

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of

Application of RBC Signals, LLC for an)
Earth Station License to Operate with) Call Sign:
Certain Low-Earth Orbit Non-Geostationary)
Satellite Orbit Cubesats) File No.:

APPLICATION FOR FIXED EARTH STATION LICENSE

RBC Signals, LLC (“RBC Signals”), pursuant to Section 25.115 of the Commission’s rules, 47 C.F.R. § 25.115, respectfully seeks a fixed earth station license to operate three earth stations at a facility in Deadhorse, Alaska, to communicate with certain low-Earth orbit (“LEO”) non-geostationary satellite orbit (“NGSO”) cubesats. The earth stations will provide a variety of mission support services; tracking, telemetry, and command (“TT&C”); and other critical housekeeping functions for these innovative microsattellites. As demonstrated in this application, grant of the authority requested herein will serve the public interest because it will substantially benefit the development and commercial deployment of next-generation LEO satellite communication services. Moreover, grant of this application will facilitate and further U.S. leadership in the advancement of novel satellite technologies.

I. BACKGROUND

RBC Signals is a Seattle, Washington-based satellite services company that provides earth station services around the world. RBC Signals partners with other earth station operators or operates its own earth stations to support various satellite service applications, and currently has special temporary authority (“STA”) to conduct short-term TT&C from the Deadhorse, Alaska

facility to support the Arkyd 6A and 6B cubesats¹ and the 3 Diamonds missions.² Here, RBC Signals seeks long-term regular authority to support five distinct LEO NGSO cubesat missions: (i) the Arkyd 6A and Arkyd 6B cubesats, developed by Planetary Resources Development Corporation; (ii) the Landmapper-BC cubesat, an earth-exploration satellite service (“EESS”) remote-sensing cubesat operated by Astro Digital US, Inc. (“Astro Digital”); (iii) the 3 Diamonds, three U.K.-licensed cubesats launched in connection with the development of Sky and Space Global (UK) Ltd.’s cubesat constellation;³ and (iv) the Astranis Demosat-2, a U.S.-licensed experimental satellite operated by Astranis Space Technologies Corp.

To support the above satellites, RBC Signals is requesting authority to operate two (2) previously authorized yagi antennas⁴ – the M2 Antenna Systems Models 400CP30A (the “400 MHz Yagi”) and 450CP26 (the “450 MHz Yagi”) – in various segments of the ultra-high frequency (“UHF”) band from 399.9-403 MHz (space-to-Earth/Earth-to-space), 449.93-450.07 MHz (Earth-to-space) and 450.20-450.25 MHz (Earth-to-space), as detailed in Table 1 below. In addition, RBC Signals seeks to operate the 5.4m ViaSat Remote Sensing Ground Station (the “5.4m”) in the 25500-27000 MHz band (space-to-Earth). A technically identical variant of the 5.4m earth station has been previously authorized by the Commission for similar LEO NGSO operations.⁵

¹ See RBC Signals, LLC, File No. SES-STA-20171213-01333 (granted on Jan. 10, 2018).

² See RBC Signals LLC, File Nos. SES-STA-20170613-00643 (expired on Aug. 22, 2017) and SES-STA-20170731-00848 (expires on March 10, 2018).

³ As discussed in more detail in Section II.A.4, RBC Signals only seeks authority to communicate with the 3 Diamonds cubesats for an abbreviated two-year license term.

⁴ *Supra* n. 1 & n. 2.

⁵ See DG Consent Sub, Inc., File No. SES-MOD-20131022-00885, Call Sign E040264 (grant of authority to operate the 5.4m in the S-band and X-band).

The proposed earth station operations are consistent with RBC Signal’s ongoing STA operations, and grant of an earth station license will allow RBC Signals to perform long-term support functions to facilitate the development of these next-generation satellite technologies. In addition to providing TT&C for orientation, coordination, and subsystem control, RBC Signals also seeks to perform limited mission data downlink support for the Landmapper-BC cubesat. RBC Signals provides the attached Technical Appendix, Attachments 1 & 2, and FCC Form 312 Schedule B for information relating to the proposed earth station operating parameters and mission overviews. In addition, RBC Signals seeks certain waivers, consistent with Commission precedent, but will otherwise operate these earth stations in accordance with the Commission’s rules and interagency requirements governing fixed earth station operations in the subject bands.

II. DISCUSSION

A. Proposed Satellite Points of Communication

Table 1, below, provides an overview of RBC Signals’ proposed operations with each satellite point of communication. In the following sections, RBC Signals provides a brief description of each satellite’s mission and its proposed frequency usage associated with the proposed points of communication.

