



UKube-1: A Multi-Payload Technology Demonstration Platform

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Outline



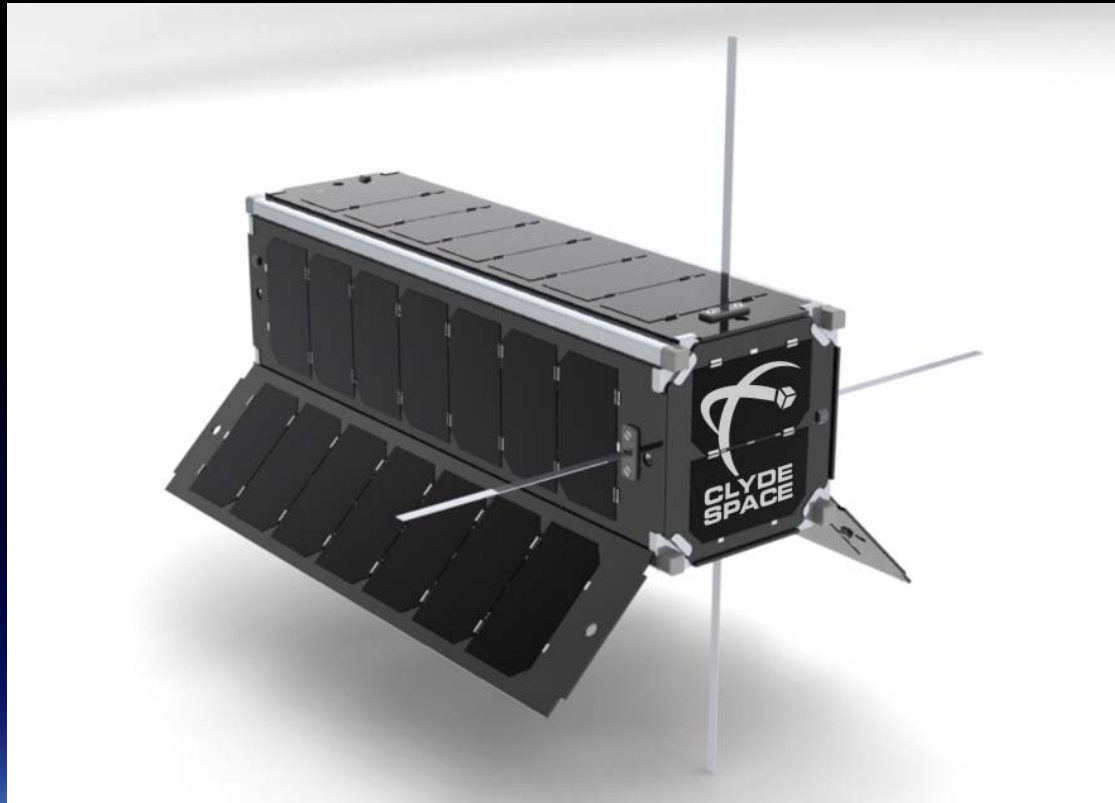
1. Timeline and functional overview
2. Payload Details & Management
3. Enabling Rapid Development and AIT
4. Conclusions

UKube-1

United Kingdom Universal Bus Experiment



- Artist's impression



Mission Objectives



- Ukube-1 shall demonstrate:
 - new UK space technology
 - the capability of useful science to be performed within a CubeSat sized spacecraft
 - industry and university based training in spacecraft development
 - education and outreach in STEM subjects
 - Payload Kick-Off to flight qualified spacecraft in less than 12 months

Mission Team



Project Management,
Technical review



Platform prime



Partnership

- Majority of effort is self-funded
- Exciting “coalition of the willing”

