probability of accidental explosions, including those resulting from conversion of energy sources on board the spacecraft into energy that fragments the spacecraft.¹²⁰ We propose to retain this requirement for the streamlined process in the form of a certification of compliance. We seek comment on whether a simple statement to this effect is appropriate,¹²¹ or whether there may be circumstances in which a more detailed disclosure and review is appropriate, for example for spacecraft that have propulsion systems or pressure vessels.

37. Regarding risk of collision, we propose that applicants certify that the probability of each satellite's risk of collision with large objects is less than 0.001, which is consistent with technical guidance developed by NASA for its space missions.¹²² We seek comment on whether the 0.001 metric is appropriate for satellites licensed in accordance with the streamlined process, or if a more stringent standard for collision risk may be appropriate, given that multiple satellites that may be deployed. We further inquire into whether an applicant's certification will be sufficient to address collision risk and debris issues, or whether we should seek additional information from satellite applicants under the streamlined process and if so what types of information would be necessary. Alternatively, we ask whether such a certification is necessary given the other eligibility criteria for the streamlined process, such as limiting orbital altitude or requiring propulsion capability.

g. Trackability

38. We propose that all applicants seeking to be licensed under the streamlined small satellite process also certify that their satellites will be no smaller than 10 cm x 10 cm x 10 cm to ensure that the satellite will be trackable as a space object.¹²³ This size is consistent with the CubeSat specification.¹²⁴ We note that while there may be methods for improving tracking of smaller objects, such as reflectors or transponders, these methods may require closer scrutiny and detailed analysis, and such analysis may be inconsistent with a streamlined process. We further propose that the applicant would also be required to certify that the satellite will include a unique telemetry marker allowing it to be readily distinguished from

¹¹⁸ 47 CFR § 25.114(d)(14)(i).

¹¹⁹ Appendix A, Rule Revisions.

¹²⁰ 47 CFR § 25.114(d)(14)(ii).

¹²¹ See Appendix A, Proposed Rules, § 25.122.

¹²² NASA Technical Standard, Process for Limiting Orbital Debris, NASA-STD-8719.14A (with Change 1) (May 25, 2012), <https://standards.nasa.gov/standard/nasa/nasa-std-871914> (NASA Standard) and <https://standards.nasa.gov/standard/nasa/nasa-hdbk-871914> (NASA Handbook).

¹²³ See Space-track.org, Documentation – Frequently Asked Questions, <https://www.space-track.org/documentation/#faq>, (“10 centimeter diameter” or ‘softball size’ is the typical minimum size object that current sensors can track and the JSpoC maintains in the catalog); Appendix A, Proposed Rules, § 25.122. In an *ex parte* filing, Alba Orbital stated that satellites with a size under a 10 cm cube can be tracked and asked that satellites with a size of 5 cm or greater be included in the streamlined process. See Alba Orbital, *ex parte* filing, IB Docket No. 18-86 (filed Apr. 2, 2018).

¹²⁴ See, e.g., National Academies CubeSat Report at 6 (defining a CubeSat for purposes of the study as a spacecraft sized in units, with each unit having a volume of about 10 cm x 10 cm x 10 cm).

other satellites or space objects.¹²⁵ We believe these certifications will help ensure that satellite operators will be able to assist entities that track space objects to more easily identify and distinguish between the small satellites utilizing the streamlined process and other space objects. We seek comment on these proposals.

h. Casualty Risk

39. We propose that applicants certify that their satellite(s) will be disposed of through atmospheric re-entry following completion of the mission.¹²⁶ Under our current satellite authorization rules, including those that apply to experimental and amateur missions, applicants planning disposal of satellites through atmospheric re-entry must provide a statement assessing casualty risk, with an estimate of whether portions of the spacecraft will survive re-entry and reach the surface of the Earth, as well as an estimate of the resulting probability of human casualty.¹²⁷ If a statement indicates a risk of human casualty, the spacecraft could result in a future claim being presented to the United States under the relevant United Nations Outer Space Treaties.¹²⁸ In light of the casualty risk, it may be necessary to consider satellite modifications that could reduce the risk to zero, or insurance and liability arrangements. We tentatively conclude that consideration of such arrangements, which is likely to involve detailed factual inquiry and potentially complicated legal and financial arrangements, is not consistent with the proposed streamlined process. Therefore, we propose that any small satellite applicant seeking to file under the streamlined process certify that it has conducted a casualty risk assessment using the NASA Debris Assessment Software (DAS)¹²⁹ or another higher fidelity model,¹³⁰ and that the assessment resulted in a human casualty risk of zero.¹³¹ We seek comment on this proposal.

i. Cessation of Emissions

40. ITU Radio Regulation No. 22.1 requires that space stations be fitted with devices to ensure immediate cessation of their radio emissions by telecommand, whenever such cessation is required under the radio regulations.¹³² Section 25.207 of the Commission's rules requires that space stations be capable of ceasing radio emissions by the use of appropriate devices (battery life, timing devices, ground command, etc.) that will ensure definite cessation of emissions.¹³³ For the small satellite streamlined process, we propose that small satellites have the ability to cease transmissions by way of command (rather than by other potential means), to ensure the reliability of the satellite's ability to cease transmissions instantaneously. We propose that the applicant would need to certify that the satellite has the ability to receive command signals and cease transmissions as a result of a command. We seek comment on this approach. As part of this approach, we seek comment on whether we should require that satellites employ a "passively safe" system, i.e., the satellite cannot transmit unless it is actively

¹²⁵ Appendix A, Proposed Rules, § 25.122.

¹²⁶ *Id.*

¹²⁷ 47 CFR § 25.114(d)(14)(iv).

¹²⁸ See Outer Space Treaty, art. 6, 7; Convention on International Liability for Damage Caused by Space Objects, art. 1, entered into force Oct. 9, 1973, 24 U.S.T. 2389, 961 U.N.T.S. 187.

¹²⁹ See NASA, Debris Assessment Software, <https://www.orbitaldebris.jsc.nasa.gov/mitigation/das.html> (DAS Website).

¹³⁰ See NASA Standard at 46 (noting that the DAS is based on a simplified model and that higher fidelity models are available).

¹³¹ See Appendix A, Proposed Rules, § 25.122.

¹³² ITU R.R. No. 22.1.

¹³³ 47 CFR § 25.207. While section 25.207 applies to Part 25 licensees, a similar requirement applies to experimental licensees under Part 5 of the Commission's rule. See 47 CFR § 5.107 (requiring that licensee maintain control of the transmitter authorized under its license, including the ability to terminate transmissions in the event of interference).

commanded to transmit via a command, and will cease transmission unless within view of a ground station.¹³⁴

2. Small Satellite Application Processing

41. *Background.* Under the Commission's current regulatory approach, decisions on NGSO-like satellite applications are made using processing round procedures.¹³⁵ The Commission adopted this approach for NGSO-like satellite systems because of the possibility of otherwise unreasonably limiting additional market entry if licenses were granted on a first-come, first-served basis.¹³⁶ For NGSO-like satellite systems, the Commission had envisioned that grant to one satellite system operator to provide service in a particular frequency band segment would preclude other satellite system operators from providing service in that frequency band.¹³⁷

42. The Commission has granted several waivers of the processing round rules for NGSO satellites, including small satellites, operating in the EESS. For these small satellites, the Commission has relied on the applicants' demonstrations that they can avoid interference events through means such as scheduling of transmissions, and would not preclude future entrants from using the same spectrum.¹³⁸ For example, where a satellite operates with a limited number of earth stations for purposes of downlinking sensor data during relatively short periods of time, it may be possible for such a satellite system to accommodate future entrants utilizing the same frequency bands. The spectrum demands of such systems differ substantially from the requirements for full-time system availability that characterize the NGSO-like systems provided for by the processing round rule.

43. *Discussion.* We propose that applications qualifying for the streamlined small satellite process be exempt from processing round procedures. Instead, each applicant under the streamlined small satellite process would be required to (a) certify that operations of its satellite will not interfere with those of existing operators, (b) certify that it will not unreasonably preclude future operators from utilizing the assigned frequency band(s), and (c) provide a brief narrative description illustrating the methods by which future operators will not be unreasonably precluded.¹³⁹ Such methods could include the sharing of ephemeris data to avoid RF interference events,¹⁴⁰ use of directional antennas, limiting operations to certain times throughout the day, limiting earth stations operating with the system to certain defined geographic locations, or some combination of these and other means that could be used to accommodate sharing in the assigned frequency band(s). Regardless of the methods used, the Commission would make an assessment of the description provided to ensure that operators do not preclude others from operating in the band and thereby limit the risk of spectrum warehousing by licensees. This approach also differs from the first-come, first-served queue used for GSO-like satellites, in that an earlier filed and granted application would not provide a basis for dismissing a later-filed request. We seek comment on this proposal. Applications would be processed in accordance with our existing procedures in other

¹³⁴ See ITU-R SA.2312-0 at 7 (describing a passively-safe system whereby the satellite is actively commanded to transmit only when in view of an associated earth station).

¹³⁵ 47 CFR § 25.157. *Space Station Licensing Reform Order*, 18 FCC Rcd at 10774, para. 23.

¹³⁶ *Space Station Licensing Reform Order*, 18 FCC Rcd at 10774, para. 25.

¹³⁷ *Id.*

¹³⁸ See, e.g., IBFS File No. SAT-LOA-20130626-00087 (granted Dec. 3, 2013) (granting a waiver of the modified processing round to Planet conditioned on the ability of future operators to enter the 8025-8400 MHz frequency band).

¹³⁹ Appendix A, Proposed Rules, § 25.122.

¹⁴⁰ Ephemeris data give the orbital parameters of satellites at different times. In the *NGSO FSS R&O*, the Commission extended the existing requirement regarding the maintenance of ephemeris data in section 25.271(e) of the Commission's rules to NGSO FSS operations generally. *NGSO FSS R&O*, 32 FCC Rcd at 7828, para. 58.

respects.¹⁴¹ We also seek comment on the certification and description requirements, and on the appropriate indicia for sharing.

44. Although there would be no processing round under our proposed licensing approach, small satellite operators licensed pursuant to the streamlined process would still typically receive interference protections in accordance with the relevant service allocation in the U.S. Table of Allocations. For example, small satellite applicants seeking to operate EESS systems in frequency bands with a secondary EESS allocation will be authorized on a secondary basis. In bands where Part 25 licensees are authorized pursuant to a processing round, however, the Commission anticipates that small satellites authorized on a streamlined basis would be subject to some limitations on a frequency-band specific basis, including, in appropriate circumstances, that operations are on a non-interference, unprotected basis with respect to those Part 25 systems. We seek comment on this proposed approach to interference protection.