Table 1. Proposed Satellite Points of Communication

Satellites	Satellite Operator	Frequency Bands (MHz)	Service	Associated Earth Station(s)
Arkyd 6A Arkyd 6B	Planetary Resources Development Corporation	449.93-450.07; 450.20-450.25	TT&C Uplink	400 MHz Yagi
		401.43-401.57	TT&C Downlink	450 MHz Yagi

Landmapper-BC	Astro Digital US Inc.	402.58-402.62; 402.88-402.92	TT&C Uplink	400 MHz Yagi ViaSat 5.4m
		400.155-400.195; 400.48-400.52	TT&C Downlink	
		25500-27000	Mission Data Downlink	
Blue Diamond Red Diamond Green Diamond	Sky and Space Global Ltd. (UK)	399.926-399.950	TT&C Uplink	400 MHz Yagi
		401.05-401.25	TT&C Downlink	
Astranis Demosat-2	Astranis Space Technologies Corporation	401.6-401.75	TT&C Uplink	400 MHz Yagi
			TT&C Downlink	

1. ARKYD 6A and ARKYD 6B

RBC Signals seeks authority to perform ongoing TT&C for the U.S.-licensed Arkyd 6A and 6B experimental cubesats, consistent with its existing 60-day STA for the identical operations proposed herein.⁶ The Arkyd 6A and 6B cubesats were developed by Planetary Resources Development Corporation (“PRDC”) to perform initial analysis of the technical and commercial feasibilities of PRDC’s commercial interplanetary space research vehicle for the exploration of near Earth asteroids (“NEAs”). RBC Signals seeks to operate the 400 MHz Yagi and 450 MHz Yagi – variants of an earth station that has been previously licensed by the Commission for similar TT&C operations⁷ – with the Arkyd 6A and 6B satellites in the 449.93-450.07 MHz band (Earth-to-space), 450.20-450.25 MHz band (Earth-to-space) and 401.43-401.57 MHz band (space-to-Earth).

a. Mission Description

The Arkyd 6A and 6B cubesats are currently authorized through multiple experimental

⁶ *Supra* n. 1.

⁷ *See, e.g.*, Spire Global, Inc., File No. SES-LIC-20160317-00247, Call Sign E160032.

authorizations from the Commission⁸ to allow PRDC to analyze core spacecraft elements and mission operations, including space-based imaging, energy management, control and command execution, and spacecraft communication. Here, RBC Signals seeks to continue providing TT&C services to the Arkyd 6A – which was launched on January 12, 2018, from India’s Polar Satellite Launch Vehicle (the “PSLV-C40 mission”)⁹ – to support PRDC’s ongoing experimentation of this novel NEA exploratory technology. Although the Arkyd 6B launch date has not yet been finalized, RBC Signals seeks the authority to include the Arkyd 6B cubesat in this authorization in anticipation of its launch in Q1 of 2018.

The Arkyd 6A and 6B satellites will be placed into a nominal circular, sun-synchronous orbit with an inclination from the equator of approximately 98.0°. Once on-orbit, the Arkyd 6A and 6B satellites will operate at an altitude of approximately 500 km in the 2025-2110 MHz band (Earth-to-space) and 8450-8500 MHz band (space-to-Earth), subject to coordination with incumbent operations. However, RBC Signals does not seek to support Arkyd 6A and 6B service links at this time, and the present application is limited to TT&C communications only.

RBC Signals incorporates by reference the satellite technical specifications and mission overview information previously provided by PRDC and will perform the proposed TT&C operations consistent with the terms and conditions of PRDC’s experimental authorizations¹⁰ and its existing STA.¹¹ RBC Signals provides the attached FCC Form 312 Schedule B and radiation

⁸ See Planetary Resources Development Corporation, File No. 0025-EX-PL-2016, Call Sign WI2XES (granting authority to launch and operate the Arkyd 6B satellite); File No. 0285-EX-CR-2017, Call Sign WH2XRI (granting authority to launch and operate the Arkyd 6A satellite); and File No. 0871-EX-ST-2017, Call Sign WL9XQ0 (granting authority to perform limited TT&C for Arkyd 6A and 6B).

⁹ See <https://spaceflight101.com/events/pslv-c40-cartosat-2er/>.

¹⁰ *Supra* n. 8.

¹¹ *Supra* n. 1.

hazard analysis for relevant information relating to the proposed TT&C operations. Grant of this earth station application is necessary to ensure no lapse in vital TT&C for these novel and important cubesat operations and will facilitate the safe operation of the Arkyd 6A and 6B satellites during these critical strategic evaluations.

b. Spectrum Use - TT&C Uplink Operations

The United States Table of Frequency Allocations (“Table of Allocations”), Section 2.106 of the Commission’s rules, 47 C.F.R. § 2.106, provides that the 449.75-450.25 MHz band may be used by non-federal stations for space telecommand (Earth-to-space), subject to such conditions that may be applied on a case-by-case basis.¹² RBC Signals will operate the 450 MHz Yagi to perform limited TT&C uplink operations in frequencies from 449.93-450.07 MHz and 450.2-450.25 MHz, consistent with the space telecommand allocation in this band. The short transmission window, as well as the remote location of the facility (on the North Slope of Alaska), limit the potential for interference from the proposed operations.

RBC Signals understands that there is limited U.S. government use of the band¹³ and acknowledges that any grant of earth station operating authority herein must not cause interference to existing federal uses. In view of the foregoing, RBC Signals anticipates that its operations will be compatible with spectrum users and will present no potential for interference in the TT&C uplink band. RBC Signals will conduct these operations on a non-harmful interference basis and, if RBC Signals learns that its operations are causing harmful interference to other operations, it will modify or suspend operations to immediately resolve such interference.

¹² See 47 C.F.R. § 2.106, fn. US87.

