Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	File No. SAT-LOA-20151123-00078
Spire Global, Inc.	)	File No. SAT-AMD-2016_____
	)	
Application to Amend	)	Call Sign: S2946
SAT-LOA-20151123-00078	)	

Description of Amendment

Spire Global, Inc. ("Spire") hereby amends its application for authority to launch and operate its LEMUR-2 constellation.[1] As an interim measure prior to the deployment of Spire's Phase II LEMUR-2 satellites, Spire seeks authority to deploy up to 100 LEMUR-2 satellites (in the aggregate), across two new Phases (Phase IB and IC), using the frequencies referred to in Part I below and into the orbits referred to in Part II below.[2] Spire further requests to amend its application to include the service classifications set forth in Part III below. Spire further requests the waivers set forth in Part IV below.

The addition of two new interim sets of Phases (IB and IC) has become necessary as a result of complications in the completion of coordination for the frequencies originally proposed by Spire for its LEMUR-2 constellation and to accommodate requests received through the

[1] *See* Application of Spire Global, Inc., File No. SAT-LOA-20151123-00078 (filed Nov. 23, 2015) ("Initial Application"). Spire's Initial Application status is granted in part and deferred in part. *See* Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Mar. 18, 2016, as corrected Mar. 24, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part June 16, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Oct. 14, 2016). This amendment supplements Spire's Initial Application and incorporates by reference the remaining information provided by Spire in its Initial Application.

[2] For the avoidance of doubt, Spire is not requesting an increase in the overall number of satellites (900) to be deployed under its license over its 15-year term.

National Telecommunication and Information Administration ("NTIA").[3] Spire is not seeking any changes to its Phase I satellites or its Phase II satellites at this time other than the ability to remove cameras.[4]

In Phase IB and IC, Spire requests authority to use multiple primary downlinks and uplinks to increase the flexibility it has to coordinate spectrum use with existing users and to operate in accordance with both the domestic and ITU Table of Frequency Allocations in foreign locations where Spire has ground stations. While Spire seeks authority on its satellites to use multiple primary downlinks and uplinks, only one primary downlink and uplink would be used for any one transmission to/from a ground station. The specific downlink and uplink frequency used for any specific transmission would depend upon Spire's discussions with third parties (including NTIA) with respect to a given domestic or foreign ground station location, the allocation in the region in which the given ground station is located and interference concerns with specific satellite or ground based systems. Such flexibility will allow Spire to efficiently use spectrum in a manner that does not interfere with existing users.

Other than the variation in frequencies and the presence or absence of cameras used by the Phase IB and IC satellites, LEMUR-2 satellites are technically identical.

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[3] *See* Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Oct. 14, 2016) (stating that "[b]ased upon information provided by the National Telecommunication and Information Administration (NTIA) as part of the frequency coordination process, future non-federal licenses for additional satellites will only be exceptionally considered for requests of downlink operations in the band 402-403 MHz, and Spire shall have no expectations that future licenses will be approved…. For future missions, transition of TT&C links out of the 402-403 MHz band is recommended").

[4] Spire may remove the onboard cameras on some of the LEMUR-2 satellites and add mass plates to ensure that the weight of satellites do not vary materially. This change to some of the LEMUR-2 satellites does not impact any of the radiofrequency, orbital debris, or other relevant parameters of the satellites. As discussed below and in the Initial Application, Spire provides earth imaging and metrological monitoring services (both of which meet the definition of earth exploration-satellite service ("EESS")), so removal of cameras does not affect service classifications. *See* Initial Application, Exhibit A at 7-9.

Grant of this application serves the public interest as it will permit Spire to continue to operate its state-of-the-art satellite service providing maritime monitoring, meteorological monitoring, and earth imaging services. The high revisit times of the satellite system will enable the provision of critical near real-time Automatic Identification System ("AIS") and Application Specific Messages ("ASM")[5] data of interest to shipping companies, harbor operators, governments, vessel traffic service data providers, and financial services companies. In addition, grant of this application will foster the development of a low-cost competitive AIS and ASM satellite constellation. Therefore, grant of this application serves one of the Federal Communications Commission's ("Commission's" or "FCC's") primary objectives of "promoting fair and vigorous competition in the satellites communications market."[6]

The National Oceanic and Atmospheric Administration ("NOAA") recently awarded Spire the first Commercial Weather Data Pilot program contract; under the contract, Spire will provide "space-based, radio-occultation data for the purpose of demonstrating data quality and potential value to NOAA's weather forecasts and warnings."[7] Approval of additional Phase IB

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[5] *See Application Specific Messages collection*, e-Navigation, http://www.e-navigation.nl/asm (last visited Nov. 11, 2016) (noting that water levels, marine traffic signals, tidal windows, and clearance time to enter port information can be passed through ASM transponders). For example, ASM transponders mounted on the Panama Canal locks can emit signals to nearby ships alerting them as to the open/close status of the canal. *See, e.g.*, *id.* The Spire Phase IB and IC satellites will only passively monitor signals from these ASM transponders.

[6] *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*, Notice of Proposed Rulemaking, 11 FCC Rcd 19841 ¶ 10 (1996).

[7] Press Release, The White House, Harnessing the Small Satellite Revolution to Promote Innovation and Entrepreneurship in Space (Oct. 21, 2016), https://www.whitehouse.gov/the-press-office/2016/10/21/harnessing-small-satellite-revolution-promote-innovation-and ("Last month, the National Oceanic and Atmospheric Administration (NOAA) awarded the first Commercial Weather Data Pilot program contracts to smallsat-constellation operators GeoOptics, Inc. and Spire Global, Inc. to provide space-based, radio-occultation data for the purpose of demonstrating data quality and potential value to NOAA's weather forecasts and warnings."); *see also id.* (noting also that the Office of Science and Technology Policy will "promote and support both government and private use of small satellites for remote sensing, communications, science, and the exploration of space").

and Phase IC satellites is necessary for successful completion of the pilot program for NOAA, and Spire believes it is the only company capable of doing so in accordance with the pilot's terms.

In addition, grant of this application will enable Spire to provide a state-of-the-art, low-cost, satellite service providing aircraft monitoring to help aircraft carriers meet regulatory mandates in a cost effective manner, including those promulgated by the Federal Aviation Administration, and to help complete a critical part of the United States ("U.S.") Next Generation Air Transportation System. To Spire's knowledge, only one other operator is currently planning to provide such a service. Therefore, grant of this application also serves the objective of promoting fair and vigorous competition in the provision of this service.

For all these reasons, grant of this amendment would serve the public interest.

I. Frequencies Requested

A. Phase I

Spire has authority to deploy twenty-eight Phase I satellites.[8] Spire is not seeking any changes to its Phase I satellites. Phase I satellites use the frequency bands identified in the grant of authority relating to the Phase I satellites.[9]

B. Phase IB

Table 1 below shows the frequency bands that Spire is seeking authority to use in Phase IB. Bands emphasized in bold italics show differences from Phase I.

[8] *See* Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Oct. 14, 2016).
[9] *See id.*

Table 1 - Phase IB Frequencies

Phase IB		
Frequency	**Use**	**Comments**
Active Frequencies Used		
2020-2025 MHz (Space-to-earth)	Primary data downlink	No change from Initial Application
2200-2290 MHz (Space-to-earth)	***Primary data downlink***	***Addition***
401-402 MHz (Space-to-earth)	***Primary TT&C downlink*** ***Backup data downlink***	***Addition***
402-403 MHz (Space-to-earth)	Primary TT&C downlink Backup data downlink	No change from Initial Application
402-403 MHz (Earth-to-space)	Primary TT&C uplink	No change from Initial Application
399.9-400.05 MHz (Earth-to-space)	***Primary TT&C uplink***	***Addition***

Like Phase I, the Phase IB satellites will also receive receive-only frequencies on certain AIS, ASM, and GNSS bands. These receive-only frequencies are listed in Table 2 below. All receive-only frequencies are software enabled. So, Spire seeks authority to launch Phase IB satellites before approval of all receive-only frequencies is granted and will upgrade the Phase IB satellites on orbit to receive receive-only frequencies as, if and when they are approved.

