

**Before the
Federal Communications Commission
Washington, DC 20554**

In the Matter of)	
)	
Astro Digital US, Inc.)	File No. SAT-MOD-_____
)	
Modification Application for Authority to)	Call Sign: S3014
Launch and Operate a Non-Geostationary)	
Satellite Orbit System in the Earth-)	
Exploration Satellite Service)	

APPLICATION

Astro Digital US, Inc. (“Astro Digital”) hereby requests modification of its partially granted space station license (“Application”),¹ as follows:

- Authority to commence use of the previously requested S-band frequencies (2025-2110 MHz) for command uplinks on the new Demo8 and Demo9 satellites; and
- Extension of the license condition deployment deadline from March 31, 2021 to December 31, 2021 to permit deployment of Demo8 and Demo9 using, *inter alia*, the 402.88-402.92 MHz frequency band (Earth-to-space) (“UHF Command Uplink”) for launch and early orbit phase (“LEOP”) operations and back-up telemetry, tracking, and command (“TT&C”), as coordinated with Federal operators.

Additionally, Astro Digital is updating its Schedule S form to remove certain frequencies that were initially requested in 2017 but are not a part of the system.² Grant of the Application will allow the company to conduct technology demonstrations associated with its Landmapper

¹ See Stamp Grant, Astro Digital, IBFS File No. SAT-AMD-20200528-00064 (granted in part Oct. 9, 2020) (“October 2020 Grant”); Stamp Grant, Astro Digital, IBFS File No. SAT-LOA-20170508-00071 (granted in part Aug. 1, 2018); Stamp Grant, Astro Digital, IBFS File No. SAT-LOA-20170508-00071 (granted in part Dec. 14, 2017); *see also* Application of Astro Digital, IBFS File No. SAT-LOA-20170508-00071 (filed May 8, 2017) (“Initial Application”).

² See Letter from Chris Bidy, CEO, Astro Digital, to Marlene H. Dortch, Secretary, FCC, IBFS File No. SAT-AMD-20200528-000 et al. (filed Aug. 14, 2020).

system and provide the company operational and business flexibility. Except as stated specifically in this Application, Astro Digital is not requesting any other changes to its authorized satellite operations and certifies that such operations remain unchanged.³

I. BACKGROUND.

On May 8, 2017, Astro Digital submitted a space station application seeking to deploy the Landmapper constellation of thirty operational satellites to provide Earth-Exploration Satellite Service (“EESS”). Astro Digital sought authority to use a number of frequency bands, including both the 402-403 MHz band (Earth-to-space) and the 2025-2110 MHz band (Earth-to-space) for command uplinks.⁴ Additionally, Astro Digital sought authority to operate a Globalstar modem on the Landmapper constellation, using Globalstar-authorized and -assigned frequencies.⁵

The International Bureau (“Bureau”) has authorized five Landmapper satellites and deferred action on the remaining twenty-five satellites. On December 14, 2017, the Bureau granted Astro Digital authority to launch and operate one satellite,⁶ and subsequently, on August 1, 2018, the Bureau granted similar authority for up to five total satellites.⁷

³ For completeness, Astro Digital is resubmitting in Attachment 2 its previously filed ownership information. *See* Letter from Chris Bidy, CEO, Astro Digital, to Marlene H. Dortch, Secretary, FCC, IBFS File No. SAT-AMD-20200528-00064 et al. (filed Nov. 19, 2020).

⁴ Many of the proposed frequency bands were simply one of several alternative proposed bands for TT&C use.

⁵ *See* Initial Application, Exhibit 43 at 9.

⁶ *See* Stamp Grant, Astro Digital, IBFS File No. SAT-LOA-20170508-00071 (granted in part Dec. 14, 2017).

⁷ *See* Stamp Grant, Astro Digital, IBFS File No. SAT-LOA-20170508-00071 (granted in part Aug. 1, 2018).

On May 28, 2020, Astro Digital filed an application seeking to make changes to the license for three of the five authorized satellites that had not yet been launched.⁸ On October 9, 2020, the Bureau authorized use of, *inter alia*, the 402-403 MHz (Earth-to-space) and 2025-2110 MHz (Earth-to-space) band for one of the three satellites, Landmapper BC-5.⁹ The Bureau deferred action on the remaining two satellites, Demo6 and Demo7, and stated in the license that Astro Digital had no authority to deploy any space station after March 31, 2021.¹⁰ Subsequently, Astro Digital withdrew the application with respect to Demo6 and Demo7.