¹³ See https://www.ntia.doc.gov/files/ntia/publications/compendium/0450.00-0454.00_01DEC15.pdf.

c. Spectrum Use - TT&C Downlink Operations

The Table of Allocations provides that the 401-402 MHz band is shared on a co-primary basis between meteorological aids and space operations services. RBC Signals seeks to perform TT&C downlink operations in frequencies from 401.43-401.57 MHz consistent with the co-primary space operations allocation in this band.¹⁴ In the interest of administrative convenience and consistency, RBC Signals only seeks to utilize the identical TT&C downlink sub-band authorized in the PRDC experimental license from 401.43-401.57 MHz when communicating with the Arkyd 6A and 6B satellites.

RBC Signals understands that there are certain U.S. government meteorological aids and earth exploration operations conducted in the 401-402 MHz band.¹⁵ Based on our research and consultations to date, RBC Signals believes the proposed TT&C downlink (earth station receive) operations in this band will not present a potential for interference to other users of this band. However, if RBC Signals learns that its operations are causing harmful interference to other operations, it will suspend or modify its operations to immediately resolve such interference.

2. LANDMAPPER-BC

RBC Signals seeks authority to perform TT&C and mission data downlink support for the U.S.-licensed Landmapper-BC satellite, for which Astro Digital was recently granted authority by the Commission to provide EESS in the United States.¹⁶ The Landmapper-BC was launched by

¹⁴ See 47 C.F.R. § 2.106 (defining “space operations” as “a radiocommunication service concerned exclusively with the operation of spacecraft, in particular space tracking, space telemetry, and space telecommand.”).

¹⁵ See https://www.ntia.doc.gov/files/ntia/publications/compendium/0401.00-0402.00_01MAR14.pdf.

¹⁶ See Astro Digital U.S., Inc., File No. SAT-LOA-20170508-00071, Call Sign S3014 (the “*Astro Digital License*”). Astro Digital also holds multiple experimental licenses to perform ongoing testing and validation of many of the key satellite and ground station technologies of the system.

Astro Digital to perform initial analysis of the technical and commercial feasibilities of its remote sensing technology and EESS data subscription services (e.g., agricultural imaging data to track crop production and efficiency). RBC Signals seeks to operate the 400 MHz Yagi and 5.4m earth station with the Landmapper-BC satellite in the 402.58-402.62 MHz and 402.88-402.92 MHz bands (Earth-to-space), the 400.155-400.195 and 400.48-400.52 MHz MHz bands (space-to-Earth) and the 25500-27000 MHz band (space-to-Earth), consistent with the *Astro Digital License*.

a. Mission Description

The Landmapper-BC satellite is the initial satellite launched in anticipation of Astro Digital’s long-term commercial plan for thirty in-orbit operational spacecraft to provide advanced remote sensing services in the United States. The Landmapper-BC satellites will be placed into a nominal circular, sun-synchronous orbit with an inclination from the equator of approximately 98.0°. Once on-orbit, the Landmapper-BC will operate at an average altitude of approximately 585 km.¹⁷ The Landmapper-BC will image the Earth’s entire landmass every day at 22 meters ground sample distance (“GSD”), and will provide general trend monitoring and data collection about land-use management on the downlink.

The Astro Digital LEO NGSO constellation will ultimately consist of two satellite types – a broad area coverage Landmapper-BC and a high definition spacecraft, the Landmapper-HD. The Landmapper-HD has not yet been licensed by the Commission and RBC Signal’s current request is solely for authority to communicate with the Landmapper-BC satellite. RBC Signals incorporates by reference the satellite technical specifications and mission overview information previously

See Astro Digital, Inc., File Nos. 0024-EX-CM-2016, Call Sign WH2XXT; 0317-EX-CR-2017, Call Sign WH2XCA; and 0021-EX-CM-2016, Call Sign WI2XCP.

¹⁷ Astro Digital is authorized to provide EESS using the Landmapper-BC at orbital altitudes between 475 km and 625 km. *See Astro Digital License*.

provided by Astro Digital and will perform the proposed TT&C operations consistent with the terms and conditions of the *Astro Digital License*.¹⁸ RBC Signals provides herein FCC Form 312 Schedule B and radiation hazard analysis for relevant information relating to the proposed Landmapper-BC operations. Grant of this earth station application is necessary because this will allow U.S.-based ground support for next-generation satellite services and will facilitate the safe operation of the Landmapper-BC satellite during the initial deployment phase.

b. Spectrum Use – TT&C Uplink Operations

The Table of Allocations provides that the 402-403 MHz band is allocated on a primary basis to non-federal meteorological-aid services and on secondary basis to EESS (Earth-to-space). Moreover, the Table of Allocations provides that “in the band 401-403 MHz, the non-Federal Earth exploration-satellite (Earth-to-space) and meteorological-satellite (Earth-to-space) services are limited to earth stations transmitting to Federal space stations.”¹⁹ Accordingly, in Section III, below, RBC Signals requests a waiver of the Commission’s Table of Allocations to permit operations of the 400 MHz Yagi in frequencies from 402.88-402.92 MHz and 402.58-402.62 MHz to support the Landmapper-BC EESS mission because it will not be transmitting to Federal stations. This waiver is consistent with the Commission’s grant in the *Astro Digital License* and RBC Signals will limit its Earth-to-space operations to a center frequency of 402.6 MHz except as necessary immediately following satellite deployment or satellite software reset.²⁰

¹⁸ *Supra* n. 16.

