

*** GRANT IN PART / DEFER IN PART ****

S3014 SAT-LOA-20170508-00071 IB2017001277
Astro Digital US, Inc.
Landmapper



File # SAT-LOA-20170508-00071

Call Sign S3014 Grant Date 12/14/17

(or other identifier)

Term Dates
From 12/14/17 To: 10/31/20

Approved: Stephen J. Duall

Stephen J. Duall
Chief, Satellite Policy Branch

Approved by OMB
3060-0678

Re-issued on 12/21/17
with correction to
condition 8

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Callsign/Satellite ID: S3014

* in part with
conditions

APPLICATION FOR SATELLITE SPACE STATION AUTHORIZATIONS FCC 312 MAIN FORM FOR OFFICIAL USE ONLY	FCC Use Only
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APPLICANT INFORMATION

Enter a description of this application to identify it on the main menu:

Land mapper NGSO EESS Space Station Constellation Application

1-8. Legal Name of Applicant			
Name:	Astro Digital U.S., Inc.	Phone Number:	650-919-4032
DBA Name:		Fax Number:	805-234-7300
Street:	NASA Ames Research Park, Suite 503	E-Mail:	jan@astrodigital.com
	340 Cody Road		
City:	Moffett Field	State:	CA
Country:	USA	Zipcode:	94035
Attention:	Mr Jan A King		

ATTACHMENT TO GRANT
 Astro Digital U.S., Inc.
 IBFS File No. SAT-LOA-20170508-00071

IBFS File No(s):	SAT-LOA-20170508-00071	<p>GRANT IN PART/ DEFER IN PART – With Conditions</p>  <p>International Bureau Satellite Division</p>
Licensee/Grantee:	Astro Digital U.S., Inc. (Astro Digital)	
Call Sign:	S3014	
Satellite Name:	Landmapper constellation	
Orbital Location: (required station-keeping tolerance)	Non-Geostationary Orbit (NGSO) at altitudes between 475 km and 625 km (see scope of grant below)	
Administration:	United States of America	
Nature of Service:	Earth Exploration Satellite Service (EESS)	
Scope of Grant:	Authority to construct, deploy, and operate one Landmapper-BC satellite to provide EESS at orbital altitudes between 475 and 625 km. ¹	
Service Area(s):	Global	
Frequencies:	25.5-27.0 GHz (space-to-Earth) (data downlink) 29.9-30.0 GHz (Earth-to-space) (data flow control) ² 1615-1617.775 MHz (space-to-space) ³ 2483.5-2495 MHz (space-to-space) Telemetry, Tracking, and Command (TT&C) frequencies: 400.5 MHz (space-to-Earth) and 402.9 MHz (Earth-to-space)	

¹ Astro Digital requested authority to construct, deploy, and operate a constellation of up to 100 satellites over a period of 15 years, with no more than 30 satellites operational at one time, operating at orbital altitudes between 475 and 625 km. We grant Astro Digital's request for one Landmapper-BC satellite scheduled for launch in December 2017 and defer action on the remainder of Astro Digital's request.

² Astro Digital's application was placed on public notice on August 25, 2017. *Satellite Policy Branch Information Space Station Applications Accepted for Filing*, Public Notice, Report No. SAT-01262 (Aug. 25, 2017). Telesat Canada filed a petition to deny, asserting that Astro Digital's use of the 29.9-30 GHz band would interfere with Telesat's use of this band, and that Astro Digital's operations are inconsistent with the Ka-band plan and it did not file the appropriate waiver. *See* Petition to Deny of Telesat Canada (filed Sept. 25, 2017). The Commission's Ka-band plan restricts the use and licensing of the Ka-band beyond those indicated in section 2.106. Because section 2.106 has no allocation for EESS in the 29.9-30.0 GHz band, however, Astro Digital's request for a waiver of the U.S. Table of Allocations is appropriate for its proposed non-conforming use of the 29.9-30.0 GHz band. Astro Digital's operations must be on a non-interference basis to other authorized users in the band thereby resolving Telesat's concerns and eliminating them as a basis for denying Astro Digital's application. *See* Petition to Deny of Telesat Canada (filed Sept. 25, 2017) and Astro Digital's Consolidated Opposition and Response (filed Oct. 11, 2017).