45. For typical NGSO FSS, MSS, or other operations requiring full-time uninterrupted availability of assigned spectrum, the ability to share spectrum with all existing and future operations is more limited or nonexistent because of the complexities of these systems. We tentatively conclude that the required indicia of sharing would not be present in these instances, and that such operations are more appropriately addressed for authorization under existing Part 25 procedures, including processing rounds. We recognize, however, that not all FSS and MSS operations require full time spectrum availability. In these instances, where the other criteria are satisfied, authorization under the proposed streamlined small satellite process might be appropriate. We seek comment on these tentative conclusions. In determining whether an application is acceptable for filing within the streamlined small satellite process, we propose to rely on the applicant's certification that it can reasonably share with existing and future operators, as described above, in addition to the other criteria we set forth in this *Notice*. We propose to subsequently evaluate the applicant's narrative description of sharing methods, however, particularly in the event that any comments or other pleadings address the applicant's ability to share with other operators. Under such an approach, we would dismiss an application without prejudice if we find that the applicant has failed to demonstrate that the proposed operations will not unduly limit other operations in the band. In such case, the applicant could refile the application as an NGSO-like application in accordance with the requirements of the Commission's processing round procedures. We seek comment on this approach. Aside from the sharing certification and procedures discussed above, we ask whether additional mechanisms would be necessary to prevent authorized small satellite operations in a particular frequency band from having an aggregate interference footprint that is inconsistent with use by other existing or planned services.

46. Consistent with the above tentative conclusion that small satellites will not preclude others from operating in the band, we further propose to exempt small satellites from the limitations on unbuilt NGSO-like systems contained in section 25.159 of the Commission's rules.¹⁴² We seek comment on this proposal.

3. Application Requirements

47. We propose that the FCC Form 312 and Schedule S would continue to serve as the basis for applications under the streamlined small satellite process.¹⁴³ These forms include basic legal and

¹⁴¹ See, e.g., 47 CFR §§ 25.112, 25.151 (acceptability for filing and public notice procedures).

¹⁴² 47 CFR § 25.159(b). This rule states that if applicants with an application for one NGSO-like satellite system license on file with the Commission in a particular frequency band, or one licensed-but-unbuilt NGSO-like satellite system in a particular frequency band, will not be permitted to apply for another NGSO-like satellite system license in that frequency band. *Id.*

¹⁴³ The FCC Form 312, Main Form and Schedule S form the foundation for all space station license authorizations. See 47 CFR § 25.114(a).

technical information that provides Commission staff with information about the proposed operations.¹⁴⁴

48. In lieu of the narrative demonstrations required by the existing Part 25 rules, we propose that applicants may instead provide the various certifications described above as the qualifying criteria for the streamlined small satellite process.¹⁴⁵ The certifications should ease the burden on applicants of completing a Part 25 application. Applicants under the proposed streamlined small satellite process would still need to provide some information in narrative form, such as how their operations will not preclude future operators in the assigned bands,¹⁴⁶ but we do not envision that these additional narrative requirements will be unduly burdensome or undermine the objectives of this *Notice*. We seek comment on the proposed changes. We also seek comment on whether there are additional application requirements or revisions to application requirements that should be considered for the streamlined small satellite process.

4. Revised Bond Requirement

49. Under the Commission's Part 25 rules, most NGSO licensees or recipients of market access must have on file a surety bond.¹⁴⁷ A bond of \$1 million must be filed at 30 days following grant and the amount of the bond that must be on file steadily escalates, with the maximum bond being \$5 million.¹⁴⁸ The surety bond requires payment in the event that the licensee either fails to meet certain milestones, or surrenders the license before meeting certain milestones for the operation of its system,¹⁴⁹ specifically, launching 50 percent of the maximum number of satellites authorized for service, placing them in their assigned orbits, and operating them in accordance with the station authorization no later than six years after the grant of the authorization.¹⁵⁰ Once the Commission determines that the milestone has been satisfied, the authorized entity will be relieved of its bond obligation. The Commission established these requirements to deter warehousing by satellite operators before a proposed satellite has been launched and begun operations and to deter speculative satellite applications.¹⁵¹

50. We propose a change to the bond requirement normally applicable to NGSO satellites authorized under Part 25. Specifically, we propose a one-year "grace period" during which small satellites that qualify for the streamlined process as outlined in this *Notice* would not have to post a bond. This grace period would begin 30 days after the license is granted, since that is typically when a licensee must post a bond. We seek comment generally on this proposal.

51. This grace period may be warranted for two reasons. First, most small satellite operators

¹⁴⁴ The Schedule S software is available electronically on the Commission's website. See FCC Schedule S System, <https://enterpriseefiling.fcc.gov/schedules/>. Applicants are advised to use the software when submitting information to ensure that it is appropriately included in IBFS. See FCC, Specific Instructions for Schedule S (April 2016), <https://enterpriseefiling.fcc.gov/schedules/resources/Instructions%20for%20Schedule%20S%20vApr2016.pdf>.

¹⁴⁵ Appendix A, Proposed Rules, § 25.122. This certification would be somewhat analogous in form to the Commission's rules on the relocation of GSO space stations. See 47 CFR 25.118(e)(5).

¹⁴⁶ See Appendix A, Proposed Rules, § 25.122.

¹⁴⁷ 47 CFR §§ 25.165(a)(3), 25.137(d)(1).

¹⁴⁸ 47 CFR §25.165(a)(1).

¹⁴⁹ 47 CFR § 25.165(c).

¹⁵⁰ 47 CFR § 25.164(b)(1). There is also a nine-year build out milestone for NGSO systems, requiring that the licensee or market access recipient have its full system launched and operational by nine years after grant or accept a reduction in its authorized satellites to the number launched and operational at that time, but this milestone is not tied to the surety bond. Because we propose a five year on-orbit lifetime, we do not believe this milestone would be relevant for small satellites authorized under the streamlined process. *Id.* at § 25.164(b)(2).

¹⁵¹ Warehousing occurs when an entity holds exclusive authorization or priority for spectrum use or an orbital position, but is unable or unwilling to deploy its authorized satellite system in a timely manner. *Space Station Licensing Reform Order*, 18 FCC Rcd at 10825, 10827, paras. 167, 173.

have a comparatively short window between filing of their application and deployment of their satellites. Applicants for small satellite short-duration missions frequently deploy and begin operations with their satellites within one year or less of obtaining a Commission license. In these instances, once satellites are authorized, there is little opportunity for the applicant to warehouse spectrum that it does not intend to use. Second, as described above, we propose that the estimated on-orbit lifetime of the individual satellites that may be authorized will be five years or less, and that licenses granted under the streamlined process may not be renewed or extended.¹⁵² Thus, to the extent that the satellite is authorized to operate in a particular frequency band, the licensee is unlikely to preclude the availability of resources to competitors or discourage innovation during this short amount of time. Furthermore, the limitations we propose to place on the applicant's license term, including the start of the five-year license term at launch of the first satellite, discussed *supra*, support this approach as well. We seek comment on these rationales for postponing the bond requirements for small satellites that could be authorized under the streamlined small satellite process proposed in this *Notice*. Are there any other considerations that the Commission should take into account when establishing the grace period?

52. Following the one-year grace period, if the authorized satellite(s) have not yet been deployed, we propose that operators could still launch and operate their satellites subject to the bond and milestone requirements applicable to NGSO satellites, provided that the satellite(s) can still meet the criteria for the small satellite process, including deorbit within the five-year license term (which we have proposed would begin when the first satellite is placed into its authorized orbit). Under this proposal, the escalating bond would need to be filed with the Commission, at the amount that would be applicable for a Part 25 NGSO satellite one year after the license has been issued.¹⁵³ We seek comment on this approach, and ask whether alternatively we should develop a different bond amount or a more or less rigorous approach to milestones for satellites licensed under the streamlined small satellite process.

53. In addition, we propose that grantees failing to begin operations during the one-year grace period, because of launch delays, for example, may surrender their license to avoid the bond requirement. Further, we suggest that grantees launching and operating one or more satellites within the one-year grace period, but failing to launch and operate 50 percent of their authorized satellites within that period, may choose to either be subject to the standard NGSO bond and milestone requirements or, in the case of licenses that specify multiple satellites, accept an automatic reduction in the number of authorized satellites to the number actually in orbit as of the close of the grace period. This proposal would not preclude the filing of a new application for additional satellites. We seek comment on these suggested outcomes.

5. Technical Rules

54. Our Part 25 rules contain technical requirements governing the operations of both satellites and earth stations. These rules specify, among other things, out-of-band emission limits, frequency tolerances, and power limits.¹⁵⁴ We propose that existing generally applicable technical rules in Part 25 also be applicable to small satellites authorized under the streamlined process. We seek comment on this proposal. In addition, we note that many of the Part 25 technical rules such as out-of-band emission and power limits are in place to avoid interference occurring to other stations. The interference environment in which a small satellite will operate will be a function of the frequency band in which it operates. Consequently, we recognize that the technical requirements for small satellites may need to be adjusted for the different bands and we seek comment on some additional technical requirements later in

¹⁵² See *infra* Section III.A.4.c.

¹⁵³ 47 CFR § 25.165(a)(1).

¹⁵⁴ See, e.g., 47 CFR §§ 25.202(d),(e),(f), 25.204.

this *Notice* in connection with the discussion of small satellite operations in particular frequency bands.¹⁵⁵

B. Frequency Considerations for Small Satellites

55. In this section, we address a number of issues relevant to frequency selection for small satellite systems generally having the characteristics described above.¹⁵⁶ Specifically, we seek comment on the relationship between the proposed streamlined process and the particular bands for which applicants may apply. We also consider issues related to coordination with Federal operations, and seek comment on several proposals to expand use of existing satellite allocated bands for small satellites. We also consider whether some MSS and FSS frequency bands could be allocated for inter-satellite links for small satellites. We also consider whether proposals may be appropriate related to inter-satellite links.

1. Scope of Frequency Use

56. We seek comment on the specific frequency use characteristics of small satellites that would be authorized under the proposed small satellite process. With respect to bands that are currently shared among services, we do not expect that small satellite operations would displace existing or planned non-satellite operations in a given frequency band. We seek comment on whether small satellites should be required to make any additional demonstrations, either for all bands or in specific bands, about their ability to share with non-satellite services. This could include, for example, demonstrating the ability to avoid interfering with incumbent non-satellite operators.¹⁵⁷ We also seek comment on whether small satellites authorized under the streamlined process should be required to protect other services and accept interference from other services in all instances where they are operating in frequency bands that are shared with non-satellite services. Alternatively, we seek comment on whether these small satellites should be afforded interference protection that is consistent with the relevant satellite allocation in a particular frequency band (e.g., primary or secondary with respect to other allocated services).

