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Corvus-BC Manufacturing Lessons Learned

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Introduction

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- Company History
  - Silicon Valley start up founded in 2015
  - Acquired Astro Digital in 2016 (Platform API for imagery data)
  - Decided to carry on ***Astro Digital** brand for joint company in the future (transitioning now)
- Mission
  - Build a system to monitor the global economy of food production
  - Design, build, and operate small multi-spectral imaging satellites
  - Monitor commercially active land at a high frequency (22 m daily, 2.5 m weekly)
- Methods
  - System integrators
  - Develop sub-systems and components when necessary
  - Provide data over web-based imagery platform
  - Work with partners in agri-intelligence, precision agriculture, security, and environmental/disaster monitoring
  - Opening up our design to enable others' missions

Our Background

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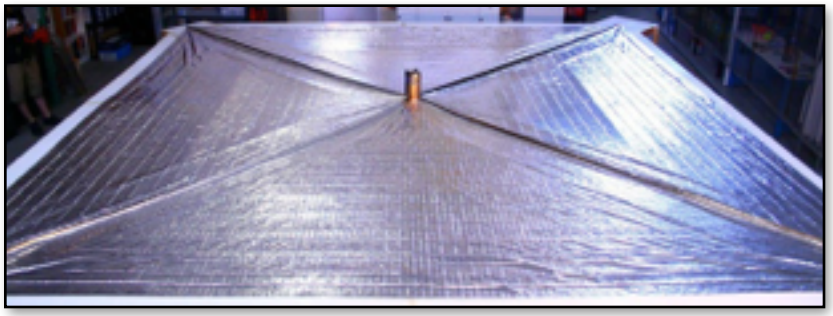
- Team assembled from all areas of industry
- 100% of current team completed Perseus-M mission
- Now focusing on assembly, integration, and test of Corvus-BC constellation

Corvus-BC

LightSail



SSL - NBNCo-1a

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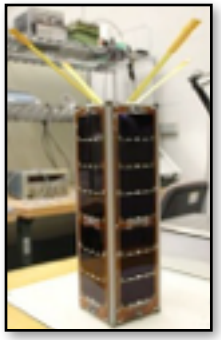
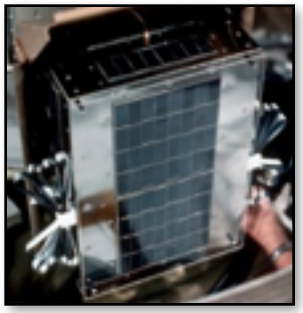


AmSat – Oscar Series



Perseus-M

Current Projects

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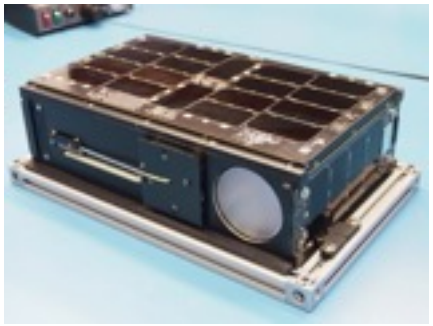
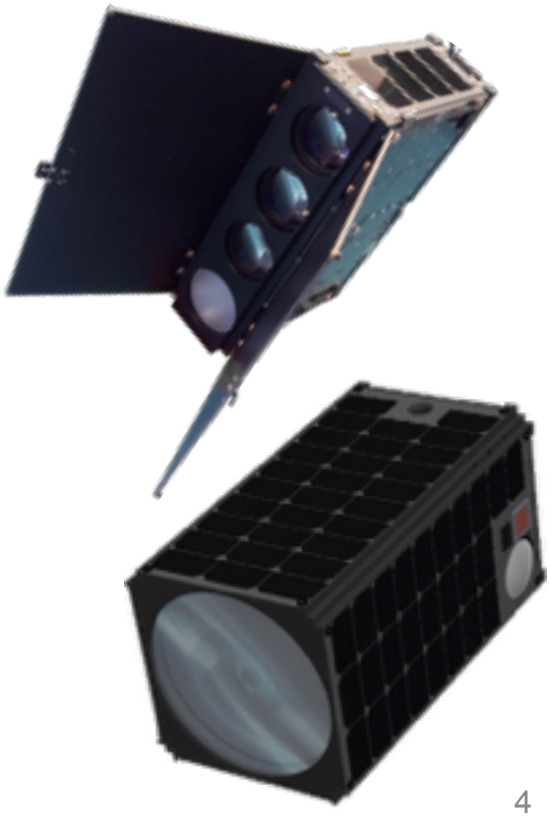
- **Perseus-M**
  - Launched in June 2014
  - 2x 6U Automatic Identification System (AIS) CubeSat
  - On-orbit testbed: Hardware verification, ACS, Ka, etc.
  - Also used for Flight Ops plan development



