ADCS2015

Airbus Defence & Space CRISA

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1. RIU/RTU Definition

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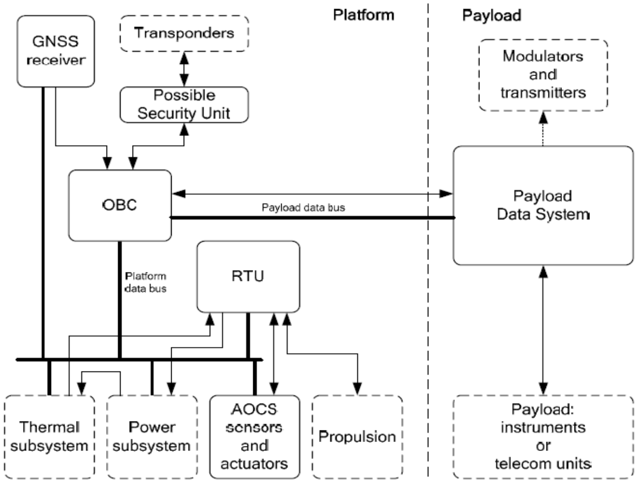
RIU/RTU Definition.

The RIU/RTU is one of the key Platform* Data Handling Subsystem equipment which is in charge of controlling and monitoring the platform subsystems from the OBC commands.

In particular it control and monitor these platform elements:

- **AOCS**
- **Propulsion**
- **Heaters (Platform Thermal Control Subsystem)**
- **Power Subsystem**
- **General Purpose HK Monitoring.**

*** This concept can be also applied to Payload Subsystems**



In general the RIU/RTU is a unit that shall be customized for each platform, and also tailoring usually is necessary for each mission. Therefore a modular concept is always a key feature for these product.

The RTU and RIU acronyms responds to the same unit concept indistinctly.

The RIU/RTU are typically non intelligent units (w/o Software) and responds upon OBC commands reception.

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1. RIU/RTU Product Definition

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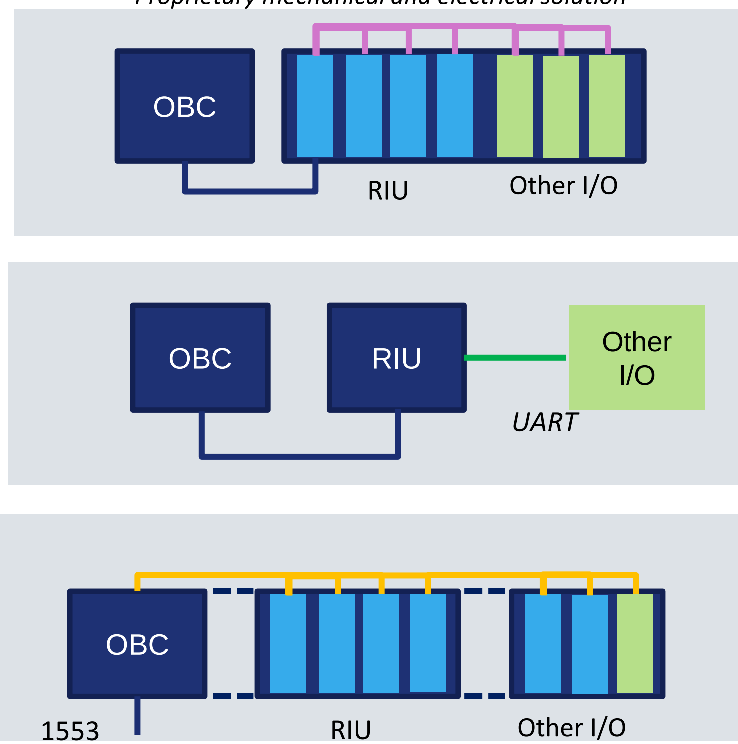
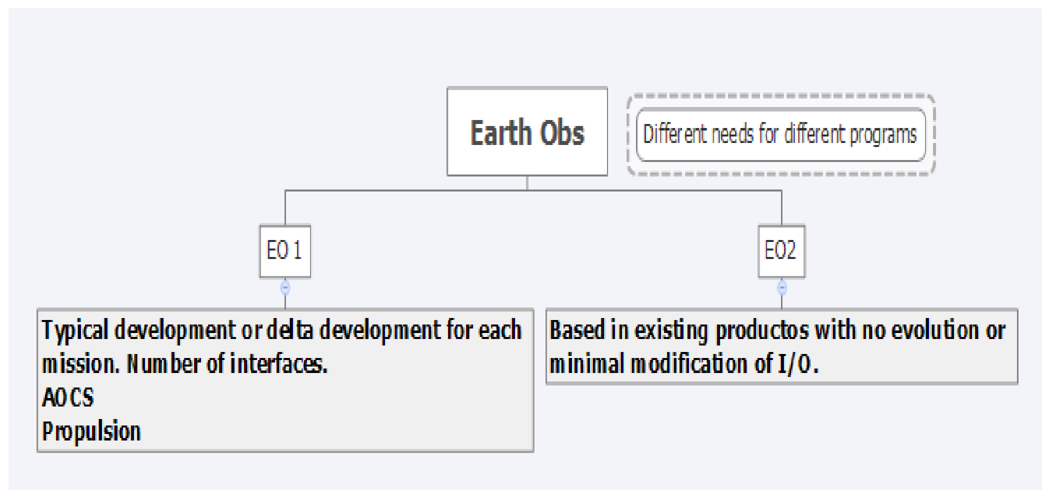
Proprietary mechanical and electrical solution



RIU/RTU extension as stand alone unit on UART

TELECOM

Telecom: Design phase based in tailored needs with no evolution o really low evolution in the number of interfaces. Unit tailored to the needs.