57. The current Part 25 rules include a list of frequency bands available for particular types of services, but indicate that operations can be authorized in other bands allocated for satellite services.¹⁵⁸ In order to assist small satellite operators in identifying possible frequency bands for use, we seek comment on including a non-exclusive list of frequencies in section 25.202 of the Commission's rules. We seek comment on the types of bands that should be specified in any such rule. We also seek comment on an alternative proposal to omit a specific list and consider applications on a case-by-case basis, bearing in mind the relevant frequency allocations. As a third alternative, we seek comment on whether the proposed process should be limited to specific frequency bands. We also seek comment on the type and quantity of spectrum that will be needed for small satellites to operate. Commenters should include data, analysis, and engineering studies on the expected demand for small satellites. We request that commenters address their need to access specific bands, bearing in mind the case of bands that have other allocations and services.

58. In addition to the sharing characteristics described above, we anticipate that the actual amount of spectrum used by any particular small satellite will be small, generally no more than a few megahertz and in some cases only a few tens-of-kilohertz, and RF output power will be low. Notably, the

¹⁵⁵ See, e.g., *infra* Section II.B.4.b (discussion of possible service rules, including out-of-band emission limits, related to small satellite operations in the 1610.6-1613.8 MHz band).

¹⁵⁶ Consistent with a resolution adopted at WRC-15, the ITU-R is currently studying the spectrum requirements for TT&C for NGSO satellites with short duration missions, assessing the suitability of existing international allocations to the space operation service below 1 GHz, and may consider possible new allocations or an upgrade of the existing allocations to the space operation service within the frequency ranges 150.05-174 MHz and 400.15-420 MHz. ITU WRC-15, Resolution 659. See WRC-15 Final Acts, Resolution COM6/19 (WRC-15), available at <http://www.itu.int/pub/R-ACT-WRC.12-2015/en>. While we recognize these ongoing efforts at the ITU, we do not limit our consideration to bands identified in the WRC-15 resolution, or to the space operation service.

¹⁵⁷ See *id.*

¹⁵⁸ See 47 CFR § 25.202.

ITU has found that for a short duration missions (three years or less) operating on frequencies below 1 GHz, a typical small satellite space segment mission uses a bandwidth of less than 100 kilohertz, a non-directional type antenna with a gain under 3 dBi, and RF output power of 1 W.¹⁵⁹ For small satellites operating on frequencies between 1 and 3 GHz, the ITU found generally a wider bandwidth of less than 7.5 megahertz is used, with non-directional antennae gain under 10 dBi, and an RF output power of less than 1 W.¹⁶⁰ These technical characteristics, such as low power and low bandwidth, are generally consistent with the small satellites granted experimental licenses by the Commission,¹⁶¹ and are also consistent with the type of operations we envision being authorized pursuant to the streamlined small satellite process described in this *Notice*. We understand that in some instances other uses may be anticipated, for example, where data downlinks require larger bandwidths, and so we also seek comment on whether modifications to the proposals discussed in this section would need to be made to accommodate these other types of operations. We also seek comment on the extent to which larger bandwidth transmissions could be conducted via inter-satellite links or alternatives such as optical links.

59. In the discussion above, we sought comment on whether the existing Part 25 technical rules should apply to small satellites. Here we also ask whether particular service rules, on a band-specific basis, may be needed to ensure protection of incumbent users. For example, geographic isolation of small satellite earth stations, power level restrictions on transmissions to and from small satellites, temporal restrictions on small satellite communications with earth stations, antenna specifications or other limitations on satellite design parameters, and/or other technical requirements may enable protection of incumbent operations, depending on the RF environment in each band.

2. Compatibility and Sharing with Federal Users

60. The U.S. Table is divided into the Federal Table of Frequency Allocations and the non-Federal Table of Frequency Allocations.¹⁶² Some bands are allocated to both Federal and non-Federal users. In addition, some footnotes to the U.S. Table specify that use of a particular band by non-Federal users is subject to successful coordination with Federal users. An established set of procedures guides the interaction between the FCC and NTIA in developing regulations for services in shared bands, and for authorizing frequency use by Federal agencies and Commission licensees.¹⁶³ Under the Memorandum of Understanding (MOU) between NTIA and the Commission, the Commission and NTIA give notice to each other of “all proposed actions that could potentially cause interference” to non-Federal and Federal operations, respectively.”¹⁶⁴

61. In discussing the compatibility of small satellites with other operations, however, we note that a number of the frequency bands where small satellites have been authorized, and where there are

¹⁵⁹ See ITU-R Characteristics Report at 9.

¹⁶⁰ *Id.*

¹⁶¹ Texas A&M University AggieSat Lab, ELS File No. 0305-EX-PL-2014 (granted Oct. 28, 2014); Tyvak Nano-Satellite Systems, Inc., ELS File No. 0399-EX-PL-2016 (granted Oct. 13, 2016); Morehead State University Space Science Center, ELS File No. 0635-EX-PL-2013 (granted February 18, 2014).

¹⁶² See generally U.S. Table, 47 CFR § 2.106.

¹⁶³ For example, the NTIA Manual describes technical requirements for Federal radio services. See generally NTIA Manual.

¹⁶⁴ “Memorandum of Understanding between the Federal Communications Commission and the National Telecommunications and Information Administration,” January 31, 2003 (MOU), available at https://apps.fcc.gov/edocs_public/attachmatch/DOC-230835A2.pdf; see also FCC News Release, “FCC and NTIA Sign New Memorandum of Understanding on Spectrum Coordination,” (Jan. 31, 2003), available at <https://www.fcc.gov/document/fcc-and-ntia-sign-new-memorandum-understanding-spectrum-coordination>.

non-Federal allocations for services such as EESS and space operations,¹⁶⁵ are shared with Federal users. Small satellite operations in these bands must be compatible with Federal uses. We seek comment on any rules that could be adopted by the Commission specific to these frequency bands that would better enable small satellite operators to consider, in advance of coordination, whether they may be able to operate in these bands while still protecting Federal operations. Examples of such rules could include traditional approaches requiring geographic isolation of non-Federal earth stations from Federal earth stations or other sites, or approaches such as permitting a satellite to transmit only when it is receiving uplink communications from certain pre-coordinated earth station sites.¹⁶⁶ These examples would not necessarily replace the need to coordinate with Federal systems on a case-by-case basis, but we seek comment on whether these approaches or cooperative arrangements, public-private partnerships, scientific research programs, or other hybrid Federal/non-Federal arrangements could help streamline sharing. How would the establishment of certain service rules or other requirements on a band-specific basis help to facilitate compatibility among separate systems and development of new types of shared and efficient uses of space and spectrum resources? We seek comment on these issues and on whether and how such rules and requirements may vary depending on the specific frequency bands being considered.

3. Small Satellite Operations as an Application of the MSS

62. We believe that it may be appropriate to permit small satellite operations in selected bands allocated to the MSS, where the characteristics of the small satellite operations, as described in this *Notice*, would limit any potential for interference into existing MSS operations, and would ensure that the small satellite operations would have less potential for interference to either in-band or adjacent band services than operations that would typically be considered in the MSS. As discussed *infra*, this proposal corresponds to allocations to the MSS (Earth-to-space) in the 149.9-150.05 MHz and 1610.6-1613.8 MHz frequency bands. Accordingly, in these specific instances, our proposal would be to add a use footnote to the U.S. Table stating that small satellites authorized under the new process in section 25.122 of the Commission's rules may be considered an application of the MSS. In connection with this proposal, we seek comment on whether such operations should in all cases be on a non-interference, unprotected basis, or whether the operations may have status in the frequency band, provided that the satellites operate consistent with any limitations on the MSS allocations and have demonstrated compliance with the small satellite process in section 25.122.

4. Discussion of New Small Satellite Operations in Select Bands

63. In this section, we highlight frequency bands with existing non-Federal frequency allocations for space operations or other satellite services (e.g., MSS) in the U.S. Table that we believe may accommodate small satellite operations in addition to the services that have been authorized in the frequency bands to date. For the frequency bands under consideration, we seek comment on potential service rules or limitations that could be placed on operations in these bands in order to better facilitate coordination and sharing with incumbent operations. In some instances, we also seek comment on proposing additional service allocations.

a. 137-138 MHz and 148-150.05 MHz

64. *Background.* The 137-138 MHz band is allocated for downlinks in Federal and non-Federal portions of the U.S. Table on a co-primary basis to the space operation service (space-to-Earth), meteorological satellite service (space-to-Earth), and the space research service (space-to-Earth).¹⁶⁷ Several sub-bands within the 137-138 MHz band are also allocated to the MSS (space-to-Earth), either on

¹⁶⁵ The space operation service is a radiocommunication service concerned exclusively with the operation of spacecraft, in particular space tracking, space telemetry, and space telecommand. 47 CFR § 2.1; ITU R.R. No. 1.23.

¹⁶⁶ This approach could be consistent with our proposal that small satellites authorized under the streamlined process have implemented a passively-safe system whereby the satellite is actively commanded to transmit by command originating from the ground. *See supra* Section III.A.1.i; ITU-R Characteristics Report at 7.