- **Corvus-BC**
  - Launch Q3, 2016
  - 3x 6U remote sensing CubeSat
  - Multispectral: Red, Green, NIR
  - 22 m GSD

- **Corvus-HD**
  - Launch Q1, 2017
  - 1x 16U remote sensing CubeSat
  - Multispectral: Red, Green, Blue, NIR, Red Edge
  - 2.5 m GSD



Corvus-BC Overview

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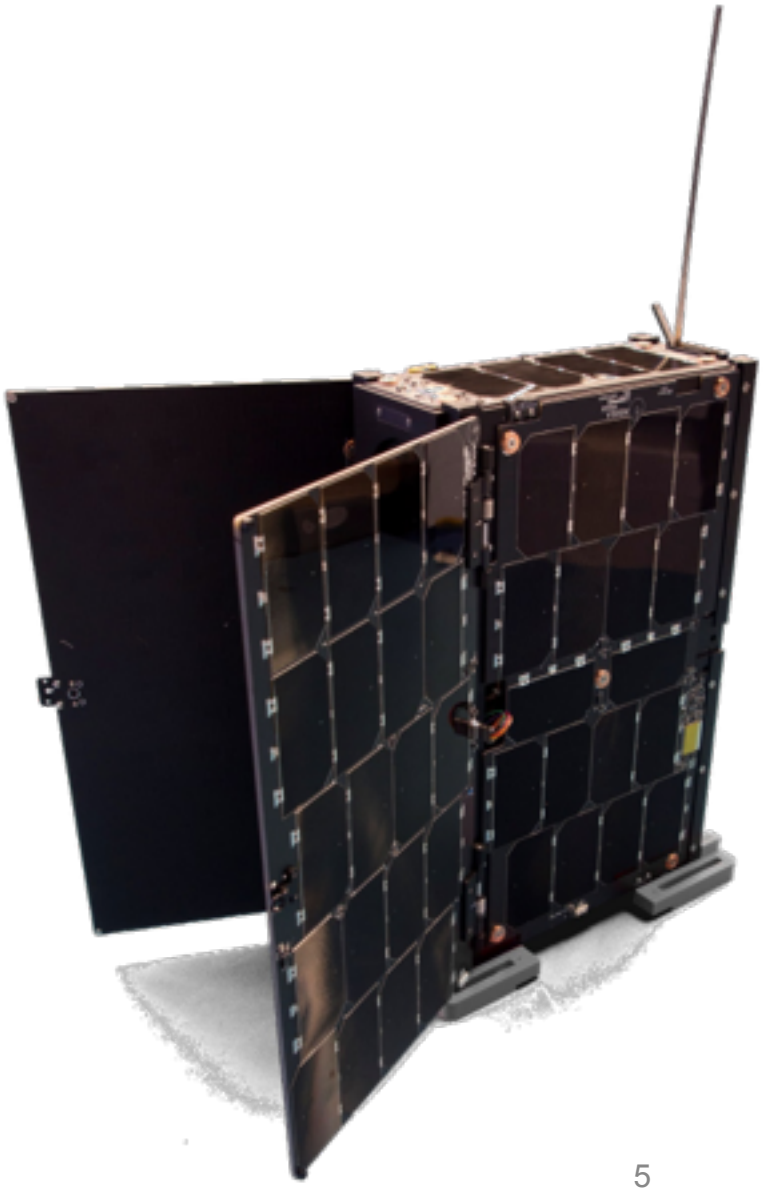
- Imaging solution: 22 m GSD at 600 km, Red, Green, NIR spectral bands
- Flight computer: ARM A8 running linux
- Power system: Scalable 48Wh Li-Ion
- Communication: UHF transceiver running at 19.2 kbps for TT&C. Payload data is downlinked through Ka-band at up to 320 Mbps
- Solar panels: ARM M0+ processor, temperature, magnetometers, sun sensors, and magnetorquer coils
- Control: 3-axis with three reaction wheels, star tracker, GPS, and gyro
- Camera Storage: 1 TB
- Imaging capability: 100,000,000 km^2 per day