Of the five authorized satellites, Astro Digital has launched and is operating three of them.¹¹ The most recent satellite, Landmapper BC-5, was successfully launched into orbit on November 20, 2020.¹²

By this application, Astro Digital seeks authority to modify its authorization with respect to the remaining two authorized satellites in order to launch and operate new demonstration satellites, Demo8 and Demo9, which are scheduled for launch in June 2021 on the SpaceX Transporter-2 mission. The satellites will operate pursuant to the frequencies previously authorized under the Astro Digital license and coordinated with Federal operators. Demo8 and Demo9 replace Demo6 and Demo7, which were not launched and are no longer a part of the

⁸ See Amendment Application of Astro Digital, IBFS File No. SAT-AMD-20200528-00064 (filed May 28, 2020).

⁹ See October 2020 Grant, Frequencies and Condition 19.

¹⁰ See October 2020 Grant, Condition 23.

¹¹ See, e.g., Letter from Chris Bidy, CEO, Astro Digital, to Marlene H. Dortch, Secretary, FCC, IBFS File No. SAT-LOA-20170508-00071 (filed June 29, 2020); see also Letter from Chris Bidy, CEO, Astro Digital, to Marlene H. Dortch, Secretary, FCC, IBFS File No. SAT-LOA-20170508-00071 (filed Dec. 14, 2020).

¹² See Letter from Chris Bidy, Astro Digital, to Marlene H. Dortch, Secretary, FCC, IBFS File No. SAT-AMD-20200528-00064 (filed Dec. 14, 2020).

Landmapper system. Upon the successful approval of this Application and launch of Demo8 and Demo9, Astro Digital will be operating five satellites under this license.

Demo8 is a technology demonstration of:

- a Rapidly Attachable Fluid Transfer Interface (“RAFTI”) – a propellant tank, fill/drain valve, and docket adapter. Testing of the RAFTI will comprise of logging data regarding tank temperature and pressure on orbit to confirm the effectiveness of the tank seal and to establish flight worthiness and heritage. For the avoidance of doubt, no on-orbit refueling or other space-service activities will be conducted on this mission.
- two propulsion systems – a hydrogen-peroxide thruster and electric propulsion thruster, which will each perform thruster firings to assess maneuvering capabilities for future collision-avoidance, spacecraft-disposal activities, and future rendezvous, proximity operations, and docking (“RPOD”) activities; and
- two stereoscopic cameras, which will conduct non-Earth imaging to assess imaging capabilities for future RPOD activities. Astro Digital will obtain National Oceanic and Atmospheric Administration (“NOAA”) approval before launch.

The Demo8 satellite will use the following frequencies:

Frequency Band	Direction	Use
UHF		
400.48-400.52 MHz	space-to-Earth	TT&C ¹³
402.88-402.92 MHz	Earth-to-space	TT&C ¹⁴
S band		
2025-2110 MHz	Earth-to-space	TT&C

Table 1. Demo8 Frequencies

Demo9 is a technology demonstration of a hyperspectral imaging payload and has no propulsion system. The Demo9 satellite will use the following frequencies:

Frequency Band	Direction	Use
UHF		
400.48-400.52 MHz	space-to-Earth	TT&C

¹³ Because Demo8 is a demonstration mission to test new equipment, Astro Digital will not be downlinking images other than for test purposes, including to verify the health and status of the imaging equipment. Astro Digital believes this use of its assigned UHF TT&C downlink is consistent with its authorization and use of the band for TT&C. Nonetheless, to the extent necessary, Astro Digital requests waiver of the U.S. Table of Frequency Allocations, given the limited nature of the use.

¹⁴ The UHF TT&C uplink will be used for backup purposes. *See infra* II.B and n.22.

