

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

In the Matter of	)	
	)	
TURION SPACE CORP.	)	File No. SAT-LOA-2022_____
	)	
Application for Authority to Launch and	)	Call Sign: _____
Operate a Non-Geostationary Orbit Satellite in	)	
the Space Operation Service and Space	)	
Research Service	)	

APPLICATION

George V. John
HOGAN LOVELLS US LLP
555 Thirteenth Street, NW
george.john@hoganlovells.com
+1-202-637-6989

Counsel for Turion Space Corp.

May 26, 2022

Patryk Wiatr
Chief Information Officer
TURION SPACE CORP.
9272 Jeronimo Road, Suite 107C
Irvine, CA 92618
+1-253-353-5966

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Service	)	

APPLICATION

Turion Space Corp. (“Turion Space”)¹ requests authority to launch and operate one non-geostationary orbit (“NGSO”) small satellite, DROID.001, under the streamlined licensing procedures for small satellites.² Approving this spacecraft with space-object imaging capabilities would help create a safer space environment in which everyone can operate.

Orbital domain awareness, space-debris removal, and satellite servicing are Turion Space’s focus areas. The company’s DROID constellation will help –

- observe active spacecraft, derelict space objects, and celestial bodies to map the orbital environment for future missions that will remediate orbital debris.
- deorbit multiple pieces of debris per spacecraft to significantly reduce the chances of large pieces of debris colliding with each other.
- modify orbits and extend life for satellites to offer satellite-architecture flexibility, allow customers to extend their satellites’ complete capabilities and launch fewer

¹ Turion Space is an Irvine, California-based company incorporated in Delaware in October 2020.

² See 47 C.F.R. § 25.122; see also *Streamlining Licensing Procedures for Small Satellites*, 34 FCC Rcd 13077 (2019) (“*SmallSat R&O*”).

spacecraft into orbit over time, and improve space safety by reducing the amount of space debris and launches.

DROID.001 starts Turion Space's ambitious mission. The satellite will only house a sensor to image space objects (at a customer's request)³ and counsel on satellite design for future DROID missions.⁴ Given the FCC's goal to enhance space safety and substantiality, authorizing DROID.001 serves the public interest.⁵

I. BACKGROUND AND SYSTEM DESCRIPTION

A. Space Segment

DROID.001, a 32-kg small satellite built by NanoAvionics⁶ with dimensions of 84.7 x 43.8 x 40.7 centimeters, will use commercial-off-the-shelf components. DROID.001 will deploy from a SpaceX Falcon 9 rideshare launch in April 2023 between 525-575 km altitude at 97.5 deg inclination.⁷ After deployment, DROID.001 will maneuver to its destination orbit (550 km altitude at 97.5 deg) using its on-board propulsion system.

DROID.001 will carry a narrow field-of-view optical system provided by HEO Robotics with the intent to image other space objects.⁸ HEO Robotics, based on its customers' needs, will instruct Turion Space on what and where DROID.001 should image. At that point, Turion Space

³ Space objects might include active satellites; uncontrollable dead satellites and other large objects (spent rocket stages, for example); debris; and celestial bodies.

⁴ Future DROID spacecraft will improve in capabilities (satellite deorbiting and/or orbit modifications, for example).

⁵ See *generally Mitigation of Orbital Debris in the New Space Age*, Report and Order et al., 35 FCC Rcd 4156 (2020).

⁶ NanoAvionics, a Lithuanian company, is an advanced small satellite bus manufacturer and mission integrator for commercial and civil customers.

⁷ German-based Exolaunch is the launch broker for the DROID.001 mission.

⁸ HEO Robotics is an Australian company that provides a satellite inspection service for customers and operates by attaching its camera system onto other satellites in orbit.

will image the desired space object without changing DROID.001's orbit. Turion Space will retain control during this entire process and at no point will HEO Robotics control DROID.001.

B. Ground Segment

The Mission Operations Center for DROID.001 will be located at Turion Space's Irvine, California headquarters. At its MOC, Turion Space will monitor and control all aspects of the satellite operations.

Turion Space's ground station provider has obtained or is in the process of obtaining the necessary authorizations for communications to and from DROID.001. The ground stations that will initially service DROID.001 are listed in the Technical Annex.

C. Frequency Plan

Table 1 captures DROID.001's frequency plan.

Frequency Band (MHz)	Link Direction	Activity
2025-2110	Earth-to-space	command uplink
2200-2290	space-to-Earth	telemetry and payload downlink (outside the United States only)
8025-8400	space-to-Earth	payload downlink

Table 1: Frequency Plan

Employing this spectrum, DROID.001 will deliver space research service and space operation service.

