SPACE AI Inc.

505 Odyssey Way, Exploration Park,

Merritt Island, 32953 FL.

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Federal Communications Commission
Office of Engineering and Technology
Experimental Licensing Branch
Washington, DC 20554

Narrative Exhibit for Experimental License Application. Form 442

Applicant: **Space AI Inc.**

1. Applicant Information: Applicant is Space AI Inc, a corporation duly organized and existing under the laws of the State of Delaware.

2. Company Overview: Space AI, Inc. is a frontier technology company developing the world's first distributed, quantum-ready edge-supercomputing infrastructure in orbit. Through a patented Space Operating System (SOS) and a network of standardized CubeSat-based nodes, Space AI Inc. enables quantum-secure communications, high-performance computing, AI, and data services directly in space. The platform is designed to support next-generation space missions, autonomous and robotic systems, and space-to-ground operations, forming the backbone of a collaborative, distributed infrastructure for the emerging space economy—from Earth orbit to cislunar space and beyond.

3. Purpose of Experiment: Space AI Inc. is pioneering the world's first distributed, edge-supercomputing network in space. This experimental mission seeks to validate the core infrastructure of a Software Defined Computing Constellation designed to provide secure, high-performance AI and data services for the burgeoning space economy. The primary objectives of this experimental license are:

- **Distributed Computing & Resource Allocation:** Testing the orchestration of computational tasks across a constellation of nodes using a patented system (U.S. Patent 10,742,313 B1) for optimized resource allocation.
- **Wideband Relay & Multi-Frequency Reception:** Validating the system's ability to receive and process signals across multiple frequency bands simultaneously for wideband relay purposes, enabling seamless data handovers and resilient communication links.
- **Distributed AI Training:** Demonstrating federated and distributed AI training at the edge, utilizing the combined processing power of the constellation to refine models directly in orbit.
- **Distributed File System (DFS):** Validating a space-based distributed file system to ensure data redundancy, high availability, and secure access across multiple orbiting NODE IO nodes.

- **Quantum Communications:** Conducting experimental validation of quantum communication protocols to support next-generation secure data exchange.
- **Inter-satellite Links (ISL):** Testing high-speed inter-satellite links to enable real-time coordination for distributed computing and file synchronization between nodes.
- **Mobile Ground Stations Test:** Validating interoperability with transportable and mobile ground nodes to ensure flexible, on-demand access from various geographic locations.
- **Edge Processing Validation:** Testing the "NODE IO" node, a Linux-powered supercomputer in CubeSat format, designed for mass production and deployment.

This application requests authority under Part 5 of the Commission's rules to test these technologies using a constellation of **10 CubeSats** in Low Earth Orbit (LEO). The mission focuses exclusively on experimental validation of high-speed communications, telemetry, tracking, command (TT&C), and data downlink capabilities. All operations are non-commercial and dedicated to technology demonstration and research only, and will not provide service for hire.

The extended downlink bandwidth requested across X-Band and S-Band is required to enable experimental testing of high data rate communications for proof-of-concept demonstrations of data-intensive applications, including high-computing algorithms, distributed computing relay, and advanced AI processing in orbit. A minimum of 10 satellites is required to achieve statistically meaningful ISL topology data and to validate multi-hop distributed computing across a realistic constellation geometry.

4. Technical Description: The constellation utilizes the NODE IO node architecture as the foundational building block. Each spacecraft is a **6U CubeSat** (approximately 10 cm × 20 cm × 30 cm, estimated mass 8–12 kg) equipped with **6 (six) Lime LMS8001 SDRs**. The LMS8001 is a wideband RF transceiver operating from 100 kHz to 11 GHz, supporting simultaneous multi-band operation. The six SDR chains are allocated across the communication functions as follows: four chains are configured for X-Band MIMO downlink (4×4 spatial multiplexing), one chain is dedicated to TT&C (S-Band primary / X-Band secondary), and one chain is dedicated to ISL (Ku-Band primary / X-Band secondary via firmware band-switching). Each LMS8001 unit supports independent frequency tuning, gain control, and modulation configuration, allowing each chain to operate simultaneously on different bands. This SDR reconfigurability enables on-orbit waveform updates, which is itself a core experimental objective of the mission.

Satellites: 10 identical 6U CubeSats. The spacecraft use aluminum/composite structures, solar panels and antennas, Li-ion batteries. No pyrotechnics, propulsion systems, or pressurized vessels beyond standard components.

Orbit: Low Earth Orbit (LEO), nominal circular altitude of 550 km, inclination approximately 90° (polar). Sun-synchronous orbit is not required, as the mission involves only satellite communications testing without imaging, Earth observation, or optical payloads. Orbital parameters may vary slightly based on the launch provider.