Table 2 - Phase IB Receive-Only Frequencies

Phase IB		
Frequency	**Use**	**Comments**
Receive Only Frequencies (passive reception of externally generated RF signals)		
AIS 1 (161.9625-161.9875 MHz)	Satellite receive only	No change from Initial Application
AIS 2 (162.0125-162.0375 MHz)	Satellite receive only	No change from Initial Application
AIS 3 (156.7625-156.7875 MHz)	***Satellite receive only***	***Addition***
AIS 4 (156.8125-156.8375 MHz)	***Satellite receive only***	***Addition***
ASM 1 (161.9375-161.9625 MHz)	***Satellite receive only***	***Addition***
ASM 2 (161.9875-162.0125 MHz)	***Satellite receive only***	***Addition***
GPS L1 (1560.07-1590.77 MHz)	Satellite receive only	No change from Initial Application
GPS L2 (1217.37-1237.83 MHz)	Satellite receive only	No change from Initial Application
GLONASS L1 (1592.95-1611.05 MHz)	***Satellite receive only***	***Addition***
GLONASS L2 (1237.8-1254.2 MHz)	***Satellite receive only***	***Addition***
Galileo E1 (1557.52-1593.32 MHz)	***Satellite receive only***	***Addition***
Galileo E5 (1166.215-1217.375 MHz)	***Satellite receive only***	***Addition***

C. Phase IC

The only differences between Phase IC and Phase IB is (i) the addition of another primary telemetry, tracking, and command ("TT&C") uplink in the 449.75-450.25 MHz band in Phase IC and (ii) the addition of a space-based ADS-B receiver capable of receiving signals in the 1087.7-1092.3 MHz band. The addition of this additional uplink frequency band will enhance the flexibility of Spire's constellation and facilitate spectrum coordination in more congested frequency bands. The addition of the ADS-B receiver will allow Spire to provide aircraft tracking services.

Table 3 shows the frequency bands that Spire is seeking authority to use in Phase IC. Bands emphasized in bold italics show differences between Phase IC and Phase IB.

Table 3 - Phase IC Frequencies

Phase IC		
Frequency	**Use**	**Comments**
Active Frequencies Used		
2020-2025 MHz (Space-to-earth)	Primary data downlink	No change from Phase IB
2200-2290 MHz (Space-to-earth)	Primary data downlink	No change from Phase IB
401-402 MHz (Space-to-earth)	Primary TT&C downlink Backup data downlink	No change from Phase IB
402-403 MHz (Space-to-earth)	Primary TT&C downlink Backup data downlink	No change from Phase IB
402-403 MHz (Earth-to-space)	Primary TT&C uplink	No change from Phase IB
399.9-400.05 MHz (Earth-to-space)	Primary TT&C uplink	No change from Phase IB
449.75-450.25 MHz (Earth-to space)	***Primary TT&C uplink***	***Addition from Phase IB***

Like Phase I and Phase IB, the Phase IC satellites will also receive receive-only frequencies on certain AIS, ASM, and GNSS bands, as well as ADS-B signals. These receive-only frequencies are listed in Table 4 below. All receive-only frequencies are software enabled. So, Spire seeks authority to launch Phase IC satellites before approval of all receive-only

frequencies is granted and will upgrade the Phase IC satellites on orbit to receive receive-only frequencies as, if and when they are approved.

Table 4 - Phase IC Receive-Only Frequencies

Phase IC		
Frequency	**Use**	**Comments**
Receive Only Frequencies (passive reception of externally generated RF signals)		
AIS 1 (161.9625-161.9875 MHz)	Satellite receive only	No change from Phase IB
AIS 2 (162.0125-162.0375 MHz)	Satellite receive only	No change from Phase IB
AIS 3 (156.7625-156.7875 MHz)	Satellite receive only	No change from Phase IB
AIS 4 (156.8125-156.8375 MHz)	Satellite receive only	No change from Phase IB
ASM 1 (161.9375-161.9625 MHz)	Satellite receive only	No change from Phase IB
ASM 2 (161.9875-162.0125 MHz)	Satellite receive only	No change from Phase IB
GPS L1 (1560.07-1590.77 MHz)	Satellite receive only	No change from Phase IB
GPS L2 (1217.37-1237.83 MHz)	Satellite receive only	No change from Phase IB
GLONASS L1 (1592.95-1611.05 MHz)	Satellite receive only	No change from Phase IB
GLONASS L2 (1237.8-1254.2 MHz)	Satellite receive only	No change from Phase IB
Galileo E1 (1557.52-1593.32 MHz)	Satellite receive only	No change from Phase IB
Galileo E5 (1166.215-1217.375 MHz)	Satellite receive only	No change from Phase IB
ADS-B (1087.7-1092.3 MHz)	***Satellite receive only***	***Addition from Phase IB***

D. Phase II

Spire is not seeking any change to Phase II at this time. Following pre-coordination with certain known federal and commercial operators in the Phase II bands, Spire may further amend its license with respect to the Phase II frequencies.

II. Deployments Requested

A. Phase I

Spire is not seeking any change to the deployment parameters of its Phase I satellites.

B. Phase IB and Phase IC

Spire requests authority to deploy up to 100 LEMUR-2 satellites (in the aggregate) that will operate in either the Phase IB or Phase IC frequencies.[10] By mid-2017, Spire will have the ability to implement the 449.75-450.25 MHz frequency band and the ADS-B receiver on new satellites manufactured thereafter. However, Spire will have to make investments in its ground architecture and license its foreign ground stations in that frequency band, all of which could take time. Therefore, Spire seeks flexibility in deploying satellites as Phase IB or Phase IC, but not to exceed 100 in the aggregate across both Phases. Spire will notify the Commission prior to and following deployment whether a given satellite is Phase IB or Phase IC for purposes of recordkeeping.

Recognizing that the Commission's concerns relating to orbital debris mitigation and the concerns of other users of space and the radio frequency spectrum are better addressed with known deployments, Spire seeks authority to deploy the Phase IB and Phase IC satellites from any of the following launches (all launch dates are "no earlier than" or "NET" dates) in Table 5 below.

[10] For the avoidance of doubt, Spire is not requesting an increase in the overall number of satellites (900) to be deployed under its license over its 15-year term.