- *Space operation service.* The space operation service concerns “exclusively with the operation of spacecraft, in particular space tracking, space telemetry and space telecommand.”⁹ Turion Space will command and receive telemetry from DROID.001 to

⁹ ITU RR No. 1.23.

ensure safe space operations and deorbit. As a result, DROID.001 qualifies as a space operation service.

- *Space research service.* The space research service covers spacecraft that participate in “scientific or technological research purposes.”¹⁰ DROID.001 will observe active spacecraft, derelict space objects, and celestial bodies. In turn, Turion Space will use the data to help map the orbital environment to plan future missions that will remediate orbital debris. As a result, DROID.001 qualifies as a space research service.

Turion Space and its ground station partner will coordinate with co-frequency service providers, particularly U.S. federal agencies, and complete electromagnetic compatibility analysis, as necessary.¹¹

1. 2025-2110 MHz

The 2025-2110 MHz band hosts primary space research service and space operation service allocations (Earth-to-space) in the international frequency allocation table and primary space research service allocation (Earth-to-space) on a case-by-case basis in the U.S. frequency allocation table.¹² DROID.001’s proposed 2025-2110 MHz (Earth-to-space) use meets these service allocations, as discussed in section I.C. The satellite will uplink commands necessary to

¹⁰ ITU RR No. 1.55.

¹¹ See, e.g., 47 C.F.R. § 2.106 nn.US258, US347; Stamp Grant, Planet Labs Inc., IBFS No. SAT-MOD-20170713-00103, at Condition 7 (granted Jul. 19, 2018) (“Transmissions of ... data in the 8025-8400 MHz frequency band may 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.”).

¹² See 47 C.F.R. § 2.106 and n.US347.

operate the satellite and complete space research, by imaging space objects, after completing coordination with co-frequency spectrum users.¹³

2. 2200-2290 MHz

The 2200-2290 MHz band hosts primary space operation service and space research service allocations (space-to-Earth) in the international frequency allocation table but omits similar allocations in the U.S. frequency allocation table.¹⁴ DROID.001's proposed use of this band meets the international service allocation requirement, as discussed in section I.C. The satellite will downlink vital DROID.001 health and orbital imaging data only outside the United States after completing coordination with co-frequency spectrum users.

3. 8025-8400 MHz

The 8025-8400 MHz band hosts a primary Earth exploration-satellite service allocation (space-to-Earth) in the international and U.S. frequency allocation tables (with the U.S. authorization subject to a case-by-case electromagnetic compatibility analysis).¹⁵ Turion Space seeks waiver of the U.S. frequency allocation table, as discussed in section 0.

4. Spectrum Sharing Capabilities

A small satellite operating under the streamlined rules is exempt from the Part 25 processing round and default service requirements.¹⁶ Such a satellite is “designed to serve its

¹³ Because DROID.001's uplink supports telecommand only, whether these operations run consistent with the space research service (Earth-to-space) allocation may prove unclear. As a result, in section 0, Turion Space seeks waiver of the U.S. frequency allocation table to the extent necessary to authorize telecommand-only operations in support of Turion Space's space research service system.

¹⁴ See 47 C.F.R. § 2.106. Turion Space requests to use the band only outside the United States consistent with the international frequency allocation and, therefore, does not seek any waiver of the U.S. frequency allocation table.

¹⁵ See 47 C.F.R. § 2.106 and n.US258.

¹⁶ *Smallsat R&O* ¶ 80.

purpose within a limited, relatively short period of time [and] have more limited frequency use characteristics than more traditional operations licensed under part 25.”¹⁷ In the absence of processing round rules, an applicant must “(a) certify that operations of its satellites will not interfere with those of existing operators, (b) certify that it will not materially constrain future operators from using the assigned frequency band(s), and (c) provide a brief narrative description illustrating the methods by which both current and future operators will not be materially constrained.”¹⁸

The small satellite certifications table in section II and attached Technical Annex explain how DROID.001 complies. In short, the satellite would communicate only when in line of sight of a few earth stations using small bandwidths, frequency agile software-defined radios, scheduled ground transmissions, and interference-mitigation techniques, including frequency coordination, conjunction-avoidance angles, and propulsive phasing to offset potential contacts over time.

II. SMALL SATELLITE CERTIFICATIONS

Turion Space hereby certifies that DROID.001 meets the following streamlined processing criteria for small satellites.