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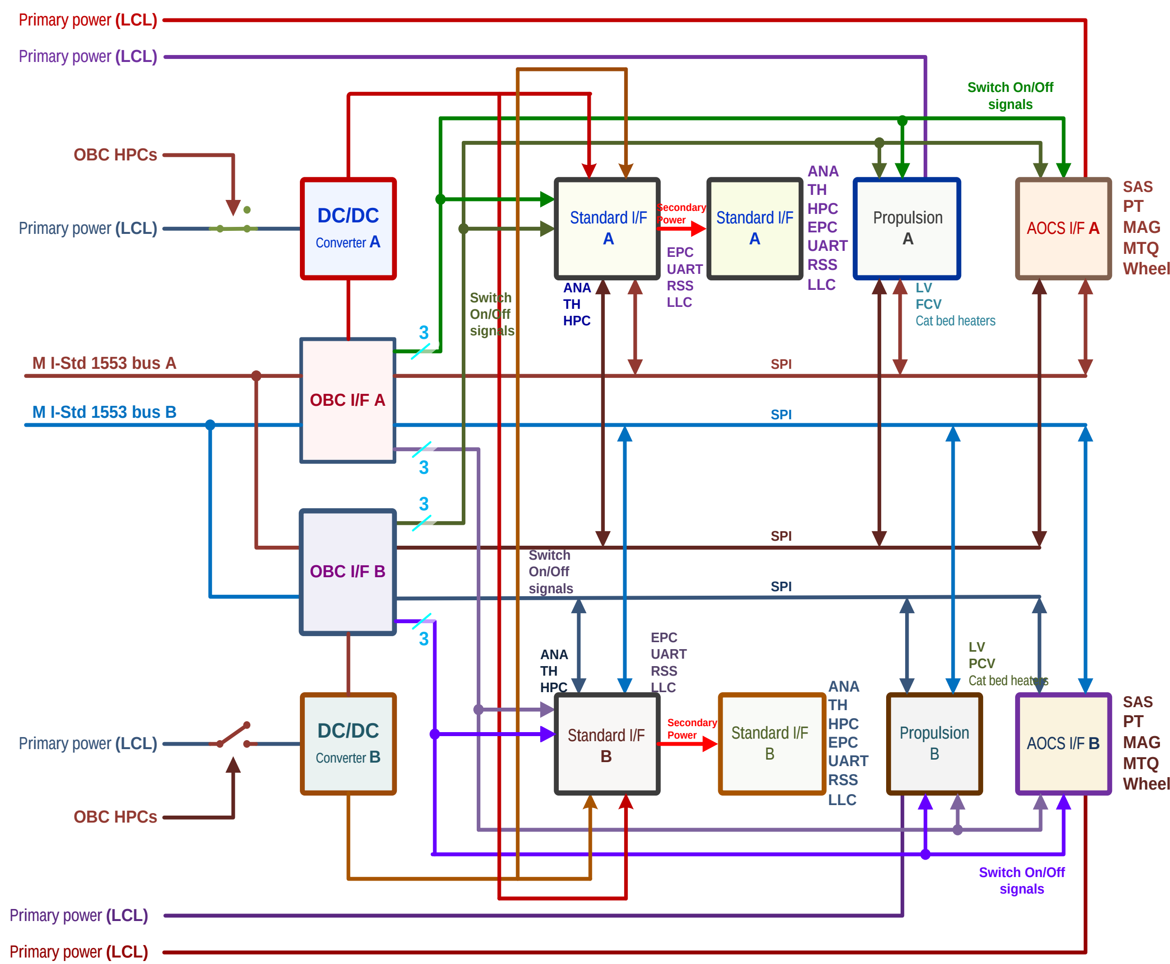
1. 1 Architecture

