

Operability and Modularity concepts of future RTUs/RIUs Airbus Prime Views

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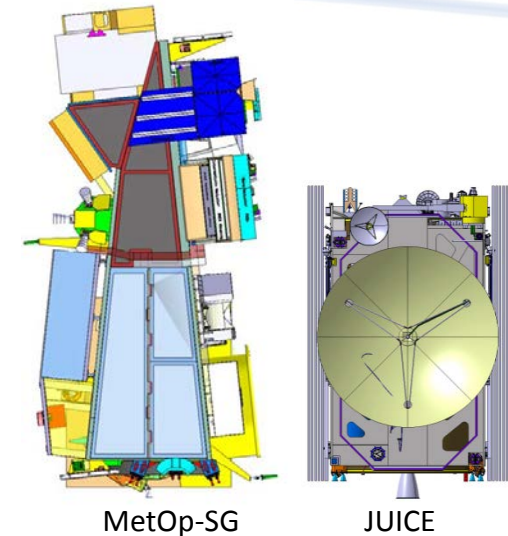
Presentation contents

- ① Background : RIU/RTUs in current Airbus programmes

- ① Prime viewpoints on :
 1. Standardisation of RTU/RIU Interface
 2. Modularity
 3. Impact of AOCS evolutions
 4. Impact of technology evolutions

RTU/RIUs in recent Airbus EO/Science programmes (1)

- ① Mil-Bus connected RIUs on all recent Airbus programmes with AstroBus operations concept.
- ① Sizing mainly driven by
 - ① number of channels
 - ① Propulsion subsystem configuration



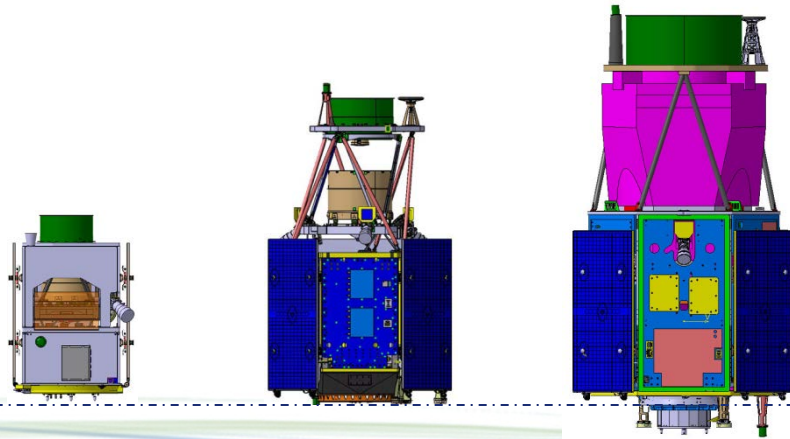
Examples:

Mission	Channels	Propulsion	PCBs	Other features
MetOp SG	~1400	Medium/ complex	12	Solar array and mechanism drive electronics as separate 1553 equipment
JUICE	~1100	complex	14	Solar array and mechanism drive electronics as separate 1553 equipment
BIOMASS (proposal)	~600	« simple »	8	Reflector Deployment interface unit (RDIU) as separate 1553 equipment

RTU/RIUs in recent Airbus EO/Science programmes (2)

Some examples (cont'd)

- Optical export
 - A single RIU configuration (approx. 600 channels, 8 PCBs) meets the needs in spite of different payload configurations

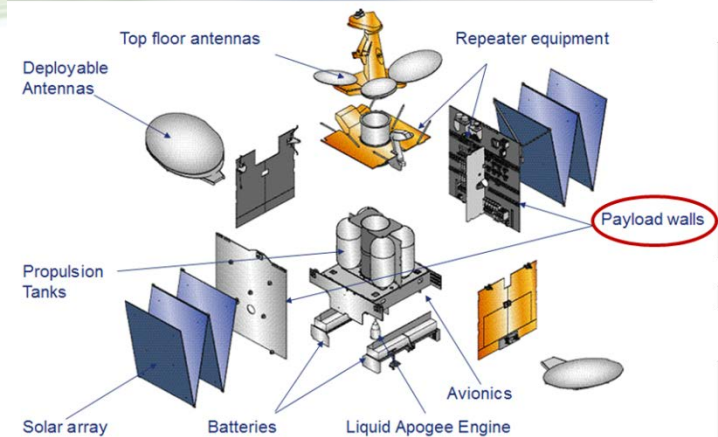


- Small science satellites
 - CHEOPS (ESA) and MERLIN (CNES) also rely on the a.m. configuration

RTU/RIUs in recent Airbus Telecom programmes (1)