Frequency Band	Direction	Use
402.88-402.92 MHz	Earth-to-space	TT&C ¹⁵
S band		
2025-2110 MHz	Earth-to-space	TT&C
Globalstar ¹⁶		
1615-1618.725 MHz	intersatellite links	TT&C (back-up) ¹⁷
Ka band		
25.5-27.0 GHz	space-to-Earth	Data downlink

Table 2. Demo9 Frequencies

The imaging payload operator has obtained NOAA approval for the hosted operations aboard the Demo9 satellite operated by Astro Digital.

II. DISCUSSION

a. Use of S-band Frequencies (2025-2110 MHz) (Earth-to-space)

Of the five authorized satellites, Astro Digital has been granted authority only to deploy one satellite, Landmapper BC-5, with S-band uplink capabilities.¹⁸ Accordingly, Astro Digital requests additional authority to deploy Demo8 and Demo9 with S-band uplink capabilities.

i. Technical Specifications

¹⁵ The UHF TT&C uplink will be used for backup purposes. *See infra* II.B n.22.

¹⁶ The satellite will use a space-hardened modem, NSL EyeStar-S3, that utilizes the Globalstar constellation and operates only on a Globalstar-authorized and assigned channel (having a center frequency of 1616.25 MHz). *See* <https://www.nearspacelaunch.com/products/eyestar-s3-radio#:~:text=The%20EyeStar%2DS3%20Radio%20is,connection%20to%20the%20Globalstar%20network>. The FCC has previously approved use of Globalstar services for ISLs, and this modem specifically. *See, e.g.*, Spaceflight, Inc., IBFS File No. SES-STA-20200728-00089 (granted Dec. 10, 2020); Astro Digital US, Inc., IBFS File No. SAT-LOA-20170508-00071, at n. 3 (granted in part Apr. 12, 2018).

¹⁷ Transmissions by the Globalstar modem must be initiated by a ground station command uplink. The company intends to use this capability only during satellite commissioning and infrequently in special situations in which additional satellite telemetry would facilitate mission operations.

¹⁸ To be clear, the FCC has already authorized the use of the other frequencies identified in this application for the first five satellites of the constellation.

For the Commission's convenience, provided below are the technical specifications regarding Astro Digital's proposed S-band use provided in the Initial Application.¹⁹ The primary command receiver will operate at a maximum data rate of 250 kbps and have a maximum transmission bandwidth of 300 kHz. Two patch antennas located on the NADIR and Zenith surfaces of the spacecraft (-Z and +Z, respectively) will be summed together so that both antennas can simultaneously receive signals. Both patch antennas utilize RHCP.

Astro Digital has already pre-coordinated the use of the S-band uplink with relevant Federal operators and proposes to use a single 300 kHz channel centered at 2056 MHz. Nonetheless, to the extent necessary, Astro Digital is able to modify the specific frequency channel in the band as necessary to facilitate coordination.

ii. Compliance with U.S. Table of Frequency Allocations

The frequency band 2025-2110 MHz is allocated to Space Operations and EESS, *inter alia*, in all ITU regions. In the United States, Space Operations are limited to Federal operators, and EESS use by commercial operators is subject to conditions as may be applied on a case-by-case basis and the limitation that any use may not cause harmful interference to authorized operations.²⁰

The Astro Digital constellation generally (and Demo8 and Demo9 specifically) meet the definition of EESS because both satellites have imaging capability. Astro Digital has pre-coordinated the use of the 2025-2110 MHz band to ensure that such use will not cause harmful

¹⁹ To the extent necessary, Astro Digital incorporates by reference its prior submission, including any applicable requests for waiver with respect to the use of the relevant band. *See generally* Initial Application, Exhibit 43, at 45-55.

²⁰ *See* 47 C.F.R. § 2.106 n.US347.

interference to authorized users, including terrestrial broadcasters and Federal operators, who are authorized on a primary basis in this band.

b. Extension of the March 31, 2021 Deployment Deadline

Condition 23 of the October 2020 Grant prohibits deployment of any space station after March 31, 2021. As the Bureau is aware, the original deployment deadline, October 31, 2020, was a coordination condition imposed by NOAA to require Astro Digital to transition from the UHF Command Uplink to a non-UHF frequency band, such as S-band.²¹

Because the S-band system is still a new technology for the company and was only recently deployed on the Landmapper BC-5 satellite, Astro Digital seeks to mitigate technical risk for Demo8 and Demo9 and maintain a UHF command system for LEOP and back-up TT&C use.²² Astro Digital had previously pre-coordinated with NOAA the use of a UHF Command Uplink by Demo6 and Demo7 and will reengage with NOAA to ensure such use by Demo8 and Demo9 would be equally acceptable.

