Project Janus
Conceptual Design Review

Team Janus
10/16/2017
CoDR Presentation Content

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Mission Overview
Josiah Hall and Syiera Williams
Mission Overview: Mission Statement

• The mission of Project Janus' flight is to demonstrate the use of a laser distancing system to measure speed of CubeSats within constellation during flight

• The beneficiaries of Project Janus are the members of Project Janus. The members of Project Janus will gain experience in their respective fields. The outcome of this project will help those operating a constellation of CUBESATs.

• The purpose is to develop a system to notify ground teams of objects in vicinity of a spacecraft, as well as their speed and direction.
Mission Overview: Mission Objectives

– The primary object is for one CubeSat equipped with laser range-finders to measure the distance and speed of a second CubeSat that is moving on a track, downlinking data through the Iridium network.

– The secondary objective is to fly a component made at a school for students with learning disabilities. This will allow the students to work in the STEM fields.

– The tertiary adjective is to record video from the flight using a mounted camera.

– The minimum success criteria is the primary CubeSat measuring and recording the average distance of the second CubeSat.
Mission Overview: Theory and Concepts

• The underlying engineering concept for Project Janus is using laser range-finders in a constellation.
  – Much like a self-driving car, the constellation will use lasers to detect distance between objects as well as measuring the speed of passing objects.
Mission Overview: Expected Results

• If the design functions properly, the primary CubeSat will record the average distance and speed of the second, and use the Iridium network to downlink this data to the ground team.
• Each CubeSat will also store data transferred using Iridium modems.
ConOps

- All systems on
- Begin data collection
- Camera starts recording

$t = 0 \text{ min}$

Altitude: 75 km

Turn on Iridium modem

$t \approx 1.3 \text{ min}$

Altitude: 75 km

End of Malemute Burn

$t \approx 0.6 \text{ min}$

Altitude: 52 km

$t \approx 1.7 \text{ min}$

Altitude: 95 km

Second CubeSat begins to move

Apogee

$t \approx 3.1 \text{ min}$

Altitude: ~150 km

CubeSat continues to move

$t \approx 4.0 \text{ min}$

Altitude: 95 km

Second CubeSat stops moving

$t \approx 4.5 \text{ min}$

Altitude: 75 km

Iridium modem communicates with ground team

$t \approx 7.5 \text{ min}$

Chute Deploys

$t \approx 15 \text{ min}$

Splash Down
Design Overview

Phillip Lentz, Michael Rarick, and Josiah Hall
Design Overview: Science Design

• Unlike many mission flown on previous RockSat missions, the goal of Project Janus is to test mechanical principles, not scientific properties.

• Project Janus will use laser range-finders to measure distance and speed of a moving object.

• Iridium modems will be used to communicate between the two CubeSat and the ground team.
Design Overview: Engineering Design

• The design will incorporate a custom CubeSat with a payload split into two sections.

• The payload will contain:
  • (2) Janus CubeSats
  • (1) Experiment by a special needs program

• One CubeSat will contain an Iridium Modem, Antenna, lithium ion battery and three optical rangefinder.

• The second CubeSat will contain a second Iridium Modem and a lithium ion battery.
Functional Block Diagram

Key:
Red = Power Flow
Blue = Data Flow

Rocket Power

Voltage Regulator

DC Electric Motor

Battery

Iridium Modem

Antenna

Camera Battery Storage

Added Experiment

Raspberry Pi 2

Battery

Iridium Modem

Antenna

IR Laser

IR Laser

IR Laser
## Activation Sequence

<table>
<thead>
<tr>
<th>Event</th>
<th>Time On</th>
<th>Units</th>
<th>Dwell Time</th>
<th>Units</th>
<th>Event Description</th>
</tr>
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<tr>
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<td>N/A</td>
<td>(T+X) (sec)</td>
<td>N/A</td>
<td>(sec)</td>
<td>N/A</td>
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<td>GSE 2</td>
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<td>(T-X) (sec)</td>
<td>N/A</td>
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<td>(T+X) (sec)</td>
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<td>(sec)</td>
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<td>(sec)</td>
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</table>

**TE-R**

0:01 (T+X) (sec)  1 (sec)

Our relay circuit will provide a signal to the USB rechargeable external battery packs contained in each of the various compartments. Each compartment will carry its own internal power supply. No devices will recharge using ROCKET power, the TE line is only used as an "ON SIGNAL" to our battery pack.
Design Overview: Payload Layout

