Project Hermes
Conceptual Design Review

Presented By: Team Hermes
Date: 10/11/2016
CoDR Agenda
(Topics to be covered)

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  • Theory and Concepts
  • Concept of Operations
  • Expected Results
  • Heritage

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  • 2D Payload Layout
  • Activation Sequence
  • Pin Assignments
  • RockSat-X User’s Guide Compliance
CoDR Agenda
(Topics to be covered)

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  • Team Organization
  • Schedule
  • Budget
  • Mentors (Faculty, industry)
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• Section 4: Conclusions
  • Why We Deserve to Fly
  • Conclusion/PDR information
Section 1
Mission Overview
Mission Overview: Mission Statement

• The mission of Project Hermes’s flight on RockSat-X 2017 is to demonstrate the functionality of the 1U Hermes Cube and to record video during flight using a VR camera.

• The direct beneficiaries are the members of Team Hermes. Team Hermes will fly the Hermes 1U Cube on the CACTUS CubeSat mission slated for launch in December 2017.

• Flying on ROCKSAT-X 2017 will allow team Hermes to test the functionality of the 1U Hermes Cube and obtain a set of “lessons” learned.
Mission Overview: Mission Objectives

• The primary mission objective on the ROCKSAT-X 2017 flight is to test the functionality of the Iridium 9603 SBD modem and other components that are slated to fly on the CACTUS mission.

• The secondary mission objective is to record video of the flight using a VR camera.

• The third mission objective is to fly components from Ragnorak industries and the University of Maryland at College Park. These components are being tested for future space flights.

• The minimum success criteria is to receive a single telemetry point from the Iridium 9603 SBD modem. The team will also try to obtain location data from the Iridium messages to report the payload’s location.
Mission Overview: Theory and Concepts

• The underlying engineering concept behind Project Hermes is to test satellite to satellite communications for CubeSats. The idea here is to use existing communications networks such as the Iridium network.

• Project Hermes flew a WIFI Iridium Modem and a smartphone in space on RockSat-X 2015 with success. Other institutions have flown Iridium modems in space. The main goal for team Hermes is to test the functionality of their equipment in space.

• The 2017 flight will be different in that the team mostly wants to test the functionality of a different kind of Iridium modem and systems that will fly on a CubeSat in 2017.
Mission Overview: Concept of Operations

1. **Launch**
   - Hermes Cube/system will power on using a signal from rocket

2. **Launch to Apogee**
   - Hermes Cube will switch to internal power
   - The VR camera/other experiments will power on

3. **Apogee**
   - Hermes Cube shall transmit house keeping data using Iridium
   - VR Camera will continue to record

4. **Descent**
   - Hermes Cube shall transmit house keeping data using Iridium
   - VR Camera will continue to record

5. **Chute Deploy**
   - Hermes Cube shall transmit house keeping data using Iridium
   - VR Camera will continue to record

6. **Landing**
   - Hermes Cube shall transmit house keeping data using Iridium
   - VR Camera will continue to record
Mission Overview: Expected Results

• If all works as designed, the team should expect telemetry data from the Iridium SBD modem and be able to command the payload from the ground. The VR camera should contain a video recording from launch to splashdown.

• The important goal here is to not quantify data but to simply obtain lessons learned. There is no real “set” pass or success benchmark for this mission. The team simply wants to fly the 1U Hermes Cube in space for functional testing.
  • The team wants to apply the lessons learned for the CubeSat mission.
Heritage

• Team Hermes flew on RockSat-X 2015 and were able to:
  • Establish Wi-Fi network in space for system bus use
  • Pair an Android Smartphone in space to an Iridium-based Wi-Fi hotspot device
  • Use & program applications (such as Iridium and various Android automation apps) available in the Google Play store to function as our Flight Software (FSW).
  • Use TCP / IP devices (smartphone & smartwatch (used by Aaron Bush)) on the ground as our Telemetry & Command System.

• Here are some links to videos from our YouTube channel:
  • https://www.youtube.com/watch?v=zGcHYIxdTc4
    • (Shows the rocket launch as seen from the PI’s cell phone)
  • https://www.youtube.com/watch?v=R7cdO9cPnCY
    • (Video recorded by Colorado University Boulder; you can see our wonderful planet Earth, as well as parts of the rocket falling back. You can also see the antenna used for the Project Hermes Payload)
  • https://www.youtube.com/watch?v=G548GDgeWj4
    • (Video from the MOC (a tent on the launch pad and our victory cheer) In the victory cheer video, the team was calling out their mission sequence in the tent.)
Section 2
Design Overview
Design Overview: Engineering Design

• Since the goal is to validate the CubeSat flight components, there will be no science performed during this flight.

• The design of the payload will mimic the 1U CubeSat configuration as closely as possible. The payload will be cut in to (3) sections:
  • 1U Hermes Cube
  • VR Camera Block
  • Added Experiments/Power Block

• The Hermes Cube will contain the: Flight Computer, Iridium Modem, Antenna, batteries, and solar panels.

