QinetiQ Space – Prime view on RTU

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QinetiQ

Company introduction – Key data

- Former Verhaert Space (name change April 2010 to QinetiQ Space)
- Founded in 1969 as industrial product developer
- Space activities started in 1983
- Delivered 100+ systems and sub-systems for manned space stations, satellites and interplanetary missions
- Acquired by the QinetiQ group (UK) in 2005
- 110 employed in BE+ 60 in Farnborough (UK)

QinetiQ Space nv Headquarters

- Located in Kruibeke - Belgium
- Offices: 3.742 m², Warehouses: 1.200 m²
- 2 Class 100.000 cleanrooms

QinetiQ Space nv Ground Station Operations

- Located in Redu - Belgium
- ESA satellite ground station
- Jointly operated with SES Astra Techcom

QinetiQ Space UK

- Located in Farnborough - UK
- Integration Facilities
- Test Facilities

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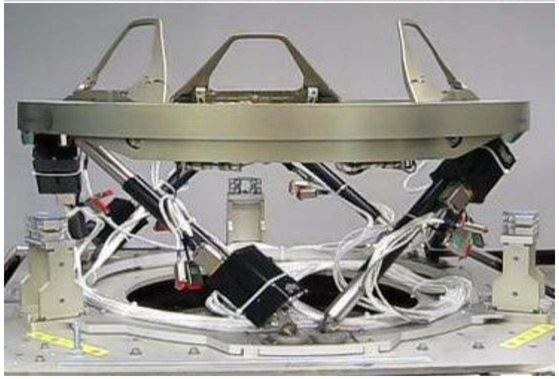
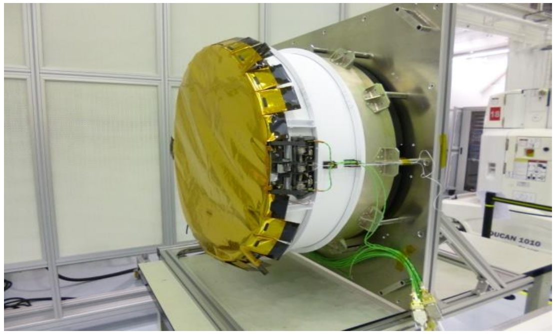
Company introduction – what we do?

- In **satellite** market,
  - **Small satellites** based on **PROBA** platform
  - **Satellite equipments**, including
    - On-board computer
    - Power subsystem
    - Remote terminal units
    - Onboard mass memories
    - Baffles and cover mechanisms

- Contributor to ISS infrastructure,
  - **scientific** instruments
    - conduct microgravity experiments,
    - Conduct medical, physical and biological research,
    - Create and test new materials,
    - Carryout technological trials,
  - **Docking mechanism**





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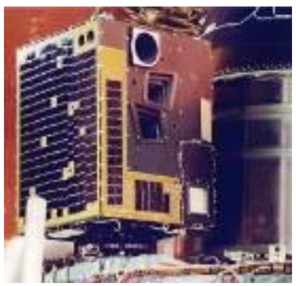
Company introduction – business lines

Fully focused on space activities

Satellites & Platforms	Scientific Payloads	Subsystems	Downstream services	
				
▪Small satellite bus ▪End-to-end mission solutions	▪Microgravity research ▪Planetary exploration ▪Earth observation	▪On-board computers ▪Docking & Berthing Systems ▪Space Mechanisms	▪Satellite Operations ▪Integrated Applications ▪Technical consultancy	
	▪Frequency Monitoring ▪Metrology	▪Electrical Propulsion ▪UHF transponders	▪GIS applic & serv ▪Space tourist training	