³ Iridium Constellation filed comments, stating that Astro Digital did not address co-frequency or adjacent band interference issues with the Iridium service links. *See* Comments of Iridium Constellation LLC (filed Sept. 25, 2017). With the frequencies requested by Astro Digital, there is no co-frequency sharing with Iridium. Regarding adjacent band sharing, Astro Digital will operate these links pursuant to Globalstar's authorizations. In addition, based on our analysis, Astro Digital's out-of-channel emission in the nearest Iridium channel would result in a carrier-to-interference ratio of approximately 32 dB. As a result, we conclude that the impact of Astro Digital's out-of-channel emission on Iridium's operations would be negligible.

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Unless otherwise specified herein, operations under this grant must comport with the legal and technical specifications set forth by the applicant or petitioner and with Federal Communication Commission's rules not waived herein. This grant is also subject to the following conditions:

1. Astro Digital must prepare the necessary information, as may be required, for submission to the International Telecommunication Union (ITU) to initiate and complete the advance publication, coordination, due diligence, and notification process for these space stations, in accordance with the ITU Radio Regulations. Astro Digital shall be held responsible for all cost-recovery fees associated with ITU filings. No protection from interference caused by radio stations authorized by other administrations is guaranteed unless coordination and notification procedures are timely completed or, with respect to individual administrations, by successfully completing coordination agreements. Any radio station authorization for which coordination has not been completed may be subject to additional terms and conditions as required to effect coordination with the frequency assignments of other administrations. *See* 47 CFR § 25.111(b).
2. In the 25.5-27.0 GHz band, power flux-density from operations must not exceed the limits in § 25.208(p), Table 21-4 of the International Telecommunication Union's (ITU) Radio Regulations, and the limits and guidelines in Recommendation ITU-R SA.1862 must be followed.
3. In the 25.5-27.0 GHz band, operations are subject to footnote US258 of the U.S. Table of Frequency Allocations, 47 CFR § 2.106, which provides that this band is allocated on a primary basis for non-Federal EESS (space-to-Earth), subject to a case-by-case electromagnetic compatibility analysis.
4. In the 29.9-30.0 GHz band, we grant Astro Digital's request to waive the United States Table of Frequency Allocations to permit EESS operations in this band as proposed.⁴ Operations, however, must be conducted on a non-interference basis with respect to Mobile Satellite Service (MSS) and Fixed Satellite Service (FSS), including licensees and grantees of U.S. market access in the NGSO FSS processing round.⁵ Further, Astro Digital shall not claim protections from systems operating in accordance with the U.S. Table of Frequency Allocations. *See* 47 CFR § 2.106. Within 30 days of grant of this authorization, Astro Digital must submit a showing indicating how its operations will comply with the requirements of this condition.
5. Within 30 days of grant of this authorization, Astro Digital must submit to the Commission its input parameters and the simulation output results, using approved ITU EPFD simulation software, demonstrating EPFD compliance with the same ITU Article 22 limits applicable to NGSO FSS operations in the 29.9-30.0 GHz band. *See* <http://www.itu.int/en/ITU-R/software/Pages/epfd.aspx>.
6. Astro Digital's request for a waiver to operate TT&C links in the 402.8-403 MHz frequency band is granted. Astro Digital shall tune TT&C UHF links to an agreed frequency range with NOAA to minimize interference to NOAA GOES Data Collection System (DCS) and radiosonde operations, and continue to work closely with NOAA to identify and implement any further measures needed to avoid radio frequency interference to these systems.
7. Astro Digital's TT&C operations in the space-to-Earth direction are limited to a center frequency of 400.5 MHz, except as necessary for a period immediately following (i) the deployment of the satellite or (ii) a satellite software reset, resulting in satellite transmissions returning to the default transmission channel, in both

⁴ For Earth-to-space transmissions, the International Table allocates 28.5-30.0 GHz to EESS on a secondary basis in Regions 1, 2, and 3.

⁵ Public Notice, Satellite Branch Policy Information, *OneWeb Petition Accepted for Filing IBFS File No. SAT-LOI-20160428-00041 Cut-Off Established for Additional NGSO-like Satellite Applications or Petitions for Operations in the 107-12.7 GHz, 14.0-14.5 GHz, 17.8-18.6 GHz, 18.8-19.3 GHz, 27.5-28.35 GHz, 28.35-29.1 GHz, and 29.5-30.0 GHz Bands*, 31 FCC Rcd 7666 (July 15, 2016). Astro Digital filed its application to operate its NGSO system in the 29.9-30 GHz band on May 8, 2017, after the November 15, 2016, cut-off date established for such systems.