• The power block will take the power from the rocket and provide an “on” signal to equipment in all (3) sections of the overall Hermes Payload.
Functional Block Diagram

Key:
- Red Arrows = Power Flow
- Black Arrows = Data Flow
2D Payload Diagram

- The diagram depicts a 2D TOP DOWN representation of the various compartments within the structure.
- The Hermes CUBE should resemble a 1U CUBESAT.
- Power circuits and Added Experiments all be contained in a 1U cube format.
- Added space is given to the VR Camera.
- The lens opening shall provide a view of the earth.
- 3D Diagrams will be provided once the components are finalized.

- The pointing requirements are as follows:
  - The Iridium antenna must point zenith (towards space).
  - The VR camera must point towards Earth.

- Note, the lay out and design are subject change.
- The overall structure has the following dimensions:
  - Length = 7 inches
  - Width = 8 inches
  - Height = 5 inches
  - Antenna = 1.89”
  - Lens Opening = 1.89”
## Activation Sequence

<table>
<thead>
<tr>
<th>Event</th>
<th>Time On</th>
<th>Units</th>
<th>Dwell Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSE 1</td>
<td>N/A</td>
<td>(T+X) (sec)</td>
<td>N/A (sec)</td>
<td>N/A</td>
</tr>
<tr>
<td>GSE 2</td>
<td>N/A</td>
<td>(T-X) (sec)</td>
<td>N/A (sec)</td>
<td>N/A</td>
</tr>
<tr>
<td>TE-1</td>
<td>N/A</td>
<td>(T+X) (sec)</td>
<td>N/A (sec)</td>
<td>N/A</td>
</tr>
<tr>
<td>TE-2</td>
<td>N/A</td>
<td>(T+X) (sec)</td>
<td>N/A (sec)</td>
<td>N/A</td>
</tr>
<tr>
<td>TE-3</td>
<td>N/A</td>
<td>(T+X) (sec)</td>
<td>N/A (sec)</td>
<td>N/A</td>
</tr>
<tr>
<td>TE-R</td>
<td>0:01</td>
<td>(T+X) (sec)</td>
<td>1 (sec)</td>
<td>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 &quot;ON SIGNAL&quot; to our battery pack.</td>
</tr>
</tbody>
</table>

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.
## Pin Assignments

<table>
<thead>
<tr>
<th>Power Pin</th>
<th>Function</th>
<th>Intended Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GSE 1</td>
<td>N/A (will not be used by CTU)</td>
</tr>
<tr>
<td>2</td>
<td>Timer Event Redundant (TE-RA)</td>
<td>(T+0.1 sec), Initialization Circuit. Pins 2&amp;3 tied together</td>
</tr>
<tr>
<td>3</td>
<td>Timer Event Redundant (TE-RB)</td>
<td>(T+0.1 sec), Initialization Circuit. Pins 2&amp;3 tied together</td>
</tr>
<tr>
<td>4</td>
<td>Timer Event 1 (TE-1)</td>
<td>N/A (will not be used by CTU)</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Tied to Common Ground</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>Tied to Common Ground</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
<td>Tied to Common Ground</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>Tied to Common Ground</td>
</tr>
<tr>
<td>9</td>
<td>GSE 2</td>
<td>N/A (will not be used by CTU)</td>
</tr>
<tr>
<td>10</td>
<td>Timer Event 2 (TE-2)</td>
<td>N/A (will not be used by CTU)</td>
</tr>
<tr>
<td>11</td>
<td>Timer Event 3 (TE-3)</td>
<td>N/A (will not be used by CTU)</td>
</tr>
<tr>
<td>12</td>
<td>GND</td>
<td>N/A (will not be used by CTU)</td>
</tr>
<tr>
<td>13</td>
<td>GND</td>
<td>N/A (will not be used by CTU)</td>
</tr>
<tr>
<td>14</td>
<td>GND</td>
<td>N/A (will not be used by CTU)</td>
</tr>
<tr>
<td>15</td>
<td>GND</td>
<td>N/A (will not be used by CTU)</td>
</tr>
</tbody>
</table>
# User Guide Compliance

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Status/Reason (if needed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center of gravity in 1&quot; plane of plate?</td>
<td>Will maintain within 1&quot;</td>
</tr>
<tr>
<td>Weight 30.0+/- 1.0 (15.0 +/- 0.5) lbs.?</td>
<td>(15.0 +/- 0.5) lbs.</td>
</tr>
<tr>
<td>Max Height &lt; 10.75&quot; (5.13&quot;)</td>
<td>5&quot;</td>
</tr>
<tr>
<td>Bottom of deck has flush mount hardware?</td>
<td>Yes, Shared Mount</td>
</tr>
<tr>
<td>Within Keep-Out Zone</td>
<td>Will maintain all borders</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>
</tr>
<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>
<td>Using X Redundant Power Lines (TE-R)</td>
<td>Yes</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, 7.5W Max Transmit</td>
</tr>
<tr>
<td>Using deployable?</td>
<td>No</td>
</tr>
<tr>
<td>Whole team consists of US Persons</td>
<td>Yes</td>
</tr>
<tr>
<td>Using ITAR and/or Export Controlled hardware</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Section 3
Management
Team Organization Chart

- Andrew Rath
- Sophia LoSchiavo
- Ian Hastings
- Erik Schroen
- More Students to join throughout the project cycle!!
Preliminary Schedule and Monitory Budget

• Team Hermes meets every Monday at 6:30 pm ET.
• The Hermes team is committed to meeting all project deadlines.
• The schedule for meetings and builds will change as the team starts receiving the necessary equipment.
• The budget at this time remains TBD. The Maryland Space Grant Consortium (MSGC) will be approached for funding. The proposal deadlines are in November. MSGC funded the Project Hermes flight on RockSat-X 2015.