Design for Manufacturability!

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- Perseus-M and Lightsail were designed for optimum volume usage (i.e., tough to build)
- Corvus-BC is designed with easy assembly in mind
  - “Server Rack” style Data Power Module
  - Lots of parallel assembly prior to system integration
  - Easy access to all subsystems by removing one panel
  - Simplified procedures

Data Power Module

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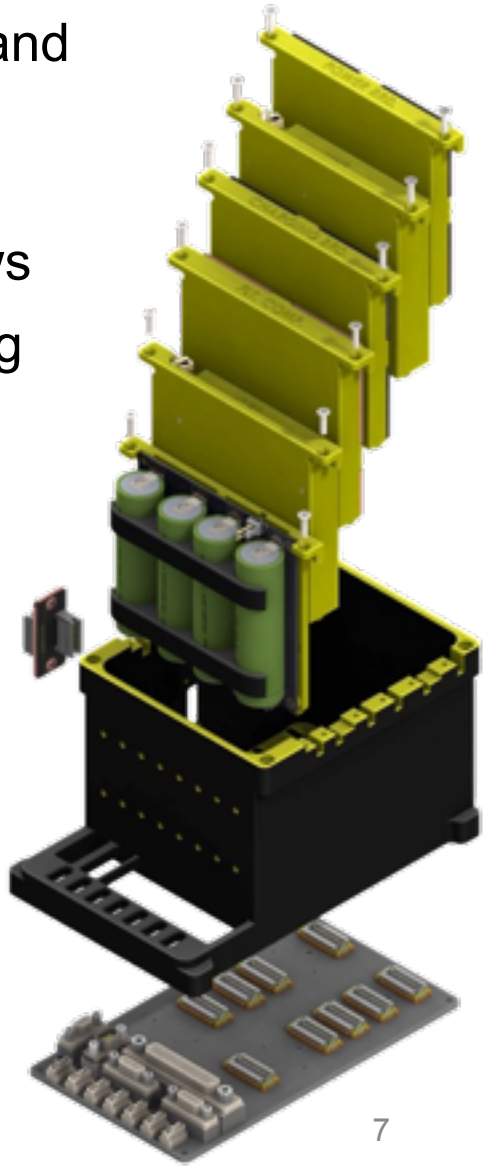
- DPM includes Flight Computer, EPS, UHF Radio, and GPS Receiver
- Each board is contained on a “Card”
- Easy to install and remove Cards with only 2 screws
- Allows for quick assembly and easy troubleshooting