Table 5- Deployment Parameters

Launch #	Launch Provider/Vehicle	Launch Date (NET)	Altitude (km)	Inclination (+/- 1 deg)
Launch 1	SpaceX/Falcon9	Q1 2017	450x720	SSO (98)
Launch 2	ISRO/PSLV	Q1 2017	580	SSO (98)
Launch 3	Roscosmos/Soyuz	Q1 2017	600	SSO (98)
Launch 4	ISRO/PSLV	Q2 2017	500	SSO (98)
Launch 5	Orbital/Minotaur4	Q3 2017	400 x 600	24
Launch 6	Roscosmos/Soyuz	Q2 2017	600	SSO (98)
Launch 7	Roscosmos/Soyuz	Q3 2017	600	SSO (98)
Launch 8	Orbital/Antares	Q1 2017	Up to 500	ISS (51.6)
Launch 9	Orbital/Antares	Q2 2017	Up to 500	ISS (51.6)
Launch 10	ISRO/PSLV	Q3 2017	500	SSO (98)
Launch 11	SpaceX/Falcon9	Q4 2017	575	SSO (98)
Launch 12	Rocket Lab/Electron	Q2 2017	500	SSO (98)
Launch 13	Rocket Lab/Electron	Q3 2017	450	45
Launch 14	Virgin/LauncherOne	Q3 2017	500	90
Launch 15	Virgin/LauncherOne	Q4 2017	500	87.9
Launch 16	Roscosmos/Soyuz	Q4 2017	585	SSO (98)
ISS Resupply	Varies	Varies	~400	~51.6

Further, to minimize potential orbital debris concerns, Spire will limit the number of satellites deployed for any one deployment to sixteen LEMUR-2 satellites.[11]

To be clear, the Commission has already authorized Spire to launch and operate eight satellites on Launch 1 (the FormoSat-5 mission), and Spire is not seeking authority to deploy more satellites on that mission.[12] Rather, because of timing issues, Spire may not be able to deploy the FormoSat-5 satellites under its existing license, which provides flexibility not to include FormoSat-5 as one of its deployments for Phase I satellites.[13] Spire therefore seeks

[11] In the aggregate across different launches, Spire may deploy more than sixteen LEMUR-2 satellites into any one orbit, but since the satellites naturally decay in their orbit, subsequent launches into the same orbit do not increase the number of satellites in that orbital plane.
[12] *See* Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Oct. 14, 2016); *see also* Spire Global, Inc., File No. SAT-LOA-20151123-00078, Spire Global - Orbcomm Agreement (filed Sept. 15, 2016) ("Spire-Orbcomm Agreement").
[13] *See id.*

authority under this application to deploy up to eight satellites on FormoSat-5 as Phase IB or Phase IC satellites, if and only if, those previously authorized satellites have not already been deployed under Spire's existing license. Spire understands and agrees that such satellites will be subject to the same conditions agreed to with Orbcomm License Corp. ("Orbcomm") and imposed under its existing license and is subject to the Spire-Orbcomm Agreement.[14]

Spire knows the orbits will include deployments from the International Space Station ("ISS"). Spire is requesting authority to pursue any number of ISS deployments (subject to the 100 aggregate number of Phase IB and IC satellites) on any launch vehicle that is scheduled to rendezvous with the ISS because ISS deployments are fluid in time, launch date, and launch vehicle, but they are similar in orbital profile and are very low risk from an orbital debris perspective. Deployments from the ISS are closely directed by the ISS program, are directly from the ISS and below the ISS's altitude at the time of deployment, are very short in orbital lifetime, and pose no danger to existing low-earth orbit systems ("LEO") or manned missions.

Spire also plans to pursue orbits above and in the same inclination as the ISS from spacecraft first docking at the ISS, if and only if, approved by the ISS program ("Above Station Deployments"). Spire does not seek blanket authority for Above Station Deployments. Instead, Spire is identifying specific launches that are likely to be Above Station Deployments (Launch 8 and Launch 9) in Table 5. Above Station Deployments are closely coordinated with, and subject to approval by, the ISS program on such terms as it deems necessary to ensure the protection of the ISS. Such deployments will be at or below 500 km, which represents a worst-case scenario from an orbital dwell time perspective. However, at the direction of the ISS program, these deployments can be below the ISS if technical and safety parameters cannot be met after

[14] *See* Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078, at 2 (granted in part and deferred in part Oct. 14, 2016); *see also* Spire-Orbcomm Agreement.

rendezvous with the ISS. Therefore, the orbital altitudes of Launch 8 and Launch 9 include a range in altitudes for which Spire seeks authority, with the final altitude being determined by the ISS Program. For each such planned deployment above the ISS, Spire will supplement the record with documentation evidencing the National Aeronautics and Space Administration's ("NASA's") approval of each Above Station Deployment.[15]

In support of this application, Spire is providing an updated Orbital Debris Risk Mitigation Plan (see Exhibit B) and an updated Orbital Debris Assessment Report (see Exhibit C) for the additional 100 aggregate LEMUR-2 Phase IB and Phase IC satellites that will be deployed into the above orbital parameters.

C. Phase II

Given the state of the LEO launch market for secondary payloads, Spire is not capable of providing deployment parameters for the Phase II satellites at this time. Spire will further amend the Initial Application to finalize a Phase II deployment plan at a later date.

III. Service Classification

Spire seeks to provide meteorological monitoring, earth imaging, maritime monitoring, and in Phase IC, aircraft tracking services, all of which should continue to be treated as an EESS and, in the case of meteorological monitoring, a meteorological-satellite service ("METS").[16] In addition, maritime monitoring via AIS/ASM and aircraft monitoring via ADS-B are recognized as parts of the mobile-satellite service ("MSS").[17] Therefore, Spire's reception of AIS, ASM,

[15] *See, e.g.*, Letter from Jenny Barna, Launch Manager, Spire Global, Inc., to Marlene H. Dortch, Secretary, FCC, File No. SAT-LOA-20151123-00078 (filed Aug. 19, 2016); *see also, e.g.*, Letter from Jonathan Rosenblatt, General Counsel, Spire Global, Inc., to Marlene H. Dortch, Secretary, FCC, File No. SAT-LOA-20151123-00078 (filed Sept. 30, 2016).
[16] *See* Initial Application, Exhibit A at 7.
[17] *See* 47 C.F.R. § 2.1 (defining the Aeronautical Mobile Satellite Service as a "mobile-satellite service in which mobile earth stations are located on board aircraft"); *see also id.* (defining the Maritime Mobile-

and ADS-B signals and transmission of data relating thereto should also be treated as a MSS. In the U.S., Spire's services qualify as a Non-Voice Non-Geostationary Mobile-Satellite Service ("NVNG MSS"),[18] which is relevant to Spire's request to use the band 399.9-400.05 MHz as discussed in Part IV(F) below. Finally, Spire operates its own spacecraft, including tracking; space telemetry; and space telecommand, and should be treated as engaged in a Space Operation Service ("Space Ops").[19]

IV. Waiver Requests

The Commission may waive any of its rules if there is "good cause" to do so.[20] In general, waiver is appropriate if: (i) special circumstances warrant a deviation from the general rule; and (ii) such deviation would better serve the public interest than would strict adherence to the general rule.[21] Generally, the Commission will grant a waiver of its rules in a particular case if the relief requested would not undermine the policy objective of the rule in question and would otherwise serve the public interest.[22] Spire submits that good cause exists to waive the rules below with respect to each frequency band in which Spire is seeking authority for its Phase IB and Phase IC satellites to operate.

Satellite Service as a "mobile-satellite service in which mobile earth stations are located on board ships"); *see, e.g., Applications by Orbcomm License Corp.*, Order and Authorization, 23 FCC Rcd 4804 ¶ 11 (IB and OET 2008) ("*Orbcomm Order*"); *Iridium Constellation LLC Application for Modification of License to Authorize a Second-Generation NGSO MSS Constellation*, Order and Authorization, 31 FCC Rcd 8675 ¶ 27 (IB and OET 2016) ("*Iridium Order*").

[18] *See* 47 C.F.R. § 2.1 (defining NVNG MSS as a "mobile-satellite service reserved for use by non-geostationary satellites in the provision of non-voice communications which may include satellite links between land earth stations at fixed locations").

[19] *See* 47 C.F.R. § 2.1 (defining Space Ops as a "radiocommunication service concerned exclusively with the operation of spacecraft, in particular space tracking, space telemetry, and space telecommand").

[20] *See* 47 C.F.R. § 1.3; *Northeast Cellular Tel. Co. v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990); *WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969).

[21] *See Northeast Cellular*, 897 F.2d at 1166.

[22] *See WAIT Radio*, 418 F.2d at 1157.