10/11/2016
Project Hermes RockSat-X 2017 (CoDR)
Mentors/Support

- **Professor Rishabh Maharaja** – Hermes Advisor/Concept Developer, RockSat-X 2015 PI
- **Marcel Mabson** – FSW/OpsCon/Systems Engineering Support
- **Former members from Hermes RockSat-X 2015**
- **Daniel Bottner** – Structural Fabrication
- Iridium modem support from **JouBeh Technologies**
- Iridium Antenna support from **Maxtena Inc.**
Risk/Worries

- The RockSat-X 2015 user’s guide stated that no rechargeable Li-Ion batteries shall be used. Is that still the case? The RockSat-X 2017 User Guide did not state that, need of confirmation.
  - The ultimate goal of the project is to proceed toward using our system onboard a CubeSat. If the project was allowed to fly a rechargeable battery, we would closely mimic our CubeSat build configuration. (Intend to fly total of three batteries)
  - Hermes RockSat-X 2015 flew a Li-Ion rechargeable battery with great success.
- The project will be emitting RF in the following frequencies:
  - L-Band: **1616-1626.5 MHz**
- Need to know the orientation of rocket **after stabilizing** for antenna and camera placement.
  - Iridium Antenna to be Zenith Pointed
  - VR Camera to be Nadir Pointed
### Contact Matrix

**Project Hermes / Capitol Technology University**

Fall 2017 RS-X Contact Matrix (global Hermes email: ctuprojecthermes@outlook.com)

<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>Super Boss (PI)</td>
<td>Angela Walters</td>
<td>1-240-554-7278</td>
<td>1-240-554-7278</td>
<td>Yes</td>
<td><a href="mailto:awalters@captechu.edu">awalters@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Advisor</td>
<td>Rishabh Maharaja</td>
<td>1-410-967-8703</td>
<td>1-410-967-8703</td>
<td>Yes</td>
<td><a href="mailto:rymaharaja@captechu.edu">rymaharaja@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Hermes RockSat Project Lead</td>
<td>Sophia LoSchiavo</td>
<td>1-570-351-4878</td>
<td>1-570-351-4878</td>
<td>yes</td>
<td><a href="mailto:seloschiavo@captechu.edu">seloschiavo@captechu.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Hermes RockSat Project Lead</td>
<td>Andrew Rath</td>
<td>1-858-382-6156</td>
<td>1-858-382-6156</td>
<td>Yes</td>
<td><a href="mailto:andrew.t.rath@gmail.com">andrew.t.rath@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Hermes FSW Lead</td>
<td>Ian Hastings</td>
<td>1-443-497-8242</td>
<td>1-443-497-8242</td>
<td>yes</td>
<td><a href="mailto:icantfly31297@gmail.com">icantfly31297@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Hermes Electrical Systems Lead</td>
<td>Erik Schroen</td>
<td></td>
<td></td>
<td></td>
<td><a href="mailto:eschroen2@gmail.com">eschroen2@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
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### Project Hermes-Capitol Technology University:

#### CoDR RS-X Team Availability Matrix

<table>
<thead>
<tr>
<th>Oct 10-14</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 AM</td>
<td></td>
<td></td>
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</tr>
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<td>8:00 AM</td>
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</tr>
<tr>
<td>9:00 AM</td>
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<tr>
<td>11:00 AM</td>
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<td>12:00 PM</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>4:00 PM</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5:00 PM</td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

Please Place priority levels for times you are available. This is done by simply typing a 1, 2, 3, or 4 in each clear box. Hashed boxes are not available.

**Example**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Priority</td>
<td>Lowest Priority</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section 4
Conclusion
Why We Deserve to Fly

• Team Hermes at Capitol Technology University has demonstrated dedication and success through the RockSat-X 2015 flight.

• This flight will be a proving ground for the Hermes 1U Cube design as well as an introduction point for new team members under the advisement of Hermes’ veterans.

• In this way, Capitol Tech students through Hermes will be able to enhance the team's cumulative experience while still producing quality results.
Conclusion/PDR steps

• Team Hermes would like to use the RockSat-X platform to test the Hermes 1U CubeSat. The Hermes 1U CubeSat is slated to launch in December 2017. The RockSat program will allow us to test our model and obtain lessons learned.

• The flight on RockSat-X 2017 is the testbed. Any lessons learned will be our success criteria.

• Looking forward toward the PDR, the team's next step will be to complete our precise design layout.
  • Waiting for equipment delivery
  • Create a 3D printed model of the layout
  • Prepare for a launch on a high altitude balloon
Questions