Generic RTU/RIU architecture



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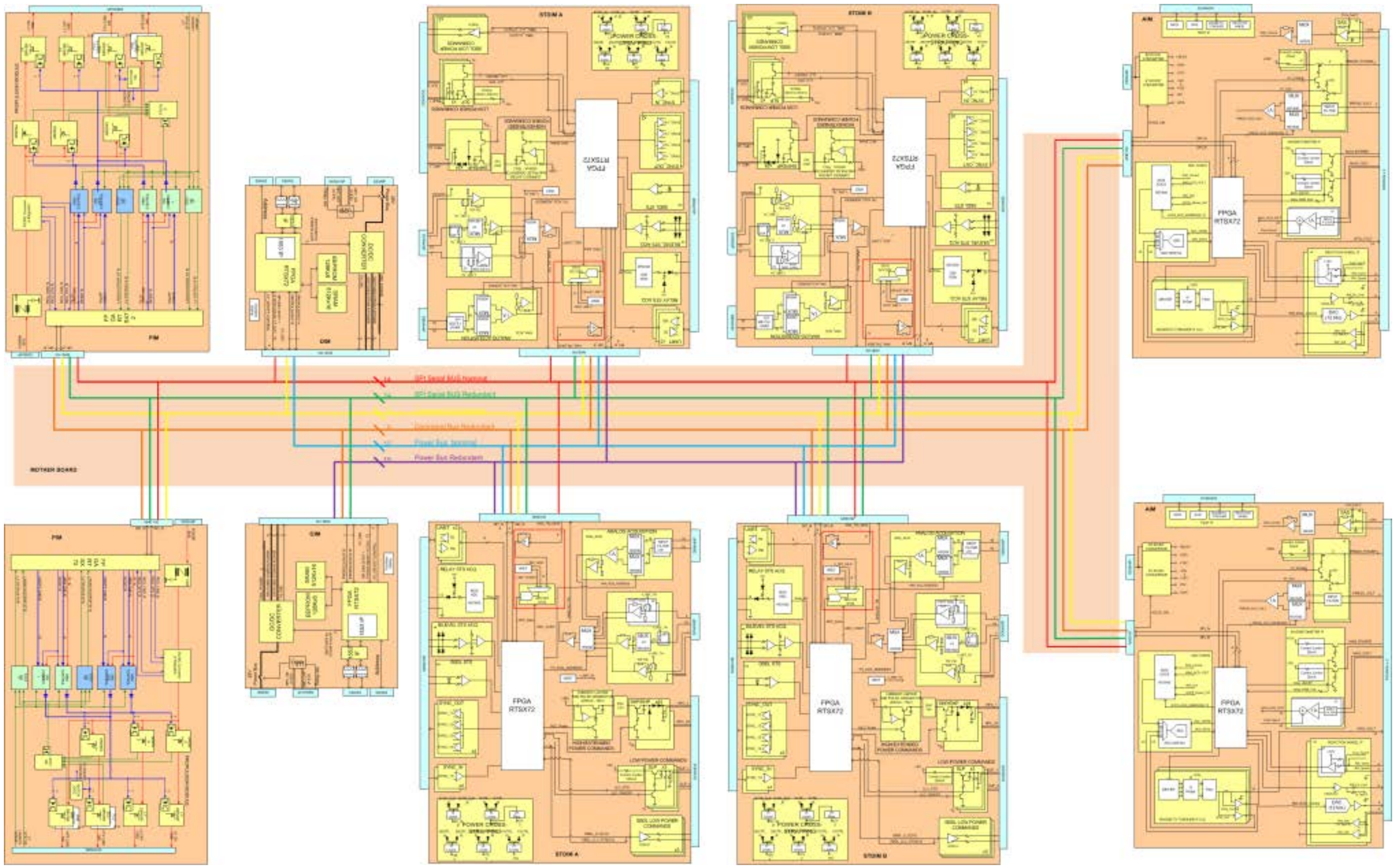
1. 1 Architecture

Generic RTU/RIU architecture



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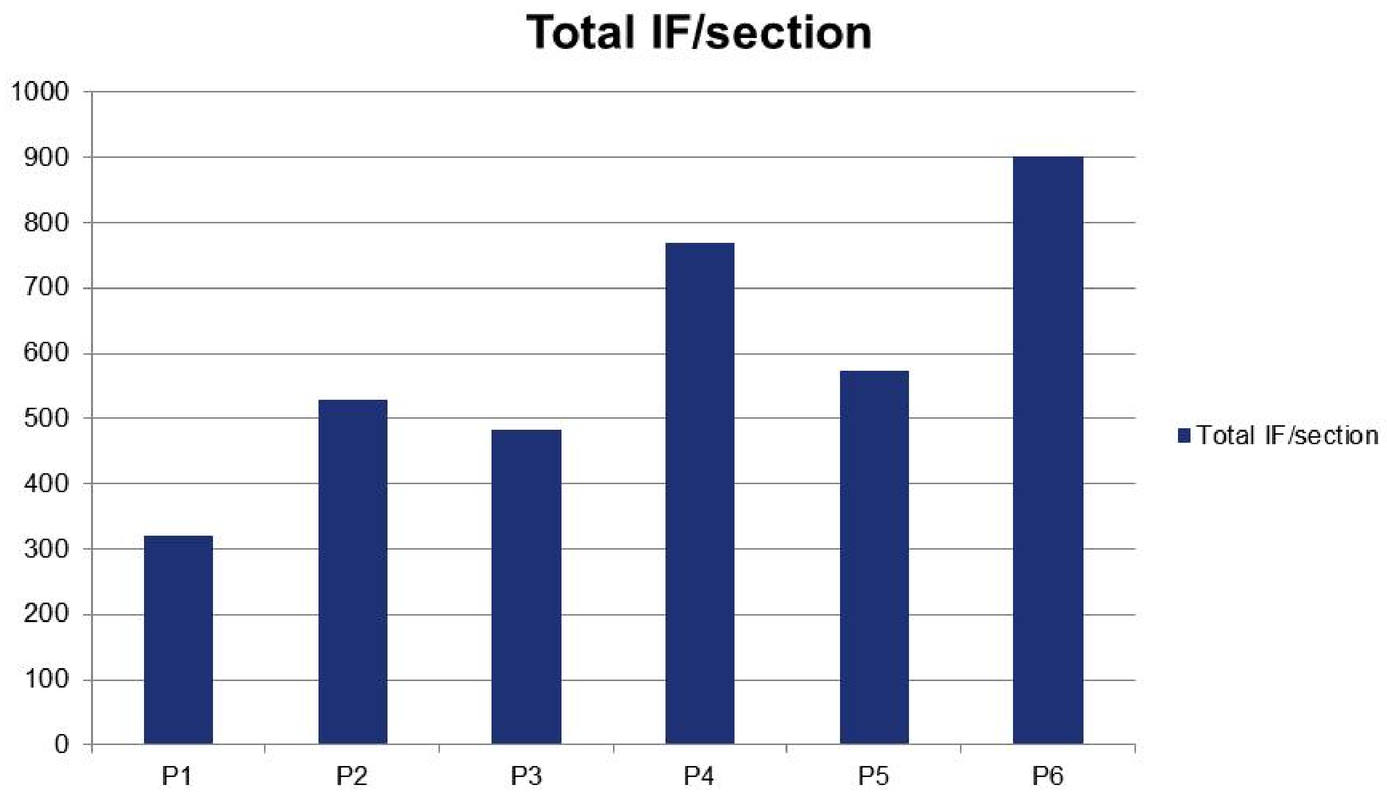
1. 2 Programs and Interfaces

Different missions, different needs.