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cases to allow for the retuning of transmissions from 400.175 MHz to 400.5 MHz.

8. Astro Digital's TT&C operations in the Earth-to-space direction are limited to a center frequency of 402.9 MHz, except as necessary for a period immediately following (i) the deployment of the satellite or (ii) a satellite software reset, resulting in the satellite returning to its default channel, in both cases to allow for the retuning of the satellite receive channel from 402.6 MHz to 402.9 MHz..
9. Astro Digital's request for a waiver of the modified processing round requirements of 47 CFR §§ 25.156 and 25.157 is granted. Astro Digital will be able to share spectrum with other EESS systems by time sharing its transmissions over the same geographic area. We grant this waiver given the opportunities for additional entrants to operate in Astro Digital's requested frequency bands. *See DigitalGlobe, Inc.*, Order and Authorization, 20 FCC Red 15696, 15699 (Sat. Div., Int'l Bur. 2005).
10. Astro Digital's request for a waiver of the default service rules in 47 CFR 25.217(b) is granted. The Commission has not adopted band specific rules for EESS NGSO operations in the 25.5-27.0 GHz band and has waived the default service rules where EESS operators comply with Part 2 of the Commission's rules and applicable ITU rules. Astro Digital must comply with technical requirements in Part 2 of the Commission's rules and the above-referenced power flux-density limits, which should prevent harmful interference to other operations in these bands.
11. Astro Digital must coordinate physical operations of spacecraft with any operator using similar orbits, for the purpose of eliminating collision risk and minimizing operational impacts. The orbital parameters specified in this grant are subject to change based on such coordination.
12. Upon receipt of a conjunction analysis from the Joint Space Operations Center (JSpOC) or other source, Astro Digital must review the warning and take all possible steps to assess and, if necessary, to mitigate collision risk, including, but not limited to: contacting the operator of any active spacecraft involved in such warning; sharing ephemeris data and other appropriate operational information with any such operator; modifying spacecraft attitude and/or operations.
13. Astro Digital must launch the space station and operate it in accordance with the station authorization no later than January 31, 2018. This authorization will be null and void automatically, without further Commission action, if Astro Digital fails to comply with this requirement.
14. The license term expires on October 31, 2020.

Licensee/grantee is afforded thirty (30) days from the date of release of this action to decline the grant as conditioned. Failure to respond within this period will constitute formal acceptance of the grant as conditioned.

This action is taken pursuant to Section 0.261 of the Commission's rules on delegated authority, 47 CFR § 0.261, and is effective upon release.

Station licenses are subject to the conditions specified in Section 309(h) of the Communications Act of 1934, as amended, 47 U.S.C. § 309(h).

Action Date:	December 14, 2017	
Term Dates	From: December 14, 2017	To: October 31, 2020

ATTACHMENT TO GRANT
Astro Digital U.S., Inc.
IBFS File No. SAT-LOA-20170508-00071

Approved:



Stephen J. Duall
Chief, Satellite Policy Branch

* Re-issued on December 21, 2017 with correction to
condition 8.

9-16. Name of Contact Representative

Name:	Jan A. King	Phone Number:	650-919-4032
Company:	Astro Digital U.S., Inc.	Fax Number:	805-234-7300
Street:	NASA Ames Research Park, Suite 503 340 Cody Road	E-Mail:	jan@astrodigital.com
City:	Moffett Field	State:	CA
Country:	USA	Zipcode:	94035 -
Attention:	Mr. Jan A. King	Relationship:	Same

CLASSIFICATION OF FILING

17. Choose the button next to the classification that applies to this filing for both questions a. and b. Choose only one for 17a and only one for 17b.

a.

- (N/A) a1. Earth Station
- a2. Space Station

b.

