OPEN and OpenOrbiter: A Needs-Responsive Solution for the Small Satellite Community

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Overview

- The Problem
- Towards a Solution
- The Open Prototype for Educational NanoSat (OPEN) Concept
- OpenOrbiter

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The Problem

- Chicken-or-egg style problem: most funding sources that would fund small spacecraft development expect demonstrated competency
- Significant funding is required for demonstrating this competency
- This may exceed the 'seed' and startup sources available at most universities.

The Problem (cont.)

- Colleges / universities may lack a required discipline to develop the spacecraft
- Research requirements may dictate the need to modify a standard subsystem design
- Program schedule and funding source requirements may not be conducive to collaboration

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# Towards a Solution

Requirements:

- Allow flexibility as to the qualifications of team members
- Reduce costs to a level that can be funded by educational or 'seed' funding sources
- Facilitate the transition from project to program
- Try not to "boldly go where no one has gone before" (at least from a project management perspective!)

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Not Reinventing the Wheel

- Open-Source Software
- Open Hardware
- 'Maker' Movement

The Open Prototype for Educational NanoSats

- A set of freely-available plans, software, fabrication instructions and test plan for a 'base model' 1U CubeSat

- Parts cost of ~$5,000 (excluding payload elements)

- Not over-simplified (e.g., it can perform real science / engineering / etc. work)
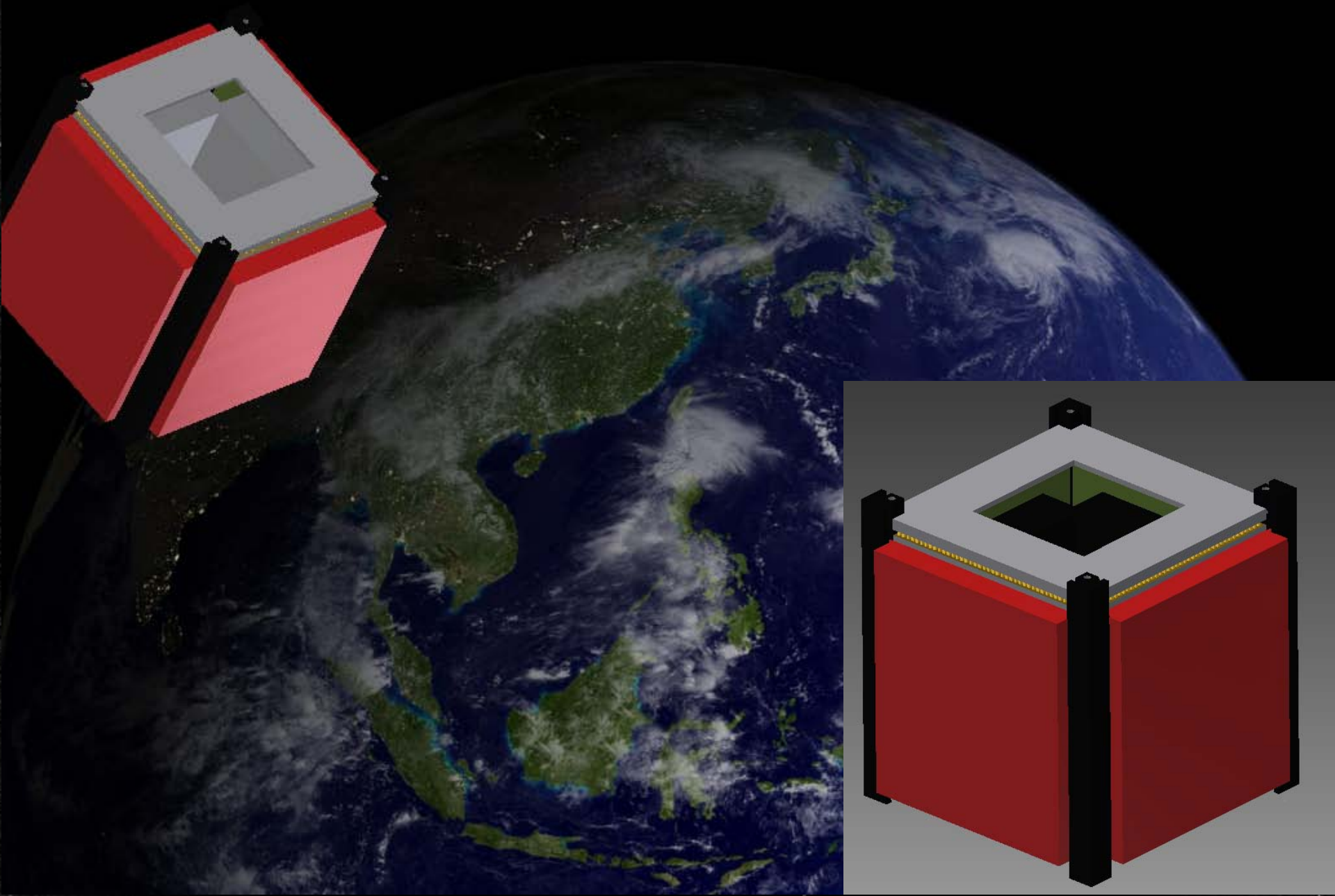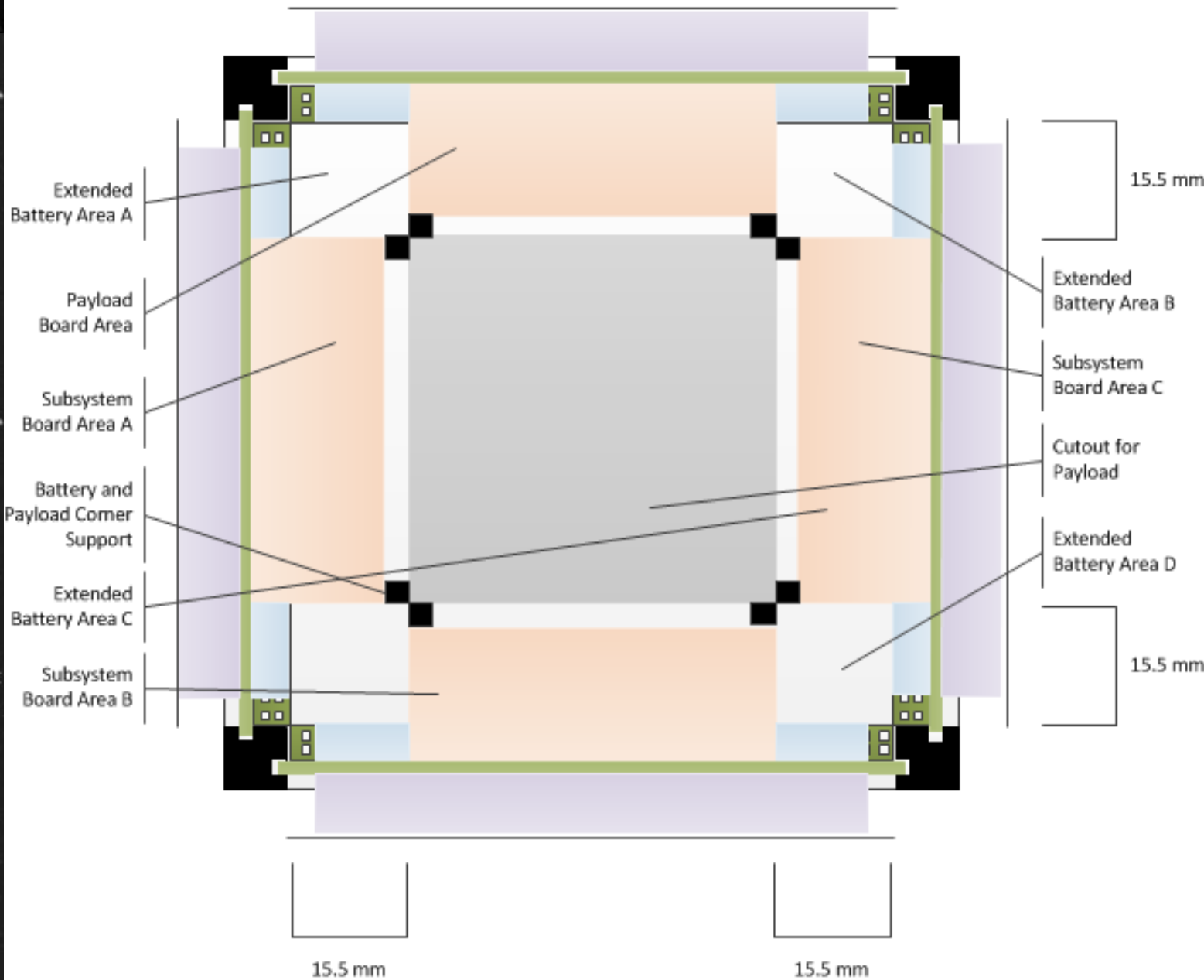
Vertical Board Insertion

- Boards are inserted from the top of the spacecraft
- They form part of the structure – removing the need (and mass/volume) of cross-braces
- Electrical (not physical stacking)
- PC-104 style connector used
- Direct access by boards to craft exterior (antenna deployment, imaging, etc.)