- Communication Bus
- Propulsion
- AOCS
- I/O
- …



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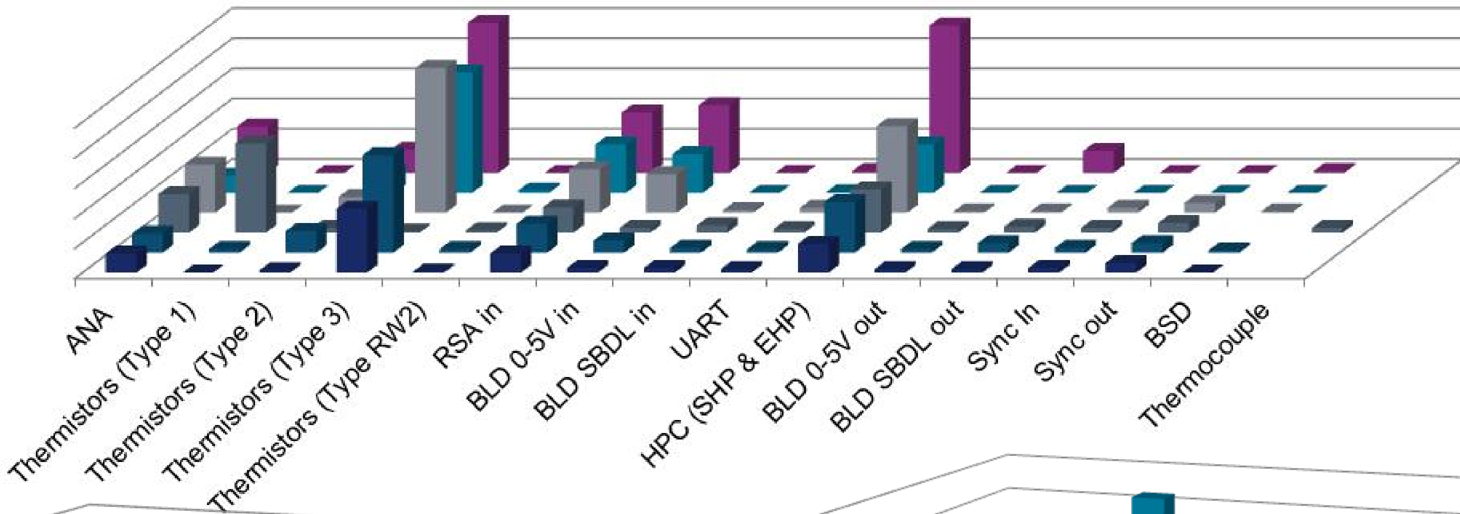
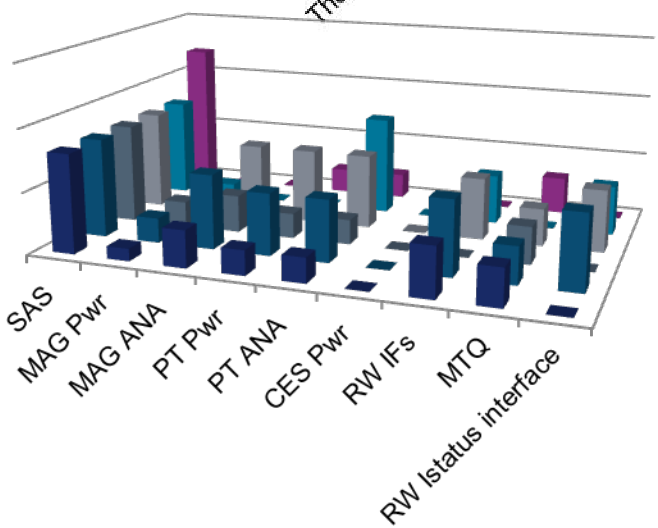
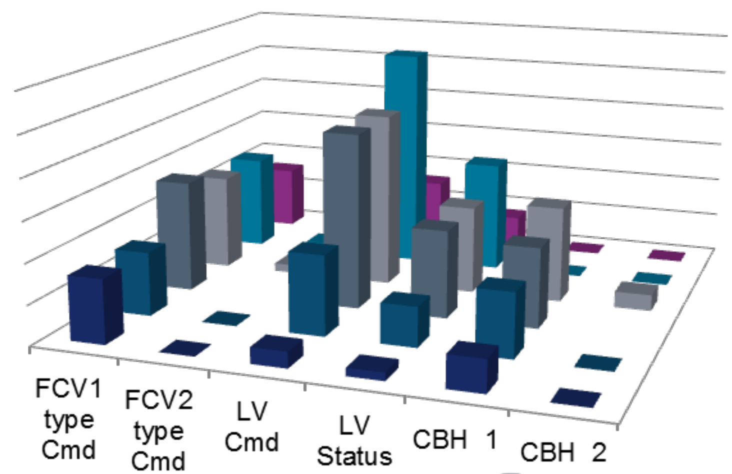
1. 2 Programs and Interfaces

Different missions, different needs.