¹⁹ 47 C.F.R. § 2.106, fn. US384.

²⁰ *See Astro Digital License*, Condition 8.

c. Spectrum Use – TT&C Downlink Operations

The Table of Allocations provides that the 400.15-401 MHz band is allocated on a primary basis to non-federal meteorological-aid and mobile satellite operations and on a secondary basis for space operations (space-to-Earth). RBC Signals seeks to perform TT&C downlink operations using the 400 MHz Yagi in the 400.155-400.195 MHz and 400.48-400.52 MHz bands consistent with the secondary allocation for space operations in this band. RBC Signals is not currently aware of any use of the subject frequency bands by incumbent operators and will coordinate as needed to ensure its TT&C operations do not cause interference with primary mobile satellite or meteorological-aid services.

d. Spectrum Use – Data Downlink Operations

The Table of Allocations and the *EESS R&O* provide that the band 25.5-27.0 GHz is allocated for non-federal EESS (space-to Earth) operations on a primary basis.²¹ RBC Signals understands that this band is also used for Federal EESS and space research operations. RBC Signals seeks to operate the 5.4m ground station with the Landmapper-BC to receive high-speed data from the satellite, consistent with the primary allocation to EESS in this band. As previously demonstrated by Astro Digital, the Landmapper-BC will provide sufficient protection to existing and planned Federal space research and EESS operations in this band.²²

RBC Signals acknowledges that authorization in this band is subject to a case-by-case electromagnetic compatibility study. RBC Signals will operate the 5.4m earth station in this band

²¹ See *In the Matter of Amendment of Parts 2, 25, and 73 of the Commission's Rules to Implement Decisions from the World Radiocommunication Conference (Geneva, 2003) (WRC-03) Concerning Frequency Bands Between 5900 kHz and 27.5 GHz and to Otherwise Update the Rules in this Frequency Range*, FCC 05-70, ¶ 87 (2005) (“*EESS R&O*”); 47 C.F.R. § 2.106, footnote US258.

²² See *Astro Digital License*, Application - Attachment E.

consistent with the *Astro Digital License*²³ and Commission rules.²⁴ RBC Signals' use of this band will be limited to intermittent receive earth stations operations, thus there is no potential for the proposed operations to cause interference to other spectrum users. Future compatibility with relevant operations, as applicable, will be easily achievable, particularly given the remote location of RBC Signal's proposed operations. Additionally, RBC Signals will not claim protection from existing authorized spectrum users in the 25.5-27.0 GHz band.

Based on the most recent version of Recommendation ITU-R SA.1862 and the guidelines put forth in Recommendation ITU-R SA.1278, Annex 1, regarding the methodology for ensuring sufficient separation distances between EESS earth stations and FS stations, Astro Digital has concluded that there is no potential for interference to existing Federal operations. Moreover, Astro Digital has shown that the Landmapper-BC will meet the PFD limits contained in Section 25.208(p) of the Commission's rules, 47 C.F.R. § 25.208(p), designed to protect authorized terrestrial receivers.²⁵

Finally, RBC Signals acknowledges that some Federal remote sensing satellites under development plan to make use of the frequency band 25.5-27.0 GHz for EESS (space-to-Earth) transmissions. Specifically, RBC Signals understands that Astro Digital has initiated discussions with the National Oceanic and Atmospheric Administration ("NOAA") regarding the Joint Polar Satellite System ("JPSS") mission; has completed preliminary interference analyses; and is closely working with NOAA to pre-coordinate the systems. RBC Signals commits to assisting both Astro Digital and NOAA as needed to ensure no interference is caused to the new JPSS Mission.

²³ *Id.* Conditions 2 & 3.

²⁴ 47 C.F.R. § 2.106, fn. US258.

²⁵ *See Astro Digital Application, Application - Exhibit 43, II.E.*

3. THE 3 DIAMONDS

RBC Signals seeks authority to perform ongoing TT&C for the UK-licensed 3 Diamonds cubesats, consistent with its existing 180-day STA for the identical operations proposed herein.²⁶ The 3 Diamonds are demonstration and proof-of-concept satellites launched in connection with the development of Sky and Space Global (UK) Ltd.'s ("SSG")²⁷ proposed cubesat constellation to provide affordable narrowband mobile communication services to users in Asia, Africa, and Latin America. RBC Signals seeks to operate the 400 MHz Yagi in the 399.926-399.950 MHz band (Earth-to-space) and 401.05-401.25 MHz band (space-to-Earth).

RBC Signals is not requesting U.S. market access for the 3 Diamonds satellites to operate or demonstrate service links in the United States and therefore is not providing the full technical information required by Sections 25.114 and 25.137 of the Commission's rules, 47 C.F.R. §§ 25.114 and 25.137. To the extent necessary, RBC Signals respectfully seeks a waiver of Section 25.114 and 25.137 of the Commission's rules to permit the limited TT&C operations proposed herein.

Pursuant to consultations with the Commission staff, RBC Signals files this application to operate the 400 MHz Yagi with the 3 Diamonds satellites for an initial two-year license period to allow for more reliable support for the 3 Diamonds demonstration satellites and avoid the need for additional STA requests. RBC Signals acknowledges and accepts this limited operational term for communication with the 3 Diamonds and seeks the typical fifteen (15) year license term for all other operations proposed in this application.