A. 2020-2025 MHz (Space-to-Earth) Data Downlink

Spire requests a waiver of the U.S. Table of Frequency Allocations to use the 2020-2025 MHz band (space-to-Earth) as a primary data downlink with its Phase IB and IC satellites on a non-conforming, non-harmful interference basis.[23]

This band is allocated to Fixed and Mobile Services in the U.S. and is presently fallow. Spire has been using this band since September 2015 in three countries, including the U.S., without reports of interference. Spire's use of this fallow band on an interim basis as it designs, builds, tests, and coordinates downlinks in 8025-8400 MHz in Phase II is an efficient use of spectrum and serves the public interest. The Commission has previously approved the use of this band for Spire's Phase I satellites.[24]

B. 2200-2290 MHz (Space-to-Earth) Data Downlink

Spire requests a waiver of the U.S. Table of Frequency Allocations to use the 2200-2290 MHz band (space-to-Earth) as a primary data downlink with its Phase IB and IC satellites on a non-conforming, non-harmful interference basis.[25]

This band is allocated to Space Ops (space-to-Earth) and EESS (space-To-Earth) on a co-primary basis across all ITU regions. In the U.S., this band is not allocated for non-Federal

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[23] *See* 47 C.F.R. §§ 2.102(a), 2.106. As a companion to Section 2.106, Spire also seeks waiver of 47 C.F.R. § 2.102(a). As the Commission recently stated, waiver of Section 2.102(a) is necessary to authorize the requested operations that are not in conformance with the Table of Frequency Allocations. *See Iridium Order* ¶ 21 n.77 (granting on its own motion waiver of Section 2.102(a) to permit Iridium Constellation LLC's ("Iridium's") proposed MSS (Earth-to-space) use of very high frequency ("VHF") bands in which there is no MSS allocation for the relevant use (domestic or international)). For convenience, all subsequent references to requests for waiver of the U.S. Table of Frequency Allocations refer to both Sections 2.102(a) and 2.106 of the Commission's rules.

[24] *See generally* Initial Application, Exhibit A at 15-16; Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Mar. 18, 2016, as corrected Mar. 24, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part June 16, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Oct. 14, 2016).

[25] *See* 47 C.F.R. §§ 2.102(a), 2.106.

use.[26] Use of this band outside of the U.S. should be possible and will allow Spire to operate in accordance with the U.S. Table of Frequency Allocations in other countries and enable further data downlink earth stations. Spire will coordinate use of this band with NTIA prior to use, can use any channel within this band that is preferred by NTIA, can use different channels at different earth stations, can limit downlinks to outside the U.S. only or take other steps that allow coordination with NTIA. Ultimately if agreement cannot be reached with NTIA, Spire can continue to use the 2020-2025 MHz band until Phase II.

C. 401-402 MHz (Space-to-Earth) TT&C Downlink and Backup Data Downlink

Spire requests a waiver of the U.S. Table of Frequency Allocations to use the 401-402 MHz band (space-to-Earth) as a backup data downlink with its Phase IB and IC satellites on a non-conforming, non-harmful interference basis.[27]

However, Spire's use of the 401-402 MHz band (space-to-Earth) with Phase IB and IC satellites for TT&C downlink is in accordance with the U.S. Table of Frequency Allocations and does not require any waivers. The 401-402 MHz band is allocated for non-Federal use for Space Ops (space-to-Earth) on a co-primary basis with Meteorological AIDS (radiosonde).[28] The band is also allocated across all ITU regions to Space Ops (space-to-Earth). The wide beamwidth of the low-band frequencies can greatly facilitate the reestablishment of a lost communications link. The addition of 401-402 MHz band will allow Spire to meet NTIA's request to vacate the 402-403 MHz band if necessary during ongoing coordination discussions. It would also make Spire's earth station deployments and operations conform to the ITU Table of Allocations and U.S. Table of Allocations, which Spire understands is preferable.

[26] *See* 47 C.F.R. § 2.106 nn.5.392, US303.
[27] *See* 47 C.F.R. §§ 2.102(a), 2.106.
[28] This band is also used by other U.S.-licensed EESS operators, including Planet. *See, e.g.*, Stamp Grant, Planet Labs Inc., File No. SAT-MOD-20150802-00053, Call Sign S2912 (granted Sept. 15, 2016).

D. 402-403 MHz (Space-to-Earth) TT&C Downlink and Backup Data Downlink

Spire requests a waiver of the U.S. Table of Frequency Allocations to use the 402-403 MHz band (space-to-Earth) with Phase IB and IC satellites on a non-conforming, non-harmful interference basis for TT&C downlink and backup data downlink.[29]

The 402-403 MHz band is allocated to EESS and METS in the Earth-to-space direction but not in the space-to-Earth direction. Accordingly, Spire's proposed continued use of this band on its Phase IB and IC satellites for downlinks would be on a non-conforming basis. NTIA has informed Spire that its use of the 402-403 MHz as a downlink may conflict with other government users' operations in this band.[30] Spire seeks authority in this application to use this band in addition to 401-402 MHz (space-to-Earth) because it will give Spire flexibility to coordinate its operations in a way that is preferred by NESDIS and NWS as discussions progress. Such discussions could lead to Spire using some combination of 401-402 MHz and 402-403 MHz in different geographic locations or at different times. Outside of the U.S., Spire has used this band in eight countries without any reports of interference. The Commission has previously approved the use of this band for Spire's Phase I satellites.[31]

[29] *See* 47 C.F.R. §§ 2.102(a), 2.106.
[30] Spire is currently in coordination discussions with NOAA National Environmental Satellite, Data, and Information Service ("NESDIS") and also the National Weather Service ("NWS").
[31] *See generally* Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Mar. 18, 2016, as corrected Mar. 24, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part June 16, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Oct. 14, 2016).

E. 402-403 MHz (Earth-to-Space) TT&C Uplink

Spire requests a waiver of the U.S. Table of Frequency Allocations to use the 402-403 MHz band (Earth-to-space) with Phase IB and IC satellites on a non-conforming, non-harmful interference basis for TT&C uplink.[32]

The 402-403 MHz band (Earth-to-space) is allocated for use by the Meteorological AIDS, EESS (Earth-to-space), and METS (Earth-to-space) on a co-primary basis across all ITU regions. However, footnote US384 in the U.S. Table of Frequency Allocations removes the allocation for non-federal services.[33] Spire has been using the 402-403 MHz band (Earth-to-space) for TT&C uplinks since September of 2015 on a non-interference, non-protected basis. Spire has successfully used this uplink in 9 countries across 21 ground station locations with no report of interference. Spire requests authority to continue to use this uplink for the Phase IB and IC satellites, given the number of ground stations that have been enabled in this band and its allocated nature in all ITU regions, and the flexibility it gives Spire to coordinate in crowded UHF bands. The Commission has previously approved the use of this band for Spire's Phase I satellites.[34]

F. 399.9-400.05 MHz (Earth-to-Space) TT&C Uplink

(i) Summary

Spire believes that its use of the 399.9-400.05 MHz band (Earth-to-space) is in accordance with the ITU allocation, relevant ITU-R Recommendations, and U.S. Table of

[32] *See* 47 C.F.R. §§ 2.102(a), 2.106.
[33] *See* 47 C.F.R. § 2.106 n.US384.
[34] *See generally* Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Mar. 18, 2016, as corrected Mar. 24, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part June 16, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Oct. 14, 2016).

