Before the
Federal Communications Commission
Washington, DC 20554

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

APPLICATION

Astro Digital US, Inc. ("Astro Digital") hereby amends its partially granted space station license and pending application ("Application")[1] and requests:

- Authority to communicate with all non-U.S. ground stations that Astro Digital has coordinated with Federal operators;
- Authority to commence use of the previously requested S-band frequencies (2025-2110 MHz) for command uplinks;
- Correction of the October 31, 2020 license condition deployment deadline to reflect that the condition applies only to the launch of new satellites using the 402.88-402.92 MHz frequency band (Earth-to-space) ("UHF Command Uplink");
- Extension of the deadline to October 31, 2023 to allow the company to deploy three additional satellites using the 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; and
- Temporary waiver of the operational satellite requirement specified in the Astro Digital License.[2]

Additionally, Astro Digital is updating its ownership information and correcting its Schedule S form.[3] Grant of the Application will provide Astro Digital needed operational flexibility and

[1] *See* Stamp Grant, Astro Digital, IBFS File No. SAT-LOA-20170508-00071 (granted in part Aug. 1, 2018) ("License"); *see also* Application of Astro Digital, IBFS File No. SAT-LOA-20170508-00071 ("Initial Application").
[2] *See* License at Condition 15.

facilitate the technological transition of the Landmapper system to its next-generation satellites. 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.

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 2025-2210 MHz band (Earth-to-space) for command uplinks.[4]

On December 14, 2017, the International Bureau ("Bureau") granted Astro Digital authority to launch and operate one Astro Digital satellite, and subsequently on August 1, 2018, the Bureau granted similar authority for up to five Astro Digital satellites.[5] The Bureau did not take action on the request to use the 2025-2110 MHz (Earth-to-space) band. The initial Landmapper satellites did not have S-band capability, and Astro Digital had not yet coordinated the S-band frequencies with Federal operators. With respect to the 402-403 MHz band, Astro Digital was authorized to use 402.88-402.92 MHz band, pursuant to coordination with Federal

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[3] The associated Schedule S corrects the polarization specified in the 25.5-27.0 GHz and 29.9-30.0 GHz bands from Right Hand Circular Polarization ("RHCP") to Left Hand Circular Polarization ("LHCP"). As a general matter, the Ka-band beams are narrow and, accordingly, in-line interference with other systems operating from Svalbard are unlikely, even when operating co-channel and co-polarized. As it is, the use of LHCP on the Landmapper system dramatically reduces Astro Digital's potential to cause interference to all known users of Ka-band frequencies from Svalbard, including particularly the Joint Polar Satellite System ("JPSS") mission, which uses RHCP. Because Astro Digital operates cross-polarized with the JPSS and other missions, there is an additional 25 dB of co-channel isolation at Svalbard.

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

[5] *See supra* note 1.

operators.[6] As part of that coordination, as discussed below in Section II.c, Astro Digital was prohibited from deploying satellites using these frequencies after October 31, 2020.

The International Telecommunication Union ("ITU") recently adopted maximum e.i.r.p. limits in the frequency band 401-403 MHz.[7] A system operating in this band and brought-into-use before November 22, 2019 would have until November 22, 2029 to comply with the limits.

On January 12, 2018 and December 3, 2018, Astro Digital launched Landmapper-BC3 and Landmapper-BC4, respectfully. On November 22, 2019, Astro Digital through its licensing administration submitted to the ITU the Bring-Into-Use notification for the 402.88-402.92 MHz frequencies for the Landmapper constellation, USASAT-30H-LM.

Astro Digital is in the process of constructing Landmapper-BC5, Demo6, and Demo7. And the three satellites are scheduled for launch in 2020, with BC5 scheduled to launch prior to October 31, 2020 on an Electron launch vehicle.

Unlike the earlier satellites, these three new satellites will have an S-band receiver onboard capable of receiving in the 2025-2110 MHz band. BC5 will be demonstrating a new type of imager and onboard payload data processor[8] and will not have a Ka-band payload.[9] Because BC5 is a demonstration mission to test new equipment, Astro Digital will not be

[6] Although not relevant here, the initial satellite was authorized to operate on the 402.6 MHz center frequency channel in certain limited circumstances. *See* License at Condition 8.
[7] *See* Final Acts, ITU World Radiocommunication Conference 2019, at 17 (2020), https://www.itu.int/dms_pub/itu-r/opb/act/R-ACT-WRC.14-2019-PDF-E.pdf.
[8] A discussion of the capabilities of the onboard processor is provided below in the discussion of Demo6 and Demo7.
[9] Astro Digital has applied for the necessary satellite image licensing approval from the Commercial Remote Sensing Regulatory Affairs Office ("CRSRA") of the National Oceanic and Atmospheric Administration.