Platform support



S-Band Transmitter



FUNCube



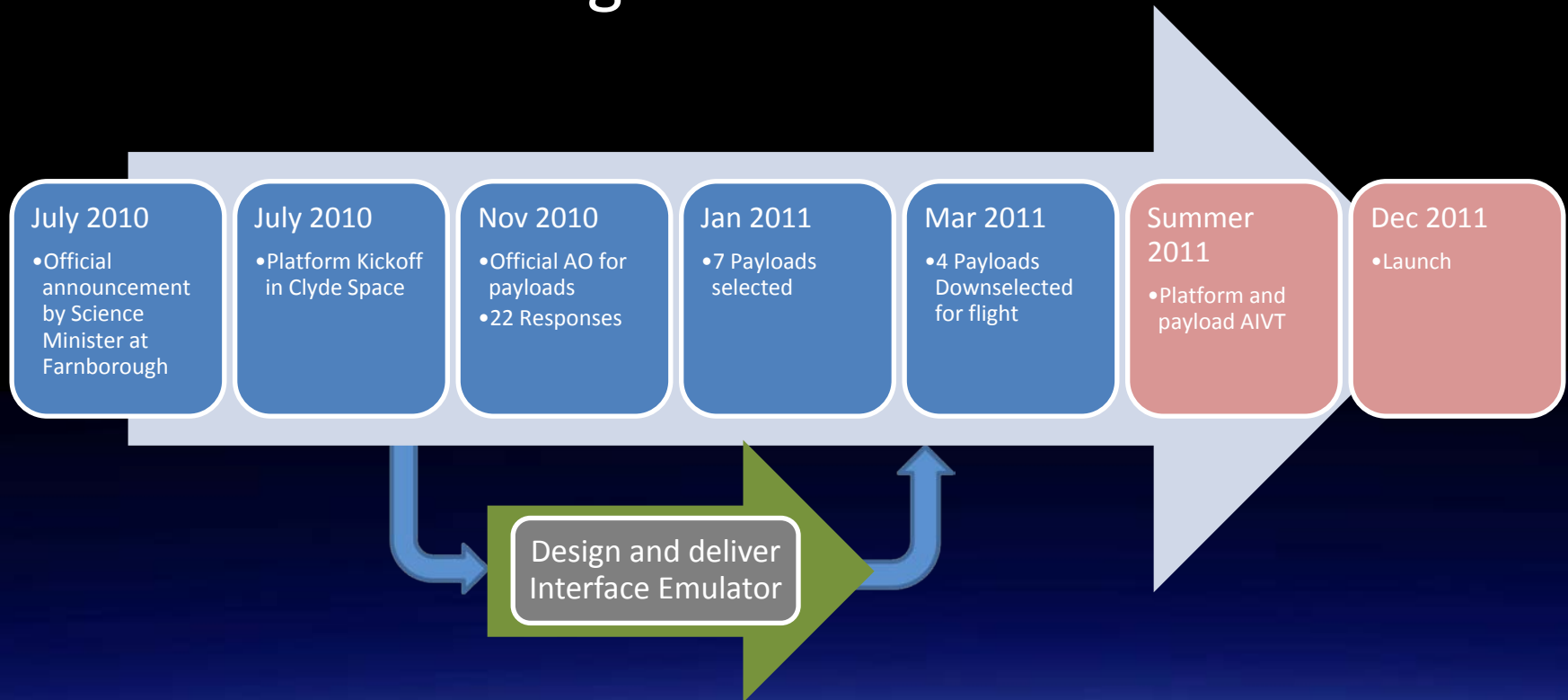
Mission