Streamlined Requirement	Turion Space Compliance
(1) The space station(s) will operate only in non-geostationary orbit.	DROID.001, a NGSO, will be deployed into a sun-synchronous circular orbit at an altitude between 525 and 575 km and settle at 550 km.
(2) The total in-orbit lifetime for any individual space station will be six years or less.	DROID.001 is expected to have a maximum in-orbit lifetime of 6 years.
(3) The space station(s): (i) Will be deployed at an orbital altitude of 600 kilometers or below; or (ii) Will maintain a propulsion system and have the ability to make collision avoidance and deorbit maneuvers using propulsion.	DROID.001 will be equipped with a propulsion system and operate at an altitude of 550 km.

¹⁷ *Id.*

¹⁸ *Id.* ¶ 81.

Streamlined Requirement	Turion Space Compliance
(4) Each space station will be identifiable by a unique signal-based telemetry marker distinguishing it from other space stations or space objects.	DROID.001 will have a unique transmitting telemetry channel, allowing the satellite to be identifiable during commissioning and in-orbit activities.
(5) The space station(s) will release no operational debris.	DROID.001 will not release any operational debris.
(6) The space station operator has assessed and limited the probability of accidental explosions, including those resulting from the conversion of energy sources on board the space station(s) into energy that fragments the spacecraft.	Turion Space has assessed and limited the probability of accidental explosions, including those resulting from the conversion of energy sources on board DROID.001 into energy that fragments the spacecraft.
(7) The probability of a collision between each space station and any other large object (10 centimeters or larger) during the orbital lifetime of the space station is 0.001 or less as calculated using current NASA software or other higher fidelity model.	The probability of collision between DROID.001 and other large objects is 0.0000042417 as calculated by the NASA Debris Assessment Software.
(8) The space station(s) will be disposed of post-mission through atmospheric re-entry. The probability of human casualty from portions of the spacecraft surviving re-entry and reaching the surface of the Earth is zero as calculated using current NASA software or higher fidelity models.	DROID.001 will be disposed of through atmospheric re-entry and, therefore, have a human casualty risk of zero.
(9) Operation of the space station(s) will be compatible with existing operations in the authorized frequency band(s). Operations will not materially constrain future space station entrants from using the authorized frequency band(s).	Turion Space certifies that DROID.001 operations will not interfere with those of existing operators and will not materially constrain future operators from using the assigned frequency bands. DROID.001 will only transmit/receive in short duty cycles when in line of sight of a limited number of earth stations. The attached Technical Annex explores in greater detail how DROID.001 can avoid harmful interference scenarios.
(10) The space station(s) can be commanded by command originating from the ground to immediately cease transmissions and the licensee will have the capability to eliminate harmful interference when required under the terms of the license or other applicable regulations.	DROID.001 can be commanded by the MOC at any time to immediately cease transmissions and to eliminate harmful interference.
(11) Each space station is 10 cm or larger in its smallest dimension	DROID.001's smallest dimension is approximately 28.8 x 43.8 cm (without solar panels deployed).

Streamlined Requirement	Turion Space Compliance
(12) Each space station will have a mass of 180 kg or less, including any propellant.	DROID.001 will have a mass of approximately 32 kg including propellant.

III. WAIVER REQUESTS

The Commission may waive rule compliance if “good cause” exists.¹⁹ Waiver is appropriate where “special circumstances warrant a deviation from the general rule and such deviation will serve the public interest” better than strict adherence to the rule.²⁰ In general, the Commission grants a waiver if the relief requested would not undermine the policy objective of the rule in question and would otherwise serve the public interest.²¹ Potential hardship, equity, or policy implementation factors may influence the waiver decision.²² Additionally, the Commission generally grants a waiver of the frequency allocation table “when there is little potential for interference into any service authorized under the Table of Frequency Allocations and when the non-conforming operator accepts any interference from authorized services.”²³ Good cause exists to waive the following rules to the extent necessary to consider and grant the application.

¹⁹ See 47 C.F.R. § 1.3; *Northeast Cellular Tel. Co. v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990); *WAIT Radio v. FCC*, 418 F.2d 1153, 1159 (D.C. Cir. 1969).

²⁰ *Northeast Cellular*, 897 F.2d at 1166.

²¹ *WAIT Radio*, 418 F.2d at 1157.

²² *Id.* at 1159.

