Astrium Satellites

Platform Input/Output Units Roadmap & Standard Building Blocks

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V 1.4

All the space you need

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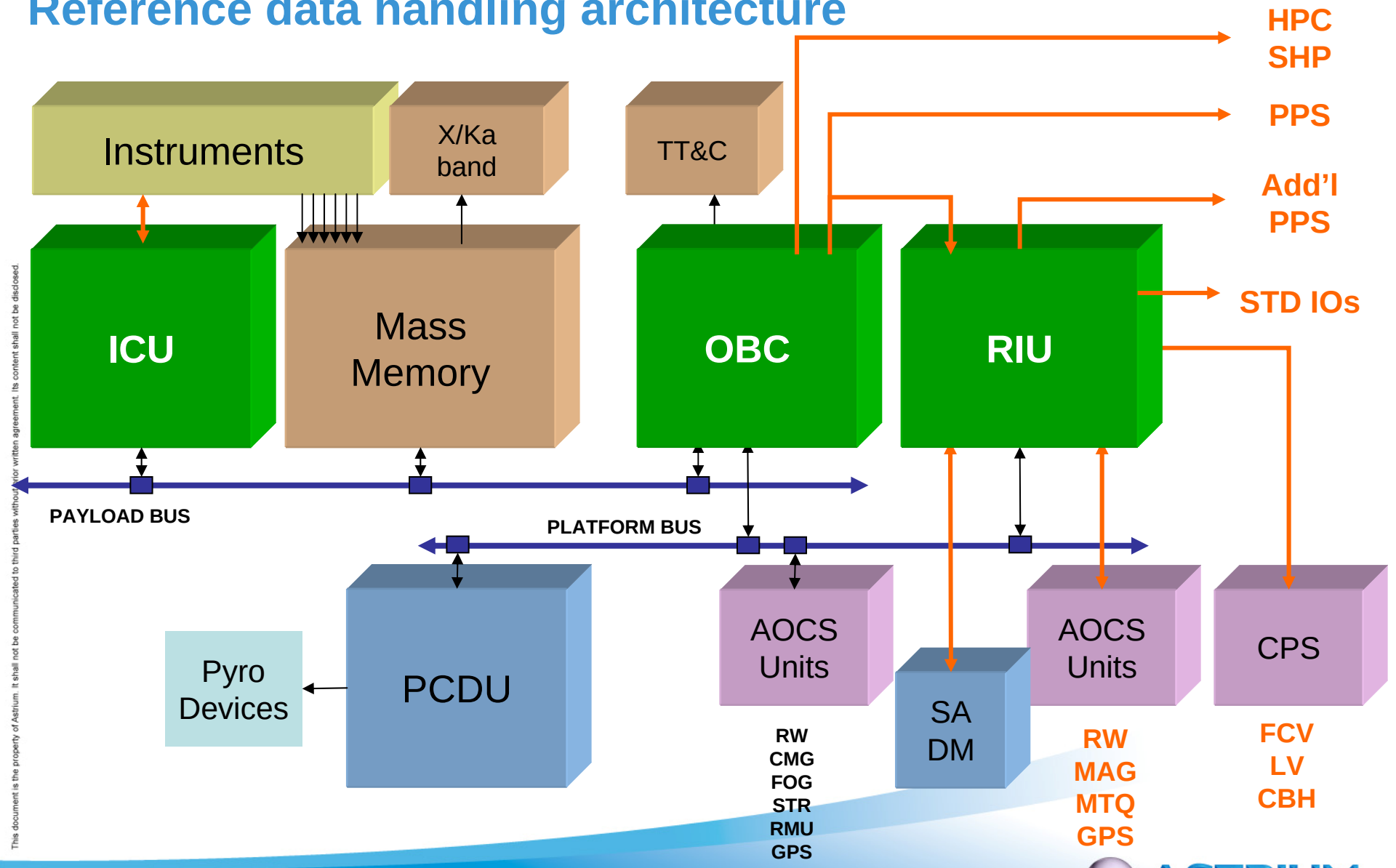
Reference data handling architecture



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Reference data handling architecture – I/O aspects