- Primary CubeSat: 6.6"; 5" x 3.5" x 3.5"
- Secondary CubeSat: 2" x 2.5" x 2"
- Antenna: 1.89" x 1" x 2"
- Motor: 3" x 1" x 1"
- Track: 7" x 0.4" x 0.5"
- Camera: 2.2" x 1.6" x 1.2"
- Laser Rangefinder: diameter 0.9" x 0.8"
- Other Project: 4" x 4" x 1"
Design Overview: Payload Layout 3D Model
Management
Josiah Hall, Syiera Williams, Michael Rarick, and Phillip Lentz
Team Organization Chart

- Advisor: Rishabh Maharaja
- Liaison: Josiah Hall

- Electronics
  - Lead: Michael Rarick
    - TJ Krauel
    - Matthew Lewin

- Fabrication
  - CAD Lead: Matthew Hinkle
    - Connor Schnitzer

- Programming
  - Lead: Phillip Lentz
    - Garvin
    - Keith Gorschboth
    - Marcus Bailey

- Research
  - Lead: Jacob Karnes
    - Edward Emmett
    - Syriera Williams
  - Caitlin Aviles
Team Mentors

• Professor Rishabh Maharaja – Janus Advisor/Concept Developer, RockSat-X 2017
Preliminary Schedule and Monitoring Budget

- Team Janus meets every Monday and Tuesday at 5:00 p.m. ET
- Meeting teams are subject to change as need be.
- The official budget is yet to be determined; however, the primarily budget is $20,000. Of this, approximately $15,000 will be used for launch, leaving $5,000 for equipment and materials.
# Contact Matrix

## Team Janus / Capitol Technology University

### Fall 2017 RS-X Contact Matrix

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Day Phone</th>
<th>Cell Phone</th>
<th>Receive Texts?</th>
<th>Email</th>
<th>Citizenship</th>
<th>Add to mailing list?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>Caitlin Aviles</td>
<td>703-300-1148</td>
<td>703-300-1148</td>
<td>Yes</td>
<td><a href="mailto:Csavileswynkoop@captechu.edu">Csavileswynkoop@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Fabrication</td>
<td>Garvin</td>
<td>910-584-7759</td>
<td>910-584-7759</td>
<td>Yes</td>
<td><a href="mailto:garvinn27@hotmail.com">garvinn27@hotmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Liaison/ CAD</td>
<td>Josiah Hall</td>
<td>706-580-2273</td>
<td>706-580-2273</td>
<td>Yes</td>
<td><a href="mailto:jdhall2@captechu.edu">jdhall2@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Fabrication</td>
<td>Keith Gorschboth</td>
<td>443-895-2019</td>
<td>443-895-2019</td>
<td>Yes</td>
<td><a href="mailto:Kagorschboth@captechu.edu">Kagorschboth@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Fabrication</td>
<td>Marcus Bailey</td>
<td>443-983-0741</td>
<td>443-983-0741</td>
<td>Yes</td>
<td><a href="mailto:mibaily400@gmail.com">mibaily400@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Fabrication Lead</td>
<td>Phillip Lentz</td>
<td>610-698-8858</td>
<td>610-698-8858</td>
<td>Yes</td>
<td><a href="mailto:phillip.lentz.1@gmail.com">phillip.lentz.1@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Programming</td>
<td>Syriera Williams</td>
<td>240-427-7317</td>
<td>240-427-7317</td>
<td>Yes</td>
<td><a href="mailto:siwilliams@captechu.edu">siwilliams@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Electronics colead</td>
<td>TJ Krael</td>
<td>301-885-9355</td>
<td>301-885-9355</td>
<td>Yes</td>
<td><a href="mailto:6970mustang@comcast.net">6970mustang@comcast.net</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>CAD Lead</td>
<td>Matthew Hinkle</td>
<td>443-416-1985</td>
<td>443-416-1985</td>
<td>Yes</td>
<td><a href="mailto:Mdhinkle@captechu.edu">Mdhinkle@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Electrons</td>
<td>Matthew Lewin</td>
<td>845-661-6328</td>
<td>845-661-6328</td>
<td>Yes</td>
<td><a href="mailto:Matt2.01701@gmail.com">Matt2.01701@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Programming</td>
<td>Jacob Karnes</td>
<td>302-331-0076</td>
<td>302-331-0076</td>
<td>Yes</td>
<td><a href="mailto:jskarnes@captechu.edu">jskarnes@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
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<tr>
<td>Programming</td>
<td>Edward Emmett</td>
<td>302-430-4741</td>
<td>302-430-4741</td>
<td>Yes</td>
<td><a href="mailto:ejemmett@captechu.edu">ejemmett@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>General</td>
<td>Connor Schnitzer</td>
<td>410-299-7641</td>
<td>410-299-7641</td>
<td>Yes</td>
<td><a href="mailto:conman1029@gmail.com">conman1029@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
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<tr>
<td>Electronics colead</td>
<td>Michael rarick</td>
<td>301-512-8132</td>
<td>301-512-8132</td>
<td>Yes</td>
<td><a href="mailto:mrarick13@gmail.com">mrarick13@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
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<tr>
<td>Avisor</td>
<td>Rishabh Maharaja</td>
<td>410-967-8703</td>
<td>410-967-8703</td>
<td>Yes</td>
<td><a href="mailto:rymaharaja@captechu.edu">rymaharaja@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
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## Team Availability