Parallel Assembly

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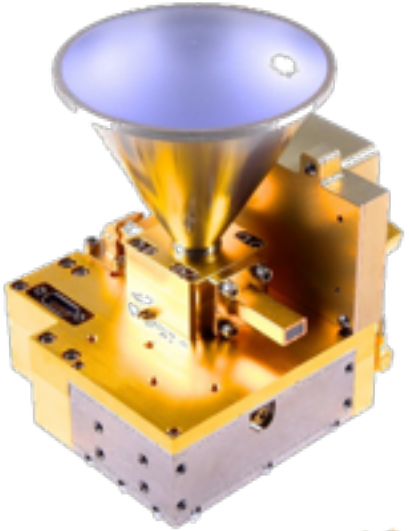
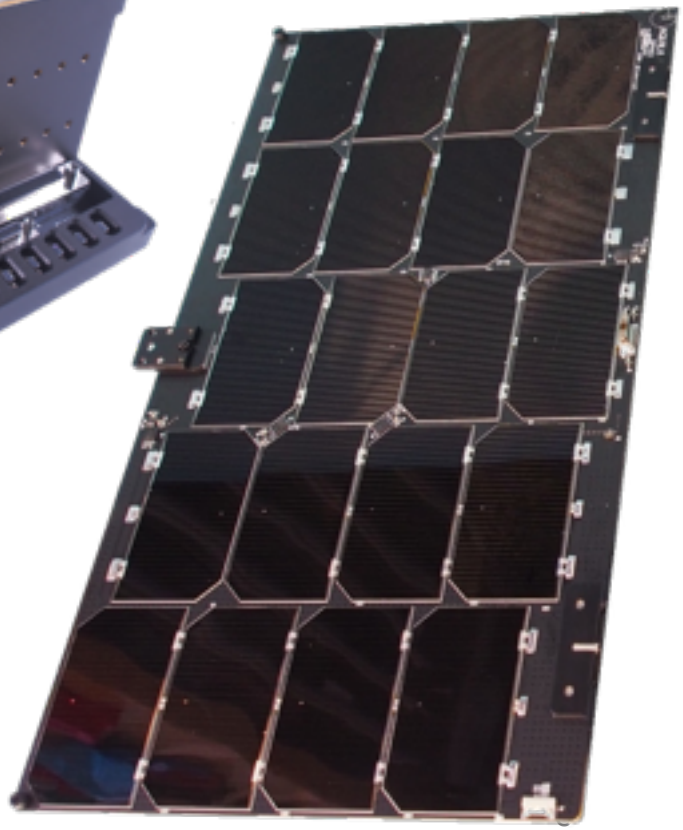
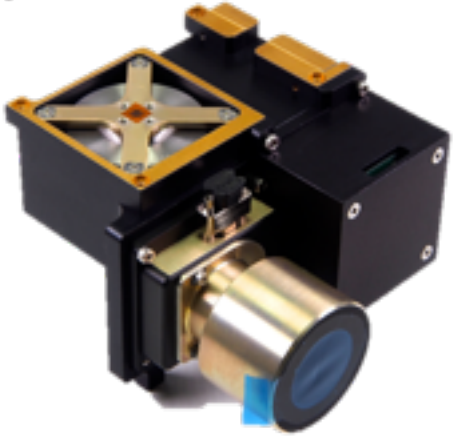
- Self-contained units that can be quickly integrated into S/C
- Simple interfaces between units limit system-level work