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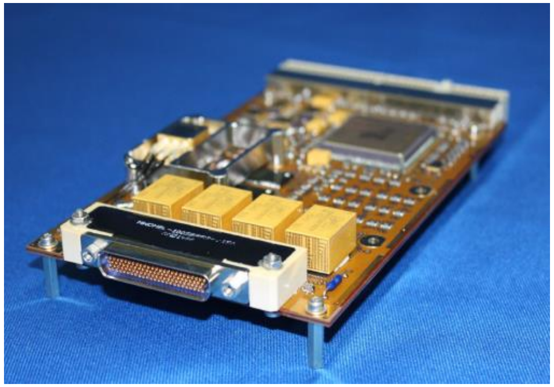
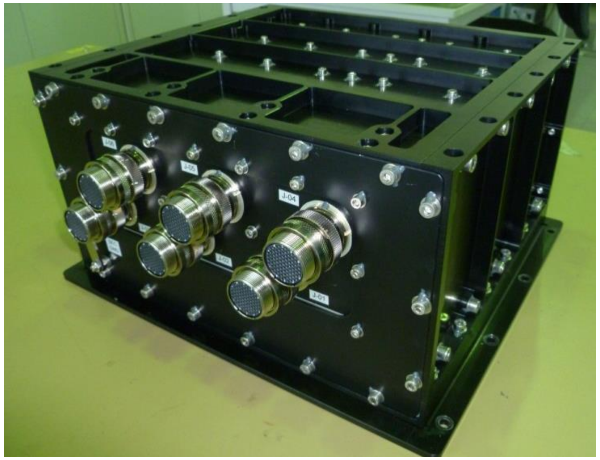
Spacecraft avionics equipments - examples

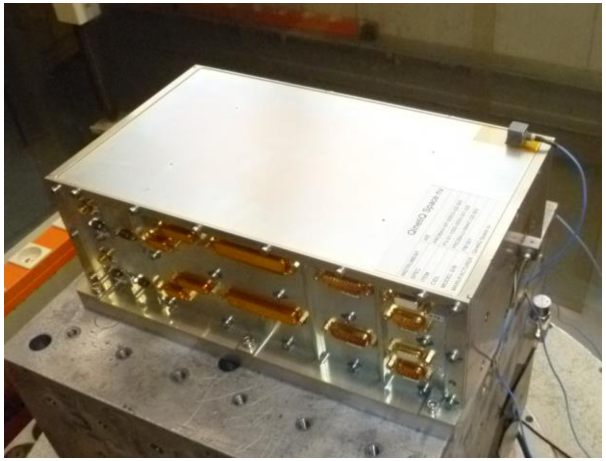
- Integrated avionics for small satellites
  - Advanced Data and Power Management System (**ADPMS**)
  - Data-processing and storage devices for earth-observation imagers (Payload processing units, **Mass Memory units**, ...)
  - Remote Terminal Unit's (**RTU**)



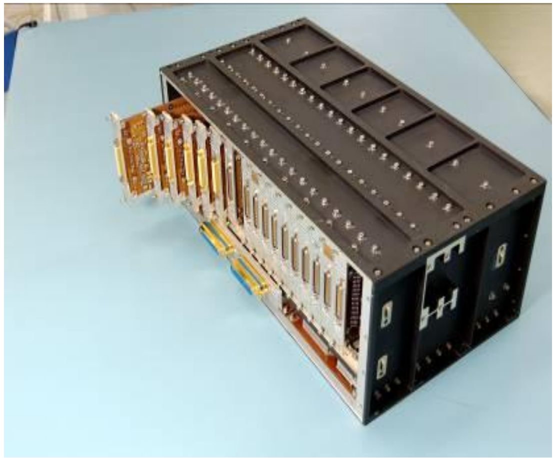
PROBA-V NAND Flash mass memory



IXV on-board computer (FM)



