Payload and Platform Sensor / Actuator Bus Nodes

TEC-ED & TEC-SW Final Presentation Days

13/05/2020

Payload and Platform Sensor / Actuator Bus Nodes

- *Budget:* 500 kEUR
- *Duration:* 24 Months
- *Prime:* TAS-UK
- *Main Objectives:*
    1. Development of Sensor/Actuator Node for future missions and with particular attention to the needs and requirements of ATHENA mission
    2. Analysis of the impact of the underlying concept for the selected mission in terms of modularity and budget constraints

Payload and Platform Sensor / Actuator Bus Nodes

4. Prepare and plan for the way forward of The Sensor Actuator Node development toward an EQM and FM to be used for ATHENA;

5. Commercial evaluation;

Payload and Platform Sensor / Actuator Bus Nodes

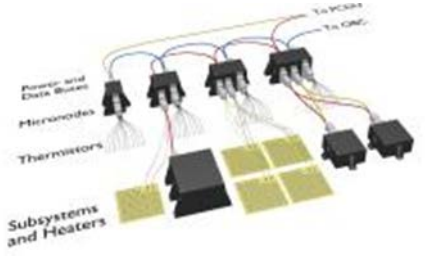
Mike Utton / Mike Walshe

Thales Alenia Space

Introduction

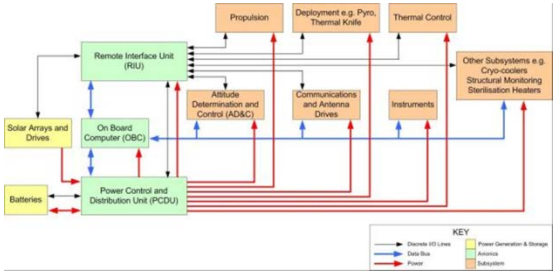
The Platform & Payload Sensor & Actuator Nodes Contract (Micronodes), builds upon previous ESA work that identified the feasibility of creating a modular Micronode architecture adaptable to many on-board control processes

- Reducing harness mass through the de-centralization of sensor data acquisition and power switching
- Increasing spacecraft reliability and resilience by reducing the dependence on centralized nodes

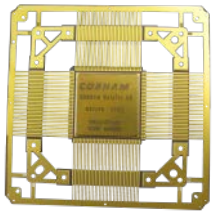


Advantage was taken of the TASTE toolset in order to model and verify the CANopen Protocol

- Allowing auto-generation of the software code



Micronodes prototype utilised as a test vehicle for the Cobham Gaisler GR716 microprocessor



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Micronodes Derivation

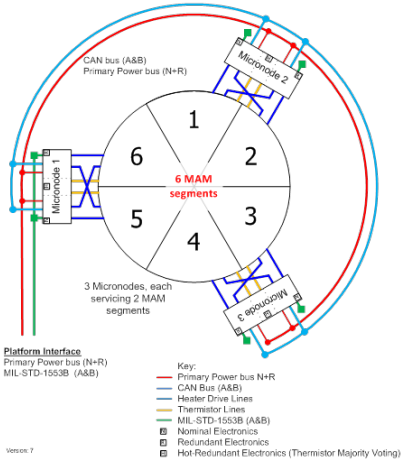
Requirement analysis identified a number of key requirements:

- Own isolated power supply, metalwork and microprocessor ➔ size, mass and power
- Independently testing at unit level ➔ cost
- Differing environmental requirements ➔ re-use difficult

	Pointing accuracy	Mass production	Autonomy	Relative ground velocity	Availability
Observation	High	Not yet			
Deep space		No	High		
TL Geo	High		Not a driver		High
TL Constellation		Yes		High	High
µSat / MiniSat constellation		Yes / COTS based		High	Not a driver

Consolidation around ATHENA Mirror Assembly Module (MAM) Thermal Control System (MTCS)

- A distributed, intelligent RTU required (162 thermistors and 48 heaters)
- Divides the MAM into 6 sections/segments (broadly 60° per segment), with each segment consisting of 9 zones (for wiring purposes).
- Each Micronode RTU is used to control 2 sections



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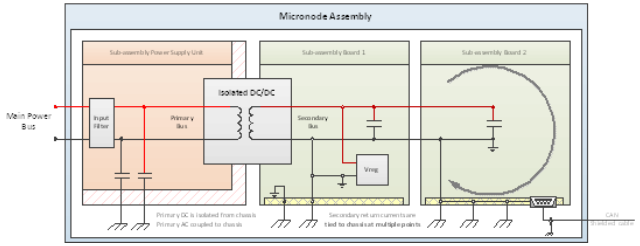
RTU Arrangement

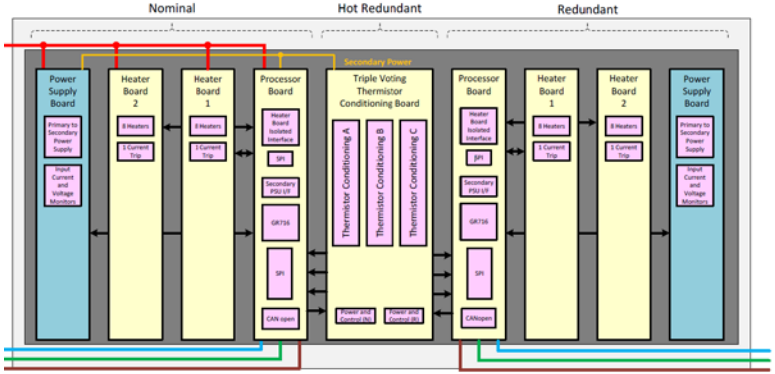
Baseline design

- The platform implements a CANopen Parallel Bus Access architecture to emulate the cross strapping capabilities of MIL-STD-1553B.
- Splits the 16 heaters into two 8 output Heater Boards
- Both Heater boards being driven and interfaced to via an opto-isolated interface