Simple System Assembly

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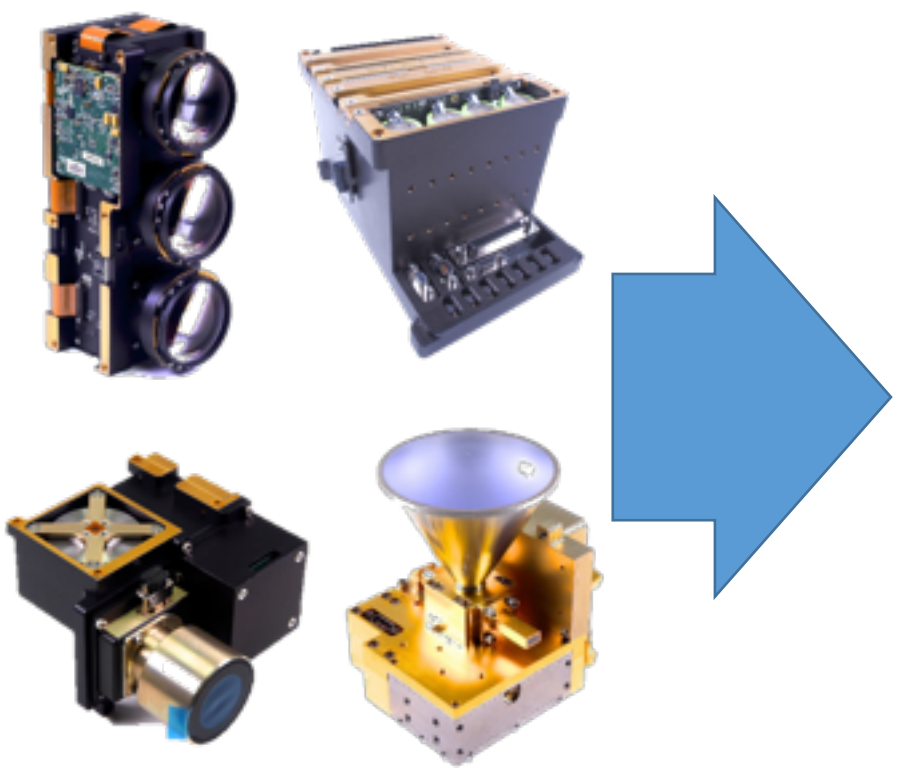
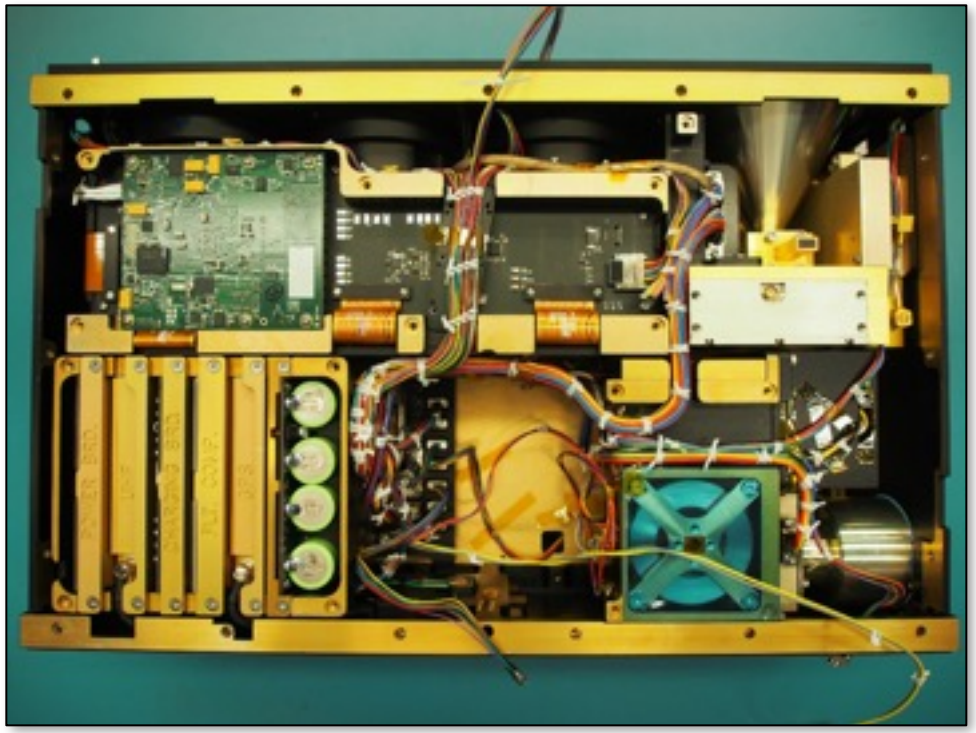