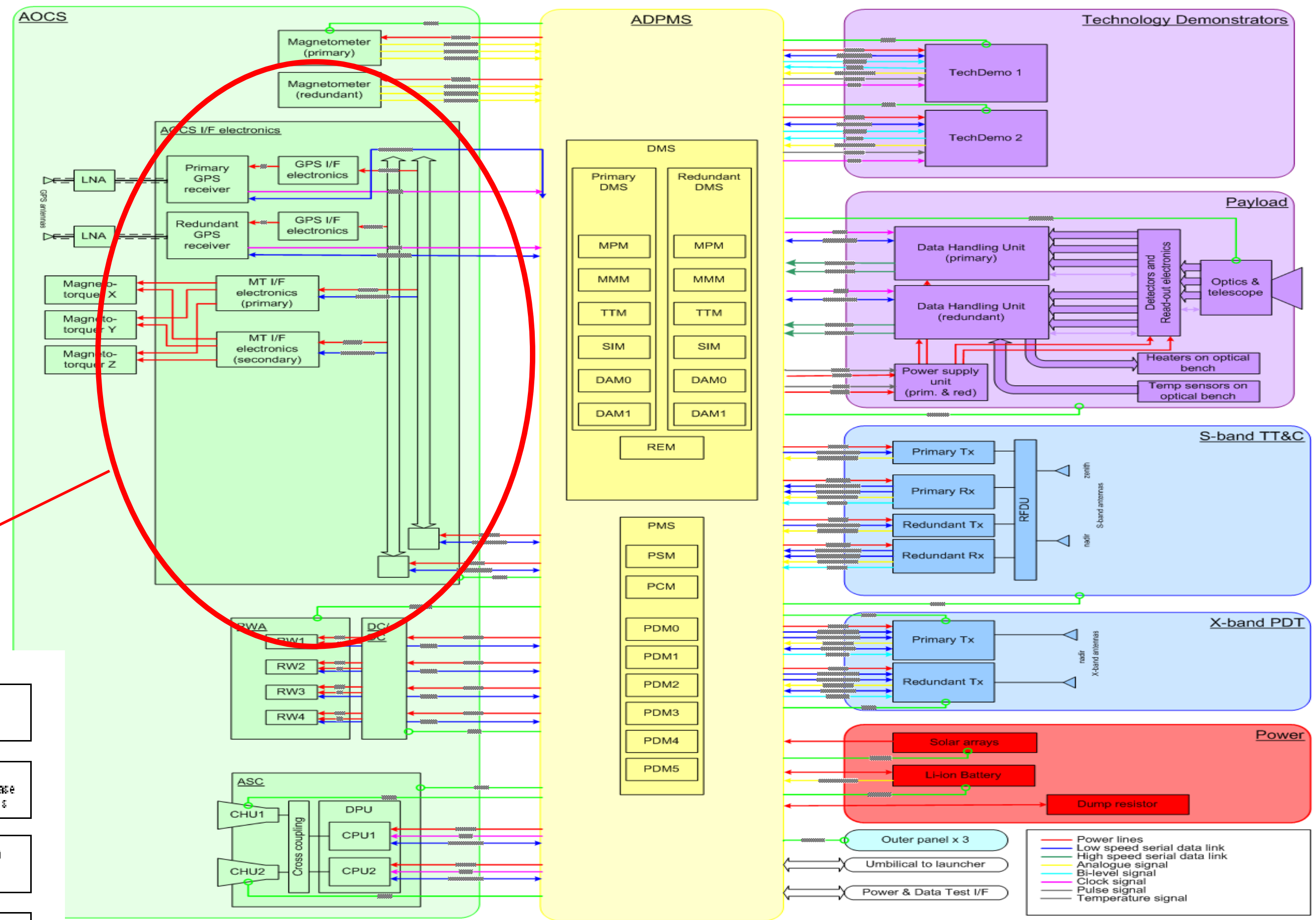
PROBA-2 RTU (FM)

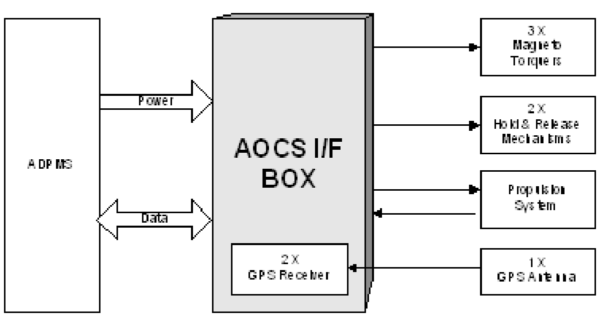


PROBA-V ADPMS (FM)