Computer



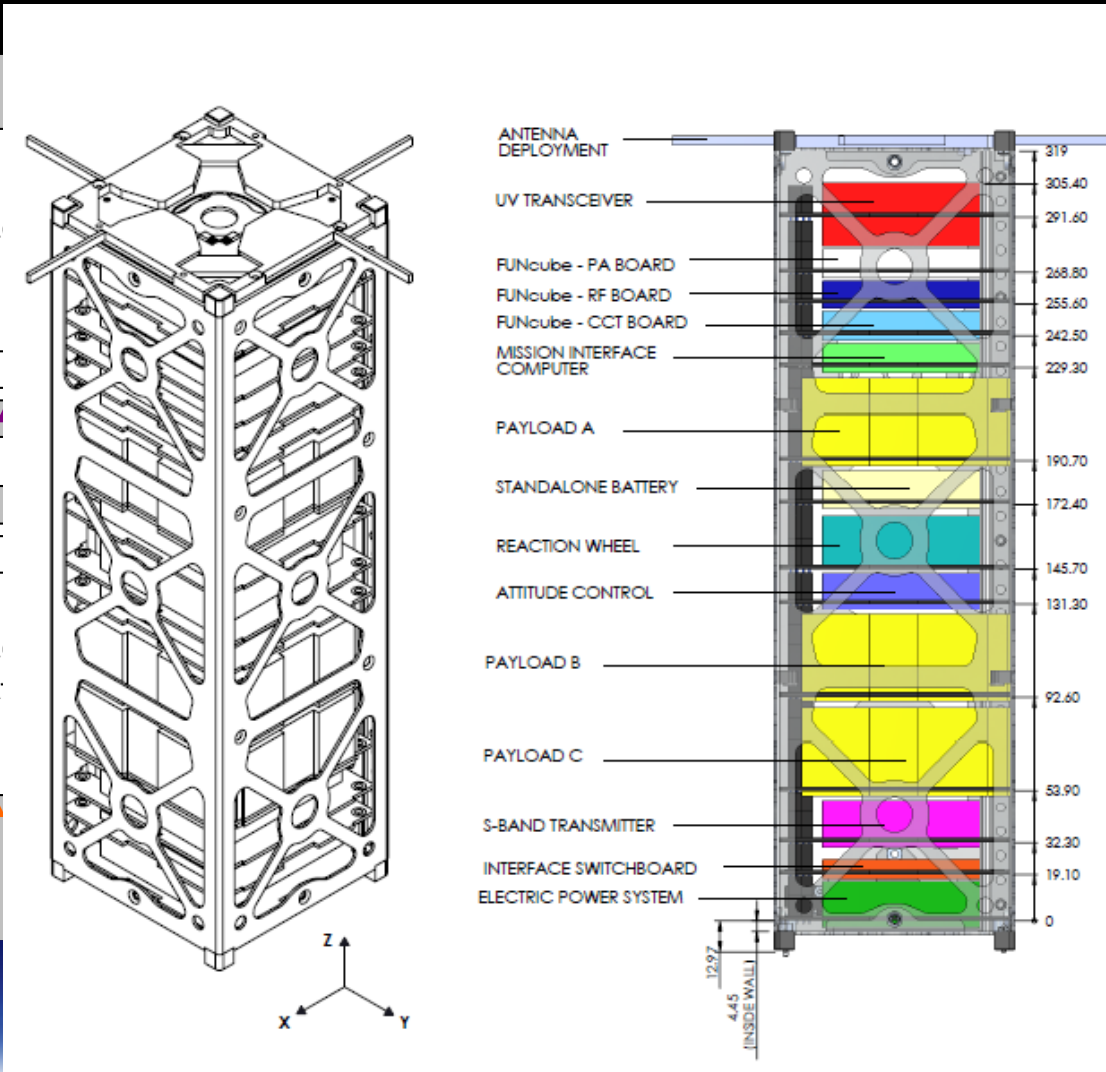
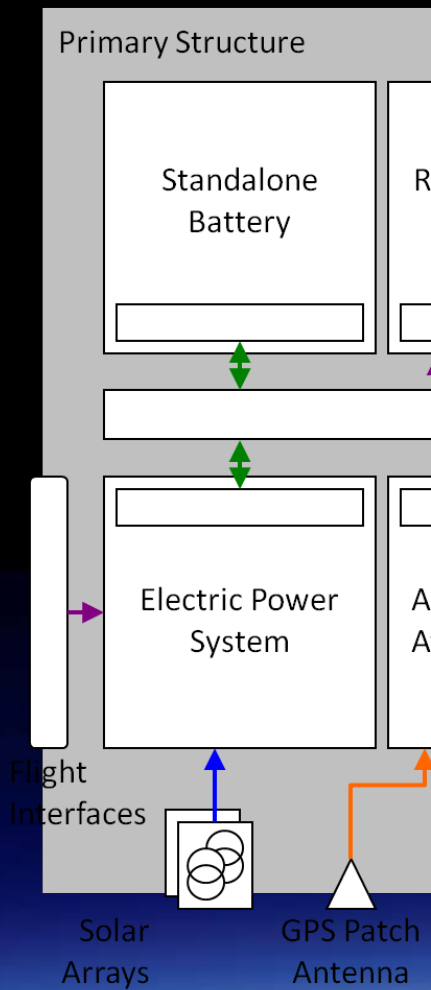
Timeline