²⁶ *Supra* n. 2.

²⁷ SSG is a wholly owned subsidiary of Sky and Space Global Limited, a publicly traded Australian company (ASX ticker symbol: SAS). RBC Signals has provided a presentation summarizing SSG's novel NGSO system concept, progress to date and future plans in Attachment 1.

a. Mission Description

The 3 Diamonds, launched on June 23, 2017, with a mission life of between two and five years, will provide lifeline connectivity services to users in the region within +/-15 degrees of the equator.²⁸ The 3 Diamonds satellites are closely spaced at an altitude of approximately 500 km and have overlapping beams for testing satellite hand-off, link performance, and other functionality. When fully launched, the SSG constellation will support user voice calls and messaging, machine-to-machine (“M2M”) and Internet of Things (“IoT”) services, and data storage and forwarding in both fixed and mobile applications in mobile satellite service (“MSS”) spectrum at 2170-2200 MHz (space-to-Earth) and 1980-2010 MHz (Earth-to-space), subject to coordination with incumbent operations. RBC Signals, however, does not seek to provide mission support in the 2170-2200 MHz and 1980-2010 MHz bands under this commercial license, but only to perform TT&C services in the 399.926-399.950 MHz band.

The 3 Diamonds satellites’ TT&C spectrum assignments were approved by the U.K. Ministry of Defence, representing a substantial validation of SSG’s narrow-band satellite communications platform.²⁹ SSG was awarded Frost & Sullivan’s 2016 Global Narrow-Band Nano-Satellite Connectivity Services Technology Innovation Award for its satellite constellation concept.³⁰ Additionally, SSG signed an agreement with the U.S. Department of Defense (“DOD”) for space situational awareness services to help ensure the safe operations of the 3 Diamonds satellites.³¹

²⁸ The full SSG constellation will operate under the SSG-CSL NGSO system filing submitted to the ITU by the United Kingdom late last year.

²⁹ See <http://www.asx.com.au/asxpdf/20160927/pdf/43bhb4pwhkhym8.pdf>.

³⁰ See <https://www.slideshare.net/FrostandSullivan/2016-global-narrowband-nanosatellite-connectivity-services-technology-innovation-award>.

³¹ See <https://www.skyandspace.global/sky-space-signs-agreement-us-department-defence/>.

RBC Signals' operations under the existing STA have been coordinated with relevant U.S. government agencies and have not caused interference to U.S. government users of the band. Moreover, RBC Signals has examined other operations in the band and will continue to work with FCC, NTIA, and NOAA staff to ensure that the proposed operations create no potential for interference to current or future government users and that the interests of the United States are fully accommodated.

RBC Signals resubmits the materials previously provided with its STA applications, including Attachments 1 & 2, which contain relevant information relating to the proposed TT&C operations, including earth station operational characteristics, satellite technical and orbital parameters, TT&C link budgets, and an orbital debris mitigation statement for the 3 Diamonds satellites.³²

b. Spectrum Use - TT&C Uplink Operations

The Table of Allocations, Section 2.106 of the Commission's rules, 47 C.F.R. § 2.106, provides that the 399.9-400.05 MHz band is shared on a co-primary basis between MSS and federal radionavigation-satellite services. RBC Signals seeks to perform limited TT&C uplink operations in frequencies from 399.926-399.950 MHz consistent with the co-primary MSS allocation in this band.

As discussed above, the 3 Diamonds satellites were launched as demonstration satellites for SSG's MSS constellation and will provide data, voice, and messaging services directly to fixed and

³² The 3 Diamonds satellites will operate under the SSG-CSL and SSG-3D ITU NGSO system filings and the UK licenses for the Red Diamond, Green Diamond and Blue Diamond satellites are included as Attachment 2. RBC Signals acknowledges that authority for TT&C operations does not constitute market access to the United States for the SSG satellites and therefore is not providing the full technical information required by Sections 25.114 and 25.137 of the Commission's rules, 47 C.F.R. §§ 25.114 and 25.137. Out of an abundance of caution, RBC Signals has requested a waiver Sections 25.114 and 25.137 in Section III.

mobile terminals. These terminals include land, maritime, and aeronautical mobile terminals, as well as fixed terminals that may serve as base stations for “bring your own” mobile devices. Additional information regarding the 3 Diamonds mission and SSG’s long-term constellation can be found on the SSG website.³³

RBC Signals will continue to operate the 400 MHz Yagi in Deadhorse, Alaska, as authorized under the current STA, and provide TT&C uplink operations for SSG’s MSS system consistent with the MSS allocation in the band.³⁴ Given the altitude and spacing of the 3 Diamonds satellites (with overlapping beams),³⁵ the TT&C earth station transmits approximately 5% of the time to communicate with the satellites. The limited transmission window, as well as the remote location of the facility (on the North Slope of Alaska), limit the potential for interference from these operations.

RBC Signals understands that there is limited U.S. government use of the band,³⁶ but acknowledges that there is a pending FCC rulemaking addressing further use of this band,³⁷ as well

³³ See <https://www.skyandspace.global/operations-overview/>.