Frequency Allocations.[35] Spire believes its use is also in accordance with the rules applicable to this band set out in 47 C.F.R. 25.142. However, to the extent, and only to the extent, the Commission believes a waiver is necessary, Spire hereby requests a waiver of the U.S. Table of Frequency Allocations to use the 399.9-400.05 MHz band (Earth-to-space) on a non-conforming, non-harmful interference basis for TT&C uplink.[36] Further, to the extent required, Spire requests this amendment be processed pursuant to the first-come, first-served procedure adopted for "GSO-like satellite systems" under Section 25.158 of the Commission's rules[37] and requests waiver of Sections 25.156 and 25.157 of the Commission's rules, which stipulate the processing of "NGSO-like satellite systems" under a modified processing round.[38] The Commission previously waived modified processing round requirements for Spire as an EESS NGSO.[39] If the Commission does not grant the latter waiver request, Spire requests that the Commission initiate a processing round with respect to this band, that Spire be treated as a lead application in such processing round, and that Spire be authorized to use this band on a non-interference basis during the pendency of such a processing round.

[35] Footnote US320 in the U.S. Table of Frequency Allocations states that the 399.9-400.05 MHz band is allocated for NVNG MSS and that the frequency band may be used for satellite links between land earth stations at fixed locations. *See* 47 C.F.R. § 2.106 n.US320. Spire proposes to use the band to command its satellites between its fixed earth stations.
[36] *See* 47 C.F.R. §§ 2.102(a), 2.106.
[37] *See* 47 C.F.R. § 25.158.
[38] *See* 47 C.F.R. §§ 25.156, 25.157.
[39] *See* Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Mar. 18, 2016, as corrected Mar. 24, 2016). *See generally Space Imaging, LLC*, Declaratory Order and Order and Authorization, 20 FCC Rcd 11964 ¶¶ 9-11 (2005) ("*Space Imaging Order*").

(ii) Spire's Use is Consistent with the ITU Allocation, Relevant ITU-R Recommendations, and U.S. Table of Frequency Allocations

The 399.9-400.05 MHz band is allocated to the MSS across all ITU regions.[40] Recommendation ITU-R M.2046 (12/2013) establishes protection criteria for NGSO MSS systems operating in the band 399.9-400.05 MHz for the benefit of ARGOS4. The ARGOS4 system of satellites comes online with the launch of 1 polar-orbiting satellite currently scheduled for 2018.[41] The next scheduled launch of a satellite is not until 2020.[42] In any event, Spire has conducted analysis showing that it can easily meet the protection criteria for this system with minimal impact on Spire's ground operations. Additionally, while it is unclear whether the TSYKADA system still operates, Recommendation ITU-R M.1470 (05/2000) proposes a methodology for sharing between MSS systems (Earth-to-space) and existing Radionavigation-Satellite Service ("RNSS") systems (space-to-Earth).[43] Spire has conducted analysis showing that it can easily meet the sharing criteria for this system, as Spire operates no ground stations within or near the Russian Federation where the TSYKADA earth stations are exclusively located.[44]

Domestically, the band is allocated for non-Federal use for NVNG MSS (Earth-to-space) on a primary basis.[45] The Commission has defined NVNG MSS as "a variety of data communications services, including, but not limited to, remote meter reading, vehicle tracking

[40] *See* 47 C.F.R. § 2.106.
[41] *See Argos Data Collection and Location System*, NOAA NESDIS, https://nosc.noaa.gov/2016_NOAA_ETW/5_Posters/Space_Rogerson_Argos_ETW_19July2016.pdf (last visited Nov. 9, 2016).
[42] *See id*.
[43] *See Recommendation ITU-R M.1470 - Methodology of sharing between MSS systems (Earth-to-space) and existing RNSS systems (space-to-Earth) in the frequency bands 149.9-150.05 MHz and 399.9-400.05 MHz*, ITU (2010), https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.1470-0-200005-I!!PDF-E.pdf.
[44] *See id.* at 2 (indicating that all TSYKADA earth stations are in the Russian Federation Territory).
[45] *See* 47 C.F.R. § 2.106.

and two-way data messaging services to customers anywhere in the world."[46] Spire's Phase IB and Phase IC NGSO satellites will monitor the (i) AIS 1, AIS 2, AIS 3, and AIS 4 signals to track vessels equipped with mobile transponders and (ii) ASM 1 and ASM 2 signals to provide monitoring aids to navigation and water levels, marine traffic signals, tidal windows, and clearance time to enter port information, which can all be passed through ASM signals via mobile transponders. Phase IC satellites will also contain an ADS-B receiver which will monitor signals to track aircraft equipped with mobile transponders and would allow aircraft to communicate ADS-B information to air traffic control systems via the Spire network. Accordingly, Spire's reception of AIS, ASM, and ADS-B signals and transmission of data relating thereto should also be treated as a NVNG MSS.

While the band also appears to have been allocated to the RNSS, that allocation appears to have been removed in all ITU regions but not the U.S. Table of Frequency Allocations.[47] In any event there appears to be no use of this band by the RNSS in the U.S.,[48] and based on a search of ITU filings, only the Russian TSYKADA system identified above that uses it outside the U.S. in the opposite space-to-Earth direction.

For the reasons above, Spire believes that its use of this band is on a conforming basis and that it will not cause harmful interference.

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[46] *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 ¶ 1 (1997).

[47] *See* 47 C.F.R. § 2.106 nn.5.224A, 5.224B (stating that the use of the band 399.9-400.05 MHz the allocation to RNSS is effective until January 1, 2015 and that use of the band by the MSS (Earth-to-space) is effective from January 1, 2015, indicating that radio navigation-satellite service is no longer primary in this band).

[48] *See 399.9-400.05 MHz*, NTIA Federal Government Spectrum Compendium, https://www.ntia.doc.gov/files/ntia/publications/compendium/0399.90-0400.05_01DEC15.pdf (noting that Federal RNSS systems have vacated this band) ("*NTIA 399 MHz Band Guide*").

(iii) Spire's Use is in Accordance with the Rules for Using NVNG MSS Set Out in 47 C.F.R. § 25.142

Spire, through its Initial Application and this amendment, believes it has shown all information required by 47 C.F.R. § 25.142(a)(1) to use this band. In addition, Spire meets the requirements of 47 C.F.R. § 25.142(a)(1) and will not cause unacceptable interference to any NVNG MSS system authorized to be constructed or operated,[49] as no NVNG MSS system uses this band[50] and Orbcomm is the only remaining NVNG MSS system and uses only an adjacent band in the 400.15-401 MHz frequency band in the opposite space-to-Earth direction.[51]

Section 25.142(a)(2), (3), and (4) are not applicable to this band. Spire is not currently seeking replacement stations, however, it will meet the requirements of 47 C.F.R. § 25.142(a)(5) with respect to any replacement stations in the future. Spire meets the requirements of 47 C.F.R. § 25.142(b)(1) as it will not provide voice services. Spire will coordinate with NTIA, under 47 C.F.R. § 25.142(b)(2); however, it should be noted that the band is almost entirely fallow with respect to U.S. government users with the exception of four assignments to land mobile operations.[52]

With respect to 47 C.F.R. § 25.142(b)(3), the only existing NVNG MSS operator is Orbcomm, and Orbcomm does not operate in this band. Orbcomm is licensed to use portions of

[49] *See* 47 C.F.R. § 25.142(a).
[50] *See Amendment of Part 2 of the Commission's Rules for Federal Earth Stations Communicating with Non-Federal Fixed Satellite Service Space Stations*, Notice of Proposed Rulemaking and Notice of Inquiry, 28 FCC Rcd 6698 ¶ 63 (2013) (noting that "[n]o MSS systems have been deployed or authorized in the 399.9-400.05 MHz band since the allocation was made almost twenty years ago and there are no pending applications or other proposed uses for this band").
[51] *See* Orbcomm, File No. SAT-MOD-20111021-00207, Attachment Schedule S Tech Report at S2, S9 (granted in part and dismissed in part May 5, 2016).
[52] *See NTIA 399 MHz Band Guide*. A search of ITU filings also indicates that NASA may use this band for space-to-Earth transmissions from Mars missions on what appears to be a non-conforming basis.

an adjacent band within 400.15-401 MHz in the opposite space-to-Earth direction.[53] The only interference potential of which Spire is aware would be Spire ground station uplinks in the 399.9-400.05 MHz band overloading Orbcomm's ground receiving equipment at Orbcomm's gateway earth stations. However, Orbcomm's gateway earth stations licensed in the 400.15-401 MHz band are located far away from Spire's earth stations.[54]

Nonetheless, Spire has reached out to Orbcomm to discuss such coordination prior to filing this amendment. Pursuant to 47 C.F.R. § 25.142(b)(3), Spire will cooperate fully and make every reasonable effort to resolve any legitimate technical problems and conflicts that may inhibit effective and efficient use of the radio spectrum with Orbcomm.[55]

With respect to 47 C.F.R § 25.142(b)(4), Spire confirms that its AIS system does not transmit information with respect to distress calls.[56] Spire confirms also that its ASM and ADS-B systems will not transmit information with respect to distress calls.