Eurostar E3000 RTU/RIU

- Connected to Mil Bus
- Flexible : type of mission -> Full CPS, PPS/EOR
- Scalable : P/L Size
- ➔ Two configurations
 - Platform (SM) : Actuator Drive Electronic
 - P/L (CM) : Modular Payload Interface Unit



P/L TM/TC range	Min.	Max.
TC	600	3500
BIL TM	100	1000
ANA TM	500	2400



Platform: ADE5 Mk2

Flexible : optional modules



Scalable: variable number of modules

Payload: MPIU Mk2

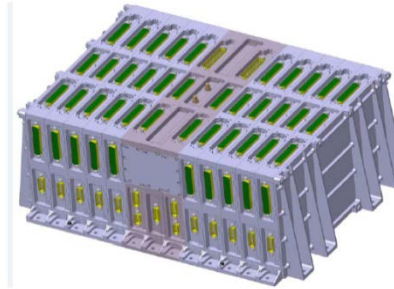
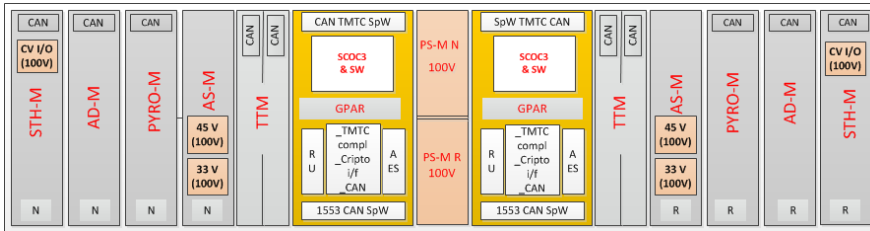


RTU/RIUs in recent Airbus Telecom programmes (2)

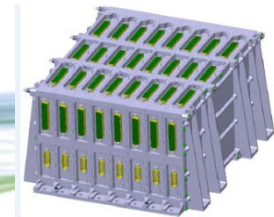
Eurostar Neo CDMU / PIU

- ◎ New Airbus DS telecom platforms
- ◎ Single concept for both units
- ◎ CDMU merges processor and RTU/RIU functions
- ◎ CDMU serves needs Eurostar Neo P/F and potential derivatives
 - ◎ Product Range is larger than Eurostar E3000
 - ◎ Targets in terms of scalability, flexibility and cost efficiency is much stringent
- ◎ CDMU/PIU modular architecture is key for reaching such objectives
 - ◎ Shared power supplies
 - ◎ CAN data bus for inexpensive communication data bus
 - ◎ Common modules for platform and payload
 - ◎ No backplane

RTU/RIUs in recent Airbus Telecom programmes (3)



CDMU Eurostar Neo



PIU Eurostar Neo

1 - Standardisation of RIU/RTU Operations Interface

- ① Expected benefit
 - ② Would enable multiple RIU supply sources without impact (or limited) at central software level provided the right level is achieved
 - ➔ Industrial securization via double sourcing
 - ➔ Geo return
- ② Preliminary feedback on SAVOIR RTU Functional & Operability spec
 - ③ Scope is limited to RTU operable features, command & control bus and discrete interfaces standardised by ECSS-E-ST-50-14C
 - ④ Some other common interfaces may be considered as well e.g. synchronisation interface or RS422/UART. Some interfaces may be discarded (ISD, OSD, BSD).
 - ③ The specified RTU meets and exceeds Airbus needs. Fear is related to the induced complexity on RTU developer side
 - ④ Emphasis is put on self-tests (dedicated state, coverage). Scope of RTU level self tests could be fairly reduced.
 - ④ Need for command lists as a generic way to interact with the RIU can be questioned
 - ④ Need is fairly limited, constraints are fed back at functional / central software level
 - ④ Command grouping, except specific cases, is not justified by command rate
 - ③ Overall consolidation of the requirements is required, in view of deriving concrete specification documents