- OBC : common definition to most programmes
  - Local I/Os limited to those needed for reconfiguration
- RIU : adaptable definition to each programme
  - System level redundancy of sensors and actuators
  - Variable I/O number (a factor two at least)
  - Standard discrete I/O definitions (ECSS / GDIR)
  - Standard set of AOCS sensor interfaces (at least of LEO missions):
    - Magnetometer, Magnetotorquer, Reaction Wheels
  - Variable number of chemical propulsion interfaces
    - Flow Control Valves, Latch Valves, Catalytic Bed Heaters
  - Distribution of GPS PPS signals when required in addition to OBC lines
- ICU :
  - Core definition can be common to several instruments
    - Processing core, time handling, thermal control (TBC)
  - Other functions are fully instrument specific (mechanisms, power distribution…)
- Communication via Platform 1553 (OBC/RIU) and Payload 1553 (OBC/ICU) :
  - Determinism, segregation, incremental validation

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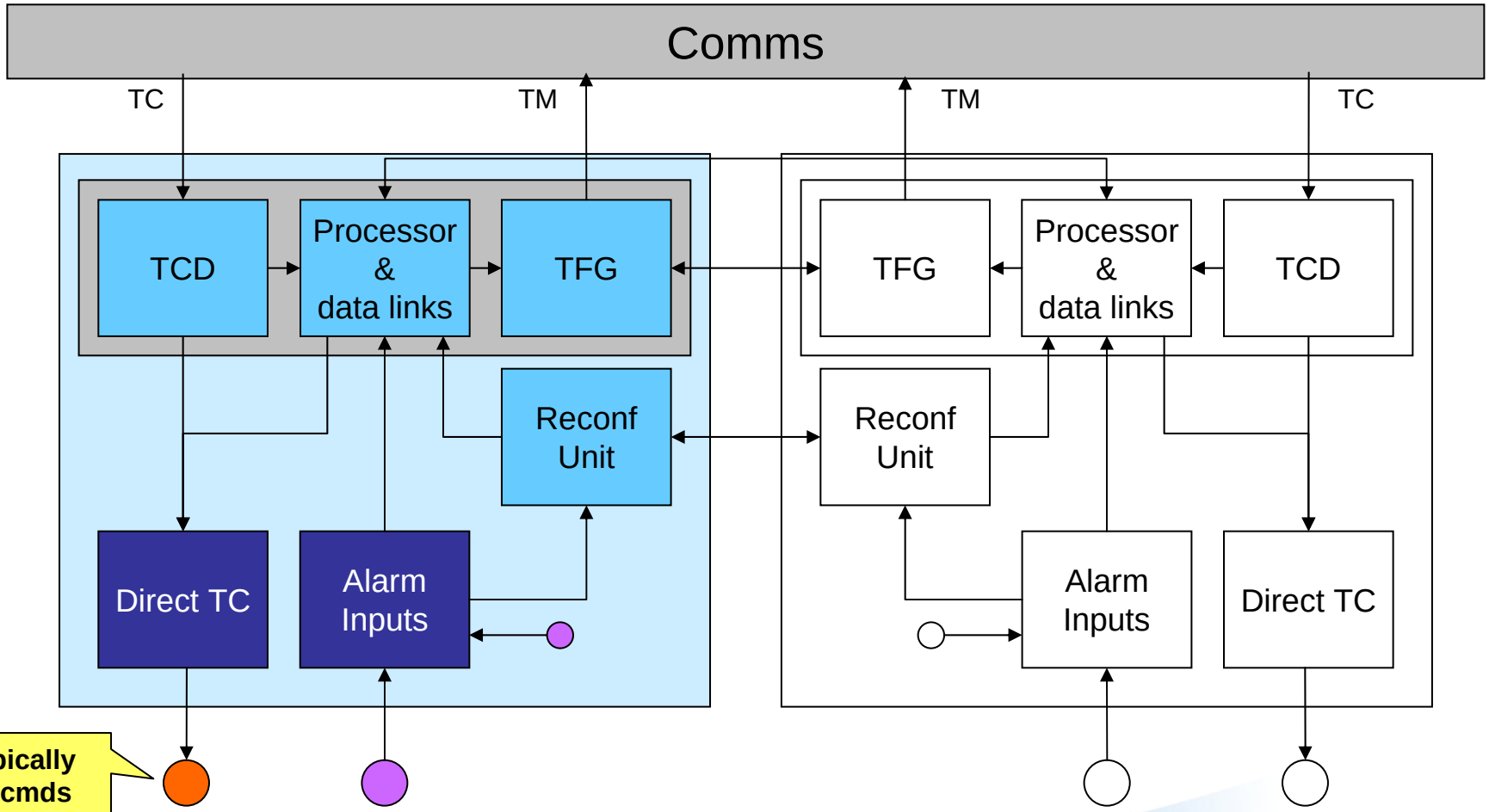
I/Os in standard OBC