Spacecraft avionics – architecture overview

- For P2 and PV
- In-house developed FT RTU with interfaces for:
  - GPS sensor
  - Magneto torquers
  - Propulsion
  - Deployment mechanism





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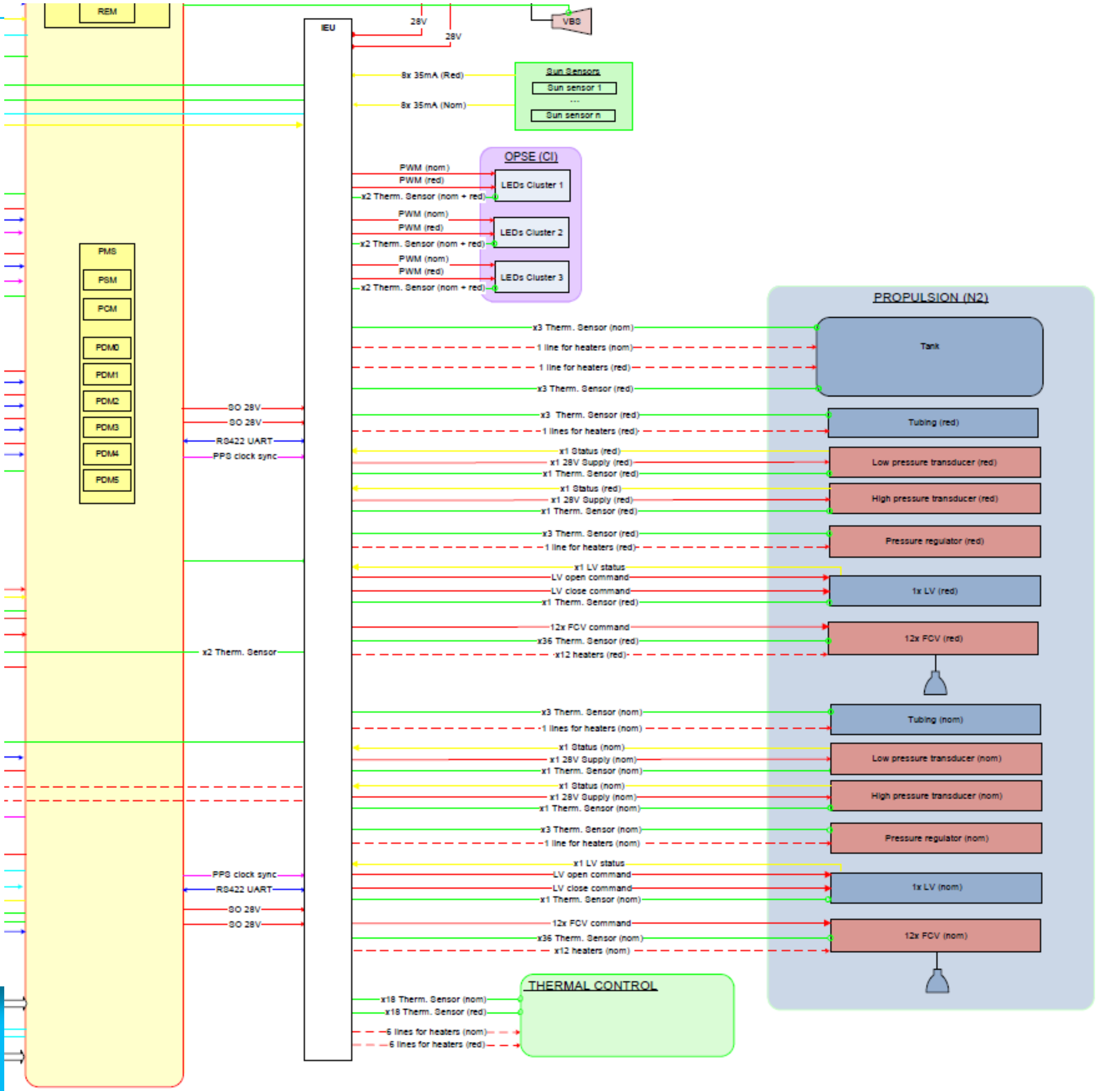
Spacecraft avionics – architecture overview