1. 3 RIU/RTUs Program Tailoring

Communication Bus:	Current Status	IMPACT	Approach
Mil-bus SPW UART CAN	Same prime low impact in evolution, Different primes different needs and evolution Each program may require an evolution in the protocol.	Depending of the protocol is needed to update / modify the IF with the OBC	Modular approach reduce the hardware development, although in terms of “protocol” it is needed to upgrade the FPGA.
	Depending on the physical layer could have different data rate.	Each prime defines the protocol and need to be adapted	RIU -> MILBUS RTU-> MILBUS, UART, SPW

1. 3 RIU/RTUs Program Tailoring

Size/Mass/Volume:	Current Status	IMPACT	Approach
Propulsion	Each program typically needs a different propulsion.	Tailoring of propulsion to each program Development of new module	Modular approach where each development is flexible in order to be adapted a future missions
Number of channels (TM & TC)	Each program typically needs a different.	Development of modules to fulfill needs of the program. No in line with a product approach	Having a catalogue of modules that could be adaptable to the mission with low impact.
AOCS	Each program typically needs a different AOCS.	Tailoring of AOCS to each program Development of new module	Modular approach where each development is flexible in order to be adapted a future missions

1. 3 RIU/RTUs Program Tailoring

FDIR	Current Status	Impact	Approach
Cross-strapping	Depending of the needs could impact in the cross-strapping	Definition of the internal architecture	Operation in hot redundancy foreseen
Cyclic acquisitions	Sometimes requested	More resources in the FPGA	Implemented
SelfTest	Sometimes requested	Lots of resources in the FPGA	Not implemented
Automatic recovery.	Sometimes requested	Lots of resources in the FPGA and impact at system level	Not implemented

Physical implementation	Current Status	Impact	Approach
Qualification Levels	Qualification typically convers some program needs	New requalification due to new levels	To adapt the current product to the needs
Mechanical Frame	Different mechanical frames per program	Qualification needed	Propose mechanical frame based in current products
Connector distribution	Different connector distribution requested per program	Qualification needed	Propose mechanical solution based in current products