Deployment: The 10 CubeSats will be deployed in separate launch opportunities over the course of the experimental term (e.g., in phases across multiple rideshare missions). All satellites are identical in design and will operate under identical technical parameters (frequencies, emissions, power levels, and orbital regime), forming part of the same experimental demonstration. Authority is requested for the operation of all 10 satellites under this single license. Launch dates and specific providers are to be determined and will be coordinated as necessary prior to each deployment.

Antenna: Patch antenna with approximately 7 dBi gain (maximum); detailed specifications attached as an exhibit.

Frequencies and Emissions:

Downlink (Space-to-Earth – High Speed Data):

- **X-Band: 8025 – 8400 MHz (375 MHz)** — Primary high-speed MIMO downlink
- **S-Band: 2200 – 2290 MHz (90 MHz)** — Secondary / backup downlink

Technical Justification: Downlink: The Lime LMS8001 SDR operates from 100 kHz to 11 GHz. X-Band (8025–8400 MHz) is selected as the primary downlink band, providing 375 MHz of contiguous bandwidth for wideband OFDM-MIMO waveforms consistent with the distributed computing relay and AI data downlink objectives of this mission. At 550 km LEO altitude and 5° minimum elevation angle, the free-space path loss at 8.2 GHz is approximately 178 dB, manageable with the 6-SDR MIMO architecture aboard each NODE IO node, where spatial multiplexing across four dedicated downlink chains provides diversity and aggregate throughput gain relative to the 7 dBi per-chain antenna gain. S-Band (2200–2290 MHz) is retained as a fully dedicated secondary downlink for link redundancy. Its approximately 11 dB lower path loss at identical geometry (∼167 dB) provides superior link margin at low elevation angles and high latitudes. Both bands are natively supported by the LMS8001 without hardware reconfiguration.

Uplink (Earth-to-Space – TT&C):

- **S-Band: 2025 – 2110 MHz** — Primary TT&C uplink
- **X-Band: 7145 – 7190 MHz** — Secondary / redundant TT&C uplink

Technical Justification: Uplink TT&C: S-Band (2025–2110 MHz) is the primary TT&C uplink, consistent with US frequency allocations for Space Operation (Earth-to-Space) under 47 CFR §2.106. X-Band (7145–7190 MHz) provides an independent redundant TT&C path following established spacecraft conventions. Both bands are within the LMS8001 operational range. The dual-band TT&C architecture ensures command uplink availability even in the event of interference or degradation affecting either band, which is critical for the autonomous distributed computing operations of the NODE IO constellation.

Inter-Satellite Link (ISL) – Dual-Band High-Speed:

- **Ku-Band: 10700 – 11000 MHz (300 MHz)** - Primary ISL
- **X-Band: 9000 – 9300 MHz (300 MHz)** - Secondary ISL / link diversity backup

Technical Justification: ISL Dual-Band Architecture: ISL operations utilize a dual-band architecture with primary operations at Ku-Band (10700–11000 MHz) and a secondary backup band at X-Band (9000–9300 MHz). High-speed ISL is essential to the core objectives of this mission: real-time distributed computing coordination, federated AI training across nodes, and distributed file system synchronization require sustained inter-satellite data exchange that cannot be achieved with narrowband TT&C links. The dual-band design is additionally an experimental objective in itself—characterizing ISL performance across two frequency bands contributes novel data to FCC and ITU-R spectrum planning for LEO inter-satellite links, for which no dedicated allocation below 22 GHz currently exists in the US frequency table.

(A) Primary ISL — Ku-Band 10700–11000 MHz:

a. **Fixed Satellite Service primary allocation — no radar conflicts.** The band 10.7–11.7 GHz carries a Primary allocation for Fixed Satellite Service

(FSS) (Space-to-Earth) in the US frequency table (47 CFR §2.106), making it the satellite-friendliest band available within the LMS8001's 11 GHz ceiling. This sub-band contains no Radiolocation, no Radionavigation, and no active Earth Exploration-Satellite allocations. Its selection as primary ISL reflects the applicant's preference for the lowest-friction regulatory path for the ISL function.

b. **Complete separation from all other requested bands.** The primary downlink ends at 8400 MHz. The primary ISL begins at 10700 MHz, providing a 2300 MHz guard band. No time-sharing or frequency coordination is required between any two requested services.

c. **ISL throughput for distributed computing.** The 300 MHz occupied bandwidth supports OFDM-MIMO waveforms enabling the high-speed ISL data rates required for distributed AI training, DFS synchronization, and constellation task orchestration across the 10-node network. Applicant commits to minimum necessary EIRP consistent with 47 CFR §5.51, and accepts interference from primary FSS operators without claiming protection.