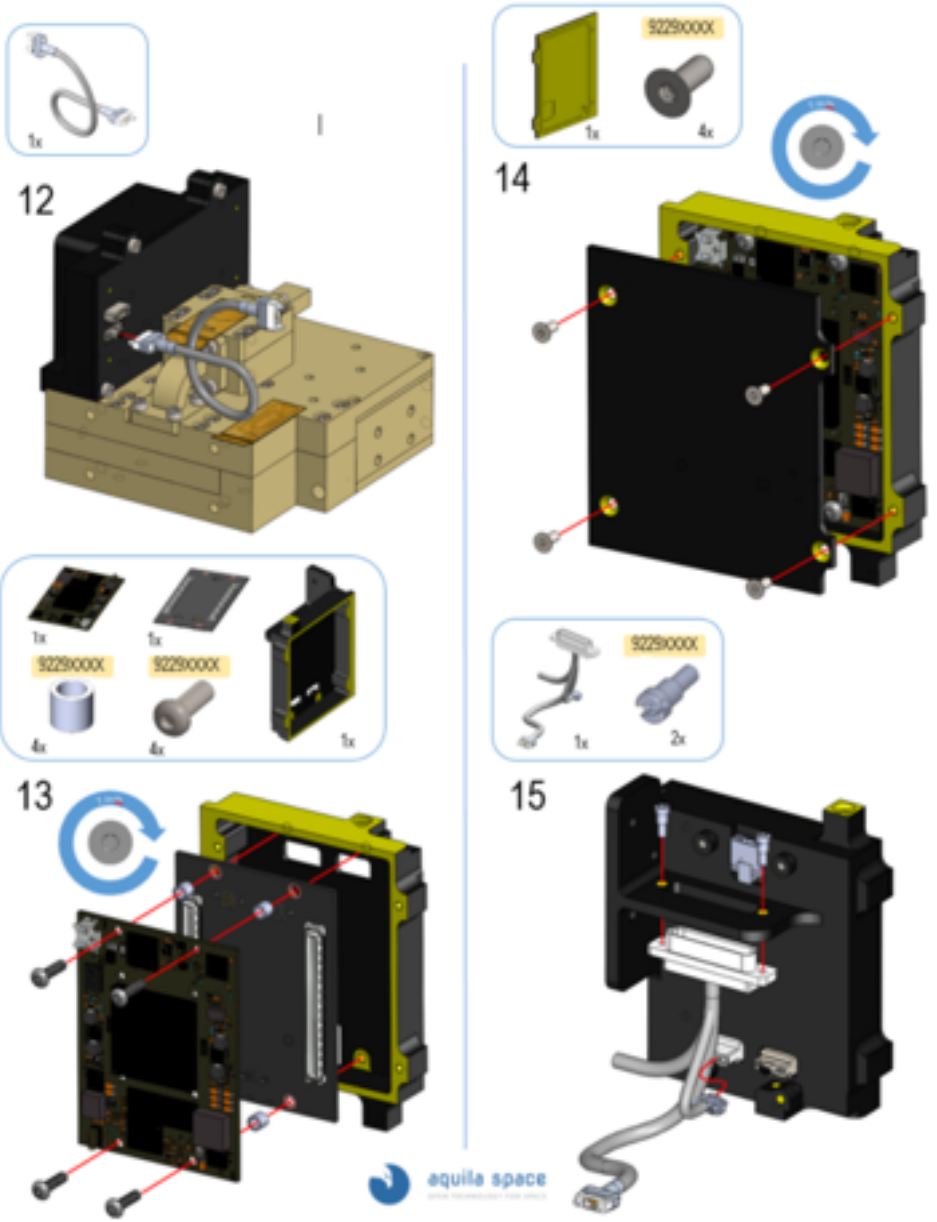
- All internal units bolt onto one panel at the system level
- Easily accessible until the absolute latest stages of assembly





