Cubesats with Smallsat Capabilities

Cubesat Developers Workshop – Calpoly April 2009

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Overview

- Where Cubesats are
- Where they need to be

Current Capabilities

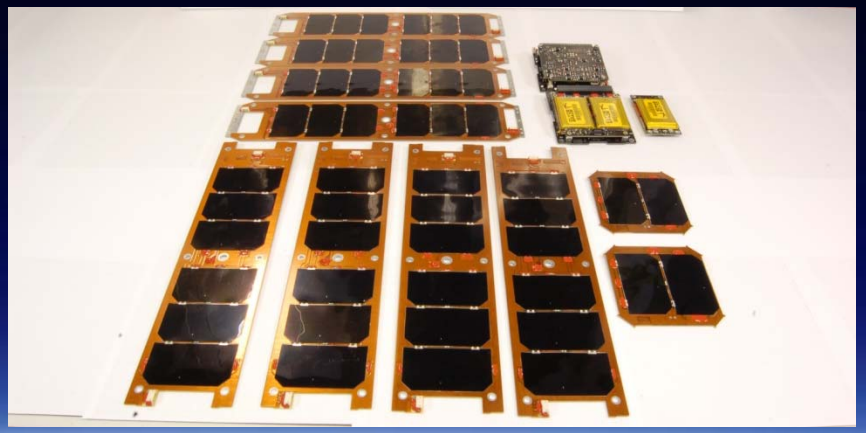
- Successful Missions showing impressive science
- Limited Control over orbit and communications
- Large pull of collective research

Cubesat Potential

- What we need to get to allow Cubesats to compete with SmallSats
  - More power
  - More versatility
    - In available buses;
    - Available payload space;
  - More Control and Manoeuvrability
  - Less weight/volume/cost!

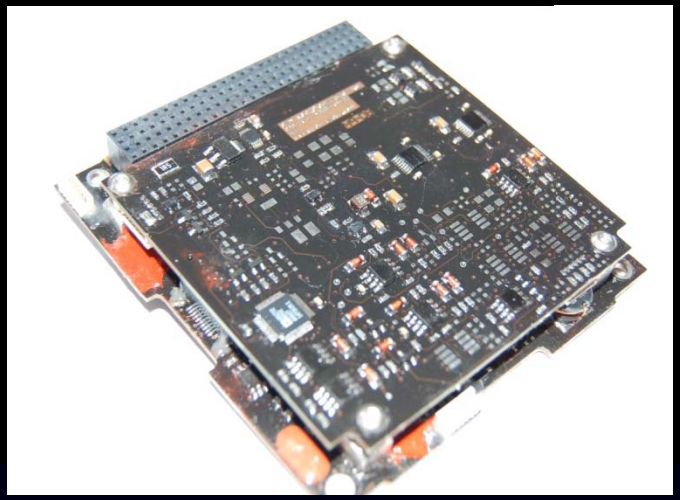
Increasing Solar Arrays

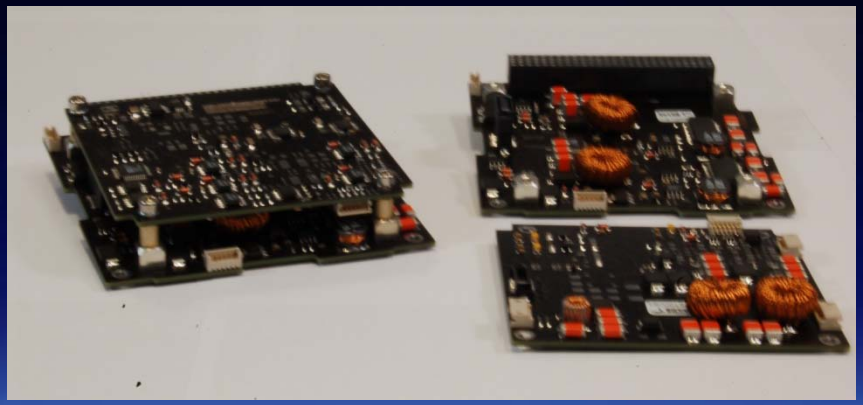
- Deployed Panels to increase solar array capacity
- Advanced structures to accommodate:
  - Arrays
  - Comms
  - Sensors
  - Payloads