downlinking images (other than occasional image thumbnails to verify the health and status of the imaging equipment).[10]

Demo6 and Demo7 will have a demonstration optical communications payload and high-performance onboard payload data processor.[11] The demonstration optical payload will have both intersatellite link and feeder link capabilities. The satellites will also have propulsive capabilities, as discussed in more detail in the attached Orbital Debris Assessment Report ("ODAR"). The two satellites will not have imaging payloads. The Demo6 and Demo7 mission will conduct in-orbit tests of the payload processor's capabilities[12] to process imagery (provided by the optical communications payloads) and other data and to facilitate constellation management, including prioritizing and scheduling payload operations and downlinks.

II. Discussion

a. Use of Non-U.S. Ground Stations

Astro Digital currently communicates with the Kongsberg Satellite Services ("KSAT") ground station in Svalbard, Norway and a U.S. ground station in Santa Clara, CA (Call Sign E170192).[13] The use of both ground stations has been coordinated with Federal operators. The

[10] Astro Digital believes this use of its assigned UHF downlink frequencies (400.48-400.52 MHz) 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.

[11] The satellites will also have on board a Ka-band transmitter, which will be used for transmission of diagnostic information regarding the optical payload and other engineering data.

[12] For Landmapper-BC5, the onboard processor will process data provided by the imager on the spacecraft.

[13] *See* Grant, Astro Digital, IBFS File No. SES-LIC-20171017-01179 (granted Jul. 27, 2018) ("Santa Clara Grant").

company also has applied to operate another U.S. ground station in Littleton, CO (Call Sign E200948).[14]

Although the License contains no restrictions regarding Astro Digital's ability to communicate with non-U.S. ground stations, the Bureau has requested that Astro Digital seek authority to communicate with any new foreign ground stations to ensure that the company has coordinated its operations with Federal operators.[15]

Astro Digital requests that the License be revised to broadly permit Astro Digital to communicate with all non-U.S. ground stations that the company has coordinated with Federal operators.[16] Astro Digital will initiate and complete coordination with relevant Federal operators prior to communications with any new ground stations and will provide the Commission a list of coordinated earth stations. Grant of the request would provide Astro Digital operational flexibility and would be consistent with Commission precedent.[17]

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

Although Astro Digital previously requested authority to operate in 2025-2110 MHz (Earth-to-space), the Bureau took no action with respect to that request because it was

[14] *See* Application of Astro Digital, IBFS File No. SES-LIC-20200310-00229 (filed Mar. 10, 2020) ("Littleton Application").

[15] For U.S. ground stations, the company will submit the required Part 25 earth station application.

[16] At present, Astro Digital seeks to communicate with KSAT's ground station facilities in Tromsø, Norway (69.6625° N, 18.9403° W) but may seek to expand communications to other non-U.S. ground stations.

[17] *See, e.g.*, Stamp Grant, Planet Labs Inc., IBFS File No. SAT-MOD-20170713-00103, at Condition 7 (granted Jul. 19, 2018) ("Transmissions of ... data in the 8025-8400 MHz frequency band many only be made to earth stations coordinated with National Aeronautics and Space Administration (NASA). Planet shall provide the FCC the list of coordinated earth stations."); Stamp Grant, Hawkeye 360, Inc. IBFS File No. SAT-LOA-20190102-00001, at Conditions 7 and 10 (granted Dec. 10, 2019) (allowing licensee to transmit to earth stations operating in the X-band and S-band frequencies and coordinated with Federal operators and requiring the submission of a list of those earth stations). Astro Digital will ensure that all necessary local authorizations are obtained to permit transmissions to/from those non-U.S. ground stations.

unnecessary at the time.[18] Astro Digital is now ready to deploy satellites with S-band capabilities and, accordingly, asks the Bureau to allow the company to commence use of the 2025-2110 MHz frequencies (Earth-to-space).

i. Technical Specifications

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.[20] 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.

Based on pre-coordination discussions with Federal operators since the filing of the Initial Application, Astro Digital proposes to use a single 300 kHz channel within the following frequency bands: 2045.1-2050.9 MHz, 2051.1-2056.8 MHz, or 2073.6-2078.5 MHz. However, Astro Digital will select the specific frequency channel only after the company completes coordination with Federal and commercial operators.