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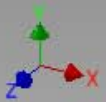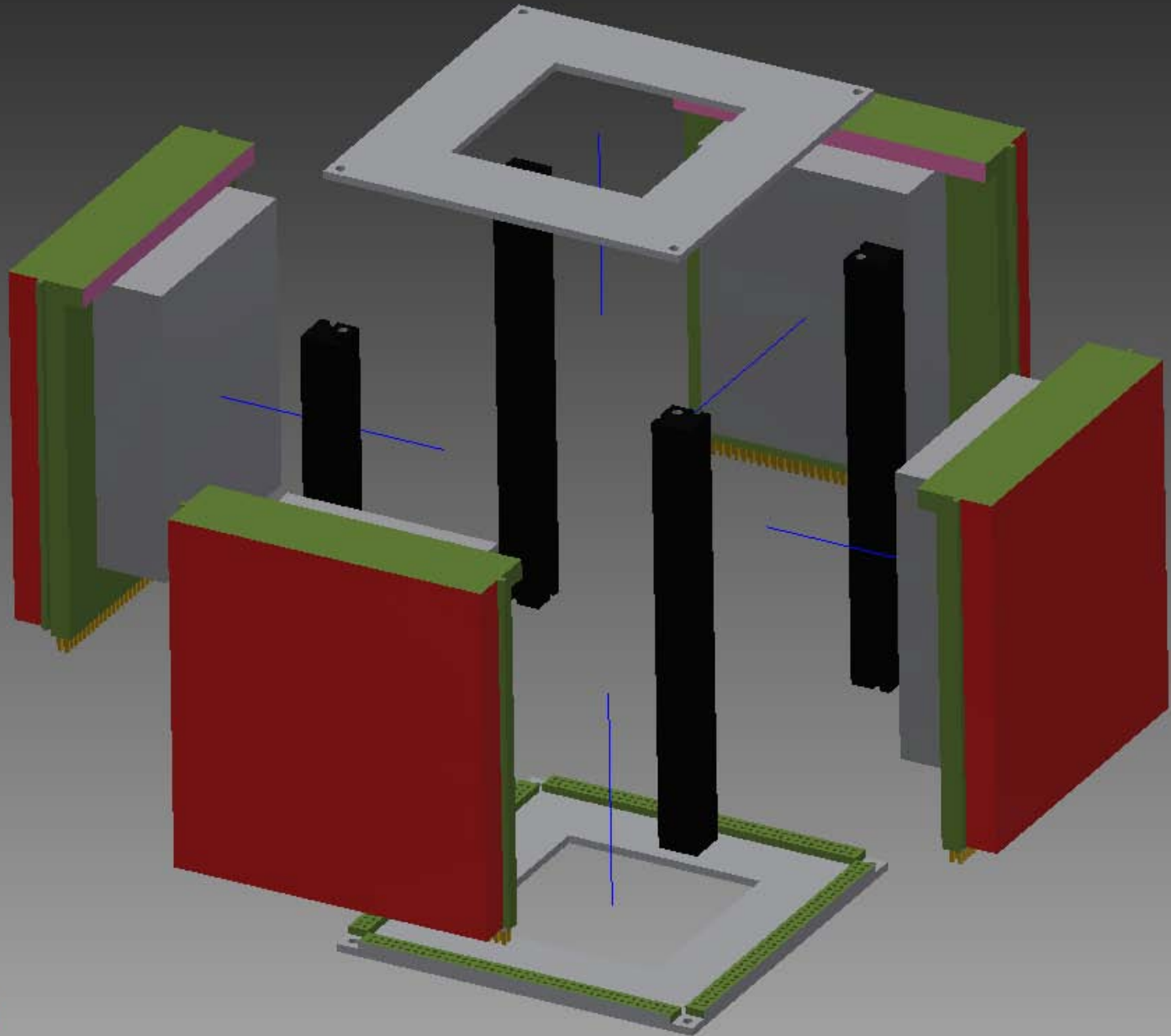
Payload Bay

- A 5 cm x 5 cm opening that runs the length of the spacecraft

- Design can be extended across 2U and 3U form factors to create larger space (e.g., 5 cm x 5 cm x 20 cm or 30 cm)

- At the center of mass, so ideal for storing propellant tanks for propulsion demonstration missions

Extended Battery Area A

Payload Board Area

Subsystem Board Area A

Battery and Payload Corner Support

Extended Battery Area C

Subsystem Board Area B

15.5 mm

Extended Battery Area B

Subsystem Board Area C

Cutout for Payload

Extended Battery Area D

15.5 mm

15.5 mm

15.5 mm

Benefits

- Allows adoption with only key-driver (person) in one area: other elements may be able to be left at base design and fabricated from instructions

- Removes the need to re-pay vendor amortized development costs for each subsequent mission

- Allows modification of subsystems (because all of the availability of complete design documents)

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OpenOrbiter Program

- Student-run space program at the University of North Dakota
- Full 'program' not just STEM exercise
  - Management
  - Public Outreach / Education
  - Policy
  - Typical STEM 'build it' disciplines

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OpenOrbiter Spacecraft

- 1U CubeSat

- Imaging mission

- Technology demonstrator for OPEN concept

- North Dakota's First Free-Orbiting Spacecraft

Next Steps

- Spacecraft development is ongoing
- Testing …
- Creation of OPEN documentation
- Launch and on-orbit validation
- Refinement based on orbital lessons learned

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Thanks & Any Questions?

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