2 - Modularity

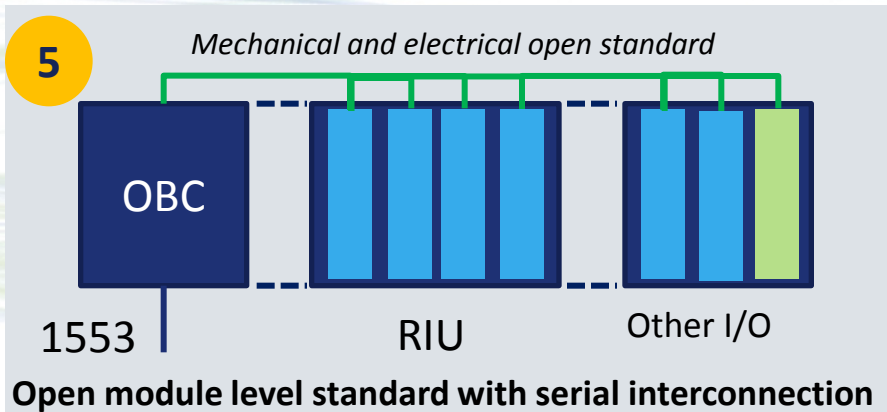
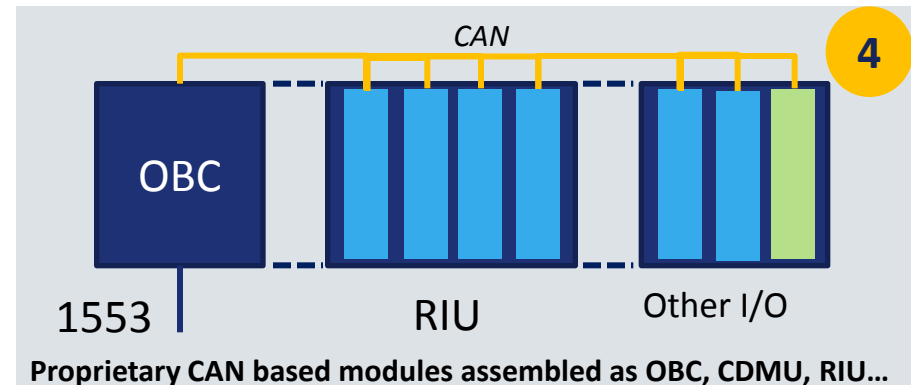
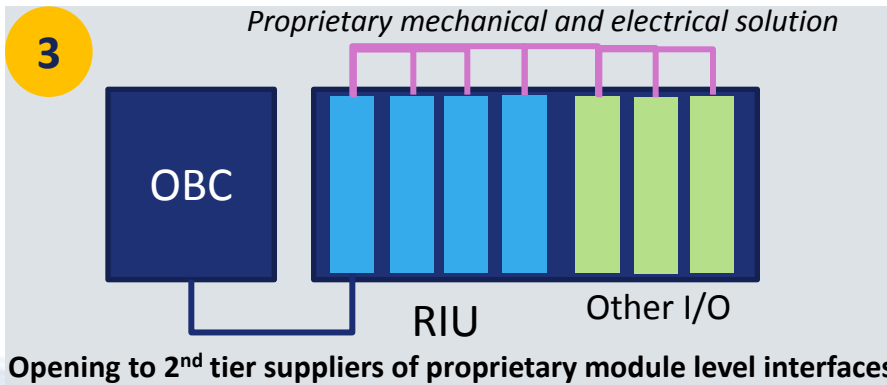
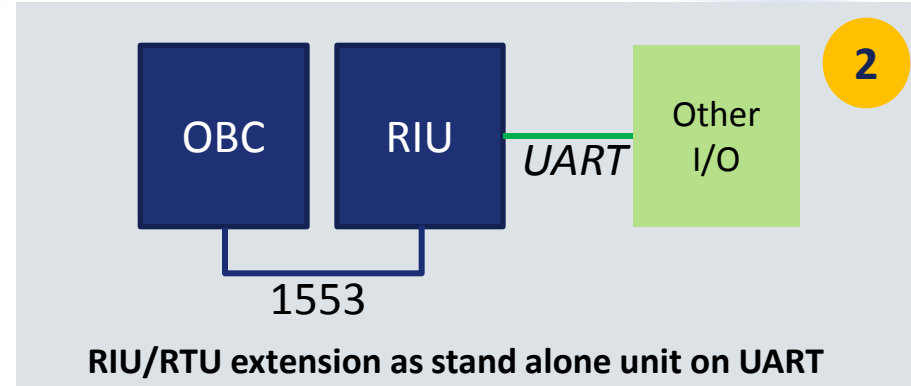
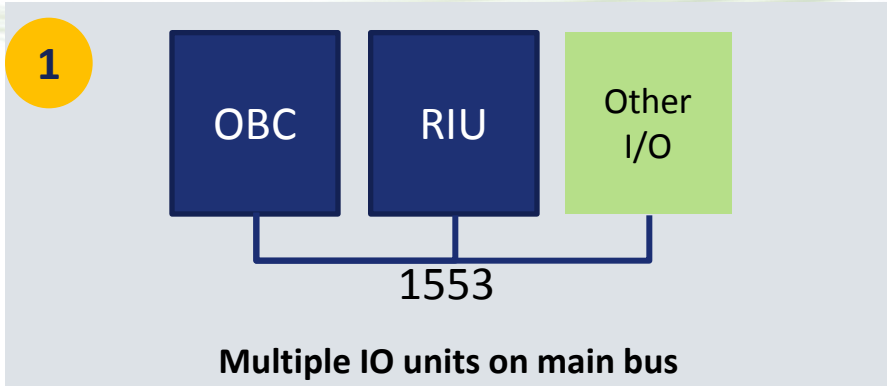
Expected benefits