Enhanced Capability EPS

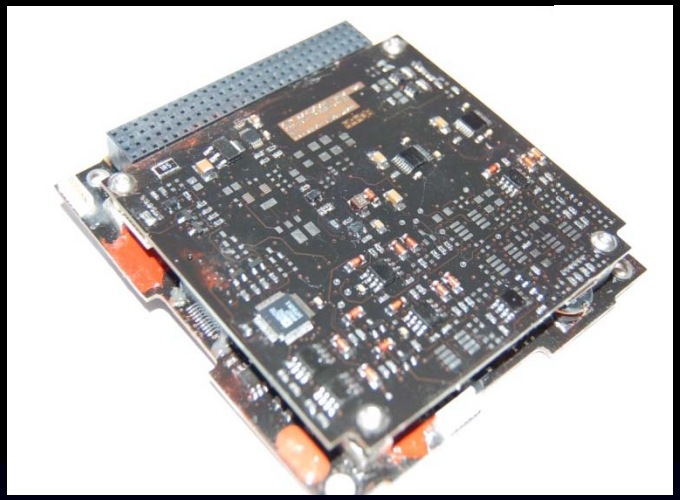
- Interface with more arrays
- Increase power available on regulated and unregulated buses
- Versatile configuration for maximum utilisation
  - Additional BCRs or regulated buses

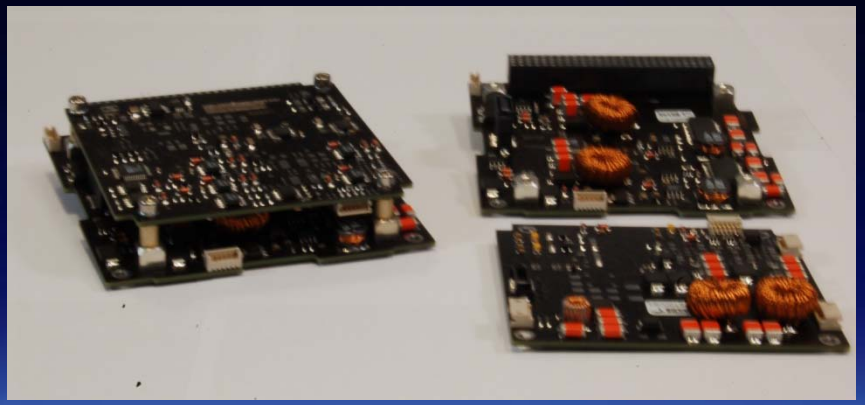




Enhanced Capability EPS

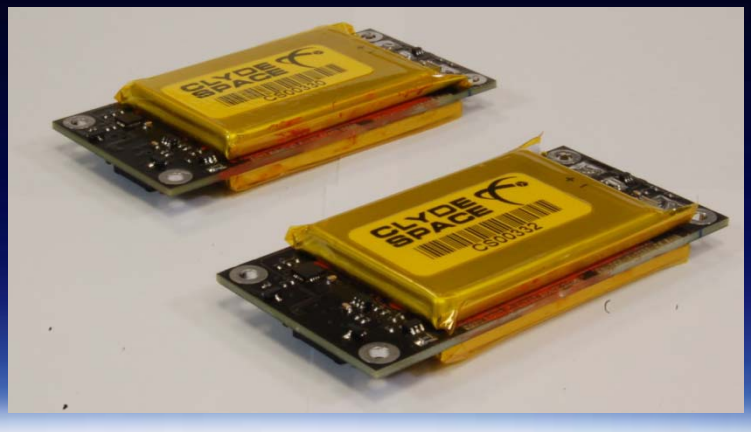
- Target Input power – 54W+
- Target Bus power:
  - Battery – 40W
  - 5V – 18W
  - 3.3V – 9W