**Team Janus/ Capitol Technology University**

**Fall RS-X Team Availability Matrix**

<table>
<thead>
<tr>
<th>Time</th>
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<th>Wednesday</th>
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<td>3</td>
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<td>2</td>
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<tr>
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<td>2</td>
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<td>10:00 AM</td>
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**PLEASE USE MOUNTAIN TIME ZONE TIMES**
## User Guide Compliance: Summary

<table>
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<th>Requirement</th>
<th>Status/Reason (if needed)</th>
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<tr>
<td>Center of gravity in 1&quot; plane of plate?</td>
<td>Will maintain within 1”</td>
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<tr>
<td>Weight 30.0 +/- 1.0 (15.0 +/- 0.5) lbs?</td>
<td>15 lbs</td>
</tr>
<tr>
<td>Max Height &lt; 5.13”</td>
<td>4&quot;</td>
</tr>
<tr>
<td>Bottom of deck has flush mount hardware?</td>
<td>YES</td>
</tr>
<tr>
<td>Within Keep-Out Zone</td>
<td>NO</td>
</tr>
<tr>
<td>Using &lt; 10 A/D Lines</td>
<td>N/A</td>
</tr>
<tr>
<td>Using/Understand Parallel Line</td>
<td>N/A</td>
</tr>
<tr>
<td>Using/Understand Asynchronous Line</td>
<td>N/A</td>
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<tr>
<td>Using X GSE Line(s)</td>
<td>NO</td>
</tr>
<tr>
<td>Using X Non-Redundant PWR Lines (TE-1, TE-2, TE-3)</td>
<td>NO</td>
</tr>
<tr>
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<td>YES, TE-R</td>
</tr>
<tr>
<td>Using &lt; 1 Ah</td>
<td>YES</td>
</tr>
<tr>
<td>Using &lt;= 28 V</td>
<td>Yes</td>
</tr>
<tr>
<td>Using RF (If yes, list frequency and TX Power)</td>
<td>Yes, 1616-1626.5 MHz, 15W Max Transmit</td>
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<tr>
<td>Using deployable?</td>
<td>NO</td>
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<tr>
<td>Whole team consists of US Persons</td>
<td>Yes</td>
</tr>
<tr>
<td>Using ITAR and/or Export Controlled hardware</td>
<td>NO</td>
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Pointing Requirements

• Project Janus carries (2) CubeSats with Iridium communication systems, thus the antennas need to be zenith pointed.

• Project members will work with the ROCKSAT-X to ensure that the antennas are positioned correctly and skyward.
Risks/Worries:

• Project Janus uses three infrared LEDs. They are not specifically mentioned in the user guide, are they safe to use in our project on RockSat?

• We need to know the orientation of the rocket after stabilization, as both antenna need to be zenith pointed.

• Team Janus is still working on fitting all the components on the base.
  – While all the pieces fit in our model, the dimensions of pieces may change, causing space confictions.
Conclusion

• Team Janus deserves to fly as we are working on a system to ease the burden on ground teams controlling large constellations in orbit.

• We have and will continue to show dedication towards completing Project Janus' mission.

• Continuing to work on the RockSat-X 2018 will provide invaluable experience for all the members of the team and help them progress in their future careers.
Questions?