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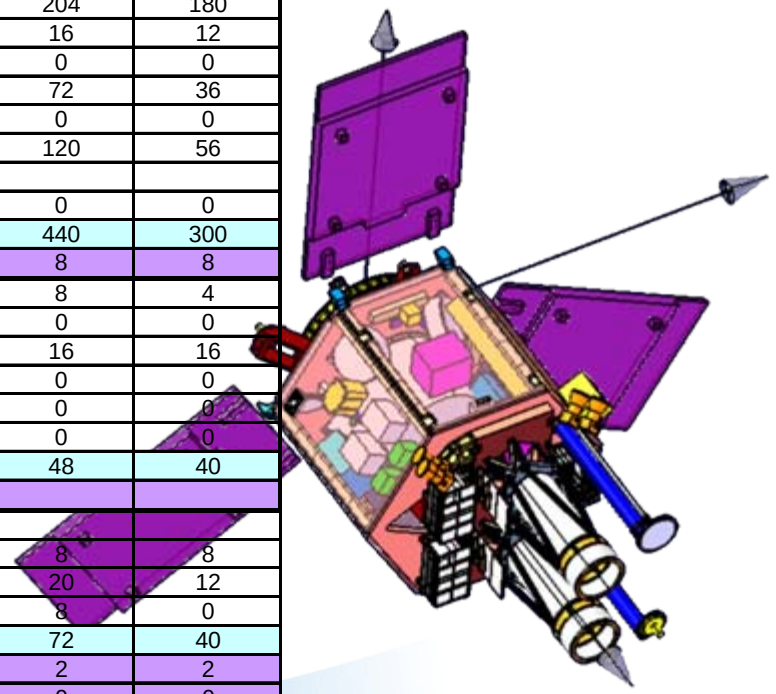
RIUs in current ESA EOS platforms

Module	Function	SEOSAT	Sentinel-2	EarthCare	GAIA	BEPI MPO	BEPI MTM
Core	OBC interface	1553	1553	1553	SpW	SpW	SpW
	Internal bus	SPI				SPI	SPI
	Nb of boards	1	2	2	2	2	2
DC DC	Voltage /Reg	28 V unreg	28 V unreg	28 V unreg	28 V reg	28 V reg	28 V reg
	Nb of boards	0	0	0	0	2	2
STD I/Os	Sync redistrib	24	0	0		0	0
incl redundancy	Ana	64	96	96	60	28	16
	Th	224	330	382	332	204	180
	BLD	16	96	96	32	16	12
	SBDL	16				0	0
	RSA	48	96	96	140	72	36
	UART	12				0	0
	HPC/SHP	96	192	192	128	120	56
	EHP		32	32			
	LLC	24				0	0
	Total STD	524	842	894	692	440	300
	Nb of boards	4	4	4	6	8	8
AOCS	Press T	2	3	6		8	4
+ cold redundancy	RW	4				0	0
	SAS Acq	8				16	16
	MTQ	3	3	3		0	0
	MAG input	3				0	0
	MAG supply	1	3	2		0	0
	Total AOCS	42	18	22	0	48	40
	Nb of boards	2	2	2	0		
Propulsion							
+ cold redundancy	LV	1	4	8	10	8	8
	FCV	8	8	8	8	20	12
	Catbed H	4				8	0
	Total PROP	26	24	32	36	72	40
	Nb of boards	1	2	2	0	2	2
SADE	Nb of boards	0	2	2	0	0	0
CSMDE	Nb of boards	0	2	0	0	0	0
Total I/O		**592**	**884**	**948**	**728**	**560**	**380**
Total boards		8	14	12	8	14	14



