NNU Revision Matrix

Revision 1	10/4/2018	Added Deployable Materials
Revision 2	2/26/2019	Updated mission details relating to removal of RF experiment boom

RFTSat – Northwest Nazarene University – 3U

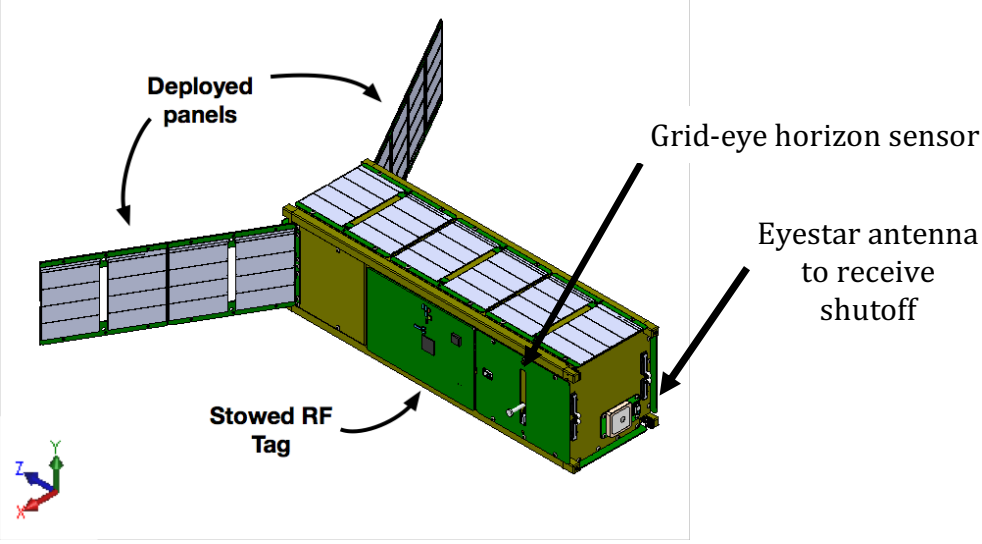

Figure1: View of RFTSat with the solar panels deployed. The backscatter channel is the radio link between the RF tag reader and the RF tag that is located inside the satellite.

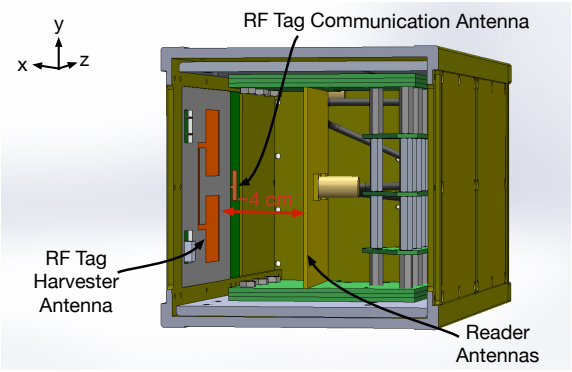

Figure 2: Cutaway view of RFTSat showing the RF tag mounted on the side of the satellite and the RF tag reader antennas housed within the satellite. The RF tag antennas face towards the inside of the satellite and harvest and backscatter energy transmitted from the RF tag reader.

The goal of the Radio Frequency Tag Satellite (RFTSat) mission is to develop and demonstrate the first space-based 5.8GHz (ISM band) RF backscattering communications system. It will allow a wireless passive RF tag to harvest RF energy transmitted through space from an RF reader on the spacecraft, store that energy in a supercapacitor, and power an MCU and various sensors on the tag. Then the collected sensor data will be transmitted back to the reader by modulating this information on the backscattered RF signal. This tag will be mounted on the inside of the

spacecraft 4cm from the reader tx/rx antennas. It will be used to measure accelerations, temperature, and radiation TID. All data will be downlinked to earth via GlobalStar satellite network.

CONOPS

Phase 1: Startup (Day 1)

Upon deployment, RFTSat will power up and start a 30 minute countdown timer. At 30 minutes, the GlobalStar radio will activate and downlink 10 health beacons containing satellite telemetry data. Once the health packets have been sent, the burn-wire mechanisms holding the deployable solar panels will be activated to release each deployable solar. Power will then be available to the payload; however, payload operations will not start for several orbits to allow the batteries to charge.

Phase 2: Conops (Weeks 1-8)

At this point, the satellite will enter its main conops mode. In the conops, the RF tag reader will be periodically powered (1-3 times every 2 days) and the data collected from the RF tag downlinked via the Eyestar Simplex radio (5-10 times every 2 days). The RF tag data will come from a temperature sensor and a total dose ionizing radiation sensor (i.e., RadFET). Satellite health data will be downlinked via the EyeStar radio every 15 minutes. The RF tag system will operate for 8 weeks and will then be shut off by the NSL onboard computer.

Phase 3: NSL Phase (Weeks 9-Re-Entry)

During this phase, NSL will shut down the NNU payload and will use the remainder of the satellite's life to test the longevity of their hardware systems. NSL will continue to transmit satellite health beacons and data from their sensors (two 8x8 pixel infrared horizon sensors and pin diode particle detectors) to Globalstar periodically.

The RFTSat structure is made of Aluminum 6061-T6 and contains standard commercial-off-the-shelf (COTS) materials, electrical components, PCBs, and solar cells. The GlobalStar radio uses 2 ceramic patch antennas. The uplink frequency is 2.4 GHz and the downlink frequency is 1.6 GHz. The 5.8 GHz RF reader/tag system uses 4 PCB microstrip antennas.

There are no pressure vessels, hazardous or exotic materials.

The electrical power storage system consists of common lithium-polymer batteries with over-charge/current protection circuitry. The lithium batteries and circuitry are ISS approved with previous flight heritage. The lithium batteries carry the UL-listing number BBCV.MH48285.