18 months to design and build a 3U CubeSat



Platform Overview



Additional FUNCube Payload



- FUNCube Transceiver provides
 - Provides a full-duplex transceiver for the platform (secondary transceiver for very low data rate communications)
 - Provides education & outreach objectives and infrastructure, with the aim to integrate with UKSA outreach and the UKube program beyond this pilot with existing AMSAT experience
 - Provides a pre-made payload for leading the platform-payload integration effort
 - Provides and supports the amateur radio community in response to their support in frequency allocation
 - Harnesses the experience of professional amateurs into the UKube program
 - Provides redundancy for the FUNcube spacecraft



4x Payloads now selected



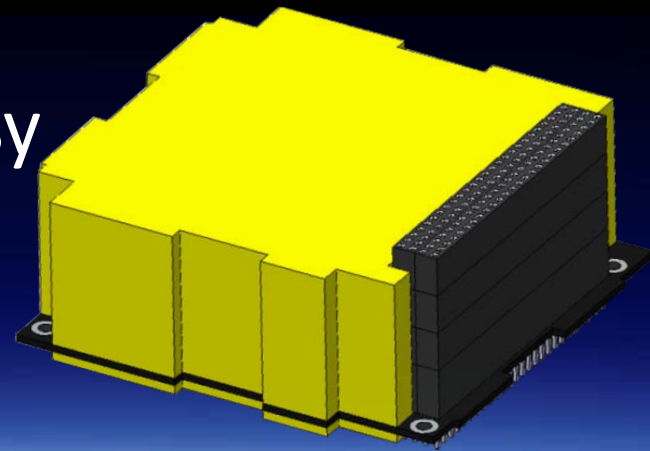
- **Astrium Janus**
 - *Cosmic Radiation random number generator*
 - *Techdemo for effects of radiation on Xilinx FPGA*
- **Open University Imager**
 - *Take high quality images*
 - *Techdemo of a European CMOS imager using 0.18u process*
- **UKSEDS MyPocketQub**
 - *Miniature platform for up to 365 additional experiments*
 - *Techdemo of OS s/craft*
- **Univ of Bath TOPCAT**
 - *Dual freq COTS GPS*
 - *Techdemo of GPS for measurement of space weather in plasmasphere*

Payload Management



- From early in the program, we knew that the payloads would be provided via an open competition
- Platform and payload development would need to happen concurrently
- Physical envelope was fairly easy
- Power and data more difficult