- For P3
- RTU with interfaces for:
  - Propulsion
  - Deployment mechanism
  - TC heaters
  - Sun sensors
  - Interfaces to payload

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The RTU on PROBA spacecraft

- The RTU – how is it used on PROBA spacecraft?
  - Never the same…
  - Seen as extension of main on-board computer, mainly interfaces.
  - Almost by definition “mission specific”, i.e. all interfaces issues are resolved here.
    - Because of RTU, core avionics can remain mission independent.
  - Consequently, interest to keep RTU “as simple as possible”; e.g. no intelligence.
    - Central OBC has plenty of CPU, no need for decentralisation of FDIR
  - RTU should be “smart modular”, i.e. smaller spacecraft should result is smaller RTU

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Operability concept for RTU

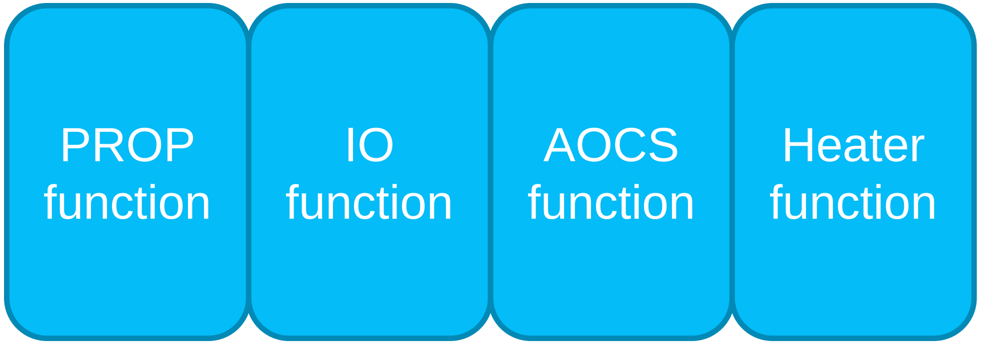
- Common operability concept is obvious beneficial

- How to reach commonality?
  - As every platform is different… Keep it simple, e.g. some examples
    - implement only low level FDIR (e.g. current protection) : detection of failures, report to central OBC
    - no automatic reconfiguration
    - Limit amount of operational modes: ON or OFF.
    - Limit reconfigurable or settable items

- Other
  - Support high-level commanding
  - Small satellite specific: support cold redundancy

Modular design

- Expectations
  - See above – RTU is almost by definition mission specific so modularity is obvious
  - Main points - smaller spacecraft should result is smaller RTU
    - Main RTU target large satellite market and offer maximum of interfaces and functions
    - Every function is different boards



Example: portion used if only 2 heaters are needed

- Consequence: RTU size depends on #functions, not on spacecraft size or amount of interface
- Improve granularity !

Building blocks

- Intelligent RTU?

  - The FDIR concept is part of the core of a satellite platform
    - Has been tried and tested since many years

  - Have experienced problems if too much FDIR in unit
      - Conflicting actions
      - FDIR too tight
      - In case of autonomous actions, state of unit is not always clear to central SW
      - …

  - Central OBC usually has plenty of CPU power,
    - No “technical” need for decentralising intelligence

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Data Handling and AOCS functional chains

- More integration?
  - Encouraged from prime point of view
    - e.g. PROBA RTU houses a GPS receiver
    - Similar concept can be applied to e.g. star tracker electronics, RW electronics etc.
  - Understood from RTU supplier less obvious

Final remarks

- RTU should be the place to absorb mission re-configurability
- To enable this, RTU should be kept “simple”
- RTU should be “smart modular”
- No commercial small satellite RTU available on the market

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