Finally, Spire confirms that neither it, nor any company that it controls or that controls it, enjoys any right for the purpose of handling traffic to or from the U.S., its territories or possessions, to construct or operate space segment or earth stations in the non-voice, non-geosynchronous MSS, or to interchange traffic, which is denied to any other U.S. company by reason of any concession, contract, understanding, or working arrangement to which Spire or any persons or companies controlling or controlled by Spire are parties.[57]

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[53] *See* Orbcomm, File No. SAT-MOD-20111021-00207, Attachment Schedule S Tech Report at S2, S9 (granted in part and dismissed in part May 5, 2016).
[54] FCC MyIBFS earth station location search results indicate Orbcomm has earth stations receiving in this frequency band at St. Johns, AZ; East Wenatchee, WA; Cannonsburg, KY; Ocilla, GA; and Arcade, NY. Spire's closest ground station is 98.8 miles away (Tukwila, WA), and most of Spire's stations are hundreds of miles away from Orbcomm earth stations.
[55] *See* 47 C.F.R. § 25.142(b)(3).
[56] *See* 47 C.F.R. § 25.142(b)(4).
[57] *See* 47 C.F.R. § 25.142(d).

For the reasons above, Spire believes that it meets all requirements to use this band.

(iv) Spire's Use of the 399.9-400.05 MHz Band Does Not Necessitate a NGSO Processing Round

Spire requests that this application be processed pursuant to the first-come, first-served procedure adopted for "GSO-like satellite systems" under Section 25.158 of the Commission's rules[58] and requests waiver of Sections 25.156 and 25.157 of the Commission's rules, which stipulate the processing of "NGSO-like satellite systems" under a modified processing round framework.[59] After previous NVNG MSS operators had failed to use these frequency bands, the Commission announced that these spectrum segments assigned to systems other than Orbcomm in the NVNG MSS bands would now be available under the first-come, first-served procedure.[60] Accordingly, the Commission should grant a waiver of the modified processing round rules here especially since the spectrum has been unused for years (with the exception of Orbcomm's partial use of an adjacent band).

Additionally, the Commission has previously waived the modified processing round requirement and allowed EESS NGSO systems to be processed on a first-come, first-served basis and should do so here for Spire's NVNG MSS system.[61] Spire's system is fully capable of sharing with current and future NGSO systems operating in the same frequency bands, and accordingly, there is no mutual exclusivity. Because the purpose of the modified processing round is to preserve opportunities for competitive entry in frequency bands where licensing the

[58] *See* 47 C.F.R. § 25.158.
[59] *See* 47 C.F.R. §§ 25.156, 25.157.
[60] Previous NVNG MSS operators failed to use these bands due to license surrenders and terminations. *See Orbcomm Order* ¶ 10.
[61] *See, e.g.*, Stamp Grant, Planet Labs, Inc., SAT-LOA-20130626-00087 (granted Dec. 3, 2013); Stamp Grant, Skybox Imaging, Inc., SAT-LOA-20120322-00058 (granted Sep. 20, 2012); *Space Imaging Order* ¶¶ 9-11.

first applicant to operate in the band would prevent subsequent applicants from using the spectrum, grant of the waiver would not undermine the rules.[62] Spectrum sharing will be possible because the Spire satellites and satellites in other systems receive only in short periods of time while visible from the dedicated transmitting earth station. For harmful interference to occur, satellites belonging to different systems would have to travel through the antenna beam of the transmitting earth station and receive at the exact same time. In such an unlikely event, the resulting interference could be avoided by coordinating the earth station transmissions so that they do not occur simultaneously. Accordingly, waiving Sections 25.156 and 25.157 will not undermine the policy objectives of these rules, and the waiver request is justified here. However, if the Commission believes that a processing round is warranted, Spire requests that it be treated as a lead application in such processing round and that the Commission allow Spire to use this band on a non-harmful interference basis for TT&C uplink until completion of such processing round.[63]

G. 449.75-450.25 MHz (Earth-to-Space) TT&C Uplink

Spire requests authority to use the 449.75-450.25 MHz (Earth-to-space) band with its Phase IC satellites for TT&C uplink.[64]

This band is authorized for Space Ops, subject to the agreement obtained under No. 9.21, however, Spire seeks to use this band on a nonprotected, non-harmful interference basis.[65] Spire will use this uplink as an alternative frequency band to facilitate coordination with NTIA and others.

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[62] *See, e.g.*, *Space Imaging Order*, 20 FCC Rcd 11964 ¶ 10.
[63] *See* 47 C.F.R. § 25.157(c).
[64] This band is also used by another U.S.-licensed EESS operator, Planet. *See*, *e.g.*, Stamp Grant, Planet Labs Inc., File No. SAT-MOD-20150802-00053, Call Sign S2912 (granted Sept. 15, 2016).
[65] *See* 47 C.F.R. § 2.106 nn.5.286, US87.

H. AIS 1 (161.9625-161.9875 MHz) and AIS 2 (162.0125-162.0375 MHz)

AIS 1 (161.9625-161.9875 MHz) and AIS 2 (162.0125-162.0375 MHz) are allocated to the Maritime Mobile (Earth-to-space), Aeronautical Mobile (OR), and MSS (Earth-to-space) on a co-primary basis.[66] Spire's use of such bands to receive AIS 1 and AIS 2 signals is in accordance with the U.S. Table of Frequency Allocations.[67] The Commission has previously approved the use of this band for Spire's Phase I satellites.[68]

I. AIS 3 (156.7625-156.7875 MHz) and AIS 4 (156.8125-156.8375 MHz)

AIS 3 (156.7625-156.7875 MHz) and AIS 4 (156.8125-156.8375 MHz) are allocated to Maritime Mobile (distress, urgency, safety and calling) and MSS (Earth-to-space) in all ITU Regions on a co-primary basis, with MSS being limited for the purposes of reception of AIS emissions.[69] The Commission has proposed but not yet adopted an MSS (Earth-to-space) allocation for AIS-3 and AIS-4.[70]

Therefore, Spire requests waiver of the U.S. Table of Frequency Allocations to allow its constellation to receive on the AIS 3 (156.7625-156.7875 MHz) and AIS 4 (156.8125-156.8375 MHz) bands only until the bands are allocated in the U.S. Table of Frequency Allocations, after which Spire seeks to be treated as operating on a conforming basis.[71] Because Spire would only