➔ Interface Emulator



Interface Emulator

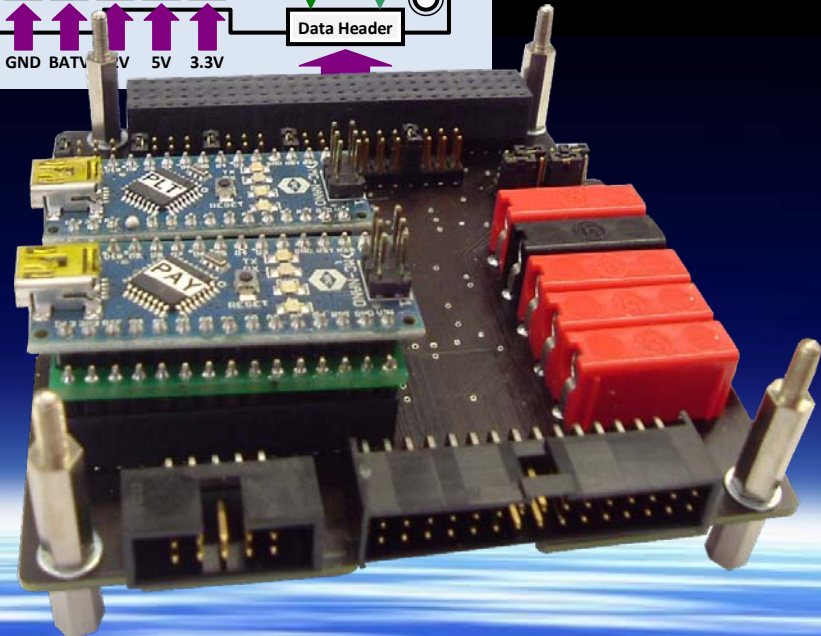
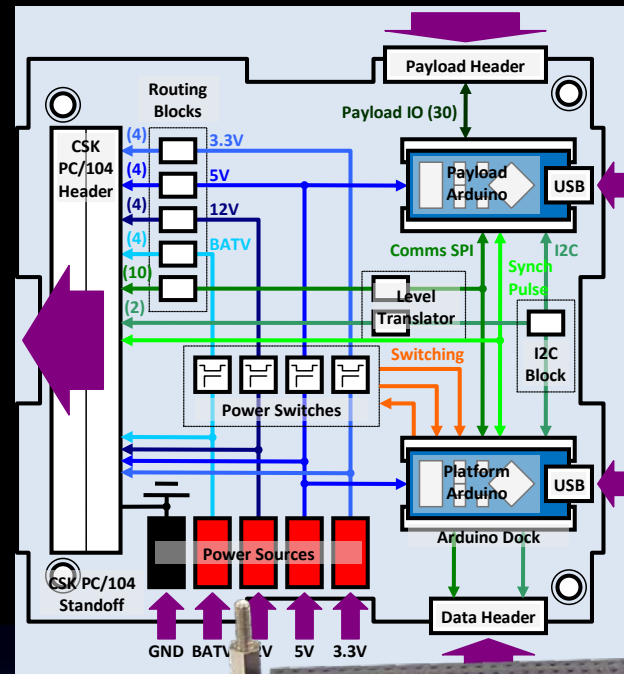


- Out of box solution for payload providers allowing rapid development
- Emulates mechanical and electrical interfaces
- Multiple emulators enable multiple payloads
 - Concurrent development of payloads
 - Concurrent development of platform
- Minimise integration time between platform and payload

Interface Emulator



- 2x Arduino uP boards
- 4x power switches
- Full mechanical interface
- Payload I2C and Comms SPI

