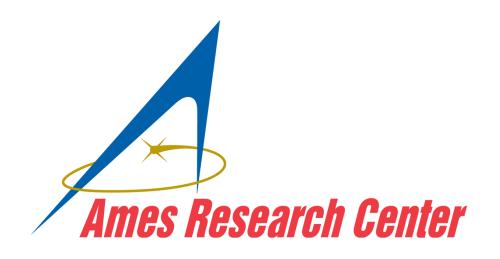
Team TARDIGRADES

- Finan Bryan (ME)
- Joe Dennison (CompE)
- Robert Goes (Math & CS)
- Cosette King (CS)
- Lily Mortensen (MSE)
- Drew Pilchard (EE)
- Grace Rosenvall (ME)
- Harrison Thomsen (EE)
- Taegan Williams (CS)





<u>Objective:</u> Reduce cost of CubeSats by using individual components and custom layouts

ADCS Subteam

- Finan Bryan (ME)
- Lily Mortensen (MSE)
- Grace Rosenvall (ME)

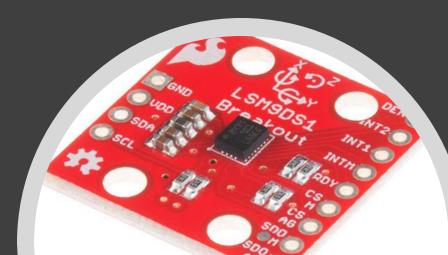
Background/Requirements



- Commercial ADCS units are very expensive
- Individual components are relatively cheap
- Our goal is to build a more effective system for a fraction of the cost.

Individual Components

- Reaction Wheels
- Sun Sensors
- Magnetorquers/Torque Rods
- IMU
- Magnetometers





Conceptual Development Process

- 1. Research each component's function.
- 2. Mathematical Analysis to narrow down requirements for potential units.
- 3. Choose the best component based on an established design matrix.

			Cost	Moment	Power	Flight Histo	ory	SUM
		Weights:	5	3	3	3		
Torque R	Torque Rods/Magnetorquers							
	SatBus MTQ M6P		9	9	7	6		111
	CSCT (Small)		7	9	8	8		110
	MTQ200		3	9	9	7		90

Static Imbalance Requirement

$$\mathbf{F}_{s} = \boldsymbol{M}^{\boldsymbol{w}}(\boldsymbol{\omega}^{\boldsymbol{w}})^{2} \mathbf{w} \times (\mathbf{w} \times \mathbf{x}) = -\boldsymbol{M}^{\boldsymbol{w}}(\boldsymbol{\omega}^{\boldsymbol{w}})^{2} \begin{bmatrix} x_{1} \\ x_{2} \\ 0 \end{bmatrix}$$

Recommendations

There are two different ways that we could approach this concept development.

Create a compact Cube sat ADCS similar to one that can be bought off of the shelf. Create a more satellite specific ADCS that is integrated well into the satellite design.





Validation

- Fly Wheels
- Magnetorquers
- Sensors
- Full Assembly Check

Potential Risks Identified

- Under-Research
- Purchase Incorrect Components
 - Power Requirement
 - Improperly sized (Under or Over)
- Mis-Assembly



9523 Subteam

- Joe Dennison (CompE)
- Robert Goes (Math & CS)
- Cosette King (CS)

- Drew Pilchard (EE)
- Harrison Thomsen (EE)
- Taegan Williams (CS)

Background

- Focusing on the use of low power consumption technology
- We will be creating a more power-efficient satellite design with encryption protocols

Source: http://mindworks.shoutwiki.com/wiki/File:2016-2017_TeamRocket_TES3.jpg



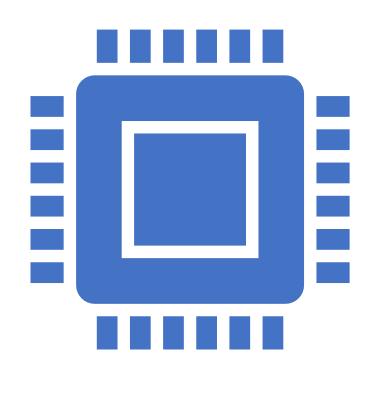
Iridium 9523

Source: https://www.iridium.com/products/iridium-core-9523/

Previous Team

- Team SCUBEE(2018-2019) developed a working carrier PCB.
- Team FIRE(2019-2020) developed and tested the base code for Short Burst Data mode.





Requirements

• Hardware

- Flight Ready Iridium Carrier Board
- Exchange SAMD21 microcontroller to an SAMD51
- RF Flyback Convertor to Gallium Nitride
- Software
 - RUDICS communication
 - 2-way Communication with ground server
 - NASA compliant encryption

Conceptual Development Process

Before:

- Waiting for SAMD51 Thing Plus
- Getting the chip working with VS
- Researching 9523

Now:

- Still researching 9523
- Command central?
- Finding all the empty broken code
- Getting the hardware and software to work together