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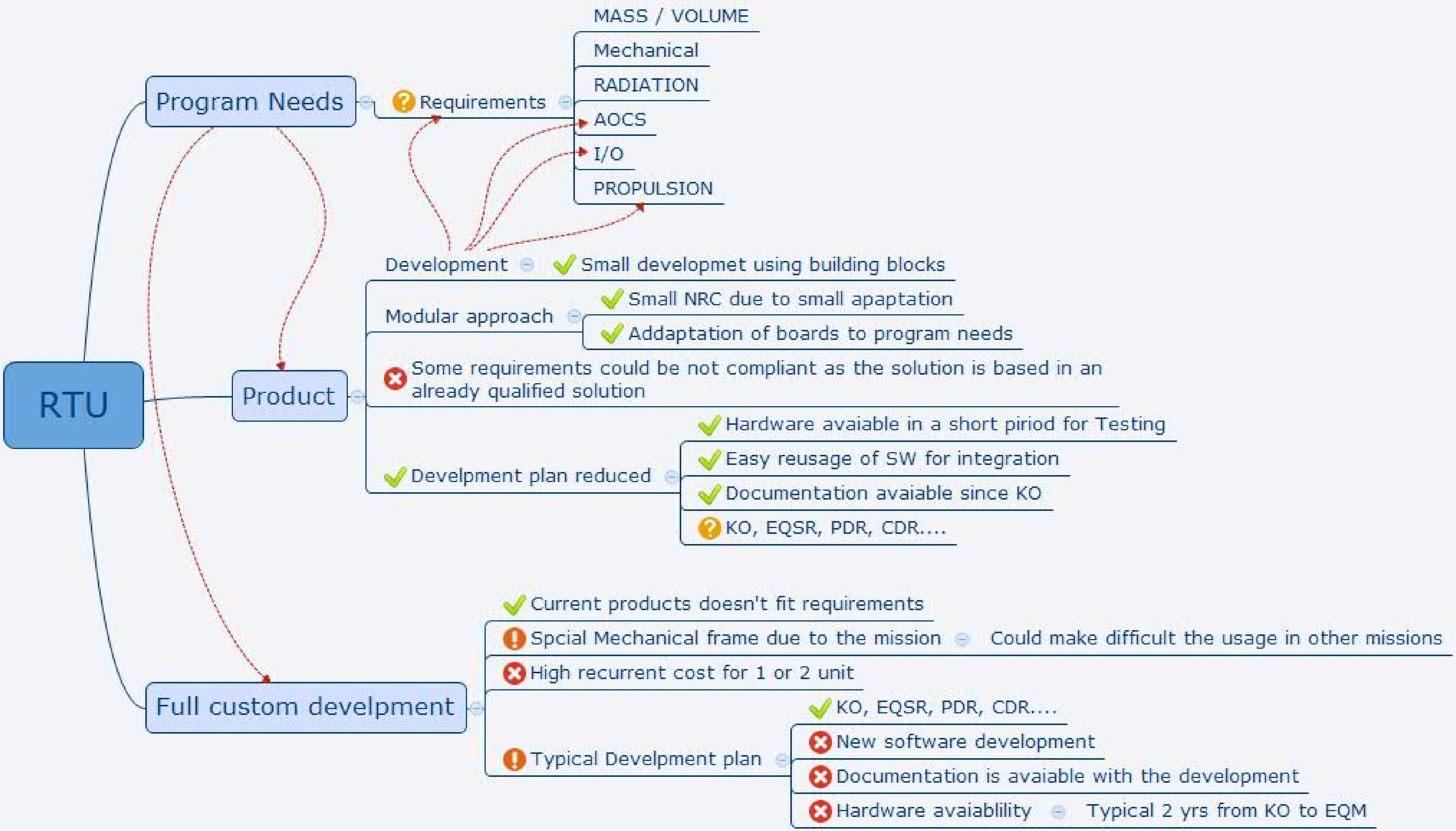
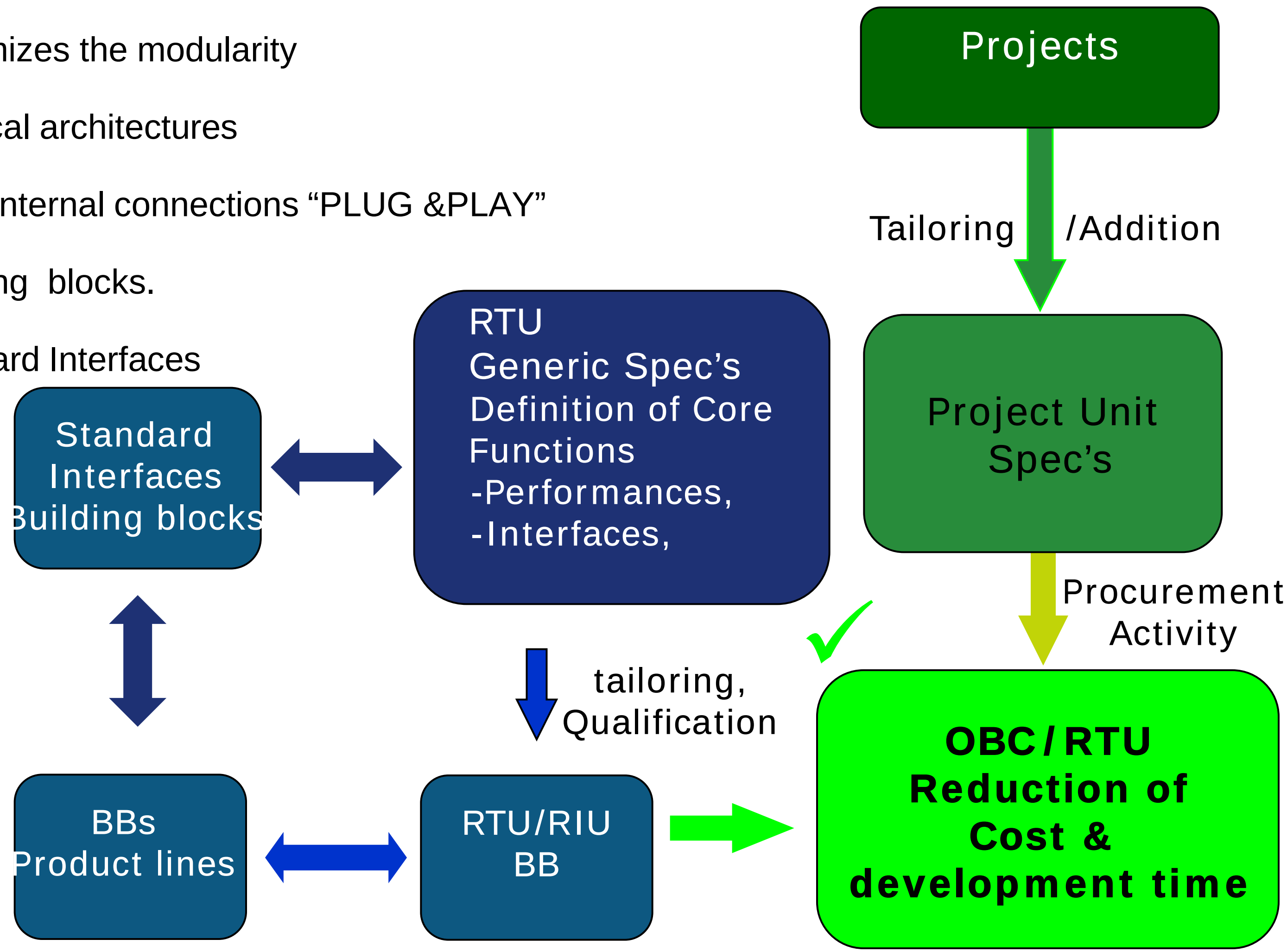
2. RIU/RTU Product vs Development



2.1 Concept & Key features “STANDARD” RIU/RTU

1. Architecture maximizes the modularity
2. Definition of physical architectures
3. Standardizing the internal connections “PLUG &PLAY”
4. Definition of Building blocks.
5. Definition of standard Interfaces



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3. 1 Modularity: Objetives

Objectives:

- Minimize non-rec cost when a non-standard/existing configuration is needed
- Gather different functions in boards instead of UNITS
- Allocate modules from other suppliers to include specific functions (GEO-Return)
- To have a flexible solution with different possible configurations to fulfill different needs

Current status:

- Possible to play with modularity right now.
- Current products could allocate modules form other suppliers?
  - Possible to play with modularity
  - Difficult to control the qualification and performances of modules developed by third parties.

- Needs of the programs make difficult to have one solution
  - Mechanical
  - Electrical

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4.1 ADS Products

RIU/RTU Products

RIU Product

The RIU was originally developed to satisfy the AS250 (Astrobus) avionics requirements and evolved in line with the Astrobus family.