³⁴ The limited, data-only TT&C operations for the 3 Diamonds MSS demonstration satellites are consistent with the Commission’s limitation on use of the band for non-voice communications of NGSO satellites. See 47 C.F.R. §25.103 (“Definitions.... *Non-Voice, Non-Geostationary (NVNG) Mobile-Satellite Service*. 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.”) See also Section II.D, *infra*, requesting, out of an abundance of caution, a waiver to permit TT&C uplink operation in this MSS band.

³⁵ The rising order of satellites above the horizon was Blue, then Green, then Red. Initial relative orbit phasing between Blue and Green was 0.31735 degrees, and between Blue and Red was 2.53879 degrees. Upon phasing completion, the relative phasing between Blue and Green is 4.44 degrees and between Blue and Red is 8.88 degrees.

³⁶ See https://www.ntia.doc.gov/files/ntia/publications/compendium/0399.90-0400.05_01DEC15.pdf.

³⁷ See generally Amendment of Part 2 of the Commission’s Rules for Federal Earth Stations Communicating with Non-Federal Fixed Satellite Service Space Stations; Federal Space Station

as a proceeding which develops U.S. preliminary views on a related WRC-19 agenda item.³⁸ RBC Signals acknowledges that any grant of earth station operating authority would be subject to the outcome of these proceedings, and will continue consultations with NTIA and NOAA staff to ensure that the interests of the United States are fully accommodated and that the proposed operations do not cause interference to current or future U.S. government operations.

RBC Signals' TT&C operations thus far have been compatible with spectrum users and have not caused interference in the 399.926-399.950 MHz uplink band. Thus, RBC Signals anticipates no compatibility or potential inference issues during operation under the requested extended earth station license. Consistent with its existing authorization, RBC Signals will conduct its TT&C operations on a non-harmful interference basis and, if RBC Signals learns that its operations are causing harmful interference to other operations, it will modify or suspend operations to immediately resolve such interference.

c. Spectrum Use - TT&C Downlink Operations

The Table of Allocations provides that the 401-402 MHz band is shared on a co-primary basis between meteorological aids and space operations services. RBC Signals seeks to perform TT&C downlink operations in frequencies from 401.05-401.25 MHz consistent with the co-primary space operations allocation in this band.³⁹

RBC Signals understands that there is no U.S. government use of the 400.05-400.15 MHz

Use of the 399.9-400.05 MHz Band; and Allocation of Spectrum for Non-Federal Space Launch Operations, ET Docket No. 13-115, RM-11341; *see also* <https://www.fcc.gov/items-on-circulation>.

³⁸ *See* International Bureau Seeks Comment on Recommendations Approved by World Radiocommunication Conference Advisory Committee, Public Notice, IB Docket No. 16-185, DA 17-365 (rel. Apr. 24, 2017).

³⁹ *See* 47 C.F.R. § 2.1 (defining “space operations” as “a radiocommunication service concerned exclusively with the operation of spacecraft, in particular space tracking, space telemetry, and space telecommand.”).

sub-band,⁴⁰ but there are certain meteorological aids and space research operations conducted in the 400.15-400.25 MHz sub-band.⁴¹ Based on our research and consultations to date, RBC Signals believes the proposed TT&C downlink (earth station receive) operations in this band will continue to present no potential for interference to other users of this band.⁴² However, if RBC Signals learns that its operations are causing harmful interference to other operations, it will suspend or modify its operations to immediately resolve such interference.

4. ASTRANIS DEMOSAT-2

RBC Signals seeks authority to perform TT&C for the U.S.-licensed Astranis Demosat-2 experimental cubesat, operated by Astranis Space Technologies Corp. (“Astranis”), in the 401.6-401.75 MHz band (Earth-to-space/space-to-Earth) consistent with RBC Signals’ recently granted 60-day STA for the identical Astranis Demosat-2 operations proposed herein.⁴³

a. Mission Description

The Astranis Demosat-2 cubesat was previously supported from Astranis’s Fairbanks, Alaska, location pursuant to Astranis’ experimental authorization.⁴⁴ Due to recent unknown interference events, Astranis has partnered with RBC Signals because of its ability to provide support for the Astranis Demosat-2 mission from its existing facility in Deadhorse, Alaska.

⁴⁰ See https://www.ntia.doc.gov/files/ntia/publications/compendium/0400.05-0400.15_01DEC15.pdf.

⁴¹ See https://www.ntia.doc.gov/files/ntia/publications/compendium/0400.15-0401.00_01DEC15.pdf.

⁴² RBC Signals would also note that the downlink PFD of the 3 Diamonds satellites in the 400.15-400.25 MHz sub-band is $-134 \text{ dBW}/(\text{m}^2 \cdot 4 \text{ kHz})$, 9 dB lower than the $-125 \text{ dBW}/(\text{m}^2 \cdot 4 \text{ kHz})$ limit set forth in Annex 1 of App. 5 of the ITU Radio Regulations. See RR 5.264 and 47 C.F.R. § 2.106.

⁴³ See RBC Signals, LLC, File No. SES-STA-20180118-00042 (granted on Jan. 26, 2018).

⁴⁴ See Astranis Space Technologies Corp., File Nos. 1624-EX-ST-2017 and 0113-EX-ST-2017, Call Sign WL9XAF (“*Astranis Experimental STA*”).