- b1. Application for License of New Station
- (N/A) b2. Application for Registration of New Domestic Receive-Only Station
- (N/A) b3. Amendment to a Pending Application
- (N/A) b4. Modification of License or Registration
- (N/A) b5. Assignment of License or Registration
- (N/A) b6. Transfer of Control of License or Registration
- (N/A) b7. Notification of Minor Modification
- (N/A) b8. Application for License of New Receive-Only Station Using Non-U.S. Licensed Satellite
- b9. Letter of Intent to Use Non-U.S. Licensed Satellite to Provide Service in the United States
- b10. Replacement Satellite Application - no new frequency bands
- b11. Replacement Satellite Application - new frequency bands (Not eligible for streamlined processing)
- b12. Petition for Declaratory Ruling to be Added to the Permitted List
- (N/A) b13. Other (Please specify)

17c. Is a fee submitted with this application?

If Yes, complete and attach FCC Form 159.

If No, indicate reason for fee exemption (see 47 C.F.R. Section 1.1114).

Governmental Entity Noncommercial educational licensee

Other (please explain):

17c. Fee Classification CLW – Space Station (Non-Geostationary)

18. If this filing is in reference to an existing station, enter:

(a) Call sign of station:

Not Applicable

19. If this filing is an amendment to a pending application enter:

(a) Date pending application was filed:

Not Applicable

(b) File number of pending application:

Not Applicable

TYPE OF SERVICE

<p>20. NATURE OF SERVICE: This filing is for an authorization to provide or use the following type(s) of service(s): Select all that apply:</p> <p><input type="checkbox"/> a. Fixed Satellite</p> <p><input type="checkbox"/> b. Mobile Satellite</p> <p><input type="checkbox"/> c. Radiodetermination Satellite</p> <p><input checked="" type="checkbox"/> d. Earth Exploration Satellite</p> <p><input type="checkbox"/> e. Direct to Home Fixed Satellite</p> <p><input type="checkbox"/> f. Digital Audio Radio Service</p> <p><input type="checkbox"/> g. Other (please specify)</p>	
<p>21. STATUS: Choose the button next to the applicable status. Choose only one.</p> <p><input type="radio"/> Common Carrier <input checked="" type="radio"/> Non-Common Carrier</p>	<p>22. If earth station applicant, check all that apply.</p> <p>Not Applicable</p>
<p>23. If applicant is providing INTERNATIONAL COMMON CARRIER service, see instructions regarding Sec. 214 filings. Choose one. Are these facilities:</p> <p><input type="radio"/> Connected to a Public Switched Network <input type="radio"/> Not connected to a Public Switched Network <input checked="" type="radio"/> N/A</p>	
<p>24. FREQUENCY BAND(S): Place an "X" in the box(es) next to all applicable frequency band(s).</p> <p><input type="checkbox"/> a. C-Band (4/6 GHz) <input type="checkbox"/> b. Ku-Band (12/14 GHz)</p> <p><input checked="" type="checkbox"/> c. Other (Please specify upper and lower frequencies in MHz.)</p> <p>Frequency Lower: 399.9 Frequency Upper: 27000 (Please specify additional frequencies in an attachment)</p>	

TYPE OF STATION

25. CLASS OF STATION: Choose the button next to the class of station that applies. Choose only one.

- (N/A) a. Fixed Earth Station
- (N/A) b. Temporary-Fixed Earth Station
- (N/A) c. 12/14 GHz VSAT Network
- (N/A) d. Mobile Earth Station
- e. Geostationary Space Station.
- f. Non-Geostationary Space Station
- g. Other (please specify)

26. TYPE OF EARTH STATION FACILITY: Not Applicable

PURPOSE OF MODIFICATION

27. The purpose of this proposed modification is to: (Place an "X" in the box(es) next to all that apply.) Not Applicable

ENVIRONMENTAL POLICY

28. Would a Commission grant of any proposal in this application or amendment have a significant environmental impact as defined by 47 CFR 1.1307? If YES, submit the statement as required by Sections 1.1308 and 1.1311 of the Commission's rules, 47 C.F.R. §§ 1.1308 and 1.1311, as an exhibit to this application. A Radiation Hazard Study must accompany all applications for new transmitting facilities, major modifications, or major amendments. Yes No

ALIEN OWNERSHIP

Earth station applicants not proposing to provide broadcast, common carrier, aeronautical en route or aeronautical fixed radio station services are not required to respond to Items 30-34.