- Minimise non-rec cost at supplier level when a non-standard/existing I/O configuration is needed
- Enable involvement of lower tier suppliers below unit level
 - to share geo return
 - to include specific functions (e.g. mech. Drive)
- Make accommodation in small satellites easier by using several smaller units


Several ways to achieve modularity

- Multiple I/O equipment either on main 1553 or via second level data link behind the RIU (UART)
- RIU suppliers to standardise their internal interfaces and open them to module suppliers
- Module-level standardisation initiative under ESA/industry umbrella for the next generation

Some modularity scenarios



Comparison of modularity approaches (1)

Criteria	Add'l unit on 1553 1	Add'l unit on dedicated RIU link (UART) 2
Minimise overall hardware customisation non rec cost	Costly (stand alone unit)	Less costly than 1553 (stand alone unit)
Minimise rec cost	Costly	Less costly than 1553
Opportunities for lower tier suppliers (e.g. small countries, NMS)	Good (1st tier supplier)	Good (1st tier supplier)
Compatibility with specific electronics developers expertise and concerns (SADE, MDE...)	Not as good as UART (complex 1553 interface)	Good
Easier accommodation on small sats	Good	Good
Time frame	Now	Now
Preliminary assessment	Interesting if existing heritage or specific industrial strategy	Preferred solution today on ENS programmes 

Comparison of modularity approaches (2)

Criteria	Opening of RIU/RTU suppliers proprietary module level interfaces 3	RIU/RTU made of standalone CAN modules (Eurostar neo) 4	Module level ESA/industry standardisation 5
Minimise overall hardware customisation non rec cost	TBD (suppliers' feedback ?)	Good with common CAN interface IC	Yes if no eqt requal when adding new module (suppliers' feedback ?)
Minimise rec cost	Lowest cost (TBC by suppliers)	Lowest cost (TBC by suppliers)	Lowest cost expected (depends on standard)
Opportunities for lower tier suppliers (e.g. small countries, NMS)	Good if partnership between 1st tier and 2 nd tier suppliers	Good	Good if affordable and not just space specific
Compatibility with specific electronics developers expertise and concerns (SADE, MDE...)	Significant investment outside supplier core business	Significant investment outside supplier core business	investment balanced by more opportunities
Easier accommodation on small sats	Not as good as other options (current form factors are large!)	TBD (depends on selected form factor standard)	TBD (depends on selected form factor standard)
Time frame	Short/medium term	Medium term	Mid/long term
Preliminary assessment	TBD (suppliers' feedback ?)	Telecom : baseline for EUROSTAR neo ENS : interesting step towards 5	Interesting track for the future

3 - Evolutions : AOCS impact on RIU/RTU ?

AOCS Item	Today on Astrobus satellites	Possible evolutions (EO/Science)	Possible impact on RIU/RTU
Star tracker	1553	Centralised processing in OBC (optical head using SpW on OBC) in some cases	none
Gyros (fine)	1553		none
GNSS Rx	1553 or UART	Centralised processing in OBC in some cases	none
Reaction wheels	Discrete links on RIU	Serial on RIU (in some cases, case of CHEOPS today)	none
Coarse sun sensor	Discrete links on RIU	SpW (ESA)	Not really considered for the moment
Earth sensor	UART on RIU		none
Magnetometer	Discrete links on RIU	New dev. with UART ?	none
Magnettorquer	Discrete links on RIU		none

➔ So far no impact on RTU/RIU of possible AOCS sensor/actuator evolutions

4 - Other possible evolutions

- ③ More « intelligence » in RIU/RTU?
 - ③ A micro-controller core in RIU may provide more freedom to suppliers in standardising their internal architectures to
 - ③ comply with OBC/RIU interface principles of various Primes
 - ③ follow evolutions of the future SAVOIR RTU operability standard
- ➔ Apart from that, Airbus do not see real benefit to decentralise « intelligent » functions from OBC to RIU
- ③ More integrated components
 - ③ Open, general purpose I/O chip with embedded ADC
 - ③ DC/DC converters
- ③ Lower cost classes

Conclusion

- ③ Many EO/Science satellites will be small/lighter in the future
 - ➔ More compact electronics
- ③ Telecom (Eurostar Neo) modular concept could be a basis for further deployment on some other applications
- ③ Affordability : some constellations may ensure reliability / dependability at constellation level and not at satellite level
 - ➔ Hardware to be available in lower cost classes
 - ➔ Reduce on-board redundancies ?

- ③ Airbus plan to cover the full mission/satellite class spectrum and deploy, whenever possible, a similar functional avionics development approach for the benefit of all applications
 - ➔ New standards shall enable this scalability