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[66] *See* 47 C.F.R. § 2.106.
[67] *See* 47 C.F.R. § 2.106.
[68] *See generally* Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Mar. 18, 2016, as corrected Mar. 24, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part June 16, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Oct. 14, 2016).
[69] *See* 47 C.F.R. § 2.106 n.5.228.
[70] *See Amendment of Parts 1, 2, 15, 25, 27, 74, 78, 80, 87, 90, 97, & 101 of the Commission's Rules Regarding Implementation of the Final Acts of the World Radiocommunication Conference (Geneva, 2007) (WRC-07), Other Allocation Issues, & Related Rule Updates et al.*, Report and Order, Order, and Notice of Proposed Rulemaking, 30 FCC Rcd 4183 ¶¶ 202-05 (2015) ("*FCC WRC-07 Allocation Order*").
[71] *See* 47 C.F.R. §§ 2.102(a), 2.106.

receive the signals and would operate on a non-harmful interference basis, grant of the waiver would not undermine the service allocations in the U.S. Table of Frequency Allocations.[72]

Grant of the requested waiver is consistent with Commission precedent. The Commission recently granted a waiver to Iridium to permit satellite reception of existing AIS 3 and AIS 4 signals transmitted by maritime vessels.[73] In granting Iridium's request, the Commission noted that "[t]he reception of transmissions, AIS or other, cannot cause harmful interference, and these transmissions will be present pursuant to existing authorizations using frequencies allocated to other services regardless of whether they are received by an Iridium second-generation satellite."[74] The Commission's reasoning in granting Iridium's waiver request is directly applicable here. Namely, because Spire's use of the AIS 3 and AIS 4 signals is receive-only, it will not cause any additional risk of interference. Moreover, because it will rely on ship-based transmissions that are already occurring, Spire's use of these signals will not prevent anyone else from using the band. Spire also notes that grant of this waiver is consistent with the Commission's current proposal to allocate the AIS 3 and AIS 4 bands to MSS (Earth-to-space) on a primary basis for AIS operations.[75]

Spire recognizes that, as a condition of this waiver, (i) it must not claim protection for reception of messages in the these bands that is not in accordance with the U.S. Table of Frequency Allocations for the pertinent area; and (ii) it may only claim protection to the extent provided by the status of the reception under the U.S. Table of Frequency Allocations.[76] Spire

[72] *See Iridium Order* ¶ 21(granting waiver of U.S. Table of Frequency Allocations to permit satellite reception of AIS 3 and AIS 4 signals). *See generally Orbcomm Order* ¶ 15 (granting waiver of the then-applicable U.S. Table of Frequency Allocations to permit satellite reception of AIS signals).
[73] *See Iridium Order* ¶¶ 21-23.
[74] *Iridium Order* ¶ 21.
[75] *See FCC WRC-07 Allocation Order* ¶¶ 202-05.
[76] *See Iridium Order* ¶ 21.

also recognizes that all reception in this band must comport with the requirements on unauthorized publication or use of communications in Section 605 of the Communications Act of 1934, as amended.[77]

J. ASM 1 (161.9375-161.9625 MHz) and ASM 2 (161.9875-162.0125 MHz)

ASM 1 (161.9375-161.9625 MHz) and ASM 2 (161.9875-162.0125 MHz) are allocated to Fixed and Mobile Services across all ITU regions and to just Mobile Services in the U.S.[78]

To the extent necessary, Spire requests waiver of the U.S. Table of Frequency Allocations to allow its constellation to receive on the ASM 1 (161.9375-161.9625 MHz) and ASM 2 (161.9875-162.0125 MHz) bands.[79] The reasons stated above with respect to AIS 3 and AIS 4 apply to this waiver request for the reception of ASM signals.

K. ADS-B (1087.7-1092.3 MHz)

1087.7-1092.3 MHz is allocated to the Aeronautical Mobile (R) and Aeronautical Radionavigation service on a co-primary basis in the U.S. Table of Frequency Allocations.[80]

To the extent necessary, Spire requests waiver of the U.S. Table of Frequency Allocations to allow its constellation to receive on the ADS-B (1087.7-1092.3 MHz) band.[81] The reasons stated above with respect to AIS 3 and AIS 4 apply to this waiver request for the reception of ADS-B signals.

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[77] *See* 47 U.S.C. § 605; *see also Iridium Order* ¶ 21.
[78] *See* 47 C.F.R. § 2.106.
[79] *See* 47 C.F.R. §§ 2.102(a), 2.106.
[80] *See* 47 C.F.R. § 2.106.
[81] *See* 47 C.F.R. §§ 2.102(a), 2.106; *Iridium Order* ¶ 21 n.77 (granting on its own motion waiver of Section 2.102(a) to permit Iridium's proposed MSS (Earth-to-space) use of VHF bands in which there is no MSS allocation for the relevant use (domestic or international)).

L. GPS L1 (1560.07-1590.77 MHz) and GPS L2 (1217.37-1237.83 MHz)

GPS L1 (1560.07-1590.77 MHz) and GPS L2 (1217.37-1237.83 MHz) frequencies are allocated for RNSS (space-to-Earth and space-to-space) on a primary basis, including for use in "spaceborne RNSS receivers for scientific and commercial applications."[82] Accordingly, Spire's proposed reception of the GPS L1 and GPS L2 signals is consistent with the U.S. Table of Frequency Allocations. The Commission has previously approved the use of this band for Spire's Phase I satellites.[83]

M. GLONASS L1 (1592.95-1611.05 MHz), GLONASS L2 (1237.8-1254.2 MHz), Galileo E1 (1557.52-1593.32 MHz), and Galileo E5 (1166.215-1217.375 MHz) (collectively "Foreign GNSS Signals")

The GLONASS L1 (1592.95-1611.05 MHz) band is allocated on a primary basis for (i) RNSS (space-to-Earth and space-to-space) and Aeronautical Radionavigation in the 1559-1610 MHz band in all ITU regions; (ii) MSS (Earth-to-space), Aeronautical Radionavigation, and Radiodetermination Satellite Service (Earth-to-space) in the 1610-1610.6 MHz band in ITU Region 2; and (iii) MSS (Earth-to-space), Radio Astronomy, Aeronautical Radionavigation, and Radiodetermination-Satellite service (Earth-to-space) in the 1610.6-1613.8 MHz band in ITU Region 2.[84]

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[82] 47 C.F.R. § 2.106; *see also Amendment of Parts 2, 25, and 87 of the Commission's Rules to Implement Decisions from World Radiocommunication Conferences Concerning Frequency Bands Between 28 MHz and 36 GHz and to Otherwise Update the Rules in this Frequency Range*, Report and Order, 18 FCC Rcd 23426 ¶¶ 3, 27, 33 (2003).

[83] *See generally* Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Mar. 18, 2016, as corrected Mar. 24, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part June 16, 2016); Stamp Grant, Spire Global, Inc., File No. SAT-LOA-20151123-00078 (granted in part and deferred in part Oct. 14, 2016).

[84] *See* 47 C.F.R. § 2.106.

The GLONASS L2 (1237.8-1254.2 MHz) band is allocated on a primary basis for (i) RNSS (space-to-Earth and space-to-space), EESS (active), Radiolocation Service, and Space Research Service (active) in the 1215-1240 MHz band in all ITU regions; and (ii) RNSS (space-to-Earth and space-to-space), EESS (active), Radiolocation, and Space Research (active) in the 1240-1300 MHz band in all ITU regions.[85]

The Galileo E1 (1557.52-1593.32 MHz) band is allocated on a primary basis for (i) MSS (space-to-Earth) in the 1535-1559 MHz band in all ITU regions; and (ii) RNSS (space-to-Earth and space-to-space) and Aeronautical Radionavigation in the 1559-1610 MHz band in all ITU regions.[86]

The Galileo E5 (1166.215-1217.375 MHz) band is allocated on a primary basis for (i) RNSS (space-to-Earth and space-to-space) and Aeronautical Radionavigation in the 1164-1215 MHz band in all ITU regions; and (ii) EESS (active), RNSS (space-to-Earth and space-to-space), Radiolocation Service, and Space Research Service (active) in the 1215-1240 MHz band in all ITU regions.[87]

The Foreign GNSS Signals span multiple allocation services domestically in the U.S., similar to the ITU allocations, and are not allocated solely to RNSS/GNSS.[88] To the extent necessary, Spire requests waiver of the U.S. Table of Frequency Allocations to allow its constellation to receive the Foreign GNSS Signals.[89] The same reasoning that applies to AIS 3 and AIS 4 above supports this request.