¹⁶⁷ 47 CFR § 2.106.

a co-primary or secondary basis, in the Federal and non-Federal Tables, but are limited to non-voice, non-geostationary (NVNG) satellite systems.¹⁶⁸ The 148-150.05 MHz band is allocated for uplinks to the MSS (Earth-to-space) on a primary basis in the Federal and non-Federal Tables, also limited to NVNG satellite systems.¹⁶⁹ The 148-149.9 MHz frequency band is also allocated by footnote to the space operation service (Earth-to-space) on a co-primary basis in the Federal and non-Federal Tables, subject to agreement obtained under No. 9.21 of the ITU Radio Regulations, limited to bandwidths not exceeding 25 kilohertz for any individual transmission,¹⁷⁰ and to the fixed service (FS) and mobile service (MS) on a co-primary basis for Federal use.¹⁷¹ The 149.9-150.05 MHz band is also allocated to the radionavigation-satellite service (RNSS) on a co-primary basis in the Federal and non-Federal Tables.¹⁷² Under an international footnote, MSS operations in the 149.9-150.05 MHz band must be coordinated under No. 9.11A of the ITU R.R., and use of the band by the MSS shall not constrain the development and use of the band by the radionavigation satellite-service.¹⁷³

65. The 137-138 MHz and 148-150.05 MHz bands were the subject of a processing round and rulemaking in 1997 and 1998, which resulted in the grant of several licenses for the provision of MSS in these bands.¹⁷⁴ Of the initial licensees, only one, ORBCOMM License Corp. (ORBCOMM), remains licensed to provide commercial NVNG MSS in the 137-138 MHz or 148-150.05 MHz bands. In 2008, ORBCOMM was granted a modification of its license for an NVNG MSS system to construct, launch, and operate additional satellites capable of operating in the 137-138 MHz and 148-150.05 MHz frequency bands.¹⁷⁵ ORBCOMM subsequently received another modification of its license in 2016.¹⁷⁶ Considering all the various modifications to its license, ORBCOMM is specifically authorized to operate in certain sub-bands.¹⁷⁷ ORBCOMM was also granted authority to operate throughout the 137-138 MHz and 148-150.05 MHz frequency bands until commencement of operations by another U.S.-licensed NVNG MSS system, consistent with the spectrum sharing plan adopted by the Commission in a 1997 order

¹⁶⁸ 47 CFR § 2.106, footnote US320. MSS operations in the 137-138 MHz band are also subject to coordination under ITU R.R. No. 9.11A. Under the Commission's rules, stations of a secondary service shall not cause harmful interference to and cannot claim protection from harmful interference from stations of primary service to which frequencies are already assigned or to which frequencies may be assigned at a later date, but can claim protection from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date. 47 CFR § 2.105(c)(2)(i)-(iii).

¹⁶⁹ 47 CFR § 2.106, footnote US320. MSS operations in the 148-149.9 MHz band must be coordinated under No. 9.11A of the ITU R.R., and the use of the band by the MSS shall not constrain the use and development of the band by the fixed, mobile, and space operation services. *See id.*, international footnote 5.219.

¹⁷⁰ 47 CFR § 2.106, international footnote 5.218.

¹⁷¹ 47 CFR § 2.106.

¹⁷² *Id.*

¹⁷³ 47 CFR § 2.106, international footnote 5.220 (not in U.S. Table).

¹⁷⁴ *Amendment of Part 25 of the Commission's Rules to Establish Rules and Policies Pertaining to the Second Processing Round of the Non-Voice, Non-Geostationary Mobile Satellite Service*, Report and Order, 13 FCC Rcd 9111 (1997).

¹⁷⁵ *Applications by ORBCOMM License Corp.*, Order and Authorization, 23 FCC Rcd 4804 (IB, OET 2008) (*ORBCOMM 2008 Order*).

¹⁷⁶ *See ORBCOMM License Corp.*, IBFS File Nos. SAT-MOD-20111021-00207, SAT-AMD-2013021200020, and SAT-AMD-20151223-00087 (granted-in-part, dismissed-in-part May 5, 2016). In addition to a discrete set of frequency bands granted to ORBCOMM for use on a primary basis in 2008, ORBCOMM was subsequently granted authorization for a 50 kilohertz downlink centered at 137.4 MHz and a feeder link centered at 150.025 MHz. *See id.* (partial grants of Apr. 25, 2013 and Dec. 17, 2015).

¹⁷⁷ *See ORBCOMM 2008 Order*, 23 FCC Rcd at 4812-13, paras. 22-23; *ORBCOMM License Corp.*, SAT-MOD-20111021-00207, SAT-AMD-2013021200020, and SAT-AMD-20151223-00087 (partial grant of Apr. 25, 2013 and partial grant of Dec. 17, 2015).

establishing rules and policies for the licensing and operation of satellite systems in the NVNG MSS.¹⁷⁸ To date, no other NVNG MSS systems have operated in these frequency bands, although a handful of experimental small satellites have proposed operations in these frequency bands.¹⁷⁹

66. *Discussion.* In light of the existing frequency allocation for space operation downlinks in the 137-138 MHz band, and the allocation for space operation uplinks the 148-149.9 MHz band in accordance with international footnote 5.218, we seek comment on use of these bands for small satellite operations. Additionally, we propose to permit small satellite uplinks in the 149.9-150.05 MHz frequency band as an application of the MSS.¹⁸⁰ The ORBCOMM system is currently operating in portions, if not all, of these frequency bands. As these frequency bands were originally considered for use by multiple satellite systems, we request comment generally on whether, and if so, how, small satellite space operations could share this spectrum while protecting ORBCOMM's existing and future MSS operations. As part of this proposal, we consider whether small satellites could utilize spectrum in those frequency bands where ORBCOMM has been authorized to operate pending commencement of operations by another U.S.-licensed NVNG MSS system (i.e., the individual sub-bands within the 137-138 MHz and 148-150.05 MHz frequency bands that were not specifically identified in ORBCOMM's license or subsequent modifications to its license).¹⁸¹ We seek comment on this proposal.

67. In addition, we note the additional requirements applicable to these frequency bands. We note that operations in the downlink band, 137-138 MHz, in the MSS are subject to a number of service rules to effectuate coordination with NOAA.¹⁸² We seek comment on whether any of these service rules should be similarly applied to potential operations by small satellites in this frequency band.¹⁸³ The uplink band, 148-150.05 MHz, is subject to coordination, to the extent specified in the U.S. Table and/or International Table, under Nos. 9.11A and 9.21 of the ITU Radio Regulations.¹⁸⁴ We seek comment on whether these coordination requirements will significantly impede use of this band by small satellites for short duration missions.¹⁸⁵

¹⁷⁸ *Amendment of Part 25 of the Commission's Rules to Establish Rules and Policies Pertaining to the Second Processing Round of the Non-Voice, Non-Geostationary Mobile Satellite Service*, Report and Order, 13 FCC Rcd 9111 (1997). The Little LEO satellite service uses constellations of low-earth orbiting (LEO) satellites to provide commercial radiolocation and two-way data messaging services. Operating at altitudes much lower than those in geostationary orbits, Little LEO satellites are typically deployed in constellations so that as one satellite moves out of view of a terrestrial station, another satellite will come over the horizon to maintain coverage. *Amendment of Part 2 of the Commission's Rules to Allocate the 455-456 MHz and 459-460 MHz bands to the Mobile-Satellite Service*, Order, 17 FCC Rcd 8899, 8900, n.4 (2002).

¹⁷⁹ See, e.g., Kubos Corporation, ELS File No. 0489-EX-CN-2017 (pending) (proposing uplink operations at 149 MHz).

¹⁸⁰ See Appendix A, Proposed Rules, § 2.106.

¹⁸¹ See *ORBCOMM 2008 Order*, 23 FCC Rcd at 4812-13, paras. 22-23; *ORBCOMM License Corp.*, SAT-MOD-20111021-00207, SAT-AMD-2013021200020, and SAT-AMD-20151223-00087 (partial grant of Apr. 25, 2013 and partial grant of Dec. 17, 2015).

¹⁸² See 47 CFR § 25.259.

¹⁸³ *Id.*

¹⁸⁴ As noted, MSS operations in the 148-149.9 MHz band are subject to coordination under No. 9.11A of the ITU R.R., 47 CFR § 2.106, international footnote 5.219, and pursuant to an international footnote, MSS operations in the 149.9-150.05 MHz band are subject to coordination under No. 9.11A of the ITU R.R., 47 CFR § 2.106, international footnote 5.220 (not in U.S. Table). Stations operating in the space operation service in the 148-149.9 MHz band are subject to agreement obtained under No. 9.21 of the ITU R.R., 47 CFR § 2.106, international footnote 5.218.

¹⁸⁵ See ITU R.R. No. 9.21. We note that in Resolution 659 (WRC-15) relating to suitable allocations for the space operation service for short duration missions, as discussed *infra*, the ITU-R recognized that allocations where No. 9.21 applies are not suitable for use by short duration missions. See ITU-R Resolution 659 (WRC-15).

b. 1610.6-1613.8 MHz

68. *Background.* The 1610.6-1613.8 MHz frequency band is allocated for Federal and non-Federal use on a co-primary basis to the MSS (Earth-to-space), the aeronautical radionavigation service, the radiodetermination-satellite service (Earth-to-space), and the radio astronomy service (RAS) on a co-primary basis.¹⁸⁶ This band is part of what is known as the “Big LEO” spectrum.¹⁸⁷ In the United States, the 1610-1626.5 MHz frequency band is currently divided between the time division multiple access (TDMA) MSS system operated by Iridium Constellation LLC (Iridium) with service links in both directions¹⁸⁸ and the code division multiple access (CDMA) MSS system operated by Globalstar Inc. (Globalstar).¹⁸⁹ Currently, Globalstar is authorized to operate at 1610-1617.775 MHz on an exclusive basis.¹⁹⁰ In accordance with the non-Federal portion of the U.S. Table, the lower portion of the spectrum, at 1610.6-1613.8 MHz is also used by RAS receivers.¹⁹¹ Globalstar’s operations in this band must protect RAS sites in the United States.¹⁹²

69. *Discussion.* We seek comment on whether small satellites could operate in this band as an application of the MSS¹⁹³ under the existing uplink allocation. These would be small satellite Earth-to-space links operating independently of the Globalstar system.¹⁹⁴ We tentatively conclude that this band offers spectrum for small satellites to use, provided that the small satellite uplink operations can protect the existing MSS operations, as well as RAS operations. To these ends, we believe that service rules would be appropriately applied to any small satellites seeking to operate in these bands as an application of the MSS. We seek comment on what service rules would be necessary to protect MSS and RAS operations. For example, small satellites seeking to operate in this band could demonstrate that they are not within certain exclusion zones related to United States RAS sites, such as those identified in section 25.213. Earth stations transmitting in these bands for any system could be limited in number and be specifically identified in the application materials for applicants seeking to operate in this band. Small satellite operations in the band could be required to observe out of band emissions limits in section 25.216 to protect the radionavigation satellite service (RNSS). Moreover, we could require that all earth stations operating with a small satellite system have directional antennas and that the system must have the ability to avoid in-line interference events to the existing operators in the band, primarily through operations at higher latitudes. We seek comment on these proposals. We also seek comment on whether authorization should be limited to communications with U.S. earth stations or if other limitations should be adopted. We seek further comment on the potential impact of small satellite operations in this band to existing or planned operations in adjacent or nearby bands, including to Iridium’s operations in the adjacent band

¹⁸⁶ 47 CFR § 2.106.