²³ *The Boeing Company Application for Blanket Authority to Operate Up to Eight Hundred Technically Identical Transmit and Receive Mobile Earth Stations Aboard Aircraft in the 14.0-14. GHz and 11.7-12.2 GHz Frequency Bands*, Order and Authorization, 16 FCC Rcd 22645 ¶ 12 (IB & OET 2001) (internal punctuation omitted). See generally *Application of Fugro-Chance, Inc. for Blanket Authority to Construct and Operate a Private Network of Receive-Only Mobile Earth Stations*, Order and Authorization, 10 FCC Rcd 2860 (IB 1995); *Application of Motorola Satellite Communications, Inc. for Modification of License*, Order and Authorization, 11 FCC Rcd 13952 (IB 1996).

To the extent necessary, Turion Space seeks waiver of 47 C.F.R. § 2.106 (U.S. frequency allocation table) to use the 2025-2110 MHz and 8025-8400 MHz bands on a non-conforming basis. Special circumstances justify the rule relief.

2025-2110 MHz. DROID.001's one uplink would only support telecommand. The proposed operations have less potential to cause interference than they would if combined with service uplink traffic. In addition, Turion Space acknowledges that the operations are subject to conditions as the Commission may apply on a case-by-case basis and may not cause harmful interference to federal and non-federal stations operating consistent with the frequency allocation table. As a result, waiving the U.S. frequency allocation table serves the public interest.

8025-8400 MHz. The orbital environment hosts numerous active and defunct space objects, for example. But commercial options to quantify and monitor these objects remain insufficient. The DROID.001 space research service—possible with only S-band or X-band²⁴—would help develop a more comprehensive space-object library. The only available non-active S-band space research service space-to-Earth band (2200-2290 MHz) is unusable inside the United States because of intense federal use. The only available non-active X-band space research service space-to-Earth band (8450-8500 MHz) is unusable because the available radio for this mission does not currently reach this spectrum.

In the absence of employable space research service allocations, DROID.001 must rely on similarly situated service allocations, such as the Earth exploration-satellite service, which like the space research service occurs in limited duration with a few earth stations and

²⁴ Frequencies below S- and X-band (VHF and UHF, for example) face data-rate limitations, and frequencies above S- and X-band (Ka-band, for example) host radio configurations the DROID platform cannot yet support.

satellites. In S- and X-band spectrum, the 8025-8400 MHz band is the only available Earth exploration-satellite service space-to-Earth frequency band inside the United States. The attached Technical Annex demonstrates DROID.001 satisfies the long-term and short-term protection criteria in ITU-R SA.1027-6 to ensure the proposed uncoordinating use would not pose harmful interference to existing or future Earth exploration-satellite service operations.

Given the non-harmful interference showing; limited space research service allocations available; and increasing demand for space-domain awareness, waiving the U.S. frequency allocation table promotes the public interest.

IV. PUBLIC INTEREST

The White House recently released its plan to promote U.S. capabilities for in-space servicing assembly and manufacturing (“ISAM”) and “send[] a clear and consistent demand signal to private industry.”²⁵ Guiding the plan are six goals, as follows:

- (1) advancing ISAM research and development; (2) prioritizing the expansion of scalable infrastructure; (3) accelerating the emerging ISAM commercial industry;
- (4) promoting international collaboration and cooperation to achieve ISAM goals;
- (5) prioritizing environmental sustainability as we move forward with ISAM capabilities; and (6) inspiring a diverse future workforce as a potential outcome of ISAM innovation.²⁶

Approving this application will help advance the plan. DROID.001 will act as a steppingstone toward creating a small satellite constellation that will monitor and deorbit space debris and service other satellites. Turion Space will accomplish this mission by

²⁵ In-space Servicing, Assembly, And Manufacturing National Strategy, National Science and Technology Council (Apr. 2022) at 5, <https://bit.ly/3KgyatA>.

²⁶ *Id.*

leveraging recent advances in satellite technology and rapidly declining launch costs, among other things.

Significant U.S. Government and commercial demand exists for DROID-type missions. U.S. military services and other agencies hosting national security missions have expressed interest in the capabilities that future DROID missions promise to offer.²⁷ And commercial customers have signed letters of intent with Turion Space totaling greater than \$250M to use the orbit modification capabilities of future DROID missions.

V. OTHER MATTERS

A. NOAA Remote Sensing Licensing

The National Oceanic and Atmospheric Administration (“NOAA”) requires a license to operate a remote sensing system.²⁸ Turion Space will secure any necessary NOAA approval for the imaging payload onboard the DROID.001 satellite.