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-

[18] *See supra* Section I.
[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] Initially, Astro Digital will only use a 300 kHz channel.

case basis and the limitation that any use may not cause harmful interference to authorized operations.[21]

The Astro Digital constellation generally (and Landmapper BC-5 specifically) meet the definition of EESS because the constellation is an Earth imaging system. Astro Digital is in the process of coordinating the use of the 2025-2110 MHz band to ensure that such use will not cause harmful interference to authorized users, including terrestrial broadcasters and Federal operators, who are authorized on a primary basis in this band.

Landmapper Demo6 and Demo7, however, are demonstration satellites designed to test a new optical communications payload capable of high-speed and high-capacity data transmissions, as well as a high-performance onboard processor. The satellites do not have imaging payloads. Accordingly, to the extent necessary, Astro Digital requests a waiver of the U.S. Table of Frequency Allocations to use the 2025-2110 MHz band for command links for the two satellites. Because Astro Digital will coordinate use of this band with authorized users and will test technology potentially relevant to the development of its satellite system,[22] Astro Digital submits that the public interest will be served and a waiver is justified. Grant of the waiver is also consistent with prior Bureau actions permitting licensees to modify satellites in a constellation to test and/or demonstrate new technology.[23]

c. Correction of the October 31, 2020 Deployment Deadline

Condition 17 of the Astro Digital License provides that:

[21] *See* 47 C.F.R. § 2.106 n. US347.
[22] *See supra* Section I.
[23] *See, e.g.,* Stamp Grant, Planet Labs, Inc., IBFS File No. SAT-AMD-20171025-00144 (granted Dec. 8, 2017) (granting the request to add a propulsion system that replaces the imaging payload on (up to) three of the licensee's authorized satellites); Stamp Grant, Planet Labs, Inc., IBFS File No. SAT-AMD-20171106-00151 (granted May 24, 2018) (granting the request to add an AIS receiver on (up to) three of the licensee's authorized satellites).

> Astro Digital must deploy the space stations authorized under this grant no later than October 31, 2020. No authority is granted to deploy space stations after October 31, 2020. The scope of this authorization will be reduced automatically, without further Commission action, to the number of space stations deployed by October 31, 2020.

As the Bureau is aware, this deployment deadline was a coordination condition imposed by the NOAA to require Astro Digital to transition from the UHF Command Uplink to a non-UHF frequency band.[24] Accordingly, Astro Digital requests that the Commission revise the language of the deployment condition to correctly reflect that the deadline applies only with respect to the UHF Command Uplink and not as a blanket prohibition on deployment after the specified deadline. Provided in the section below is a revised license condition reflecting this proposed change.

d. Extension of the October 31, 2020 Deployment Deadline

Astro Digital requests a three-year extension of the October 31, 2020 deadline until October 31, 2023 to allow the company to launch an additional three satellites using the UHF Command Uplink. Those three satellites would use the UHF Command Uplink only for LEOP and back-up TT&C.[25]

As explained above, Astro Digital is in the process of transitioning its command links to the S-band frequencies. However, because the S-band system is untested, Astro Digital seeks to

[24] During a pre-coordination meeting with Astro Digital and representatives from the FCC and other Federal agencies, 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.").

[25] 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.

mitigate technical risk for its next three missions and maintain a UHF command system for LEOP and back-up TT&C use.

After verifying the capabilities of the S-band technology on these three satellites, future satellites would transition more fully to S-band command links.[26] 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, the three Astro Digital satellites, Landmapper-BC5, Demo6, and Demo7, are scheduled to launch in 2020. Indeed, BC5 is scheduled to be deployed prior to the October 31, 2020 license condition deadline. To allow Astro Digital sufficient time to launch these three 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, a three-year extension of the deadline until October 31, 2023.

Astro Digital requests that Condition 17 of its License be replaced in its entirety with the following text:

> "17. Until October 31, 2023, Astro Digital may deploy up to three additional space stations capable of transmitting in the 402.88-402.92 MHz band (Earth-to-space), as coordinated with Federal operators. Such space stations deployed after the date of this grant may operate in the 402.88-402.92 MHz band only for launch and early orbit phase operations and back-up telemetry, tracking and command. No authority is granted to deploy space stations operating in the 402.88-402.92 MHz band after October 31, 2023."