[85] *See id.*
[86] *See id.*
[87] *See id.*
[88] *See id.*
[89] *See* 47 C.F.R. §§ 2.102(a), 2.106.

Although the Commission has stated that the reception of signals by earth stations located in the U.S. from foreign radionavigation satellites requires Commission approval,[90] that requirement is not applicable to the reception of signals from foreign satellites by space stations. Although the *DISCO II Order* is not applicable to Spire's receipt of Foreign GNSS Signals,[91] Spire nonetheless demonstrates that the foreign policy and national security concerns that underlie the Commission's rules and policies are not implicated by Spire's satellite constellation reception and use of existing GLONASS or Galileo GNSS signals to create radio occultation profiles.

Spire can discontinue its reception of foreign signals, if requested, and confirms that it is not paying any foreign governments for the reception of those GNSS signals. Spire will not use any foreign GNSS signal to determine the position of its satellites for navigation purposes. Instead, Spire will continue to rely on GPS to determine the position of its own satellites for navigation purposes. Spire will only use the received positions of GLONASS satellites and Galileo satellites (in addition to the positions of GPS satellites) to generate meteorological radio occultation profiles.[92]

The more GNSS signals used to derive radio occultation profiles, the more accurate such profiles will be. In fact, NOAA's COSMIC-2 satellites will use NASA's Jet Propulsion

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[90] *See National Telecommunications And Information Administration Provides Information Concerning Executive Branch Recommendations for Waiver of Part 25 Rules Concerning Licensing of Receive-Only Earth Stations Operating with Non-U.S. Radionavigation Satellites*, 26 FCC Rcd 3867 (2011) ("NTIA Letter"). The NTIA Letter stated that the recommendation of a waiver request would "adhere to the principles set forth in [the] DISCO II Order." *Id. See also* 47 C.F.R. §§ 25.131(j)(1), 25.137.

[91] *See generally Amendment of the Commission's Regulatory Policies to Allow Non-U.S.-Licensed Space Stations to Provide Domestic and International Satellite Service in the United States*, Report and Order, 12 FCC Rcd 24094 (1997) ("*DISCO II Order*").

[92] *See* Initial Application, Exhibit A at 8 n.28. Radio Occultation measures transmissions from GPS, GLONASS, and Galileo systems that pass through the atmosphere. The magnitude of the refraction in the transmission will vary based on the temperature and water vapor concentration in the atmosphere. This measurement of the refractions will allow for enhanced weather forecasting models.

Laboratory-designed TriG receiver, which receives foreign GNSS signals to derive radio occultation profiles, including GLONASS signals.[93] Moreover, GLONASS and other GNSS positions will be checked and verified against third-party sources, and any bad or false data will be readily identified.[94]

Finally, Spire's profiles are additive data to existing weather models and, thus, will not be relied upon exclusively. If the additive data make the models work better, customers will buy the data; if they do not make the models better, customers will not buy the data. So, not only are GLONASS and Galileo signals subject to independent verification by Spire, the profiles are also subject to independent verification by Spire's customers. In sum, failing to allow Spire to use GNSS signals, including GLONASS, would amount to purposefully degrading the commercial weather capabilities of U.S.-based companies and serve no legitimate national security interest.

N. Schedule S

Contemporaneously herewith Spire is filing a new Schedule S to cover its Phase IB and Phase IC satellites and frequencies.

Due to the limitations of the Commission's Schedule S software, Spire clarifies some of its responses provided in the Schedule S and, to the extent necessary, seeks waiver of Section 25.114(c) of the Commission's rules, which requires certain information to be filed in the Schedule S. In many cases, the Schedule S and Form 312 are not formulated to readily accommodate non-traditional satellite systems, such as Spire's innovative small satellite system, and the information requested may be inapplicable, irrelevant, and/or burdensome to produce. The following bullets clarify some of Spire's Schedule S inputs.

[93] *See FORMOSAT-7 Program Description*, National Space Organization, http://www.nspo.org.tw/2008e/projects/project7/program-description.html (last visited Nov. 9, 2016).
[94] *See Verify QC*, Veripos, http://www.veripos.com/verify-qc.html (last visited Nov. 5, 2016).

- The orbital planes are based on the Table 5 deployment parameters in this amendment narrative. Spire seeks flexibility for *up to* sixteen satellites in any deployment but has filled Schedule S out with the most likely scenarios for each launch.
- The "Right Ascension of Ascending Node" and "Argument of Perigee" in each of the orbital planes is listed as "0 degrees," which is what the Schedule S software required Spire to input.
- The "NGSO Antenna Gain" contour maps are attached as PDFs on a per beam basis and include all orbits sought (but not all satellites on all orbits because they would not change from satellite to satellite within an orbit). All beams are shown for Phase IC, which covers all frequencies in Phase IB as well. ISS launches are shown at 400 km and Above Station Deployments are shown at 450 km, which are the most likely deployment scenarios.
- There is a primary and backup radio in each ultra high frequency ("UHF"), so that increases the number of beams, which is why some beams are labeled "P" (primary) and some beams are labeled "B" (backup).
- There is also an automated beacon signal, which will transmit a short, encrypted packet of satellite health data every ten seconds.[95] It will use a 15 kHz channel (UD3 beam) versus the other UHF active downlink that will use a 60 kHz channel (UD1 and UD2 beams). The health beacon will only operate in the 401-402 MHz band. Spire needs one frequency band for this automated beacon signal worldwide, and it makes most sense for it to be in the 401-402 MHz band.

[95] *See* Initial Application, Exhibit A at 9-10.

- The Antenna Pointing Error and Antenna Rotational Error choices are limited. Spire has selected "1.0," which is an accurate estimate of the error when satellites are checked out and stabilized in nadir.

In sum, strict application of the rules here is unnecessary to serve the purposes of the rules, which is to ensure that the Commission has all the relevant information to evaluate the application. Because Spire has provided all relevant information in the Narrative and Schedule S, waiver of the certain Schedule S requirements is appropriate.[96]

O. <u>Ownership and Change of Address</u>

In Exhibit D, Spire has updated its ownership and address information.

[96] *See* 47 C.F.R. § 1.3; *see, e.g.*, Stamp Grant, ViaSat, Inc., SAT-LOI-20140204-00013 (granted Jun. 18, 2014) (waiving Schedule S requirements because they were found to be unnecessary for the space station application).

V. Conclusion

For the foregoing reasons, Spire respectfully requests that its license application be amended to include the above waiver requests and additional information.

Respectfully submitted,

/s/ Jonathan Rosenblatt

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Dated: November 14, 2016

ATTACHMENT 1

Technical Certification

I, Joel Spark, hereby certify, under penalty of perjury, that I am the technically qualified person responsible for the preparation of the engineering information contained in the technical portions of the foregoing application and the related attachments, that I am familiar with Part 25 of the Commission's rules, and that the technical information is complete and accurate to the best of my knowledge and belief.

/s/ Joel Spark
Joel Spark
Lead Engineer Satellite Bus
Spire Global, Inc.

Dated: November 14, 2016