Consistent with the Commission's requirements for a 60-day STA,⁴⁵ RBC Signals files this request for regular authority to permit ongoing TT&C support for the Astranis Demosat-2. RBC Signals' existing STA operations at Deadhorse have not caused interference to other users of the band and RBC Signals will continue to work with FCC, NTIA and NOAA staff to ensure that the Astranis Demosat-2 operations create no potential for interference to current or future government users and that the interests of the United States are fully accommodated. Moreover, a grant of this request will allow RBC Signals to reliably assist with the early stage analysis of the technical feasibility of the Astranis mission and conduct more thorough demonstrations for these important operations.

RBC Signals' TT&C operations will be identical to the operations previously described in the *Astranis Experimental STA* application.⁴⁶ In the interest of administrative convenience, RBC Signals incorporates by reference the satellite and earth station information previously provided by Astranis in the *Astranis Experimental STA* application and provides the FCC Form 312 Schedule B for information relating to the 400 MHz Yagi operating parameters with Astranis Demosat-2.

RBC Signals operations with the Astranis Demosat-2 satellite will be on an unprotected and non-interference basis, intermittent and only as-needed to conduct experiments between one and six times per day while the satellite passes over the Deadhorse earth station.

b. Spectrum Use – TT&C Uplink/Dowlink

The Table of Allocations provides that the 401-402 MHz band is shared on a co-primary basis between meteorological aids and space operations services. RBC Signals seeks to perform

⁴⁵ See 47 C.F.R. § 25.120(b)(3).

⁴⁶ See Astranis Space Technologies Corp., File Nos. 1624-EX-ST-2017 and 0113-EX-ST-2017, Call Sign WL9XAF, Updated Narrative and Attachments (filed on Aug. 8, 2017).

TT&C uplink and downlink operations in the 401.6-401.75 MHz band pursuant to the co-primary space operations allocation in this band⁴⁷ and consistent with the terms and conditions in the *Astranis Experimental STA*.

TT&C uplink operations in the 401.6-401.75 MHz band will take place intermittently and for brief periods (approximately 10 minutes) when the satellite is in view of the Deadhorse, Alaska facility. RBC Signals ensures that its TT&C operations are fully compatibility with other spectrum users and are conducted on an unprotected and non-interference basis only. Nonetheless, if RBC Signals learns that its operations are causing harmful interference to other operations, it will suspend or modify its operations to immediately resolve such interference.

Based on our research and consultations to date, RBC Signals believes the proposed TT&C downlink (earth station receive) operations in this band will present no potential for interference to other users of this band. RBC Signals' TT&C operations thus far have been compatible with spectrum users and have not caused interference in the 401-402 MHz band at the Deadhorse, Alaska facility. RBC Signals anticipates no compatibility or potential inference issues as a result of ongoing TT&C receive operations with Astranis Demosat-2. Consistent with its existing STA authorization, RBC Signals will conduct its TT&C operations on a non-harmful interference basis, and if RBC Signals learns that its operations are causing harmful interference to other operations, it will modify or suspend operations to immediately resolve such interference.

III. WAIVER REQUESTS

The Commission may waive its rules for “good cause shown.”⁴⁸ As discussed below, good cause exists to waive certain rules in this case to permit RBC Signals to perform critical TT&C

⁴⁷ See 47 C.F.R. § 2.1 (defining “space operations” as “a radiocommunication service concerned exclusively with the operation of spacecraft, in particular space tracking, space telemetry, and space telecommand.”).

⁴⁸ See 47 C.F.R. § 1.3. *WAIT Radio v. FCC*, 418 F.2d 1153, 1157 (D.C. Cir. 1969).

functions for the Landmapper-BC and 3 Diamonds missions. Such waivers would not undermine the purpose of the rules, and are consistent with Commission policies and precedent.

A. Waiver of Section 2.106

RBC Signals respectfully seeks a waiver of Section 2.106 of the Commission's rules, 47 C.F.R. § 2.106, to the extent necessary to operate the 400 MHz Yagi and perform TT&C in the 402.58-402.62 MHz and 402.88-402.92 MHz band to provide TT&C for the Landmapper-BC.

The Section 2.106 of the Commission's rules, the Table of Allocations, provides that the 402-403 MHz band is allocated on a primary basis to non-federal meteorological-aid services and on secondary basis to EESS (Earth-to-space). Moreover, "in the band 401-403 MHz, the non-Federal Earth exploration-satellite (Earth-to-space) and meteorological-satellite (Earth-to-space) services are limited to earth stations transmitting to Federal space stations.⁴⁹ Thus, RBC Signals seeks a waiver of this footnote to permit it to provide TT&C uplink support for the Landmapper-BC EESS mission, facilitating the development and evaluation of an innovative U.S.-licensed satellite. Grant of the requested waiver is consistent with the Commission's grant in the *Astro Digital License* and RBC Signals will limit its Earth-to-space operations to a center frequency of 402.6 MHz except as necessary immediately following satellite deployment or satellite software reset.⁵⁰

Based on the foregoing, RBC Signals respectfully requests the waiver, which will provide them with the flexibility to dependably provide critical satellite support for the Landmapper-BC and more efficiently and effectively support these new satellite technologies.

B. Waiver of Sections 25.114 and 25.137

RBC Signals respectfully seeks a waiver of Sections 25.114 and 25.137 of the Commission's

⁴⁹ *Supra* n. 19.