¹⁸⁷ The Commission has previously classified some satellites operating in LEO as Big LEOs or Little LEOs. Big LEOs provide voice and data communications above 1 GHz, while Little LEOs provide data communications below 1 GHz. *Review of Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz Bands*, Report and Order, Fourth Report and Order, and Further Notice of Proposed Rulemaking, FCC 04-134, at para. 1, n.1 (2004).

¹⁸⁸ See *Iridium Constellation LLC*, Order and Authorization, IBFS File Nos. SAT-MOD-20131227-00148, SAT-AMD-20151022-00074, DA 16-875 (IB, Sat Div. and OET, 2016).

¹⁸⁹ See *Globalstar Licensee LLC and Iridium Constellation LLC*, Order of Modifications, 23 FCC Rcd 15207, 15208, 15222, paras. 3, 44 (2008).

¹⁹⁰ *Id.* at 15207, para. 1.

¹⁹¹ 47 CFR § 2.106.

¹⁹² See 47 CFR § 25.113(a)(1).

¹⁹³ See Appendix A, Proposed Rules, § 2.106.

¹⁹⁴ Operations of small satellites using the Globalstar system are addressed in Section III.B.8 *infra*.

above,¹⁹⁵ and to RNSS systems operating below 1610 MHz. We seek comment on whether application of the existing out of band emissions limits in section 25.216 of the Commission's rules would be sufficient to protect these systems from harmful interference.

5. Use of MSS and FSS Frequency Bands for Inter-Satellite Links with Small Satellites

70. *Background.* The Commission's rules and the ITU Radio Regulations define "inter-satellite service" as a radiocommunication service providing links between satellites.¹⁹⁶ Section 25.279(a) of the Commission's rules states that space stations may use frequencies in the inter-satellite service as indicated in section 2.106, and other frequencies where inter-satellite links are part of the service definition.¹⁹⁷ For example, the definition of FSS states that in some cases FSS may include satellite-to-satellite links, which may also be operated in the inter-satellite service.¹⁹⁸ The definition of MSS likewise includes radiocommunication service "between space stations used by this service,"¹⁹⁹ thereby permitting frequencies allocated to MSS to be used for inter-satellite links. For service allocations in some frequency bands, the Table of Frequency Allocations specifies a directional limitation on operations.²⁰⁰ For example, an allocation for FSS may be limited by parenthetical to the space-to-Earth direction. In that instance, inter-satellite communications would not be in accordance with the Table of Allocations.²⁰¹ Where a parenthetical to the FSS allocation specified "space-to-space" communications, the operation of inter-satellite links would be in accordance with the allocation, subject to any other limitations.

71. In the MSS, Globalstar has operated several experimental inter-satellite links with small satellites.²⁰² The small satellites use Globalstar equipment developed for earth station operations to transmit and receive data by means of the Globalstar system, including Globalstar satellites and ground infrastructure. The experimental communications have taken place on frequencies currently authorized to Globalstar for MSS, typically in the 1615-1617.75 MHz or 2483.5-2495 MHz bands. Iridium has similarly been authorized on an experimental basis to utilize its MSS satellites to communicate with small satellites equipped with Iridium user terminals in spectrum authorized for use by Iridium, including in the 1618.725-1626.5 MHz band.²⁰³ In filings for experimental authorizations, Iridium and Globalstar acknowledge that their Part 25 authorizations currently do not cover these types of space-to-space

¹⁹⁵ Iridium and Globalstar share 0.95 megahertz of spectrum at 1617.775-1618.725 MHz. See *Globalstar Licensee LLC, GUSA Licensee LLC and Iridium Constellation LLC, Iridium Satellite LLC, Iridium Carrier Services LLC, Modification of Authority to Operate a Mobile Satellite System in the 1.6 GHz Frequency Band*, Order of Modifications, 23 FCC Rcd 15207 (2008). Iridium has an exclusive assignment of MSS spectrum in the 1618.725-1626.5 MHz band. *Id.*

¹⁹⁶ 47 CFR § 25.103.

¹⁹⁷ 47 CFR § 25.279(a).

¹⁹⁸ 47 CFR § 25.103.

¹⁹⁹ 47 CFR § 25.103.

²⁰⁰ ITU R.R. No. 5.49 ("In the case where there is a parenthetical addition to an allocation in the Table, that service allocation is restricted to the type of operation so indicated.")

²⁰¹ While not in conformance with the International Table, space stations at both ends of the inter-satellite link would still be subject to applicable notification requirements under the Radio Regulations.

²⁰² See, e.g., Globalstar, Inc., ELS File No. 0242-EX-PL-2016, Exh. Description of Research Project v.4 (granted June 24, 2016) (for communications with three experimental small satellites); Globalstar, Inc., ELS File No. 0468-EX-PL-2015, Exh. Clarification of License Request Purpose (granted Sept. 28, 2015) (for communications with a small satellite).

²⁰³ See, e.g., Iridium Satellite LLC, ELS File No. 0064-EX-ST-2015, Exh. Request for Special Temporary Authority (granted Jan. 22, 2015) (Iridium satellite phone installed on a university's small satellite used to communicate between the satellite and the Iridium constellation).

communications.²⁰⁴ The frequency bands that have been used for inter-satellite communications between small satellites and the Iridium and Globalstar system do not include an allocation for space-to-space operations in the MSS.²⁰⁵ Therefore, these operations to date, licensed under the experimental process, have not been in conformance with the Table of Frequency Allocations.

72. *Discussion.* We tentatively conclude that it would serve the public interest to develop an allocation for space-to-space operations in the MSS in the frequency bands that have been used for communications with the Globalstar and Iridium systems. There are a number of benefits to inter-satellite operations, given the capabilities and existing infrastructure of these MSS systems and the ability of small satellite operators to obtain components needed to communicate with these systems. We believe that encouraging relay operations using Iridium, Globalstar, or other systems can alleviate some of the difficulties faced by small satellite operators in identifying frequencies for Earth-to-space and space-to-Earth links and building or seeking out ground station infrastructure. We seek comment on these tentative conclusions. In addition, given the interest in similar relay communications with satellites operating in the FSS, we ask whether there are other frequency bands that may be appropriate to identify for facilitating inter-satellite communications between satellites operating in the FSS and small satellites. Alternatively, we ask whether there is a definitional change we could develop and propose for MSS, FSS, or ISS that would enable broader change at the ITU for future accommodation of these services within existing allocations. We also seek comment on whether there are additional requirements, for example, technical requirements, that could be adopted to facilitate the use of MSS or FSS frequency bands for inter-satellite links without creating potential interference to other operations.

73. Additionally, we seek comment on providing for the authorization of inter-satellite service links in the frequency bands that have been used for communications with the Globalstar and Iridium systems through a footnote to the U.S. Table. We also seek comment on the bands within the MSS allocations currently used by Globalstar and Iridium, such as 1613.8-1626.5 MHz and 2483.5-2495 MHz, that would be appropriate for this proposal. We recognize, for example, that frequency bands such as 1610-1613.8 MHz may not be appropriate for such operations, in order to ensure protection of radio astronomy installations.

IV. FEES

74. We note two important matters related to our statutory fees.²⁰⁶

75. *Application Fees.* With respect to the one-time application processing fee, the Commission's fee schedule is set forth in section 8 of the Act.²⁰⁷ The fee schedule includes a category for "Low-Earth Orbit Satellite Systems," which the Commission has interpreted to mean NGSO space stations. The Commission's International and Satellite Services Fee Filing Guide describes an NGSO space station as: "NGSO space stations orbit the earth in non-geostationary orbits,"²⁰⁸ and the associated one-time processing fee for authority to deploy and operate these space stations is \$454,705.00. Because we expect most small satellites would use low-earth orbits, we would expect them to fall into this current application fee category.

76. Recently, Congress passed the Repack Airwaves Yielding Better Access for Users of

²⁰⁴ See, e.g., Globalstar, Inc., ELS File No. 0242-EX-PL-2016, Exh. Description of Research Project v.4; Iridium Satellite LLC, ELS File No. 0064-EX-ST-2015, Exh. Request for Special Temporary Authority.

²⁰⁵ See 47 CFR § 2.106.

²⁰⁶ Applicants for U.S. market access do not currently incur application or regulatory fees. See, e.g., *Procedures for Assessment and Collection of Regulatory Fees*, 28 FCC Rcd 7790, 7809, para. 48 (2013) ("Despite the regulatory benefits provided by the Commission to non-U.S. licensed satellite systems serving the United States they do not incur the regulatory fees (or application fees) paid by U.S.-licensed satellite systems.").

²⁰⁷ 47 U.S.C. § 158.

²⁰⁸ 2016 *Application Fees Order*, 31 FCC Rcd. 7534.

Modern Services Act of 2018, or the RAY BAUM'S Act of 2018, which authorized the Commission to "by rule amend the schedule of application fees . . . so that the schedule reflects the . . . addition of new categories of applications."²⁰⁹ Such application fees should "recover the costs of the Commission to process applications."²¹⁰ Given our expectation that small satellite applications will take less time and fewer Commission resources to process than a typical NGSO system, we propose to establish a new application fee for small satellite applications well below the application fee of \$454,705 for Low-Earth Orbit Satellite Systems—specifically we estimate a fee of \$30,000 would likely recover the costs to the Commission to process these applications.²¹¹ We anticipate that processing a small satellite application may require comparable Commission resources to processing an application for a modification of an NGSO system, for which the application fee is currently \$32,480. Modification applications typically do not require review of a full set of data, but only those aspects of the operations that are changing, and frequently do not require a processing round. This more limited review is less resource intensive, and similarly, we expect that review of satellite application filed under the proposed streamlined process would be more limited given the streamlined application and lack of processing rounds. We seek comment on this application-fee proposal, as well as whether a higher or lower fee would be appropriate. We further seek comment on the costs and benefits of this proposal. We also note that the Commission will be developing an accounting system to track the costs of applications, including small satellite applications,²¹² and we expect that our experience actually processing these new applications will eventually inform the appropriate application fee.

77. *Regulatory Fees.* The second fee-related matter concerns annual regulatory fees for small satellites. Entities authorized to operate NGSO systems under Part 25 currently must pay an annual regulatory fee which, for fiscal year 2017, was \$135,350.00 per operational system.²¹³ As a general matter, the Commission does not entertain issues about specific parts of the regulatory fee schedule apart from its annual review of the overall regulatory fee schedule,²¹⁴ given the interdependency of the fees charged across individual categories.²¹⁵ Accordingly, any comments regarding regulatory fees, as applicable to small satellites, should be filed in the proceedings we open for conducting the annual review of such fees.²¹⁶

²⁰⁹ Consolidated Appropriations Act, 2018, 115th Cong., Division P, section 102 (amending section 8(c) of the Act).