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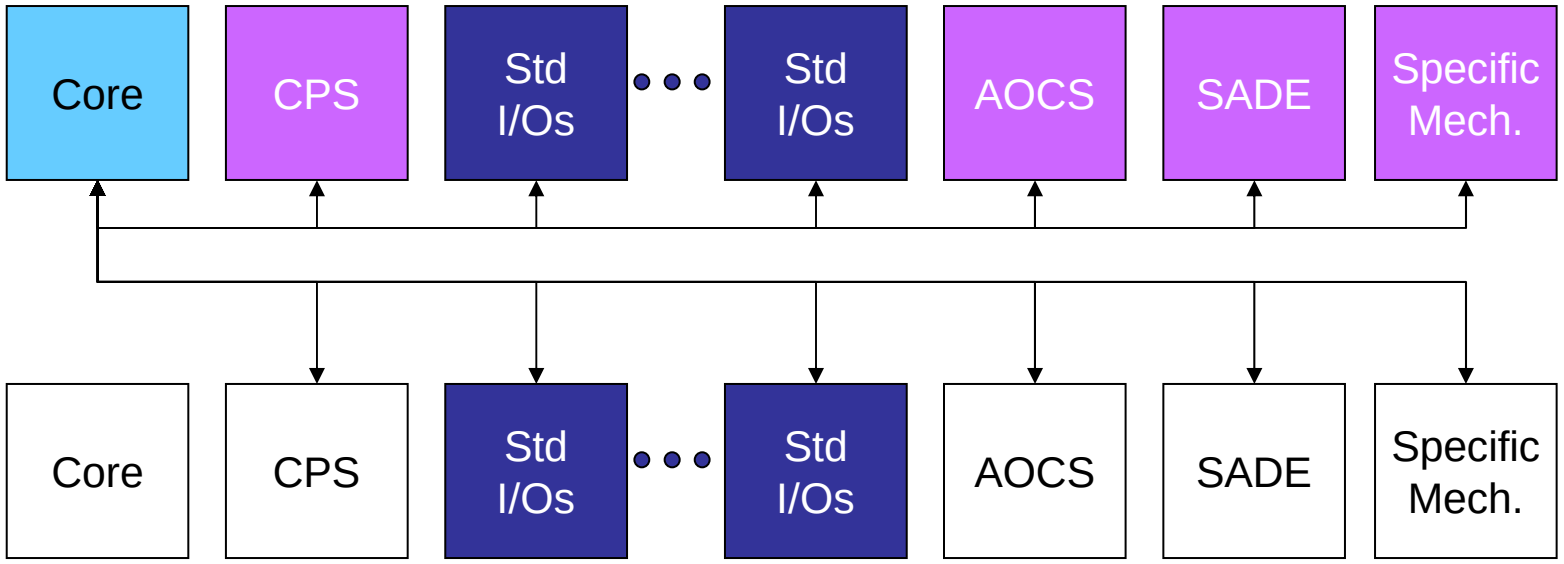
RIU Internal Modularity

Depends on
AOCS configuration,
propulsion type,
rotating SG,
specific mechanisms



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Instrument Control Units

- **Two ICU types**
  - Intelligent controllers (e.g. EarthCare, Sentinel-1)
    - OBC like processing module allowing payload PUS command & control with limited platform OBC software involvement
    - I/Os (standard types and specific ones)
    - External Tier-2 data bus to interface other instrument electronic units
  - RIU like units (e.g. SEOSAT)
    - I/Os (standard types and specific ones)

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Current I/O Units – Assessment

- **RIU functions are very similar from one programme to the other, but**
  - I/O number varies in the 400 – 1000 range
  - significant variability in terms of design, e.g.
    - Core / IO board communications and task sharing
      - Simple centralised architecture
      - Or decentralised with module level FPGAs
    - AD conversion
      - Centralised ADC
      - Or ADC at Input module level
    - Redundancy and segregation
      - Nominal modules & redundant modules
      - Or Segregated fault containment areas within a single module
- **ICUs could share several building blocks with Platform units (OBC, RIUs)**
- **In general, rather low integration level, use of costly FPGAs and ADC instead of integrated mixed ASIC solutions**

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Future RIUs – Spacecraft Prime interests

- **Enable new optimised architectures (e.g. decentralization)**
  - Availability of low cost small decentralised I/O modules
  - Standardization of an RIU external extension data bus
- **Reduce Prime's own cost (software, AIT, people training)**
  - Reduction of the number of I/O types
  - Standardization of RIU operations and of OBC/RIU protocol
  - Standardization of RIU redundancy management
- **Reduce equipment cost**
- **Meet Geo return constraints on institutional programmes**