Simplified Procedures

- Pictorial procedures allow for better comprehension and quick assembly
- Easier for assembler to understand designer's intentions
- Adapts well to changes
- Harness routing becomes much more of a science than an art
- A little more work to create the procedure initially, but it saves time where it counts
- Creating kits with all parts for a subassembly also speeds up the process



Software Testing

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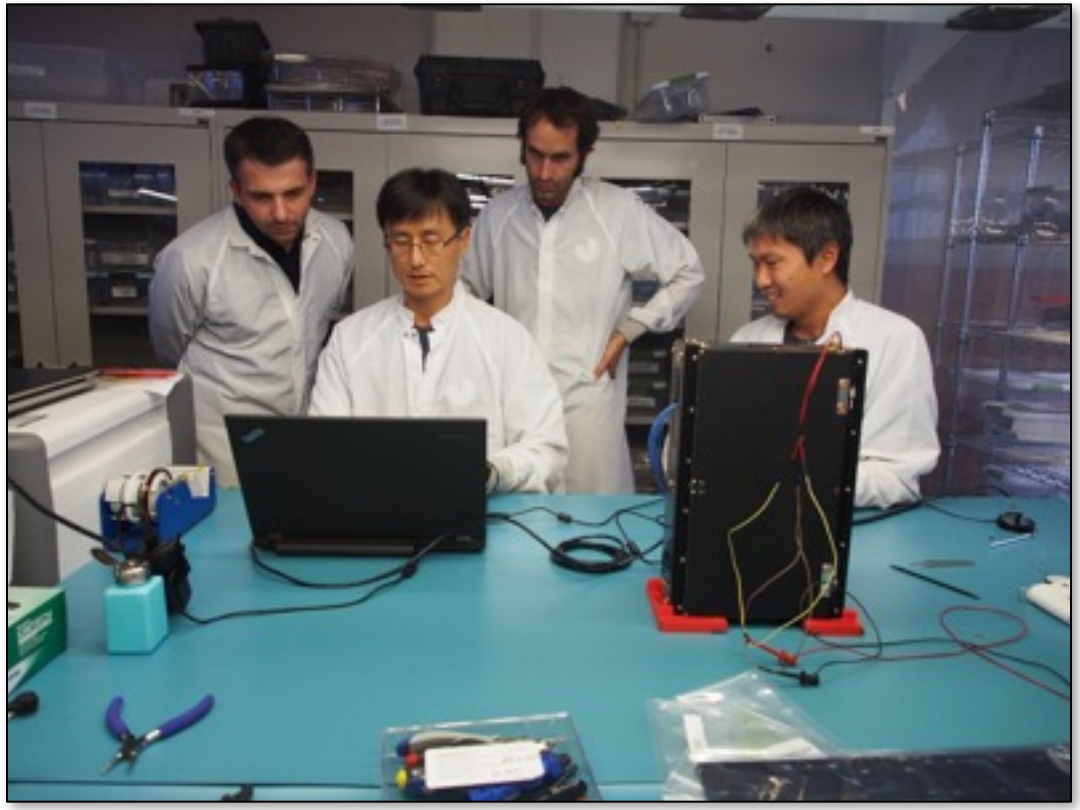
- For Aquila, software always seems to have to wait until final integration to run full-up tests
- We improved this time by integrating multiple development BenchSats early on
  - Imager BenchSat, Ka BenchSat, ACS BenchSat, etc.
- Perseus-M satellites also serve as on-orbit development platforms



General Observations

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- Build early and often: If you can fit check something or connect two boards together early, do it
- No amount of analysis makes things work the first time (usually)
- Standardize your fasteners, connectors, parts, etc.
- Keep an eye out for upcoming bottlenecks