⁵⁰ *See Astro Digital License*, Condition 8.

rules, 47 C.F.R. §§ 25.114 and 25.137, to the extent necessary to perform TT&C for the 3 Diamonds without making the full technical showings required for non-U.S. licensed space stations to access the U.S. market.

Section 25.137 of the Commission's rules requires that an applicant proposing to use a U.S.-licensed earth station to communicate with foreign-licensed spacecraft demonstrate that the Commission's policies for U.S. market access are satisfied, including the obligation to file detailed satellite technical information as specified in Section 25.114. Because the 400 MHz Yagi will be used solely for TT&C operations and no SSG satellite services will be conducted in the United States, and because sufficient information to assess the satellites' operation in the relevant bands has been submitted, grant of a waiver will not undermine the purpose of these requirements. As noted, RBC Signals is not requesting U.S. market access nor any other authorization to test and demonstrate the 3 Diamonds satellites' service functionality in the United States. Accordingly, RBC Signals has not provided the full technical information contemplated by Sections 25.114 and 25.137 of the Commission's rules for such authority. Still, out of an abundance of caution, RBC Signals seeks a waiver of Sections 25.114 and 25.137 of the Commission's rules, should the Commission deem such waiver necessary in this limited context.

The 3 Diamonds satellites are licensed by the United Kingdom, a WTO-member country. To the extent relevant, there is a presumption in favor of entry for these satellites.⁵¹ In addition, the United Kingdom has stringent satellite licensing requirements, including for orbital debris mitigation purposes, that are well-recognized by the Commission.⁵² Thus, the Commission can be assured that operation of the 3 Diamonds satellites will be fully consistent with international standards and

⁵¹ See 47 C.F.R. § 25.137(a)(2).

⁵² See generally *Inmarsat plc*, Petition for Declaratory Ruling, File Nos. SAT-PPL-20081219-00235 and SAT-APL-20090609-00068, Call Sign S2780.

requirements.

Moreover, strictly requiring a full satellite application technical demonstration is unnecessary and unduly burdensome in this limited context. RBC Signals is proposing to operate a single earth station in a remote area of Alaska for the limited purpose of performing TT&C for an abbreviated license term during the 3 Diamonds demonstration mission. In the attached Technical Appendix, RBC Signals provides technical information necessary to assess earth station and satellite operational characteristics, including link budgets, emissions information, and an orbital debris mitigation statement for the 3 Diamonds satellites. The proposed TT&C operations will be consistent with industry practice and conducted on a non-harmful interference basis.

The Commission has previously granted similar waivers in the context of proposed TT&C operations with foreign-licensed satellites.⁵³ Accordingly, grant of the requested waiver is consistent with Commission precedent and would permit RBC Signals to commence TT&C operations to support the 3 Diamonds demonstration mission in a timely manner.

IV. PUBLIC INTEREST CONSIDERATIONS

RBC Signals' earth station operations as requested in this application will support diverse EESS systems and applications, from asset tracking and atmospheric monitoring services (including

⁵³ See, e.g., SES Americom, Inc., File No. SES-MFS-20160624-00607, Call Sign E050287 (granting authority for an earth station to provide TT&C services to the foreign-licensed ASTRA 3A operating at 86.85° W.L.); Hawaii Pacific Teleport, L.P., File No. SES-MFS-20131030-00913, Call Sign E030115 (granting authority for an earth station to provide TT&C services to ASTRA 3A operating at 176.85° W.L.); SES Americom, Inc., File No. SES-STA-20161110-00884, Call Sign E050287 (granting authority for an earth station to provide TT&C services to ASTRA 3A during drift from 86.85° W.L. to 47.0° W.L.); Hawaii Pacific Teleport, L.P., File No. SES-STA-20131030-00914, Call Sign E030115 (granting authority for earth station to provide TT&C services to ASTRA 3A operating at 176.85° W.L.); PanAmSat Licensee Corp., File No. SES-STA-20090922-01212, Call Sign E040125 (granting authority for an earth station to communicate with the foreign-licensed NSS-12 satellite for purposes of providing launch and early operations services).

emergency response and natural resource protection) to the development of affordable narrowband mobile communication services to users in Asia, Africa, and Latin America.

The requested operations will facilitate U.S.-based ground support for state-of-the-art LEO NGSO cubesats providing next-generation satellite services that will improve how individuals, governments, and businesses send, receive, and process critical data and information.

Grant of this earth station license will further the public interest by positioning the United States as a leader in the development and encouragement of pioneering satellite technologies. The satellites that RBC Signals proposes to support are at the forefront of reinventing satellite connectivity solutions and grant of a license would further cement the United States' dedication to the advancement of satellite services in the U.S. Grant of this application will also ensure no interruption of RBC Signals' existing TT&C support for the 3 Diamonds and Arkyd 6A satellites and enable the continued demonstration of the significant benefits and commercial viability of these satellite communications systems.

V. CONCLUSION

Based on the foregoing, RBC Signals respectfully requests that the Commission grant its earth station license application to provide TT&C and mission support services for the above-described LEO NGSO cubesats from its facility in Deadhorse, Alaska. RBC Signals also respectfully requests that the Commission allow the waivers requested herein, which facilitate the deployment and development of these next-generation satellite technologies.