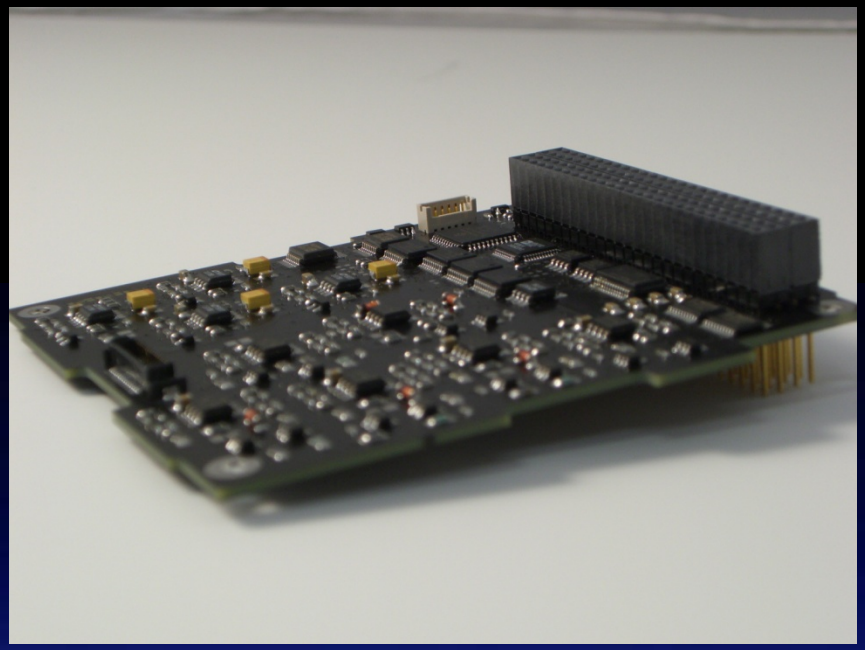
Increasing Battery Capacities

- Standard Batteries from 1.25AHr to 3.25AHr
- Additional remote batteries anywhere in the stack (1.25Ahr per Battery)
- Target - Advanced Battery Materials Development
  - Target 250Whrs/kg



Switch and Telemetry Interface

- Independently controllable power lines
  - From Battery/5V/3.3V/GND
  - Can interface with Bidirectional Magnetorquers
- Interface various sensors and actuators to the I2C bus
- Configurable Serial interfaces
  - LVTTL
  - TTL
  - RS232



ADCS

- Plug n Play ADCS
- Onboard and External Sensors
- Onboard Actuator interfaces
- Algorithms processed on-board
- Simple Command Interface
  - Send the desired attitude
  - Retrieve sensor information if desired
- Self Calibration within ADCS test bed
- Funded by Scottish Government Grant

- ADCS Targets
  - Corse to fine control
  - Detumbling from rates of $>3°s^{-1}$
  - GNS Upgrade Option

μ – Pulsed Plasma Thruster

Soon we can;

- Perform Orbit Trim Manoeuvres
- Gain PRECISE ADCS
- Change Orbital Plane and Altitude (…a little)
- ESA funded with MARS Space and University of Southampton

- Targets:
  - 12μNs per Joule
  - 60μNs Impulse Bit

3U Platform

Payload Interface and Management

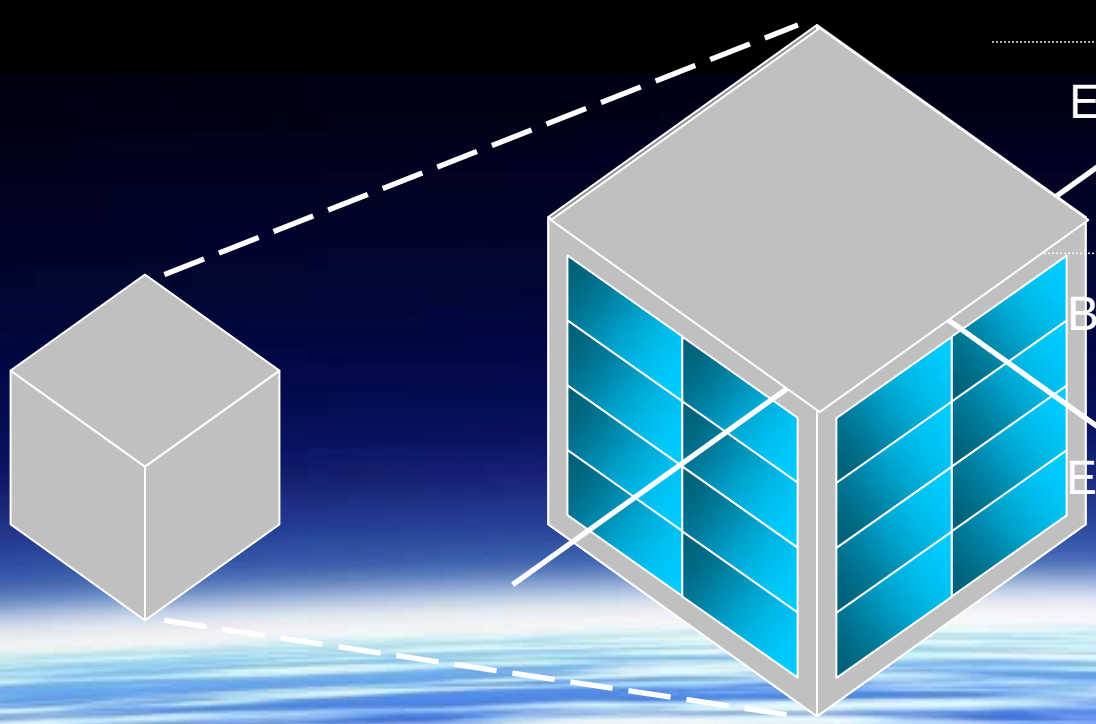
Communications

Attitude determination and control

Electric power system

Batteries

Electric Propulsion



Concluding Remarks

- Cubesats have proven they are a useful platform with massive potential
- To realise this potential requires advancements to the currently available systems
- Could become the most launched platform in history