²¹⁰ *Id.* (amending section 8(a) of the Act).

²¹¹ We note that the effective date of this statutory change is October 1, 2018, and we make clear that we are not proposing to make any changes to our application fees before that date. *Id.* (section 103 of the Act, effective date).

²¹² *Id.* (adding section 9A(f) to the Act).

²¹³ *Assessment and Collection of Regulatory Fees for Fiscal Year 2017*, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7057, 7088, Appendix C (2017) (*2017 Regulatory Fees Order*); *2017 Regulatory Fees Fact Sheet*.

²¹⁴ 47 U.S.C. § 159(b)(1)(B).

²¹⁵ The Commission annually reviews the regulatory fee schedule, proposes changes to the schedule to reflect changes in the amount of its appropriation, and proposes increases or decreases to the schedule of regulatory fees. *2017 Regulatory Fees Order*, 32 FCC Rcd at 7058. The Commission allocates the total amount to be collected among the various regulatory fee categories. *Id.* at 7059. Thus, a change in the regulatory fee schedule applicable to one category may affect the regulatory fees applicable to other categories.

²¹⁶ Academic researchers from the Samuelson-Glushko Technology Law & Policy Clinic filed an *ex parte* letter stating that absent changes, the annual regulatory fee of \$135,350 currently assessed to NGSO systems would effectively prevent universities seeking to deploy small satellite systems from utilizing the proposed licensing procedures, and asking that we seek comment on the regulatory fee in this *Notice*. See Letter from Blake Reid, Director, et. al., Samuelson-Glushko Technology Law & Policy Clinic to Jose Albuquerque, Chief, Satellite Division, International Bureau, FCC, IB Docket No. 18-86 (filed Apr. 9, 2018). Given the interdependency of the fees charged across individual categories, comments regarding regulatory fees should be filed in the proceedings for

V. CONCLUSION

78. Small satellites represent a dynamic sector in the satellite industry. Our goal is to encourage innovation in this realm by developing processes that can accommodate new types of missions while still ensuring that operators do not experience harmful interference and that the operations are in the public interest. Accordingly, we seek comment on these proposals.

VI. PROCEDURAL MATTERS

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

79. Pursuant to section 1.1200(a) of the Commission's rules, this *Notice* shall be treated as a "permit-but-disclose" proceeding in accordance with the Commission's *ex parte* rules.²¹⁷ 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 presentations 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 rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations or 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. Comment Period and Procedures

80. 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. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.

Filings can be sent by hand or messenger delivery, 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.

All hand-delivered or messenger-delivered paper filings for the Commission's Secretary must be delivered to FCC Headquarters at 445 12th St., SW, Room TW-A325, Washington, DC 20554.

(Continued from previous page) _____
annual review of those fees, and there are no limitations that would hinder development of the record in those proceedings.

²¹⁷ 47 CFR § 1.200(a).

The filing hours are 8:00 a.m. to 7:00 p.m. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes and boxes must be disposed of before entering the building.

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 445 12th Street, SW, Washington DC 20554.

People 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 or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (tty).

C. Initial Regulatory Flexibility Analysis

81. As required by the Regulatory Flexibility Act of 1980 (RFA),²¹⁸ the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on small entities of the policies and rules proposed in the *Notice of Proposed Rulemaking*. The analysis is found in Appendix B. We request written public comment on the analysis. Comments must be filed in accordance with the same deadlines as comments filed in response to the *Notice* and must have a separate and distinct heading designating them as responses to the IRFA. The Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, will send a copy of this *Notice*, including the IRFA, to the Chief Counsel for Advocacy of the Small Business Administration.

D. Paperwork Reduction Act

82. This document contains proposed new and modified information collection requirements. If the Commission adopts any new or revised information collection requirement, the Commission will publish a separate notice in the Federal Register inviting the public to comment on the requirement, as required by the Paperwork Reduction Act of 1995, Public Law 104-13 (44 U.S.C. § 3501-3502). In addition, pursuant to the Small Business Paperwork Reduction 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.

VII. ORDERING CLAUSES

83. Accordingly, IT IS ORDERED, pursuant to sections 4(i), 7, 8, 301, 303, 308, and 309 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 157, 158, 301, 303, 308, 309, that this Notice of Proposed Rulemaking is ADOPTED.

84. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this *Notice of Proposed Rulemaking*, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

²¹⁸ See 5 U.S.C. § 603.

APPENDIX A**Proposed Rules**

For the reasons discussed above, the Federal Communications Commission proposes to amend Parts 2 and 25 of Title 47 of the Code of Federal Regulations, as follows:

PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS: GENERAL RULES AND REGULATIONS

The authority citation for Part 2 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

1. Amend § 2.106, the Table of Frequency Allocations, as follows:

Under “UNITED STATES (US) FOOTNOTES,” add, in numerical order, footnote USXXX.

USXXX In the bands 149.9-150.05 MHz and 1610.6-1613.8 MHz, small satellites as authorized under 47 CFR 25.122 operate as an application of the mobile-satellite service (Earth-to-space).

PART 25 – SATELLITE COMMUNICATIONS

The authority citation for Part 25 continues to read as follows:

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

2. In § 25.113, revise paragraph (i) to read as follows:

§ 25.113 Station construction, deployment approval, and operation of spare satellites.

(i) An operator of NGSO space stations under a blanket license granted by the Commission, except for those authorized pursuant to the application process in § 25.122, need not apply for license modification to deploy and operate technically identical replacement satellites in an authorized orbit within the term of the system authorization. However, the licensee must notify the Commission of the intended launch at least 30 days in advance and certify that its operation of the additional space station(s) will not increase the number of space stations providing service above the maximum number specified in the license.

3. In § 25.114, revise paragraph (d) to read as follows:

§ 25.114 Applications for space station authorizations.

* * * * *

(d) The following information in narrative form shall be contained in each application, except NGSO space station applications filed pursuant to § 25.122:

* * * * *

4. In § 25.117, revise paragraph (d)(1) to read as follows:

§ 25.117 Modification of station license.

* * * * *

(d)(1) Except as set forth in § 25.118(e) and (f), applications for modifications of space station authorizations shall be filed in accordance with § 25.114 and/or § 25.122, as applicable, but only those

items of information listed in § 25.114 and/or § 25.122 that change need to be submitted, provided the applicant certifies that the remaining information has not changed.

* * * * *

5. In § 25.121, revise paragraphs (a)(1) and add paragraph (a)(3) to read as follows:

§ 25.121 License term and renewals.

(a) * * *

(1) Except for licenses for DBS space stations, SDARS space stations and terrestrial repeaters, 17/24 GHz BSS space stations licensed as broadcast facilities, and licenses for which the application was filed pursuant to § 25.122, licenses for facilities governed by this part will be issued for a period of 15 years.

* * * * *

(3) Licenses for which the application was filed pursuant to § 25.122 will be issued for a period of 5 years, without the possibility of extension or replacement authorization.

* * * * *

6. Add § 25.122, to read as follows:

§ 25.122 Applications for streamlined small satellite authorization.

(a) This Section shall only apply to applicants for NGSO satellite systems that are able to certify compliance with the certifications set forth in paragraph (c) of this section. For applicants seeking to be authorized under this section, a comprehensive proposal for Commission evaluation must be submitted for each satellite in the proposed NGSO satellite system on FCC Form 312, Main Form and Schedule S, as described in § 25.114(a)-(c), together with the certifications described in paragraph (c) of this section and the narrative requirements described in paragraph (d) of this section.

(b) Applications for NGSO satellite systems may be filed under this section, provided that the total number of space stations in the system is ten or fewer.

(1) To the extent that space stations in the satellite system will be technically-identical, the applicant may submit an application for blanket-licensed space stations.

(2) Where the space stations in the satellite system are not technically-identical, the applicant must certify that each type of space station satisfies the criteria in paragraph (c) of this section, and submit technical information for each type of space station.

(c) *Certifications under this section.* Applicants filing for licenses under the streamlined procedure described in this section must include with their applications certifications that the following criteria will be met for all space stations to be operated under the license:

(1) The space station(s) will operate only in non-geostationary orbit;

(2) The total on-orbit lifetime is planned to be five years or less for the system;

(3) The space station(s):

(i) Will be deployed at an orbital altitude of 400 km or below;

(ii) Will be deployed from the International Space Station, or a vehicle docked with the International Space Station; or

(iv) Will maintain a propulsion system and have the ability to make collision avoidance maneuvers at any time the space station is located above an altitude of 400 km.

(4) The space station(s) will be identifiable by unique markers distinguishing it from other space stations or space objects;

(5) The space station(s) will release no operational debris;

- (6) No debris will be generated in an accidental explosion resulting from the conversion of energy sources on board the space station into energy that fragments the spacecraft;
- (7) The probability of a collision between each space station and any other large object during the orbital lifetime of the space station is less than 0.001.
- (8) The space station(s) will be disposed of post-mission through atmospheric re-entry. The probability of human casualty from portions of the spacecraft surviving re-entry and reaching the surface of the Earth is zero based on reasonable calculations;
- (9) Operation of the space station(s) will not cause harmful interference to space stations currently authorized under this part and operating in the requested frequency band(s) consistent with the U.S. Table of Frequency Allocations. Operations will not unreasonably preclude future entrants from utilizing the requested frequency band(s);
- (10) The space station(s) will not transmit unless it receives a command originating from the ground to do so and can be commanded by command originating from the ground to cease transmissions;
- (11) Each space station will have physical dimensions greater than 10 cm x 10 cm x 10 cm; and
- (12) Each space station will have a mass of 180 kg or less.

(d) *Other application information.* The following information in narrative form shall be contained in each application:

- (1) An overall description of system facilities, operations, and services and an explanation of how uplink frequency bands would be connected to downlink frequency bands;
- (2) Public interest considerations in support of grant;
- (3) 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 unreasonably precluding other operations in the requested frequency band(s);
- (4) For space stations with any means of maneuverability, including both active and passive means, a description of the design and operation of maneuverability and de-orbit systems; and
- (5) If at the time of application any manned spacecraft is located at or below the deployment orbital altitude of the space station seeking a license, a description of the design and operational strategies that will be used to avoid in-orbit collision with such manned spacecraft.

