



GENERAL PROJECT INFORMATION		
<b>Project Name</b>		
MSUSAT		
<b>Date Prepared</b>		
		10/20/21
<b>Project Sponsor</b>		
EAET Department		
<b>Project Manager</b>		
Kate Nechaeva (EET)		
<b>Team Members</b>		
Daniel Perry (EET), Daniel Tucker (EET), Erik Fiske (EET), Seth Schisler (EET), Sean DeVaney (EET), Ahmed Hussain (EET), Firehwot Woldeyes (MET), Daniel Sterer (MET), Matt Bingaman (Cybersecurity), Ivo Georgiev (Faculty advisor)		

SCOPE STATEMENT
<b>Business Need and Problem Statement</b>
<p>The exploding popularity of Cube Satellites (CubeSats) is something that our team of seniors is excited to share with the greater MSU community. We believe that designing a CubeSat is a great opportunity for the university, being both an application of what we have learned and a very real possibility of putting MSU Denver's name up there with CU Boulder and Colorado School of Mines.</p> <p>Currently NASA's open-source spacecraft flight software stack cFS, while very well designed, lacks data protection layers. We want to contribute to the securing of cFS. We plan to develop and install a hardened version of cFS on top of a custom embedded Linux operating system running on MSUSAT's on-board computer and make it available to the community as a penetration-testing target over radio. We plan to achieve this by flying MSUSAT on a high-altitude balloon and stress-test its cyber resilience through a Hack-in-Flight competition for cybersecurity students and hobbyists.</p> <p>With this first MSUSAT, we mean to lay the foundation for a cross-departmental multi-cohort senior program. While our core team is composed of EET students, we have already attracted 2 MET students to design the satellite structures. We are negotiating with other departments, including CS, AVS, and Cybersecurity.</p>



<b>Project Goals and Objectives</b>
<ul style="list-style-type: none"><li>• Design and build a power distribution board that can support the satellite board stack</li><li>• Design and build a command, control, and communications (3C) board</li><li>• Design and build a back plane to connect critical systems and payloads</li><li>• Design a physical structure for the satellite which follows NASA's CubeSat standards</li><li>• Build a custom embedded Linux image to run the on-board computer based on RPi 4</li><li>• Install NASA's BSP/OSAL/cFE/cFS spacecraft flight software stack</li><li>• Cyber-harden the software stack</li><li>• Prepare a Hack-in-Flight competition</li><li>• Design and build a separate high-power communications board for the competition</li></ul>
<b>Benefits</b>
<p>This project holds a lot of opportunities for multiple MSU departments.</p> <ul style="list-style-type: none"><li>• It will set a standard of expectations for future EET senior projects</li><li>• It will create relationships among EET, AVS, MET, CPE, CS, and Cybersecurity</li><li>• It will start a potentially long-term MSUSAT program</li><li>• It will provide a large range of real-life student learning opportunities</li></ul>
<b>Metrics</b>
<ul style="list-style-type: none"><li>• Were we successfully able to fly?</li><li>• Were we receiving reasonable data and telemetry readings?</li><li>• Were we able to communicate with MSUSAT?</li><li>• Indicators of whether the hackers were successful or unsuccessful in their attempts to hack-in-flight</li></ul>



SUPPORTING DETAIL
<b>Needs</b>
<ul style="list-style-type: none"><li>• Knowledge, design, and/or operational support from:<ul style="list-style-type: none"><li>- MET department with CubeSat structure development (obtained)</li><li>- AVS department with balloon flight (obtained)</li><li>- CS/CPE with software stack development (planned)</li><li>- Cybersecurity department with data safety protocols (in progress)</li></ul></li><li>• Budget:<ul style="list-style-type: none"><li>- PCB board printing and population costs</li><li>- Electrical components, computing equipment, development kits (started)</li><li>- Lab equipment</li><li>- Structure fabrication costs</li><li>- Balloon launch costs (\$1,500/flight)</li><li>- Logistics and prize fund for the “Hack-in-Flight” competition</li><li>- Iridium short-message service costs (for RockBLOCKs)</li></ul></li></ul>
<b>Critical Milestone Date(s) – <i>include desired end date</i></b>
<ul style="list-style-type: none"><li>• Telemetry test balloon flight (October 30, 2021)</li><li>• Critical systems built and tested (December 10, 2021*)</li><li>• Critical systems test balloon flight (Feb 10, 2022*)</li><li>• Balloon launch with a payload (May 10, 2022*)</li></ul> <p style="text-align: right;">*Dates subject to change</p>
<b>Risks</b>
<ul style="list-style-type: none"><li>• Novice team</li><li>• We don’t complete our designs</li><li>• We can’t obtain the hardware needed due to global chip shortage</li><li>• We are unable to implement desired data security</li><li>• Hardware failure</li></ul>