AS250 -> AS100 -> AS400

RTU Product

Developed in the frame of GSTP5.2, Flexible unit, easily adaptable and configurable based on the Architecture design

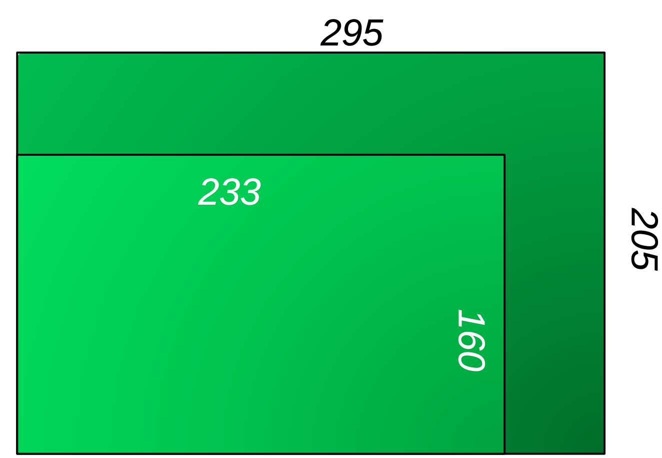
RT2015 -> PROBA3

4.2 Concept & Key features ADS RIU/RTUs

1. Architecture maximizes the modularity and upgradeability becoming the key characteristic of all the modules.
2. Flexible Redundancy
3. Standardized Mechanical Interface. -> 2 different mechanical frames for different needs.
4. Use of self-contained modules and standardizing the internal connections
5. Testing each module completely independently

- Configuring the RIU/RTU as will be defined **adding, removing or duplicating** modules **without any impact or redesign in the final product**

Board size comparison
RTU vs RIU

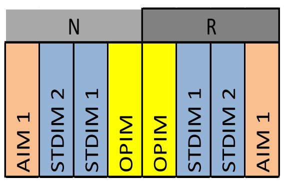


4. 3 RIU Product

The RIU was originally developed to satisfy the AS250 (Astrobus) avionics requirements but from this original product Crisa has developed three versions:

AS250 RIU Version: Generic Product for AS250 ENS low orbit platform for Earth Observation Missions.

- **This RIU consists in 4Nom + 4Red modules with this module configuration:**



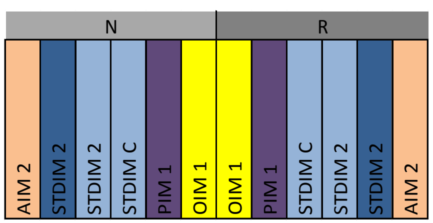
AIM Module: AOCS Interface Module

OPIM Module: OBC and Propulsion Interface

STDIM 1 & 2 : Generic I/O Module with Digital, Analog, Serial, & Thermistors Input & Output Interfaces

AS1000 RIU Version: Product tailoring for AS1000 Mission.

- **This RIU required an important tailoring that includes the rearrangement of the functions and then the development of three new boards, also it required the packaging tailoring to 6 + 6 modules:**



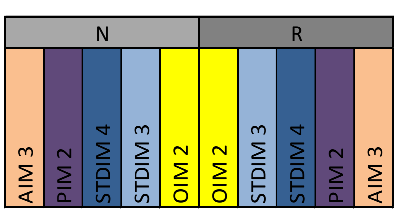
OIM Module: Specific module for the OBC Interface Module

PIM Module: Specific Module for the Propulsion Interface

STDIM C: Specific I/O module to satisfy the AS1000mission I/O requirements.

AS400 RIU Version: tailoring to AS400 German Platform for Radar Satellites

- **The RIU for the AS 400 HP Platform required to evolve AIM, PIM, OIM and STDIM boards. Also the packaging should be adapted to 5 + 5 modules:**



OIM 2 Module: Evolution of OIM 1 module for the OBC Interface Module

PIM 2 Module: Evolution of PIM 1 Module for the Propulsion Interface

STDIM 3 & 4 : Evolution of STDIM 1 module for Generic I/O Module with Digital, Analog, Serial, & Thermistors Input & Output Interfaces

4. 4 RTU Product

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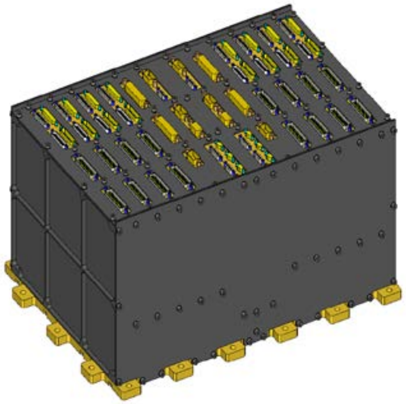
RTU2015

Developed in the frame of GSTP5.2

- **The modular RTU (RTU2015) will reuse to the maximum the building blocks from previous programs (AS250, AS1000)**

- **Astrium primes (Telecom & Earth Observation) contribute to specification through RANGE.**

- **Flexible unit, easily adaptable and configurable based on the Architecture design**
  - I/F based on ECSS specifications



The key objective of the RTU2015 is to allow hosting new modules to be developed for mission specificities or to incorporate new platform functionalities within a qualified frame.