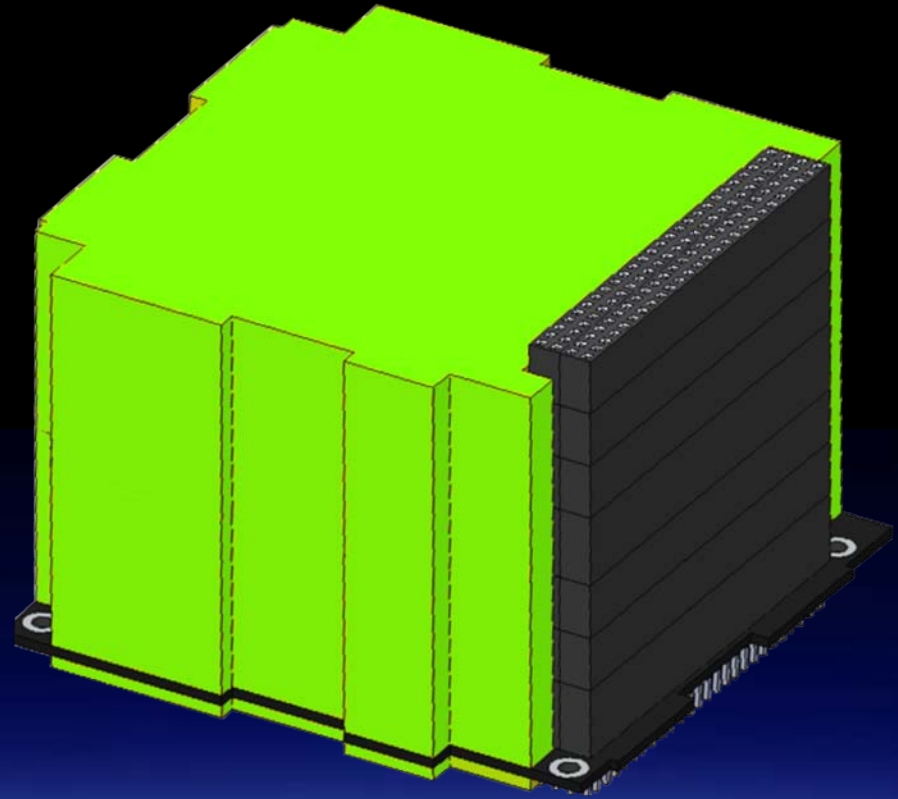


Working with CSK (PC/104)