The Micronode Software was designed for maximum reuse with minimum constraints on the design

- Modular design, based around using the ECSS CANopen standard for the command and control protocol
- Use of auto code generation via the TASTE model



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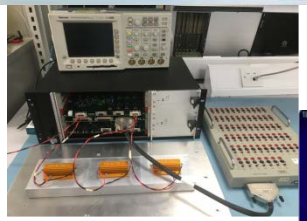
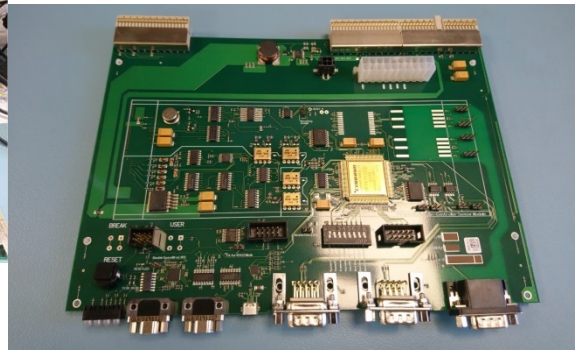
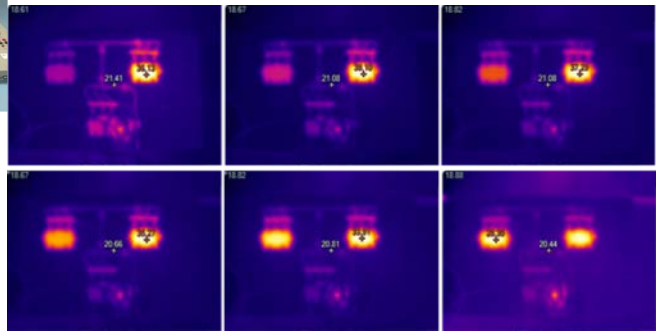
Testing







Testing at a system level was performed on the complete Micronode assembly using software on the GR716

The temperature for all three nodes maintained around the setpoint within ± 2° in the worst case, and typically within ±1°

Integrated testing demonstrated the following

- Commanding via the CAN bus
- Communication to read conditioned thermistor values
- Application of a calibration polynomial to each thermistor value
- PID thermal control loops for each heater output
- Commanding of heater outputs via the discrete opto-isolated SPI interface
- Switching heater loads

Lessons Learnt

Use of the TASTE toolset, provides an ability to generate efficient, low footprint source code

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Next Steps

Micronodes concept, with its CANopen protocol and Open Hardware Architecture fits within the Advanced Data Handling Architecture

- Delta functionality being implemented in software
- Following on use and implementation of the ESA TASTE toolset

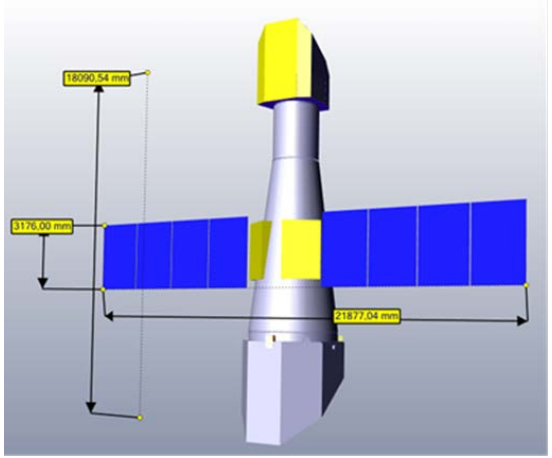
Evolution of the Open Hardware and Software specified within for micronodes prototype provides of achieving this

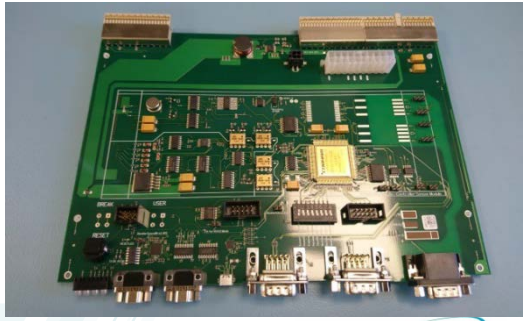
- Specifically in the area of Advanced Data Handling Architecture

Further development of the micronodes concept is proposed, alongside the ATHENA programme

- Whilst <7% of requirements were not directly addressed vs. prototype, they did not have an impact on overall solution

Installation of the Micronodes Prototype in to the ESA TASTE laboratory





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Thales Alenia Space UK Ltd

Company Vision:

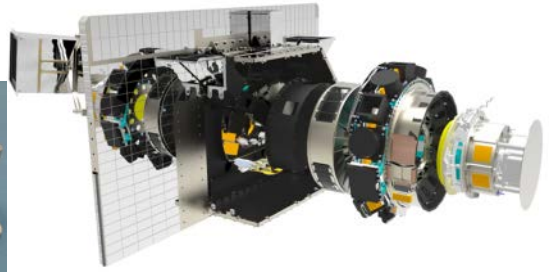
- To become a Prime Contractor for ESA and UK national satellite programmes
- Propulsion Centre of Competence for whole TAS JV, based in Harwell and Belfast
- Maintain role as subsystem integrator for high integrity systems for Space applications

Locations:

- Bristol (design and development of satellite equipment and systems)
- Harwell (design & development of propulsion subsystems)
- Belfast (propulsion integration)

Number of employees:

- 200+ staff and growing (majority employed in Bristol)



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