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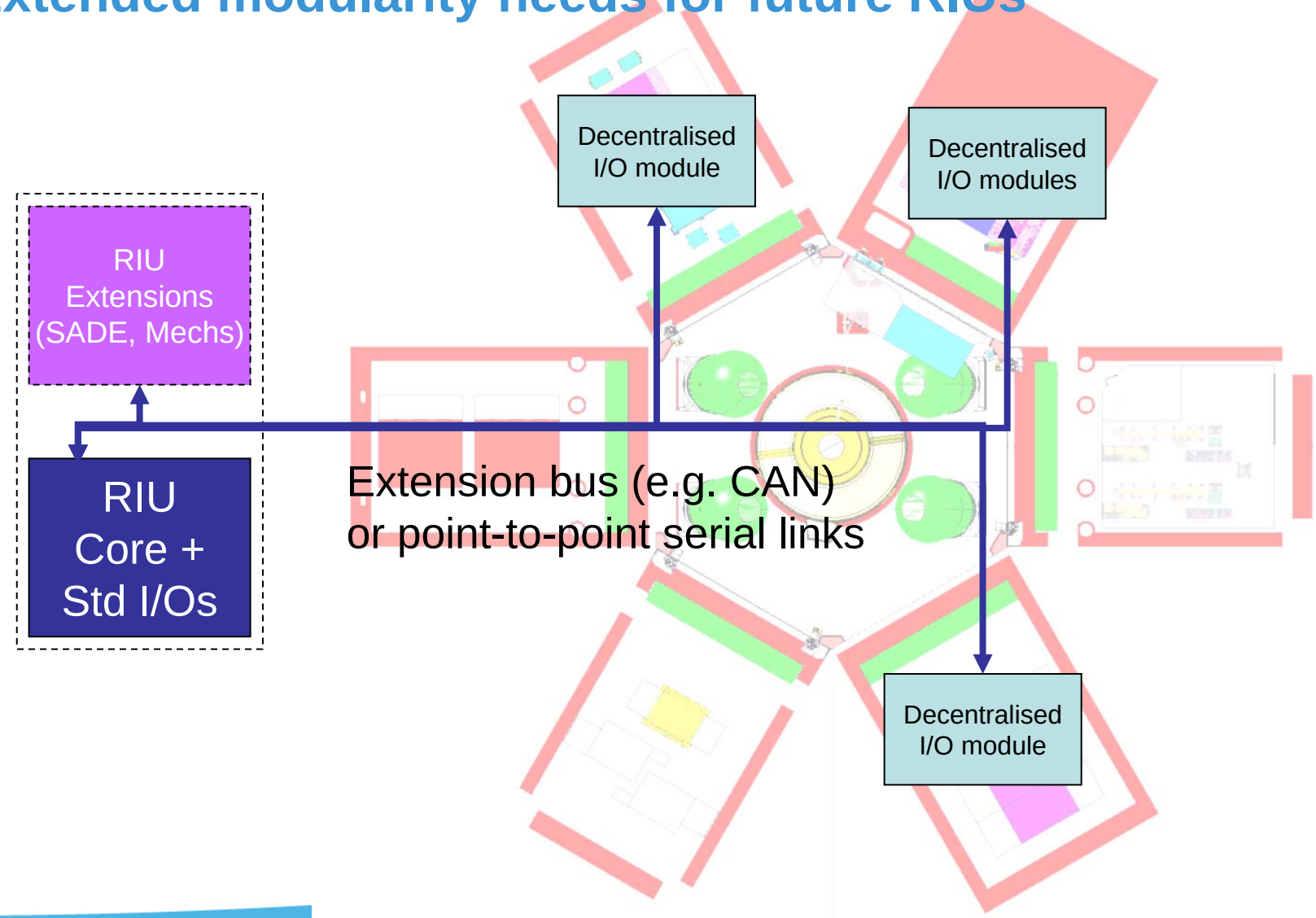
Extended modularity needs for future RIUs



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Future RIUs – Equipment supplier interests

- **Enable development of real equipment product lines**
  - Stabilization and harmonization of requirements
- **Access to more integrated technologies to reduce development risk and cost**
  - Standard I/O unit architecture elements
    - Decentralised bus type (e.g. CAN)
    - RIU internal bus (e.g. SPI)
  - Standard ASIC building blocks
    - A small set of mixed ASICs (Std IOs, AOCS, High power commands…)
    - A European design, manufacturing and test flow
  - High density connectors
  - Standard microcontroller IP for core function (TBC)