[26] To be clear, such 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 supra* Part I. 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.

e. Temporary Waiver of Operational Satellite Requirement

In an abundance of caution, Astro Digital requests temporary waiver of Condition 15 of its License, which states that the license "will become null and void if, at any time during the license term, none of the authorized satellites is operating."[27] The Commission may waive any of its rules if there is "good cause" to do so.[28] In general, waiver is appropriate if (1) special circumstances warrant a deviation from the general rule; and (2) such deviation would better serve the public interest than would strict adherence to the rule.[29] 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.[30] Astro Digital submits that good cause exists here.

In early April 2020, Landmapper BC-4 experienced an anomaly, and Astro Digital has not been able to contact its sole operational Landmapper satellite. As a practical matter, a temporary loss of contact may be attributable to a number of technical issues either space-based or ground-based, and in many cases, an operator is able to reestablish contact and recommence normal operations. Astro Digital is currently attempting to do so and remains hopeful that its efforts will soon be successful. Nonetheless, in an abundance of caution, because of the potential dire consequences if Astro Digital is unable to reestablish contact, the company requests temporary waiver of the operational satellite requirement until its next satellite deployment, which is scheduled to be launched in 2020.[31]

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[27] License at Condition 15. To the extent necessary, Astro Digital also requests a waiver of 47 CFR § 25.161 for the reasons stated in this section.
[28] *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).
[29] *See Northeast Cellular*, 897 F.2d at 1166.
[30] *See WAIT Radio*, 418 F.2d at 1157.
[31] As discussed above, Astro Digital would have until October 31, 2023, at most, to deploy its next satellite.

The purpose of the operational satellite requirement is to prevent spectrum speculation and warehousing and was implemented here as an alternative to the Commission's milestone and bond requirement.[32] Because there are no spectrum speculation or warehousing concerns in this case, grant of the temporary waiver request is warranted.

In January 2018, weeks after grant of its satellite license, Astro Digital successfully deployed into orbit Landmapper-BC3.[33] Later that year, Astro Digital deployed another satellite, Landmapper-BC4. This year, Astro Digital intends to launch three additional satellites, Landmapper-BC5, Demo6, and Demo7, as part of its Landmapper constellation. Each of those satellites is currently under construction. Astro Digital also has constructed and operates two earth stations, one in Santa Clara, CA and one in Littleton, CO.[34] All told, Astro Digital has spent millions on its Landmapper satellite program.[35] Accordingly, there is no reason to believe that spectrum speculation or warehousing is a concern here. Indeed, if all goes as planned, Astro Digital will have launched five satellites within three years of its license grant.[36]

Strict adherence to the license condition here does not serve the public interest. Astro Digital has incurred substantial costs to develop and deploy its constellation and is potentially a few months away from the launch of additional satellites. Stripping Astro Digital of its License

[32] *See* License at Conditions 15 and 16. The Commission has applied this license condition on licensees in instances where the relevant party is about to deploy or has already deployed satellites, has a continuing need to replenish those satellites, and the associated authorization is for the non-exclusive use of spectrum.
[33] *See* Astro Digital 2019 Annual Report (filed June 28, 2019).
[34] *See* Grant, Astro Digital, File No. 0049-EX-CR-2020 (renewed Apr. 6, 2020) ("Momentus X1 Grant"); Santa Clara Grant; *see also* Littleton Application.
[35] Moreover, Astro Digital has throughout this time actively engaged in other satellite programs, including the testing and demonstration of the Perseus M satellites and the Momentus X1 satellite. *See, e.g.*, Grant, Astro Digital, File No. 0329-EX-CR-2019 (renewed Jan. 9, 2020); Momentus X1 Grant.
[36] Under the Commission's normal milestone and bond regime, a licensee would have had six years to deploy at least one satellite or lose its license. *See generally* 47 C.F.R. §§ 25.164, 25.165.

just prior to its upcoming deployment would unfairly impose a draconian result on Astro Digital simply because of its two unexpected satellite failures. Indeed, international[37] and FCC[38] space policies consistently recognize that, as a practical matter, launches and satellites fail, and in those cases, fairness requires that operators be given additional time to complete their missions.

Further, special circumstances arising from the wide-ranging impact of the global COVID-19 pandemic justify a temporary waiver of the operational satellite requirement. Government restrictions on social distancing and Astro Digital's concerns regarding the deadly virus and the safety of its employees has impaired and will continue to impair the ability of the company to fully use available recontact opportunities, decreasing the chances that Astro Digital will be able to reengage the satellite.

For all of the above reasons, Astro Digital submits that a waiver of the operational satellite requirement is justified.