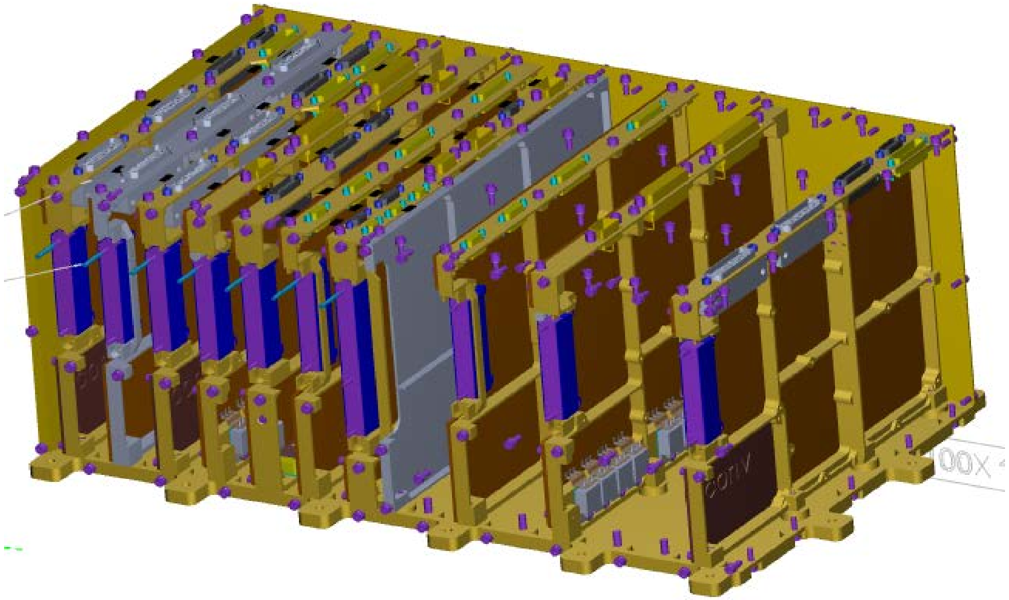
Qualification covers from 10+10 to 4+4 modules.

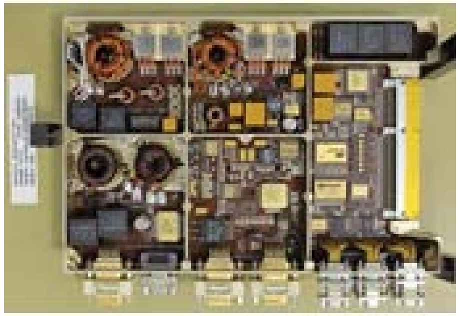
Strongly supported by ESA, especially for Science missions

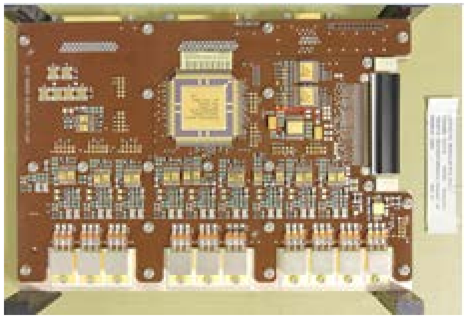
IN LINE WITH SAVOIR INICIATIVE

4. 4 RTU Product KEY POINTS

In line with SAVOIR approach







- **Plug and play modules**
- **Highly configurable**
  - Different modules for different requirements
- **Flexible redundancy**
- **3 main buses:**
  - Spw, MILBUS, UART
- **Qualification convers different configuration.**
- **Building blocks based**
- **Could host modules from third parties like ESA New Member State**

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5.1 Building blocks: Definition and Status

Building block definition: Set of interfaces already developed and tested that could be easily adapted to the requirements of the mission.

Current building blocks:

- Analog and Digital acquisitions (ANA, TH, RSA, Bi-level, 422…)
- Analog and Digital commands
- Communications (UART links, BSD)
- MTQ, RW, SAS, MAGNETOMETER, PT
- FCV, CBH, LV ARM and Commands.
- DC/DC
- 1553, SPW, UART links to OBC

Improvements in current BB:

- BB based in new components to reduce cost, (Mixed signal ASICs (parts), flash-based FPGAs?, Lower quality parts?)
- Standard specification of the interfaces.
- Standard specification of the propulsion

5.2 Building blocks: Evolution

Building block definition: Set of interface already developed and tested that could be easily adapted to the requirements.

Future building blocks:

	Benefits	Drawbacks
Microcontroller	More autonomy, pre-processing of telemetries, discharge SW of some tasks	Software vs Firmware Critical tasks could not be placed as AOCS control
Primary Power Distribution LCL Double protected lines	Same solution for all the units, easy to implement. Reduction of non rec cost	Needs could be difficult to implement, several building blocks needed.
Mix-signal components	Reduction of overall number of components and therefore direct impact in cost	Development time could be higher than expected
Secondary Power Distribution DC/DC converters, Point of loads	Same solution for all the units, easy to implement. Reduction of the development time and number of components	Difficult to cover all the different needs Current POLs are foreseen for low voltage
Communication Link **External (OBC)** **Internal**	Standard for all the units, no development each program. More robust protocols.	Primes to define one single protocol seems not feasible. ASICs should be adapted to this new bus

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6. AOCS: Status and Evolution

AOCS: Attitude and Orbital control system

Current functions implemented in RIU:

- RW: Based in discrete interfaces although it is possible to control by UART links
- MTQ: Based in generic specification to cover several options depending on the spacecraft.
- Coarse Sun Sensor: Based in discrete interfaces
- Magnetometer: Supply and telemetry based in generic specification

Improvements in current functions:

- So far AOCS's RTU/RIU are based in generic specifications widely adaptable to different programs with low impact or no impact.
- Evolutions in components to reduce cost.

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7. Propulsion: Status and Evolution

Current functions implemented in RIU:

- FCV: Based in discrete interfaces
- CBH: Based in discrete interfaces.
- LV: Based in discrete interfaces
- Pressure transducer: Supply and telemetry based in generic specification.

Current status:

To develop a new propulsion module depending on the needs of the program**.**

Improvements in current functions:

- Each propulsion needs different interfaces. Not stable solution
- Commanding strategy changes depending on the program.
- Standardization of thrusters or type of propulsion, COLD GAS / MONOPROPELLANT

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8. Conclusion

Current developments:

- Products could be used for future programs with low impact
- New components will be needed if Mass /Dimensions want to be reduced
- Compact solutions will require a technological evolution

Primes / ESA to work to standardize building blocks / Standard functions.

Questions???