29. Is the applicant a foreign government or the representative of any foreign government?	<input type="radio"/> Yes <input checked="" type="radio"/> No
30. Is the applicant an alien or the representative of an alien?	<input type="radio"/> Yes <input checked="" type="radio"/> No <input type="radio"/> N/A
31. Is the applicant a corporation organized under the laws of any foreign government?	<input type="radio"/> Yes <input checked="" type="radio"/> No <input type="radio"/> N/A
32. Is the applicant a corporation of which more than one-fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
33. Is the applicant a corporation directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?	<input type="radio"/> Yes <input checked="" type="radio"/> No <input type="radio"/> N/A
34. If any answer to questions 29, 30, 31, 32 and/or 33 is Yes, attach as an exhibit an identification of the aliens or foreign entities, their nationality, their relationship to the applicant, and the percentage of stock they own or vote.	OWNEXHB

BASIC QUALIFICATIONS

35. Does the Applicant request any waivers or exemptions from any of the Commission's Rules?
If Yes, attach as an exhibit, copies of the requests for waivers or exceptions with supporting documents.

Yes No

36. Has the applicant or any party to this application or amendment had any FCC station authorization or license revoked or had any application for an initial, modification or renewal of FCC station authorization, license, or construction permit denied by the Commission? If Yes, attach as an exhibit, an explanation of circumstances.

Yes No

37. Has the applicant, or any party to this application or amendment, or any party directly or indirectly controlling the applicant ever been convicted of a felony by any state or federal court? If Yes, attach as an exhibit, an explanation of circumstances.

Yes No

38. Has any court finally adjudged the applicant, or any person directly or indirectly controlling the applicant, guilty of unlawfully monopolizing or attempting unlawfully to monopolize radio communication, directly or indirectly, through control of manufacture or sale of radio apparatus, exclusive traffic arrangement or any other means or unfair methods of competition? If Yes, attach as an exhibit, an explanation of circumstances

Yes No

39. Is the applicant, or any person directly or indirectly controlling the applicant, currently a party in any pending matter referred to in the preceding two items? If yes, attach as an exhibit, an explanation of the circumstances.

Yes No

40. If the applicant is a corporation and is applying for a space station license, attach as an exhibit the names, address, and citizenship of those stockholders owning a record and/or voting 10 percent or more of the Filer's voting stock and the percentages so held. In the case of fiduciary control, indicate the beneficiary(ies) or class of beneficiaries. Also list the names and addresses of the officers and directors of the Filer.

41. By checking Yes, the undersigned certifies, that neither applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. See 47 CFR 1.2002(b) for the meaning of "party to the application"; for these purposes. Yes No

42a. Does the applicant intend to use a non-U.S. licensed satellite to provide service in the United States? If Yes, answer 42b and attach an exhibit providing the information specified in 47 C.F.R. 25.137, as appropriate. If No, proceed to question 43. Yes No

42b. What administration has licensed or is in the process of licensing the space station? If no license will be issued, what administration has coordinated or is in the process of coordinating the space station?

43. Description. (Summarize the nature of the application and the services to be provided). (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.)

Applicants seeks authority to launch and operate an Earth-Exploration Satellite Service system.

EXHIB43

43a. Geographic Service Rule Certification

By selecting A, the undersigned certifies that the applicant is not subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25.

A

By selecting B, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will comply with such requirements.

B

By selecting C, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will not comply with such requirements because it is not feasible as a technical matter to do so, or that, while technically feasible, such services would require so many compromises in satellite design and operation as to make it economically unreasonable. A narrative description and technical analysis demonstrating this claim are attached.

C

CERTIFICATION

The Applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests an authorization in accordance with this application. The applicant certifies that grant of this application would not cause the applicant to be in violation of the spectrum aggregation limit in 47 CFR Part 20. All statements made in exhibits are a material part hereof and are incorporated herein as if set out in full in this application. The undersigned, individually and for the applicant, hereby certifies that all statements made in this application and in all attached exhibits are true, complete and correct to the best of his or her knowledge and belief, and are made in good faith.

44. Applicant is a (an): (Choose the button next to applicable response.)

- Individual
- Unincorporated Association
- Partnership
- Corporation
- Governmental Entity
- Other (please specify)

45. Name of Person Signing

Jan A. King

46. Title of Person Signing

Chief Technical Officer

47. Please supply any need attachments.

1: LM_Freq_Util_Rev 0.1

2:

3:

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND / OR IMPRISONMENT
(U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION
(U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).

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