Time Lapse

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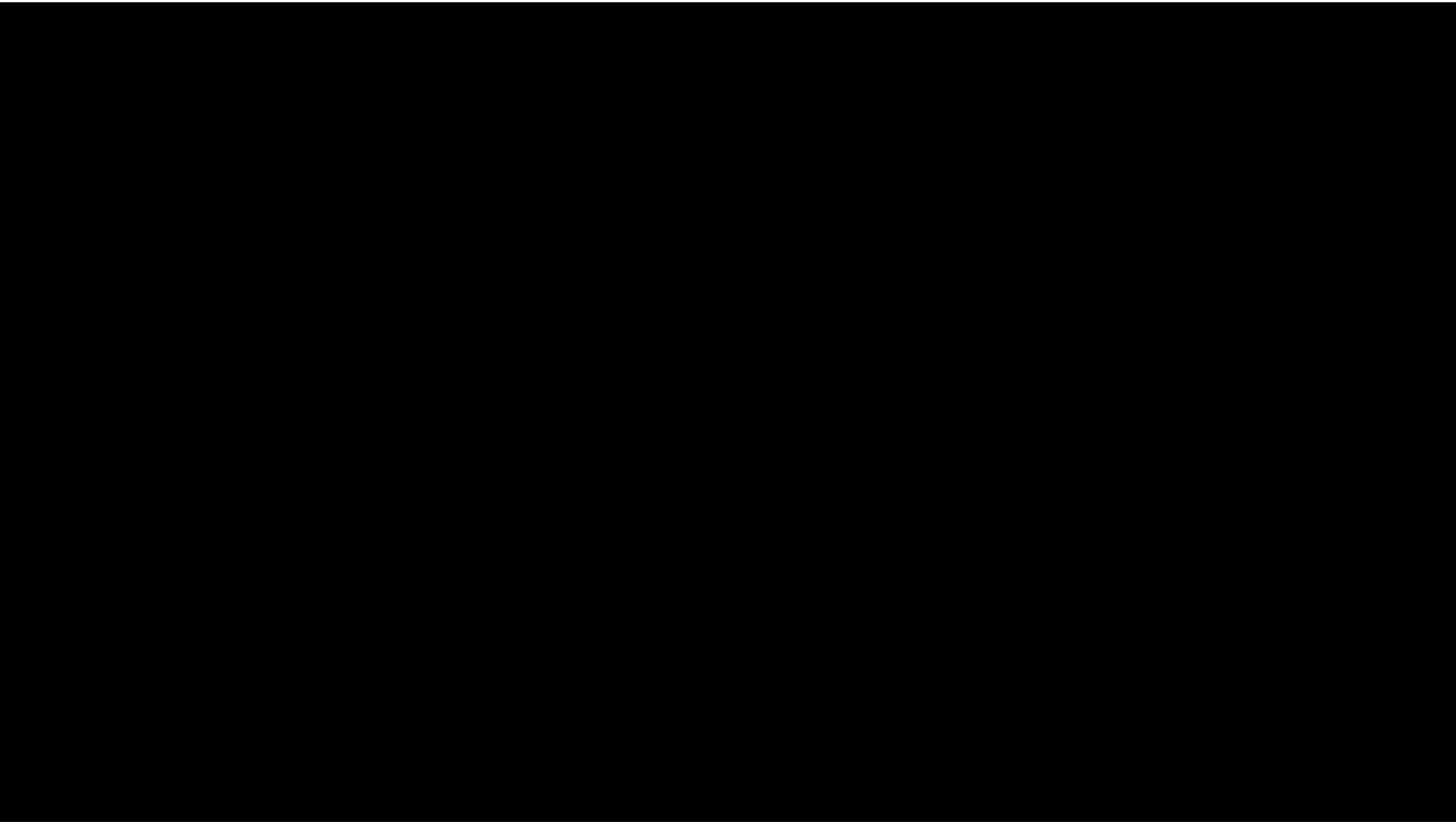

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Questions?