7. In § 25.156, revise paragraph (d)(1) to read as follows:

§ 25.156 Consideration of applications

* * * * *

(d)(1) Applications for NGSO-like satellite operation will be considered pursuant to the procedures set forth in § 25.157, except as provided in § 25.157(b) or § 25.157(i), as appropriate.

* * * * *

8. In § 25.157, revise paragraph (a), and add paragraph (i) to read as follows:

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

(a) This section specifies the procedures for considering license applications for “NGSO-like” satellite operation, except as provided in paragraphs (b) and (i) of this section. For purposes of this section, the term “NGSO-like satellite operation” means:

- (1) Operation of any NGSO satellite system, and

(2) Operation of a GSO MSS satellite to communicate with earth stations with non-directional antennas.

* * * * *

(i) For consideration of license applications filed pursuant to the procedures described in § 25.122, the application will be processed and granted in accordance with §§ 25.150-25.156, taking into consideration the information provided by the applicant under § 25.122(d)(3), but without a processing round as described in this section and without a queue as described in § 25.158.

9. In § 25.159, revise paragraph (b) to read as follows:

§ 25.159 Limits on pending applications and unbuilt satellite systems.

* * * * *

(b) Applicants with an application for one NGSO-like satellite system license on file with the Commission in a particular frequency band, or one licensed-but-unbuilt NGSO-like satellite system in a particular frequency band, will not be permitted to apply for another NGSO-like satellite system license in that frequency band, except for applicants filing pursuant to § 25.122.

* * * * *

10. In § 25.165, revise paragraphs (a) and (e), and add paragraph (h) to read as follows:

§ 25.165 Surety bonds.

(a) For all space station licenses issued after September 20, 2004, other than licenses for DBS space stations, SDARS space stations, space stations licensed under the process outlined in section 25.122, 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. Failure to post a bond will render the license null and void automatically.

* * * * *

(e) A replacement space station is one that:

(1) Is authorized to operate at an orbital location within $\pm 0.15^\circ$ of the assigned location of a GSO space station to be replaced or is authorized for NGSO operation and will replace an existing NGSO space station in its authorized orbit, except for space stations authorized under section 25.122;

(2) Is authorized to operate in the same frequency bands, and with the same coverage area as the space station to be replaced; and

(3) Is scheduled to be launched so that it will be brought into use at approximately the same time, but no later than, as the existing space station is retired.

* * * * *

(h) Licensees of space stations under the process outlined in section 25.122 need not post a bond unless the space station is not launched, orbiting, and operational, as described in § 25.164, within a period of one year plus 30 days following grant of license. If the space station is not operational following the one year plus 30 days period, then the licensee must file a bond in accordance with paragraph (a)(1) of this Section, and be subject to the requirements of paragraphs (b), (c), and (g) of this section.

* * * * *

11. In § 25.217 of the Commission's rules, revise paragraph (b)(1) as follows:

§ 25.217 Default service rules.

(b)(1) For all NGSO-like satellite licenses, except as specified in paragraph (b)(4), for which the application was filed pursuant to the procedures set forth in § 25.157 after August 27, 2003, authorizing operations in a frequency band for which the Commission has not adopted frequency band-specific service rules at the time the license is granted, the licensee will be required to comply with the following technical requirements, notwithstanding the frequency bands specified in these rule provisions: §§ 25.143(b)(2)(ii) (except NGSO FSS systems) and (iii), 25.204(e), and 25.210(f) and (i).

* * * * *

(4) For all small satellite licensees, for which the application was filed pursuant to § 25.122, authorizing operations in a frequency band for which the Commission has not adopted frequency-band specific service rules at the time the license is granted, the licensee will not be required to comply with the technical requirements specified in this section.

* * * * *

APPENDIX B

Initial Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980, as amended (RFA),¹ the Commission has prepared this present 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 this *Notice of Proposed Rulemaking (NPRM)*. Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines specified in the *NPRM* for comments. The Commission will send a copy of this *NPRM*, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).² In addition, the *NPRM* and IRFA (or summaries thereof) will be published in the Federal Register.³

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

This *NPRM* seeks comment on several proposals relating to the Commission's rules and policies related to small satellites. The rules proposed in this *Notice* will accommodate authorization under Part 25 of the Commission's rules of satellites that until now have been licensed through the experimental licensing process in Part 5 of the Commission's rules and have not been able to provide full commercial service, or have been required to file for a regular Part 25 NGSO authorization. Adoption of the proposed changes would modify 47 CFR Part 25 of the Commission's rules to make small satellite authorization more accessible, limit regulatory costs borne by applicants, shorten application processing times, and offer protection for critical communication links, while promoting efficient use of spectrum.

B. Legal Basis

The proposed action is authorized under sections 4(i), 7, 8, 301, 303, 308 and 309 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 157, 158, 301, 303, 308, 309.

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

The RFA directs agencies to provide a description of, and, where feasible, an estimate of, the number of small entities that may be affected the proposed rules, if adopted.⁴ The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."⁵ In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.⁶ 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 Small Business Administration (SBA).⁷

¹ See 5 U.S.C. § 603. The RFA, see 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. 857 (1996).

² See 5 U.S.C. § 603(a).

³ See 5 U.S.C. § 603(a).

⁴ 5 U.S.C. § 604(a)(3).

⁵ 5 U.S.C. § 601(6).

⁶ 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in 15 U.S.C. § 632). Pursuant to the RFA, 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." 5 U.S.C. § 601(3).

⁷ Small Business Act, 15 U.S.C. § 632 (1996).

Satellite Telecommunications and All Other Telecommunications

The rules proposed in this Notice would affect some providers of satellite telecommunications services, if adopted. Satellite telecommunications service providers include satellite and earth station operators. Since 2007, the SBA has recognized two census categories for satellite telecommunications firms: “Satellite Telecommunications” and “All Other Telecommunications.” Under both categories, a business is considered small if it had \$32.5 million or less in average annual receipts.⁸

The first category of Satellite Telecommunications “comprises establishments 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.”⁹ For this category, Census Bureau data for 2012 show that there were a total of 333 satellite telecommunications firms that operated for the entire year.¹⁰ Of this total, 299 firms had annual receipts of under \$25 million, and 12 firms had receipts of \$25 million to \$49,999,999.¹¹

The second category of Other Telecommunications is comprised of entities “primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. 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. Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.”¹² For this category, Census Bureau data for 2012 show that there were a total of 1,442 firms that operated for the entire year.¹³ Of this total, 1,415 firms had annual receipts of under \$25 million.¹⁴ We anticipate that some of these “Other Telecommunications firms,” which are small entities, are earth station applicants/licensees, but since we do not propose changes to our licensing rules specific to earth station, we do not anticipate that these entities would be affected if our proposed rule changes are adopted.

We anticipate that our proposed rule changes may have an impact on space station applicants and licensees. While traditionally space station applicants and licensees only rarely qualified under the definition of a small entity, the small satellite applicants and licensees that are contemplated by this Notice may qualify as small entities that would be affected by our proposed actions.

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

This *NPRM* seeks comments and proposed several rule changes that will affect small satellite authorization procedures, recordkeeping, and other compliance requirements for space station operators. Many of the proposed changes, as described below, would decrease the burden in various regards for entities that plan to launch or operate satellites that may be colloquially referred to as “small satellites.”

First, this *NPRM* proposes to simplify application requirements by tailoring a section specifically for small satellites or small satellite constellations meeting certain characteristics, such as low total number of satellites, short mission duration, and low altitude orbit. These proposals include some documentation requirements consistent with those already established for an applicant under Part 25 of the Commission’s rules. We propose that some of the informational requirements, however, may be completed by a

⁸ See 13 C.F.R. § 121.201 NAICS code 517410 and code 517919.

⁹ U.S. Census Bureau, 2007 NAICS Definitions, “517410 Satellite Telecommunications”.

¹⁰ See <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>.

¹¹ *Id.*

¹² U.S. Census Bureau, 2007 NAICS Definitions, “517919 Satellite Telecommunications”.

¹³ See 13 C.F.R. § 121.201, NAICS code 517919.

¹⁴ <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>.

certification rather than narrative description, which we believe will lessen the burden on these small satellite applicants.

Second, this *NPRM* proposes to identify frequencies which may be useful for small satellites. This portion of the *NPRM* should not increase any requirements with respect to small entities, but instead, is designed to help small entities apply for satellite licenses.

Third, this *NPRM* proposes to decrease the application fees applicable to small satellites to \$30,000.

In sum, this *NPRM* seeks to make obtaining authorization of small satellites more accessible, limit regulatory costs borne by applicants, shorten application processing times, and encourage the protection of communications links, while enabling efficient use of spectrum.

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

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.”¹⁵

This *NPRM* seeks comment from all interested parties. The Commission is aware that some of the proposals under consideration may impact small entities. Small entities are encouraged to bring to the Commission’s attention any specific concerns they may have with the proposals outlined in this *NPRM*.

The Commission expects to consider any economic impact on small entities, as identified in comments filed in response to this *NPRM*, in reaching its final conclusions and taking action in this proceeding.

In this *NPRM*, the Commission considers rule revisions to reflect changes and advances in the satellite industry. This *NPRM* proposes to eliminate some information filing requirements. We propose that applicants may provide certifications in lieu of narrative information. In addition, we propose that applicants be exempt from the bond requirement for a certain period of time, and that applications for small satellites will not be subject to the processing round procedures. These proposals are designed to lower the regulatory burden involved in licensing small satellites and reduce application processing times, thereby lessening the burden of compliance on small entities with more limited resources than larger entities. Additionally, the *NPRM* proposes to decrease the application fee for small satellite applicants.

The proposed streamlined process is optional, so a small satellite applicant could still choose to apply under the Commission’s existing Part 5 or Part 25 rules. The proposed changes, however, would facilitate authorization of small satellites under Part 25 of the Commission’s rules. These changes could support smaller entities who aim to develop and launch a small satellite or a small satellite constellation.

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

None.

¹⁵ 5 U.S.C. § 603(c)(1)-(c)(4).

**STATEMENT OF
CHAIRMAN AJIT PAI**

Re: *Streamlining Licensing Procedures for Small Satellites*, IB Docket No. 18-86.

A few weeks ago, I had the chance to visit Launchpad 39A at the Kennedy Space Center in Cape Canaveral, Florida. That's where numerous historic space missions launched—including Apollo 11, which sent the first humans to the moon, and Apollo 13, the “successful failure” which set a record for the farthest distance humans ever traveled from Earth. It's a testament to human ingenuity that since those missions, we have expanded the variety and increased the quantity of objects launched into space, including recently a car.

