# SC1 Satellite Technical Description

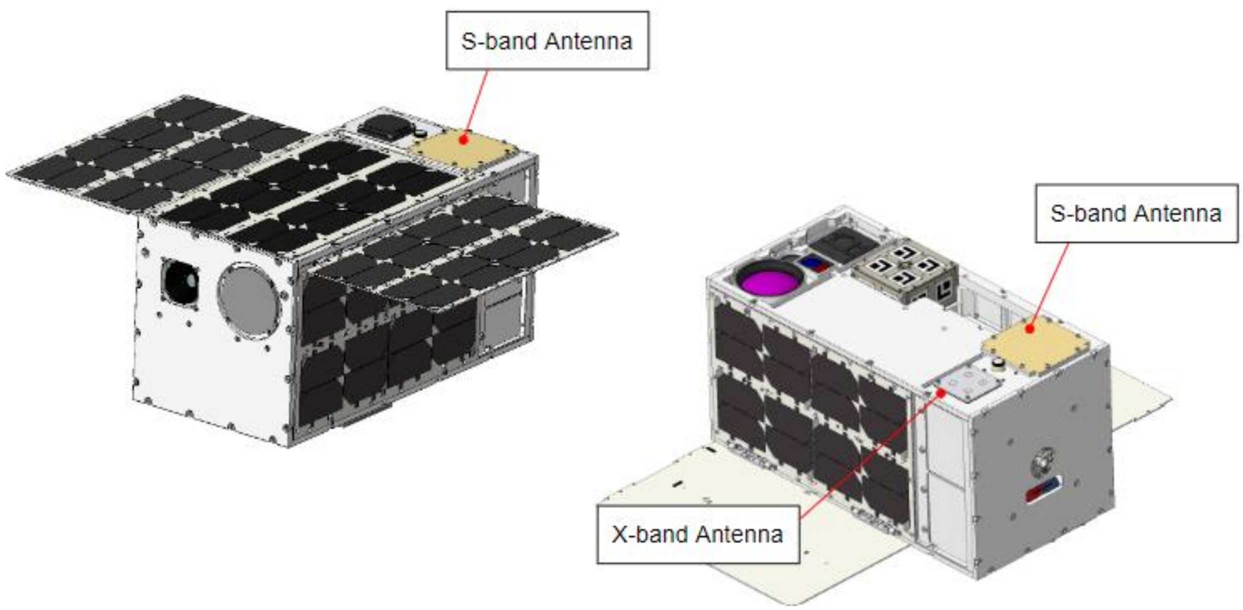
The overall goal of the SC1 mission is to design and develop a custom spacecraft bus and control system in-house and to improve GITAI's perception, guidance, navigation and control technologies in an orbital environment.

The satellite will be launched as a secondary payload aboard the SpaceX Rideshare Bandwagon-2, from Vandenberg Space Force Base, CA, no earlier than December 2nd, 2024. It will be inserted into a circular orbit at 510 km, on an inclination from the equator of 45 degrees. Atmospheric friction will slow the satellite and reduce the altitude of the orbit until de-orbiting occurs within 5 years after the end of the mission. See the Orbital Debris Assessment Report for details.

Following spacecraft commissioning, SC1 will perform maneuver tests to verify the propulsion system's functionality and performance. After the maneuver tests, SC1 will deploy a payload cube (attached via restraint) and will observe the cube with two wide field-of-view visual cameras, a 3D lidar sensor, a laser rangefinder, and an infrared camera.

The spacecraft is a single unit with the dimensions of 16 stacked 10 cm X 10 cm X 10 cm CubeSat modules (giving an overall dimension of 20 cm X 20 cm X 40 cm.) The total mass is about 20 kg. See the Orbital Debris Assessment Report for details.

**Figure 1 SC1 Overview**




The satellite contains the following systems:

**<u>Attitude Determination and Control System (ADCS):</u>** The attitude determination and control system is capable of controlling the 3-dimensional attitude of the spacecraft. The system consists of four reaction wheels for momentum, and 3 magnetorquers mounted on the structure for canceling environmental torques and unloading the momentum of the reaction wheels. The critical components are the magnetorquers, dual triaxis magnetometers, a 6-axis Inertial Measurement Unit

(IMU) and reaction wheels. Additional hardware being flown but not required for flight control includes a GPS receiver and a star tracker.

**Command and Data Handling (CDH) Subsystem:** The printed circuit board in the CDH subsystem is the satellite bus on-board computer (OBC). The bus OBC receives data from the spacecraft subsystems and communicates all data to the transceiver and vice versa. It will also perform health checks on subsystems to confirm they are responsive.

**Communication Subsystem:** The communication subsystem includes: an X-Band Transmitter, an S-Band Telemetry/Telecommand (TM/TC) Transceiver, 2 S-Band Antennae Type IV and an X-Band 2x2 Element Patch Antenna Array. A 3rd party will provide ground stations for communication from the satellite to the ground. In conformance with § 5.107 Transmitter control requirements, all transmission from the satellite can be terminated by command from mission operations via the S band uplink.

**Power Subsystem:** The power subsystem is a direct energy transfer system using a solar array producing approximately 16W of orbit average power to charge the 252 Whr battery system. The solar arrays utilize standard photovoltaic cells; the batteries are COTS Lithium-Ion cells. The OBC sends signals to the Power Distribution Module to control load switching.

**Thermal Subsystem:** The thermal subsystem controls hardware temperature with passive cooling (surface finish and/or color) to maintain low temperature during sun exposure and utilizing heaters to stabilize temperatures during eclipse. Sensors are wired to the controller board, which hosts thermal control algorithms to control the heaters.

**Structure Subsystem:** The 16U satellite structure is fabricated with aluminum (A7075). There are two 6U deployable solar arrays and a deployable payload cube attached to the satellite with a polyester restraint.

**Propulsion Subsystem:** The propulsion system utilizes one thruster with Green Bipropellant ($N_2O$+Propylene) and a self-pressurizing tank. The propulsion system is on board to gain flight heritage and for on-orbit testing and calibration. No orbit change is planned.

**3D Recognition Payload Subsystem:** The payload complement includes a restrained deployable cube with fiducial and reflective markers on the surface for testing GITAI’s proprietary visual and 3D recognition software. The payload sensor suite includes two wide field-of-view visual cameras, a 3D LiDAR sensor, a laser rangefinder and an infrared camera.

**WiFi Payload Subsystem:** This payload will test the connection stability of the Wi-Fi to communicate between modules within the spacecraft. The Wi-Fi module on the payload computer will communicate with the Raspberry Pi Pico W Wi-Fi module, in the 2.4GHz band.