Recommendations



More Research on the 9523



Fix code



Meet in person & get working components together

Identification of Risks



Timeline

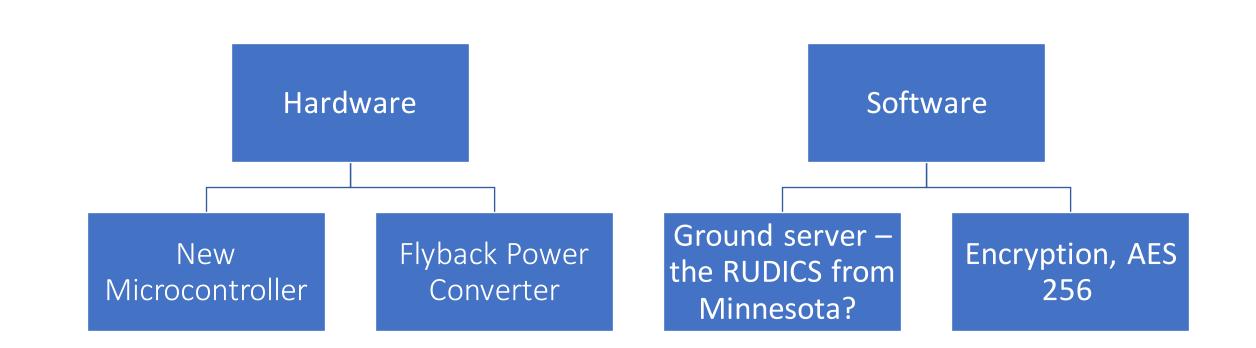


WARNING: High-Power RF Transmitter Do Not Operate in Proximity of GPS Devices.

Fault tolerant code

Radiation

Validation

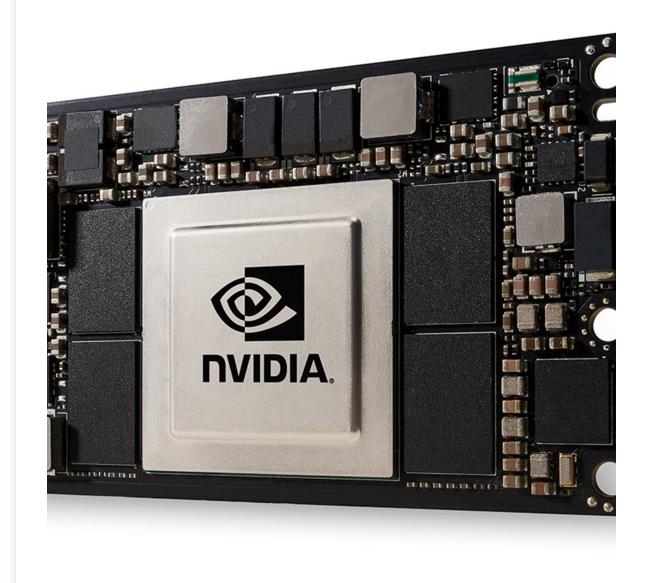


Al in the sky Subteam

- Robert Goes (Math & CS)
 - Lily Mortensen (MSE)

Background

- Harness unique capabilities of GPUs
- Demonstrate active Machine Learning
 - Enable Star Tracker
- Incorporate a heat pipe to cool GPU
- Design nontoxic and durable radiation shielding for AI unit



Source: nvidia.com

Project Management

Project Schedule

		Year	r 2020																
		Month		Sept Oct			Nov			Dec									
Task Description	Duration	Assigned	9/7	9/14	9/21	9/28	10/5	10/12	10/19	10/26	11/2	11/9	11/16	11/23	11/30	12/7	12/14	12/21	12/28
Iriduim 9523 subgroup Tasks																			
ECE																			
Look over Dev board and SAMD51 manual	5 weeks	Joe																	
Wire Devboard to SAMD51 via RS-232 header	2 weeks	Joe																	
Porting from the Pi to the SAMD51	2 weeks	Joe																	
Split firmware between dev board and SAMD51	3 weeks	Joe																	
Select GaN switch and transformer for flyback and 5V buck																			
boost power converter	2 weeks	Drew + Harrison																	
Flyback converter design	2 weeks	Drew + Harrison																	
Schematic with upgaded boost convertor/SAMD51	2 weeks	Drew + Harrison + Joe																	
Test final satellite board	Next Sem	Joe																	
<u>8</u>																			
Look over past code repositories/9523 manual	4 weeks	Robert + Cosette + Taegan																	
Determine SAMD51 encryption library	1 weeks	Robert																	
Get team fire code running on SAMD51	1 weeks	Robert																	
Identify Decryption issue	2 weeks	Robert																	
Seperate Hardware/Communication Code	1 weeks	Robert																	
Feature complete (blocked row 30)		Robert + Cosette + Taegan																	
Bug Testing	1 week	Robert + Cosette + Taegan																	
Determine new Rudics Needs	1 week																		
Determine ground server requirements	4 weeks	Robert + Cosette + Taegan																	
Encryption and Decryption Implementation	2 weeks	Robert + Cosette + Taegan																	
ADCS subgroup Tasks																			
Research ADCS components	2 weeks	Finan + Grace + Lily																	
Preliminary Force Calculations	1 week	Finan + Grace + Lily																	
Generate Component shortlist with design matrix	4 weeks	Finan + Grace + Lily																	
Prototype layout/design Round 1	2 weeks	Finan + Grace + Lily																	
Refine Force Calculations to match shortlist	2 weeks	Finan + Grace + Lily																	
Final component selection	4 weeks	Finan + Grace + Lily																	
Calculations complete for control of final components	2 weeks	Finan + Grace + Lily																	
Prototype design Round 2 with final components	2+ weeks	Finan + Grace + Lily																	

Budget

Date of Purchase	Expense Item	Vendor	Amount	Shipping	Total amount	Quantity	Total Budget
9/30/2020	25 pk M2F jumper wire	Banna Robotics	2.99	3.65	6.94	1	3,000
9/30/2020	Adafruit Grand Central M4 Express featuring the SAMD51	Adafruit	37.5	11.18	48.68	1	
9/30/2020	SparkFun Thing Plus - SAMD51	Sparkfun	19.85	7.09	66.94	3	
				Total Spent	122.56		

Questions?