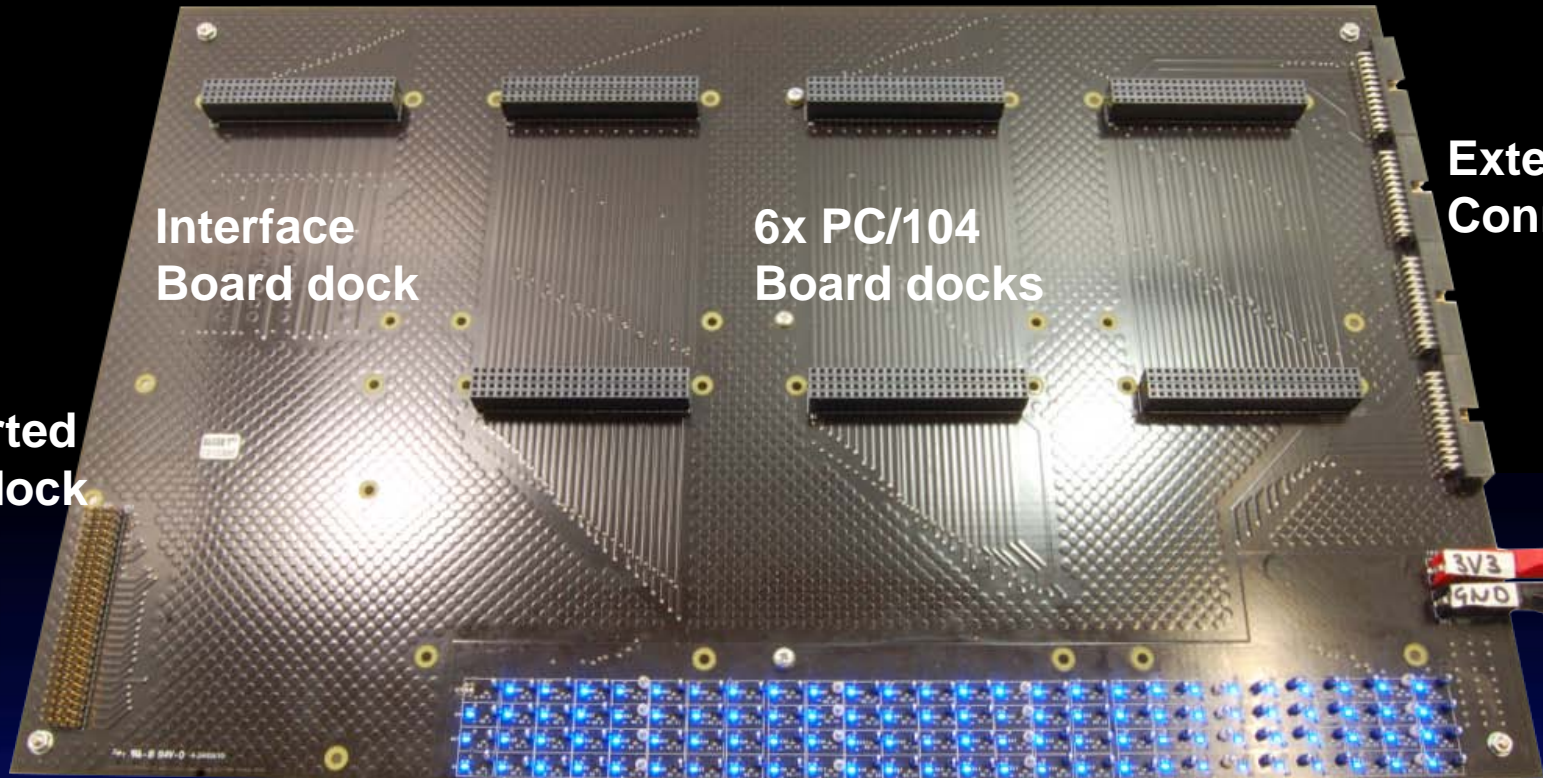


The dilemma

- Wide variety of COTS subsystems
 - Cost & availability benefits
- PC/104 is not ideal during subsystem development and AIVT
- Debugging of new subsystems very difficult



