Mission Description: LIME

NOVI LLC focuses on combining AI with edge processing and integrated sensor solutions to deliver high-value low-latency intelligence. By combining edge processing and opportunistic communications in this mission, NOVI is demonstrating the foundation of future smart satellite buses. Such buses will enable users to pre-sort data onboard increasing the quality of downlinks and making automated decisions decreasing system response times across a variety of potential payloads.

LIME – Low-latency Intelligence and Monitoring Experiment – is a 3U small satellite mission primarily dedicated to characterizing the availability of Iridium short burst data links in orbit. The satellite was designed by NOVI under a Small Business Innovation Research (SBIR) contract. Launch and in-space operations are covered by a follow-on sub-contract with The Space Dynamics Laboratory. The specific objectives of the mission are to:

1. Create combined geographical and temporal maps of in-orbit Iridium Short Burst Data (SBD) uplink and downlink communications coverage with the antenna in a variety of orientations.

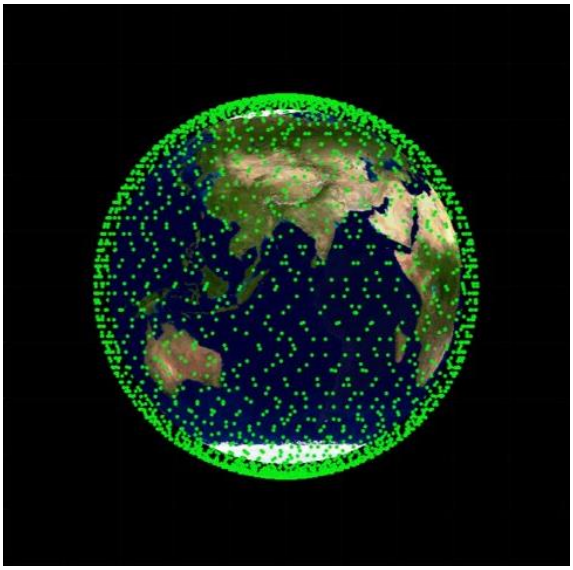

Figure 1: Simulated Mapping of Iridium SBD Transmission Attempts

2. Run system health monitoring software to experiment with the use of machine learning in predicting and detecting system faults before or soon after they occur.
3. Quantify the performance of the machine-learning hardware flown and gain flight heritage to determine its suitability for future LEO missions.

By mapping the availability of Iridium SBD communications, LIME may improve the viability for future satellites to use the Iridium network in LEO as a form of opportunistic communications potentially replacing traditional ground stations, or as a method of communicating outside of ground station line-of-sight. Use of the Iridium SBD system to increase the portion of orbit in which a satellite can communicate with operators has the potential

to drastically reduce the delay between data collection and reporting or fault indication and response.

By running system health monitoring algorithms onboard, LIME will be capable of detecting and possibly predicting hardware and software anomalies automatically. This enhanced information can be used by operators to reduce response time and decrease overall system down time. Increasing the autonomy of satellites is essential as constellations grow and missions spread further from Earth.

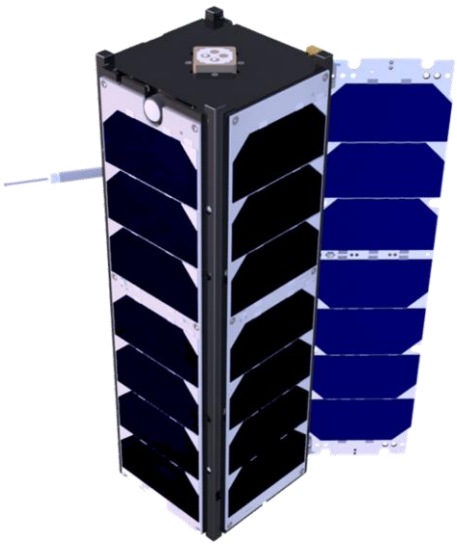

Figure 2: LIME Satellite

The LIME satellite is a 3U CubeSat. It is approximately 34 x 10 x 10 cm in volume while stowed with a mass of ~5.3 kg. To control the attitude during experiments, LIME features a three-axis attitude control system featuring both magnetorquers and reaction wheels.

LIME is manifested to launch as a rideshare payload on SpaceX's Trasporter-12 mission. Once deployed, the satellite will operate in a sun synchronous orbit at an expected altitude of 520 km and a 97.4° inclination, and a MLTDN of 10:30 (MLTAN of 22:30). As described in the included orbital debris assessment report (ODAR), LIME should de-orbit within less than five years following the end of its mission. LIME features no propulsion devices and will not be capable of adjusting its orbit.

Our team requests authorization for the use of two transmitting communications systems. Primary S-band omni-directional communications with transmissions at a center frequency within the range of 2200-2290 MHz with a bandwidth of 140.0 kHz used for telemetry, data downlink, tracking and command. Transmissions within the range of 1616 to 1625.999 MHz will be used to test communications with the Iridium network.

Table 1: Links Used

Link Type	Frequency (MHz)	Bandwidth (kHz)
General Uplink (Rx)	Requested: 2067.0 Capable Of: 2025-2110	140.0
General Downlink (Tx)	Requested: 2240.0 Capable Of: 2200-2290	140.0
Experimental Iridium Tx	1616 to 1625.999	35.5
Experimental Iridium Rx	1616 to 1625.999	35.5
GPS Signals (Rx only)	GPS, GLONASS, GALILEO, QZSS, Beidou	Various

To comply with 47 CFR 5.84, if harmful interference to an established radio service occurs, upon becoming aware of such harmful interference NOVI will command LIME to immediately cease the interfering transmission/s. If the s-band communications are interfering, NOVI will command LIME's s-band transmitter to be inhibited. The inhibit will persist through reboots. If the Iridium communications are interfering the Iridium module will be switched off. This will also persist through reboots of the spacecraft.

47 CFR 5.115(a) Requirement: To support the operational security of the LIME cubesat, neither the satellite nor the associated ground facilities are designed to transmit station identification signals for the spacecraft.