²¹ See Stamp Grant, Astro Digital, IBFS File No. SAT-LOA-20170508-00071, Condition 17 (granted in part Aug. 1, 2018). During a pre-coordination meeting with Astro Digital and representatives from the Commission and other Federal agencies in March 2020, representatives from NOAA acknowledged the basis for the deployment deadline. The same deadline was imposed as a coordination condition in another license granted after the Astro Digital license grants, but that subsequent grant contained greater specificity regarding the purpose of the deadline. See, e.g., Stamp Grant, Spire Global, Inc., IBFS File No. SAT-AMD-20180102-00001, at Condition 15 (granted in part Nov. 29, 2018) (“For future missions, transition of TT&C links out of the 402-403 MHz band is required such that operations within the frequency band do not extend beyond October 31, 2020.”).

²² Back-up TT&C communications shall only be used in the event of the inability to use the primary TT&C link in the S-band frequencies, such as when the satellite is tumbling, and for occasional testing to ensure the operational capability of the back-up TT&C system.

After verifying the capabilities of the S-band technology on these satellites, future satellites would transition more fully to S-band command links.²³ Astro Digital believes this temporary measure would allow the company to move forward with the deployment of its constellation responsibly, while also ensuring that, in the long-term, Astro Digital is transitioning its command links to the S-band frequencies consistent with NOAA's guidance.

As discussed above, Demo8 and Demo9 are scheduled to launch in June 2021. To allow Astro Digital sufficient time to launch these two satellites and to protect against potential launch delays, including the unknown impact of the current COVID-19 pandemic, the company is requesting, in an abundance of caution, an extension of the deadline from March 31, 2021 to December 31, 2021.²⁴

c. Orbital Debris Considerations

Astro Digital is submitting an Orbital Debris Assessment Report ("ODAR") for each of the Demo8 and Demo9 missions. Each ODAR demonstrates that the satellites meet Commission and National Aeronautics and Space Administration orbital debris mitigation standards, including with respect to the orbital dwell period and on-orbit collision and human causality risk.

III. CONCLUSION

Astro Digital respectfully requests that the Bureau expeditiously grant this Application.

Respectfully submitted,

²³ To be clear, future satellites would not include UHF command systems unless such systems would meet the recently adopted 7 dBW limit for operations in the 401-403 MHz band. *See* ITU Radio Regulations No. 5.264A. To the extent Astro Digital intends to deploy UHF systems meeting the limit, Astro Digital would seek authority to modify its license and would coordinate such operations with affected Federal operators, as necessary.

²⁴ This modest 6-month buffer period is consistent with the Commission's action for Landmapper BC-5. *See* October 2020 Grant, Condition 23 (requiring Landmapper BC-5 to deploy by Mar. 31, 2021, six months after the scheduled launch date).

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Dated: March 19, 2021

/s/ Chris Biddy

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ATTACHMENT 1
Technical Certification

I, Jan King, 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/ Jan King

Jan King
Chief Scientist
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Dated: March 19, 2021

ATTACHMENT 2
Ownership Exhibit (as filed Nov. 19, 2020)

Astro Digital US, Inc. (“Astro Digital”) is a privately held corporation.

The following individuals hold 10% or more of the equity and/or voting interest in Astro Digital:

Chris Biddy

3171 Jay Street

Santa Clara, CA 95054

~20.8% equity and voting interest on a fully diluted basis

~20.5% equity and voting interest on a non-fully diluted basis

Michael Wilson

3171 Jay Street

Santa Clara, CA 95054

~12.5% equity and voting interest on a fully diluted basis

~11.4% equity and voting interest on a non-fully diluted basis

Astro Digital Officers and Board of Directors

Officers:

Name	Title	Citizenship
Chris Biddy	Chief Executive Officer	USA
Michael Wilson	Chief Financial Officer	USA
Kyle Leveque	Chief Technical Officer	USA

Board of Directors:

Name	Citizenship
Chris Biddy	USA
John Cuseo	USA