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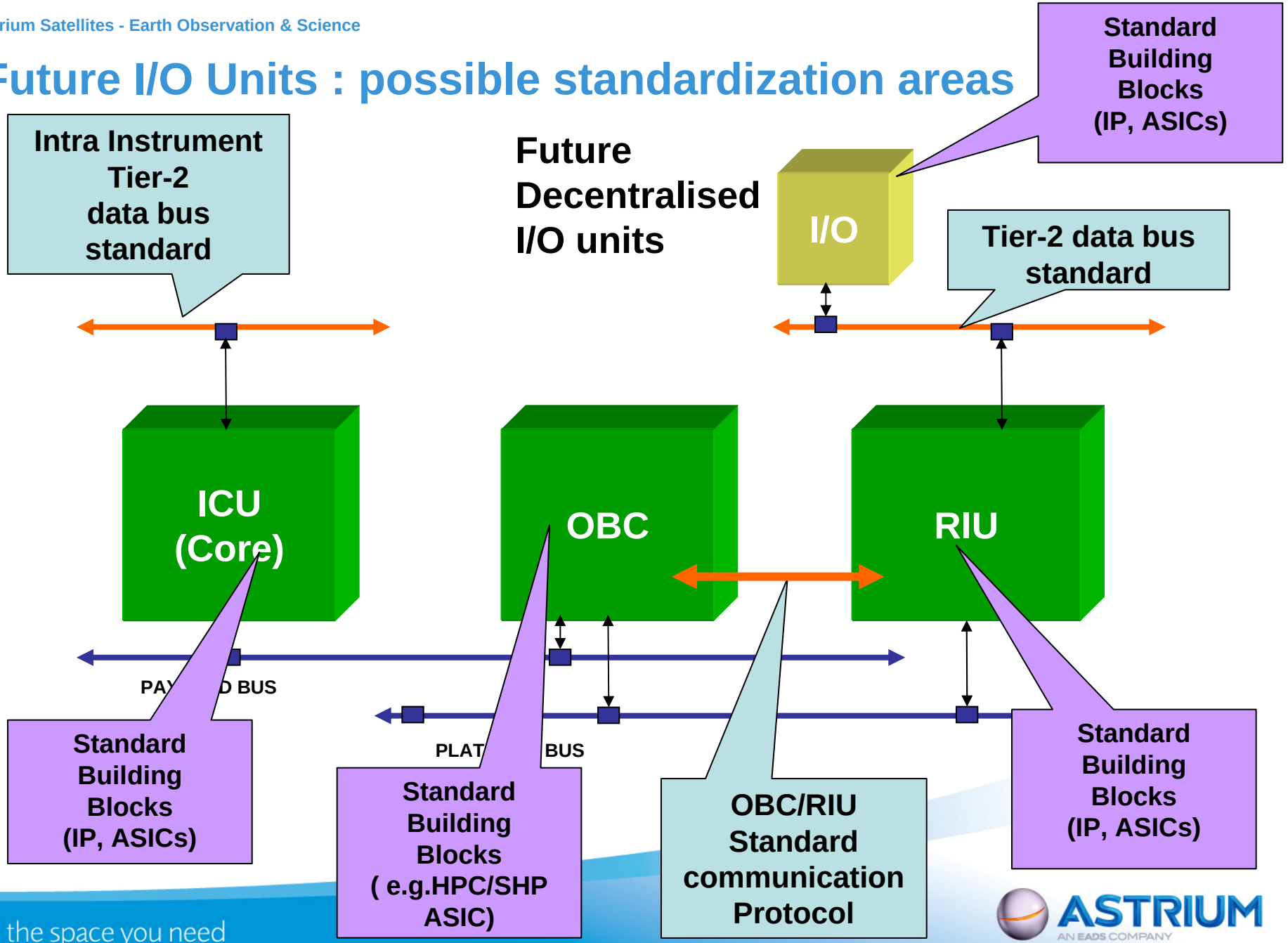
Future I/O Units : possible standardization areas



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Conclusion

- A technical strategy encompassing most I/O unit cases can be defined
- While electrical interfaces are already standardised today, standardization of key functional/protocol interfaces is a key enabling factor for the emergence of efficient equipment product lines
- Enabling highly integrated technologies to be brought to adequate TRL to reduce cost and risk on Phase CDs

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Thank you for your attention

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