Beavercube II Satellite Technical Description

The overall goal of the MIT Beavercube II mission, is to demonstrate the use of a Vector Accelerator System on Chip (SoC) on-orbit in a CubeSat in service of on-orbit autonomous feature identification from collected images.

The satellite will be carried to the International Space Station (ISS) aboard SpaceX-36, from Vandenberg Space Force Base, No Earlier Than March 1, 2027. It will be deployed from the ISS and inserted into an orbit at 410 km apogee and 410 km perigee, on an inclination from the equator of 51.6 degrees. Transmission will begin 60 minutes after deployment, and cease 2 years later, at the end of the mission. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs less than a year after the end of the mission. See the Orbital Debris Assessment Report for details.

The spacecraft is a single unit with the dimensions of 3 stacked 10 cm X 10 cm X 10 cm CubeSat modules, with two double deployed solar panels, as shown in Figure 1. The total mass is about 4 Kg.

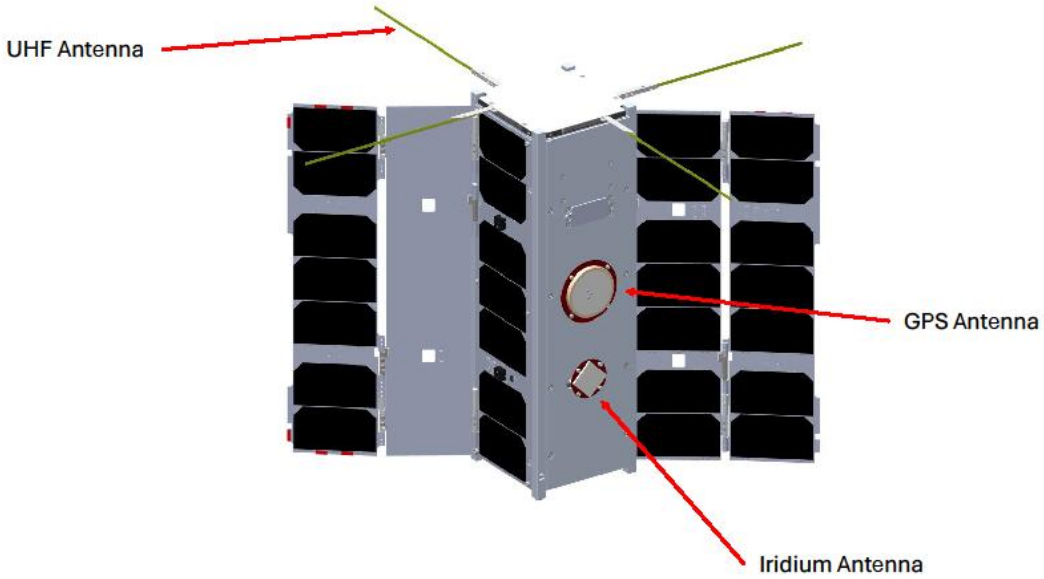

Figure 1 Beavercube II Overview

The satellite contains the following systems:

Attitude, Determination, and Control (ADC) Subsystem: The ADC Subsystem consists of a single reaction wheel, a magnetic control board which has 3 magnetorquers and magnetometers, three Inertial Measurement Units (IMUs), and a GPS all controlled from the primary flight computer over serial lines.

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Command and Data Handling (CDH) Subsystem: The primary circuit board in the CDH subsystem is the BeaverCube Flight Computer (BFC) board. The BFC has three microprocessors on it, two RaspberryPi Compute Module 3's and one TI STM32. The TI STM32 handles all peripheral communication, basic C&DH, and control of safe states and is the most critical processor onboard.

Communications Subsystem (COMMS): The COMMS consists of the Lithium Radio Board with a dipole antenna, and the NSL Eyestar S4 Iridium transciever with a patch antenna.

The Lithium Radio Board is the primary radio and uses the dipole antenna to communicate on 450.1 MHz Up and 401.5 MHz Down. The two UHF ground stations are the MIT campus ground station, and the MIT Radome, both located in Cambridge, MA.

The NSL S4 transceiver provides 2 way communication between the spacecraft and the mission operations center via the Iridium constellation.

Electrical Power Subsystem (EPS): The EPS is a direct energy transfer system using a solar array producing approximately 26W of orbit average power to charge the 40Wh battery system. The solar arrays utilize standard Spectrolab XTJ-Prime photovoltaic cells in the ClydeSpace Photon-DD Solar Array; the battery system is a COTS ClydeSpace Optimus lithium polymer battery qualified to NASA standards EP-Wi-032. The TI STM32 on the BFC sends signals to the EPS Manager Board (a ClydeSpace Starbuck-Nano Plus) to control charging and load switching.

Thermal Control Subsystem (TCS): The TCS controls hardware temperature through cold biasing of the thermal design, utilizing heaters to stabilize temperatures. Sensors are wired to the TCS board, which hosts signal routing to the TI STM32 which runs the thermal control loop.

Structure Subsystem: The structure is fabricated of aluminum.

Propulsion Subsystem: No propulsion subsystem is included.

Payload Subsystem: The Payload Subsystem is broken into two parts, the Camera Payload and the Processing Payload. The Camera Payload is made up of 3 total COTS cameras, 2 visible spectrum (MatrixVision BlueFox cameras) and 1 LWIR spectrum camera (FLIR Boson 640). All 3 cameras communicate with the Raspberry Pis on the BFC over USB 2.0 cables.

The Processing Payload consists of a single Compute Board which houses the Vector Accelerator SoC and its necessary power electronics and memory circuitry. It communicates with the C&DH system through the Raspberry Pi USB hub. It is responsible for doing image processing and autonomous task management of the imaging tasks for the Camera Payload.