(B) Secondary ISL — X-Band 9000–9300 MHz:

a. **Link diversity and propagation backup.** The secondary ISL at 9000–9300 MHz provides an independent frequency path when the primary Ku-Band ISL is unavailable or degraded. Ku-Band propagation is more susceptible to rain fade and atmospheric attenuation than X-Band; the secondary ISL provides a lower-frequency fallback with superior link margin under adverse propagation conditions, particularly relevant for the polar-orbit constellation operating at high latitudes.

b. **Complete separation from primary downlink.** The primary downlink ends at 8400 MHz. The secondary ISL begins at 9000 MHz, providing a 600 MHz guard band. Both may operate simultaneously without scheduling constraints.

c. **Sub-band selection minimizes conflict with primary service users.** Within 9.0–9.5 GHz, the sub-segment 9000–9300 MHz is selected to avoid the 9300–9500 MHz portion where maritime radionavigation radar systems are concentrated. Applicant acknowledges the Radiolocation and Earth Exploration-Satellite (Active) primary allocations in 9000–9300 MHz, commits to non-interference operation, and accepts all interference from primary-service users without claiming protection.

d. **Space-to-Space geometry and low EIRP.** ISL transmissions are directed laterally between satellites at 550 km altitude. CubeSat transmit power results in power flux densities at the Earth's surface substantially below ITU-R interference threshold levels. The LMS8001 SDR supports firmware-level frequency agility within the sub-segment, enabling avoidance of specific frequencies when active Earth Exploration-Satellite (Active) transmissions are detected.

All operations will be conducted on a non-interference basis (NIB), with no claim to protection from interference. Transmissions will be episodic and low duty cycle. Onboard Doppler compensation will be implemented.

Transmitting Equipment: Lime LMS8001 SDR system, 6 units per satellite, supporting operation from 100 kHz to 11 GHz with software-defined modulation. OFDM-MIMO primary waveform for downlink and ISL; BPSK/GMSK for TT&C.

Emission Designators:

- **375MG7D -** X-Band primary MIMO downlink (375 MHz; OFDM multi-subcarrier; multiple digital channels; data)
- **90M0D1D -** S-Band secondary downlink (90 MHz; digital; single channel; data)
- **300MG7D** - Ku-Band primary ISL (300 MHz; OFDM multi-subcarrier MIMO; multiple digital channels; data)
- **300MG7D** - X-Band secondary ISL (300 MHz; OFDM multi-subcarrier MIMO; multiple digital channels; data)
- **300KG1D** - TT&C uplink/downlink (300 kHz; combination modulation; digital)

Note on emission designators: The character "G" in designators 375MG7D and 300MG7D accurately describes OFDM waveform structures wherein multiple digital subcarriers are combined onto a single RF carrier, consistent with ITU-R classification of multi-carrier OFDM emissions as G-class. The primary and secondary ISL bands share the 300MG7D designator as both employ identical OFDM-MIMO waveforms; they are distinguished by their respective frequency assignments above.

5. Orbital Parameters and Lifetime: Nominal altitude: 550 km (circular); inclination: approximately 90° (polar); expected operational lifetime: 1–3 years, with total on-orbit lifetime less than 5 years via passive atmospheric reentry. See attached Orbital Debris Assessment Report (ODAR) for detailed mitigation compliance.

6. Justification for Term: A 24-month term is requested to accommodate phased deployments across multiple launch opportunities, post-launch testing, data collection, performance evaluation, and iterative experimentation of the advanced communications and computing architectures.

7. Stop Buzzer / Emergency Contact: In the event of harmful interference, transmissions will cease immediately upon notification by the Commission or its representatives. Emergency contact: A**ntonio Montesinos, Director of Business Development, rfops@spaceai.com.**

8. Earth Stations: The proposed operations will utilize associated earth stations, including both mobile and fixed configurations. These include portable 1U nodes equipped with the same advanced SDR-capable systems (functioning as ground communication nodes), which are transportable and may be operated from various temporary or mobile locations as needed for testing and experimentation. Additionally, associated fixed earth stations may be used at specific, predetermined locations for dedicated testing or higher-performance operations.

All earth station operations, whether mobile or fixed, will be conducted exclusively within the territory of the United States. Specific coordinates, antenna configurations, transmit powers, and other parameters for these mobile (MO) and fixed (FX) stations are not finalized at the time of this application and will be managed to ensure compliance with FCC rules and non-interference basis (NIB) operations. Details regarding earth station parameters, including EIRP, location during operations, and antenna specifications, will be provided to the Commission upon request or prior to commencement of transmissions.

9. ITU Filing: A SpaceCap notice for the satellite network has been submitted separately to the FCC Space Bureau. A commitment to pay all applicable ITU cost recovery fees is attached.

10. Orbital Debris Mitigation: See attached Orbital Debris Assessment Report (ODAR), which demonstrates compliance with FCC §§ 25.114(d)(14) and 5.64, NASA orbital debris mitigation standards, and the Commission's 5-year post-mission deorbit requirement for LEO operations.

Applicant certifies that all statements herein are true and correct, and that the proposed operations will comply with all applicable FCC rules and regulations.

Sincerely,

Diego Favarolo

President.

Space AI Inc.