B. ITU Requirements

When issuing launch-and-operational authority, the Commission submits advance publication information (“API”) to the International Telecommunication Union (“ITU”).²⁹ In concert with this application, Turion Space submits the ITU API and, in Attachment 1, unconditionally accepts all associated cost recovery responsibilities.

C. Ownership Information

Turion Space’s ownership structure appears in Attachment 2.

²⁷ See, e.g., *Space Prime*, SpaceWerx, <https://bit.ly/3KTUxqg> (last viewed Jan. 28, 2022) (“Space Prime leverages industry partnership engagement strategy to identify nascent space technology sectors that, if primed, could advance U.S. national security and economic prosperity.”).

²⁸ See generally 15 C.F.R. § 960.

²⁹ See 47 C.F.R. § 25.111.

VI. CONCLUSION

Orbital stewardship becomes possible with Turion Space's proposed services. Authorizing DROID.001 would help kickstart this necessary initiative and, therefore, would serve the public interest.

Respectfully submitted,

/s/ Patryk Wiatr

George V. John
HOGAN LOVELLS US LLP
555 Thirteenth Street, NW
george.john@hoganlovells.com
+1-202-637-6989

Counsel for Turion Space Corp.

May 26, 2022

Patryk Wiatr
Chief Information Officer
TURION SPACE CORP.
9272 Jeronimo Road, Suite 107C
Irvine, CA 92618
+1-253-353-5966

ATTACHMENT 1
(ITU COST RECOVERY DECLARATION)

May 26, 2022

Secretary
Office of the Secretary
Federal Communications Commission
45 L Street, NE
Washington, DC 20554

Subject: ITU Cost Recovery Declaration for the DROID.001 Non-Geostationary Orbit
Satellite in Non-Planned Frequency Bands

Dear FCC Secretary,

Turion Space Corp. (Turion Space) is aware that in accordance with Resolution 88 of the International Telecommunication Union (ITU) Plenipotentiary Conference (Marrakech, 2002), and ITU Council Decision 482, as modified, cost-recovery fees will apply to satellite network filings received by the Radiocommunications Bureau after November 7, 1998. As a consequence, Commission applicants are responsible for any and all fees charged by the ITU to process their satellite network filings. Turion Space hereby states that it is aware of this requirement and unconditionally accepts all cost recovery responsibilities associated with the ITU filings for the DROID.001 satellite network. Please address all cost-recovery inquiries, and ITU correspondence and filings, related to the DROID.001 satellite network to the following point of contact. We understand that should there be any change in the point of contact information we will inform the Commission within 30 days of the foreseen event.

Point of Contact Name: Patryk Wiatr

Organization Name: Turion Space Corp.

Address: 9272 Jeronimo Road, Suite 107C
Irvine, CA 92618
United States of America

E-Mail: pwiatr@turionspace.com

Telephone Number: +1-253-353-5966

Turion Space understands that it must remit payment of any resultant cost-recovery fee to the ITU by the due date specified in the ITU invoice, unless an appeal filed prior to the due date is pending with the ITU. We fully understand that a license granted in reliance on such a commitment will be conditioned upon discharge of any such cost-recovery obligation. We also acknowledge that, in accordance with 47 C.F.R. § 25.111, should we have an overdue ITU cost-recovery fee and have

no appeal pending with the ITU, the Commission may dismiss any application associated with that satellite network.

Respectfully submitted,

/s/ Patryk Wiatr

Patryk Wiatr
Chief Information Officer
TURION SPACE CORP.
9272 Jeronimo Road, Suite 107C
Irvine, CA 92618
+1-253-353-5966

ATTACHMENT 2
(OWNERSHIP INFORMATION)

Turion Space Corp. (“Turion Space”) is a privately held corporation. The following individuals hold 10% or more of the equity and/or voting interest in Turion Space.

Shareholder	Citizenship or Country of Incorporation	Equity and/or Voting Interest Percentage
Ryan Westerdahl	U.S.	34.7390
Tyler Pierce	U.S.	24.5087
Patryk Wiatr	U.S.	20.447

The following individuals are Turion Space’s board directors.

Name	Citizenship
Ryan Westerdahl	U.S.

The following individuals are Turion Space’s officers.

Name	Title	Citizenship
Ryan Westerdahl	CEO	U.S.
Tyler Pierce	CFO	U.S.
Patryk Wiatr	CIO	U.S.

All Turion Space board directors and officers may be reached at the address below.

Turion Space Corp.
9272 Jeronimo Road, Suite 107C
Irvine, CA 92618