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[37] *See, e.g.*, ITU Rules of Procedure § 11.48 (2017) (acknowledging that the ITU Radio Regulations Board may extend a bring-into-use deadline in cases of force majeure or co-passenger delay concerning the launch of the satellite); ITU Space Services Department, *Bringing into use and suspension of space services frequency assignments recording in the master international frequency register and not subject to a plan*, Document WRC18/31-E at § 2.10 (Oct. 30, 2018); ITU Radio Regulations § 11.49 (permitting administrations three years to bring back into use suspended frequency assignments).

[38] The FCC has previously waived its rule terminating a satellite authorization if a satellite is inoperable or removed from its authorized location for more than 90 days. *See* 47 CFR § 25.161 ("Authorization Termination Rule"); *Application for Modification of the AMC-16 Fixed-Satellite Service Space Station to Temporarily Vacate the 85° W.L. Orbital Location and for Telemetry, Tracking and Control Operations during Drift of the AMC-16 to and from the 118.75° W.L. Orbital Location*, Order and Authorization, 21 FCC Rcd 3430 (2006) (permitting licensee to retain its grant while it temporarily relocated the authorized satellite to provide replacement service for a failed satellite); *Application of SES Americom, Inc. for Modification of the AMC-16 Fixed Satellite Space Station License*, Memorandum Opinion and Order, 21 FCC Rcd 14785 (2006) (maintaining an authorization for fifteen months for a satellite relocated to deliver replacement service elsewhere); Stamp Grant, EchoStar Satellite Operating LLC, IBFS File No. SAT-MOD-20080825-00158 (granted Feb. 2, 2009) (preserving a satellite license after the authorized satellite's in-orbit failure because the licensee relocated another satellite to provide replacement service within seven months).

f. Orbital Debris Considerations

The Astro Digital imaging satellites are subject to regulation by NOAA under Title 51 of the U.S. Code.[39] Pursuant to those licensing requirements, Astro Digital submitted end-of-life disposal plans for its Landmapper constellation, and NOAA approved the application.[40] Accordingly, FCC review and approval of Astro Digital's post-mission disposal plan is not necessary with respect to the Landmapper imaging system.[41]

Landmapper-Demo6 and Demo7, however, contain demonstration optical communications payloads and no imaging payloads. Accordingly, these two satellites are not subject to NOAA jurisdiction, and Astro Digital is submitting an ODAR applicable to those two satellites. The ODAR demonstrates that the two satellites meet NASA orbital debris mitigation guidelines, including with respect to post-mission disposal of the satellites.

[39] *See* 51 U.S.C. § 60122(b).

[40] Astro Digital's amendment application to its imaging license with respect to Landmapper-BC5 is currently pending, and Astro Digital will notify the FCC when it has been granted by CRSRA. For completeness, Astro Digital notes that the lens on BC5 is made of the same materials as the lens on prior satellites. Additionally, the new imager has only one lens as opposed to three lenses on prior satellites, and that one lens is also smaller. Accordingly, there is even less reentry risk associated with the BC5 satellite than for the prior satellites authorized by CRSRA.

[41] The Commission has previously determined that "[t]o the extent that a remote sensing satellite applicant has submitted its post-mission disposal plans to NOAA for review and approval, [it] will not require submission of such information" as part of its examination of the debris mitigation disclosures of remote sensing satellites. *See, e.g.*, *Mitigation of Orbital Debris*, Second Report and Order, 19 FCC Rcd 11567 ¶ 104 (2004); *Mitigation of Orbital Debris in the New Space Age*, Report and Order and Further Notice of Proposed Rulemaking, IB Docket No. 18-313, FCC 20-54, at 103 (rel. Apr. 24, 2020) (revised 47 C.F.R. § 25.114(d)(14)(vii)(E)).

III. CONCLUSION

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

Respectfully submitted,

/s/ Chris Biddy

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Dated: May 28, 2020

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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Date: May 28, 2020

Ownership Exhibit

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

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

Astro Digital Foreign Shares Trust
2121 Lohmans Crossing Rd
Suite 504-521
Lakeway, TX 78734
~39% equity and voting interest on a fully diluted basis

The trustee of the Astro Digital Foreign Shares Trust is Albert Schultz, a U.S. citizen, and holds voting control of the trust, as subject to the trust agreement. Control of Astro Digital resides in the Officers and Directors.

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
Jan King	Chief Scientist	USA

Board of Directors:

Name	Citizenship	Address
Chris Biddy	USA	3171 Jay St., Santa Clara, CA 95054
John Cuseo	USA	3171 Jay St., Santa Clara, CA 95054