In recent years, for example, smaller, less-expensive satellites with short-duration missions—often known as “small satellites”—that are often used for scientific research by universities, and increasingly for commercial operations, have also been developed and launched into space. Their numbers have grown, and with them a problem: more satellites mean more regulatory reviews, but our current rules weren't designed with these smaller satellites in mind.

Today, we begin the process for solving this problem. We aim to streamline the process for authorizing commercial small-satellite operations. If operators want to launch satellites with certain characteristics, such as short orbital lifetimes, they could choose to file under a new, alternative small satellite process. These procedures would be less burdensome while still preserving FCC interests in issues like efficient spectrum use and limiting orbital debris. We also ask a number of questions, including about application fees, that will inform our decision-making as we consider implementing this new process.

This is yet another measure the FCC is taking to address one of its own continuing missions: encouraging innovation through next-generation technologies. Easing the regulatory burdens for new space missions and research using small satellites will ultimately benefit everyone from academic researchers to small businesses.

Thank you to the dedicated staff who worked on this item: Jose Albuquerque, Christopher Bair, Stephen Duall, Jennifer Gilsonan, Karl Kensinger, Daudeline Meme, Sankar Persaud, Tom Sullivan, Troy Tanner, and Merissa Velez from the International Bureau; Patrick Forster, Michael Ha, Nicholas Oros, Jamison Prime, and Ron Repasi from the Office of Engineering and Technology; Scot Stone from the Wireless Telecommunications Bureau; Roland Helvajian from the Office of Managing Director; and Deborah Broderson, David Horowitz, and Andrea Kelly from the Office of General Counsel.

**STATEMENT OF
COMMISSIONER MIGNON L. CLYBURN**

Re: *Streamlining Licensing Procedures for Small Satellites*, IB Docket No. 18-86.

Great things come in small packages! The first time those of us of a certain height attached real meaning to this phrase, came on the heels of being consoled after being made to feel exceptionally small and inadequate, from the words or hands of a playground bully.

Today, however, this oft-recited phrase can be used to describe several trends taking place in the technology and communications industries. The first commercial cellphone was literally the size of a brick. Today's smart phones fit in our back pockets. In the 1960s and 70s, you needed a room the size of a huge office to house that generation's super computer. Now, those smart phones in our purses contain more computing power than all at NASA back in 1969.

A few years back, researchers at the University of Illinois developed batteries only a few millimeters in size and they can be used to jump-start a car, and so long as consumers continue to demand portability when it comes to their electronic devices, and as long as there are engineers working on satisfying that demand, we should expect the trend towards smaller device sizes to continue.

This shrinking trend when it comes to our technology devices, is now impacting the satellite industry. "Small satellites" are being deployed into orbit efficiently and cost-effectively for a variety of uses. We are seeing rising numbers of holders of experimental and amateur licenses for small satellite systems, seek authorization of those systems for commercial use. The Earth imagery and other information from these systems are being used by the tech industry to develop big data technologies for a variety of applications. One such application is in the field of agriculture, where satellite and other data is being used to improve crop yields. Small satellite systems are also being used for space in cloud data and analytics providing advanced maritime, aviation, and weather tracking.

Today, the Commission rightly acknowledges this trend in the commercial industry and proposes new licensing procedures that should facilitate greater investment and innovation. Providing for one streamlined set of procedures, and seeking comment on how we can tailor our Part 25 license and service rules for small satellite systems, means that we are off to a great start. I am in full support of today's item and thank Tom Sullivan and the International Bureau for an impressive Notice of Proposed Rulemaking.

**STATEMENT OF
COMMISSIONER MICHAEL O'RIELLY**

Re: *Streamlining Licensing Procedures for Small Satellites*, IB Docket No. 18-86.

I approve of today's notice that should promote innovation and entrepreneurship by facilitating and streamlining the launch of small satellites, such as CubeSats. Over the past year, the Commission has witnessed impressive advancements in satellite technologies. From NGSO constellations and next-generation geos, to impressive space launch capabilities, we are witnessing the proliferation of systems providing faster broadband speeds, engaging in earth observation, and pushing the envelope of scientific research. Hopefully, this proceeding will lead to future inventions and services that we cannot envision today.

This item's focus on smaller systems and shorter-term projects should promote such research and development, along with the marketing of new services. As proposed, the streamlined processes would be available for applications involving ten or fewer satellites with a life cycle of five years or less. As we go forward, we must be clear about which entities will be able to utilize these streamlined procedures and be careful that we do not create unintentional loopholes that could give some entities a competitive advantage over others.

Further, with this proceeding comes added responsibilities. We must ensure that the increased use of small sats does not cause harmful interference to other services. This an issue we have been faced with and have not adequately resolved in the context of NGSOs and in-line interference.

As I have discussed before, we also need a better plan to address orbital debris and dead satellites so that we do not clutter space with such things as used rocket parts. Therefore, we must make certain that these small sats will not cause damage to other satellites and that they de-orbit appropriately at the end of life.

Generally, the Commission must consider orbital debris when contemplating satellite rules going forward. Other federal agencies are working on best practices, and industry and governments are working on ways to clean up space, including such ideas as launching nets and harpoons to snag pieces of space trash as they fly by.¹ It is estimated that there may be more than 650,000 objects larger than a fingernail and 170 million pieces larger than one millimeter.² This may not sound like much to some, but these objects can travel at speeds of up to 17,500 miles per hour, causing quite a bit of damage. While the FCC should not be regulating space debris, it should engage on this issue and do its part to ensure that its licensees are responsible stewards of the orbits surrounding the Earth. We certainly should ensure that we do not add to the problem. I look forward to discussing this issue with industry and other federal agencies in the coming months.

¹ Stephen Clark, *Eliminating Space Junk Could Take Step Toward Reality with Station Cargo Launch*, SPACEFLIGHT NOW, Apr. 1, 2018, <https://spaceflightnow.com/2018/04/01/eliminating-space-junk-could-take-step-toward-reality-with-station-cargo-launch/>.

² Dave Mosher and Samantha Lee, *More than 14,000 Hunks of Dangerous Space Junk are Hurling Around Earth – Here's Who Put it All Up There*, BUSINESS INSIDER, Mar. 29, 2018, <http://markets.businessinsider.com/news/stocks/space-junk-debris-amount-statistics-countries-2018-3-1019848316> (adding that the Space Surveillance Network tracks 23,000 objects larger than a softball and that 14,000 of these are uncontrolled).

**STATEMENT OF
COMMISSIONER BRENDAN CARR**

Re: *Streamlining Licensing Procedures for Small Satellites*, IB Docket No. 18-86.

Both on the ground and beyond Earth's atmosphere, wireless technology is getting smaller. On the terrestrial side, upwards of 80% of new deployments are small cells. And we're seeing a similar trend in space—smaller, less expensive satellites are being deployed in increasing numbers. In fact, the U.S. now leads the world in small sat launches. Americans stand to benefit from these commercial deployments with use cases ranging from the Internet of Things to smart agriculture applications.

As policymakers, we need to make sure our rules keep pace with these changes in technology. And that means ensuring that our regulations are “right sized” and tailored to reflect the costs and impacts of these innovations.

Last month, the FCC recognized this principle when we voted to exempt small wireless facilities from regulatory procedures designed for large towers. The record showed that, by subjecting small cells to large scale regulations, we were discouraging broadband deployment in those communities that need it most and threatening to undermine the United States' efforts to win the global race to 5G.

In this Notice, we recognize that the same problem could exist for small satellites. While our traditional Part 25 approach for processing satellite applications involves legal, technical, and other showings that may make sense for large satellites or significant constellations, the regulatory costs associated with these reviews can prevent the business case for small sats from getting off the ground. So I am glad we are now proposing to define a new category of small sats and seeking comment on streamlined approval procedures. This step should encourage investment and innovation in small sats while continuing to promote our interests in limiting orbital debris and protecting against harmful interference.

An oversized regulatory burden should never be what stands in the way of progress, so I am pleased to support this proposal. I want to thank the staffs of the International Bureau and the Wireless Telecommunications Bureau for their work on this item.

**STATEMENT OF
COMMISSIONER JESSICA ROSENWORCEL**

Re: *Streamlining Licensing Procedures for Small Satellites*, IB Docket No. 18-86.

Welcome to the second space age. During the first, which began with the end of the Second World War, space missions depended on the prowess of our superpowers. This was for good reason—going to space was out-of-this world expensive. Missions were awe-inspiring but rare. But this new space age is different. It relies on radically new technologies and business models. It features a much wider range of space interests and actors. Satellites are smaller, crowd-funded constellations are possible, and space tourism is no longer simply a dream. In short, we have so many more reasons to reach for the stars.

So today we take steps to tailor our licensing framework for this new era. That's important. Across the board, we need to do more to prepare for the proliferation of satellites headed to higher altitudes. To this end, in this rulemaking we seek comment on an alternative application process for small satellites, ask questions about on-orbit lifetime, and explore issues of maneuverability and trackability. We also seek comment on new frequencies for new constellations of small satellites.

I look forward to the record that develops. But to be truly prepared for the second space age I think there are two additional issues that deserve our attention now.

First, the FCC needs to tackle the growing challenge of orbital debris. At present, the risk of debris-generating collisions is reasonably low. Still, some satellite collisions have happened. As more actors participate in the space industry with larger satellite constellations, the frequency of these accidents is going to increase. Unchecked, growing debris in orbit could make some regions of space unusable for decades to come. That's not an acceptable outcome. It's why we need—right now—to develop a comprehensive policy to mitigate collision risks and ensure space sustainability.

Second, the FCC needs to coordinate more closely with other federal authorities to figure out just what our national policies are for this jumble of new space activity. Right now, the National Space Council is considering policy changes to help promote the growth of the commercial space industry. Their efforts encompass everything from streamlining licenses to reforming export controls to protecting airwaves facilitating space activities. Its membership spans the civil, military, and commercial sectors, including the Secretary of State, Secretary of Defense, Secretary of Transportation, Secretary of Homeland Security, and Director of National Intelligence. Representatives from the Office of Management and Budget, National Aeronautics and Space Administration, and the Joint Chiefs of Staff, among others, also serve on this council. It's an impressive list. But the FCC should have a seat at this table. It's a glaring omission that the agency does not because through our oversight of the airwaves and licensing of satellite services we have an important role ensuring the viability of space for future generations. Cutting the FCC out of this discussion is an unseemly mistake—and one that deserves a fix.