CSK Format Flatsat



Interface
Board dock

6x PC/104
Board docks

Extension
Connectors

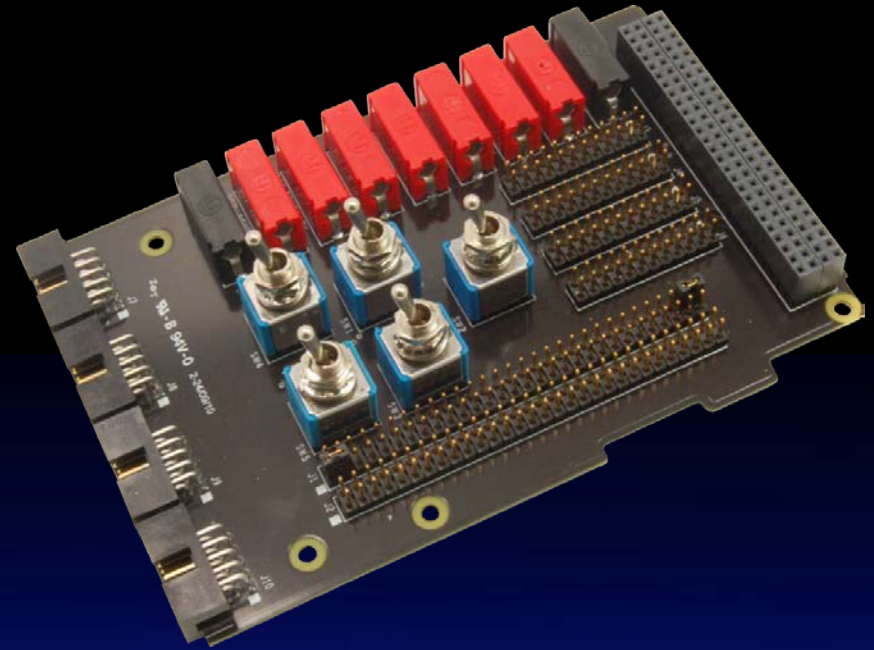
1x inverted
Board dock

104 LEDs and 104 Test points

Interface Board



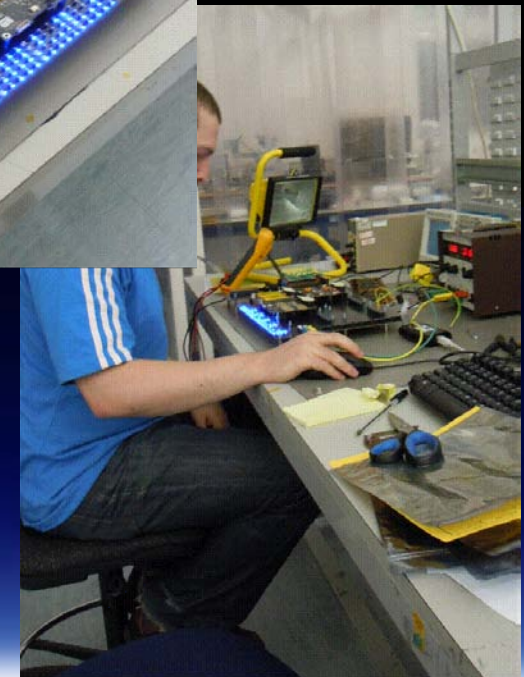
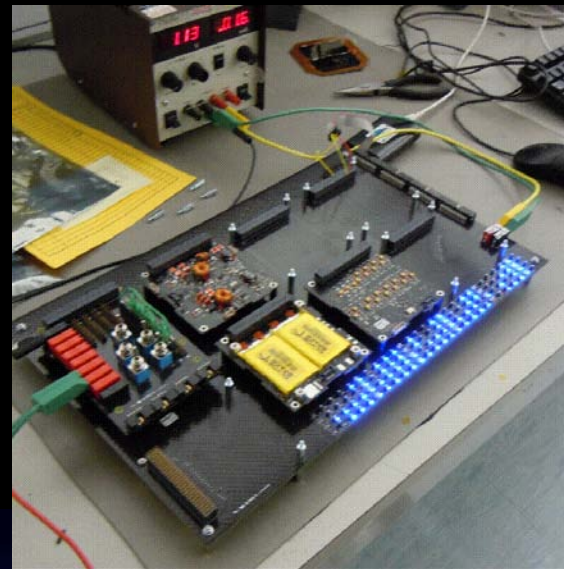
- Primary interface for test equipment and computer
- Power interface for CubeSat
- Simulation of sep switch/pull pin on CubeSat structure
 - Both Pumpkin and Isis format



Aiding Rapid Development



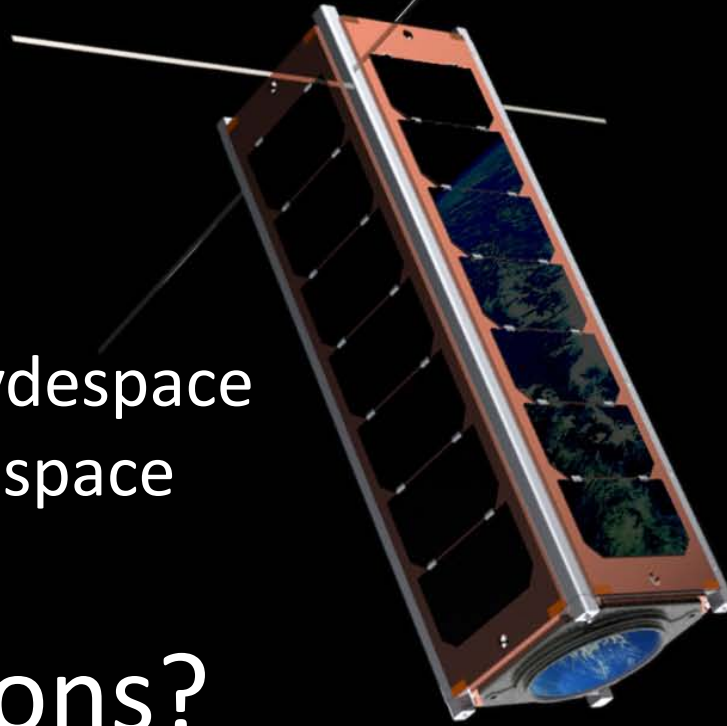
- Using flatsat to aid debugging of UKube systems
- Plan to make some (small) changes
 - Supports
 - PCB thickness?
- Expect to have ready for wider use early Q2



Conclusions



- Novel technical approaches (hardware and software emulators) facilitate community based engineering projects
- CubeSats present an excellent opportunity as a low cost tech demo platform
- When government funds become available, act quickly to secure! COTS + rapid development of subsystems allows this to happen
- UKube1 is envisaged as the pilot for a *full national Cubesat programme* supported by Government, industry and academia.
- Announcement on the pilot will hopefully be made in the summer, UK Space Agency budget negotiations permitting.



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Questions?

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