Earth Observation, Navigation and Science

Earth Observation, Navigation & Science

Command & Control Interfaces

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AIRBUS

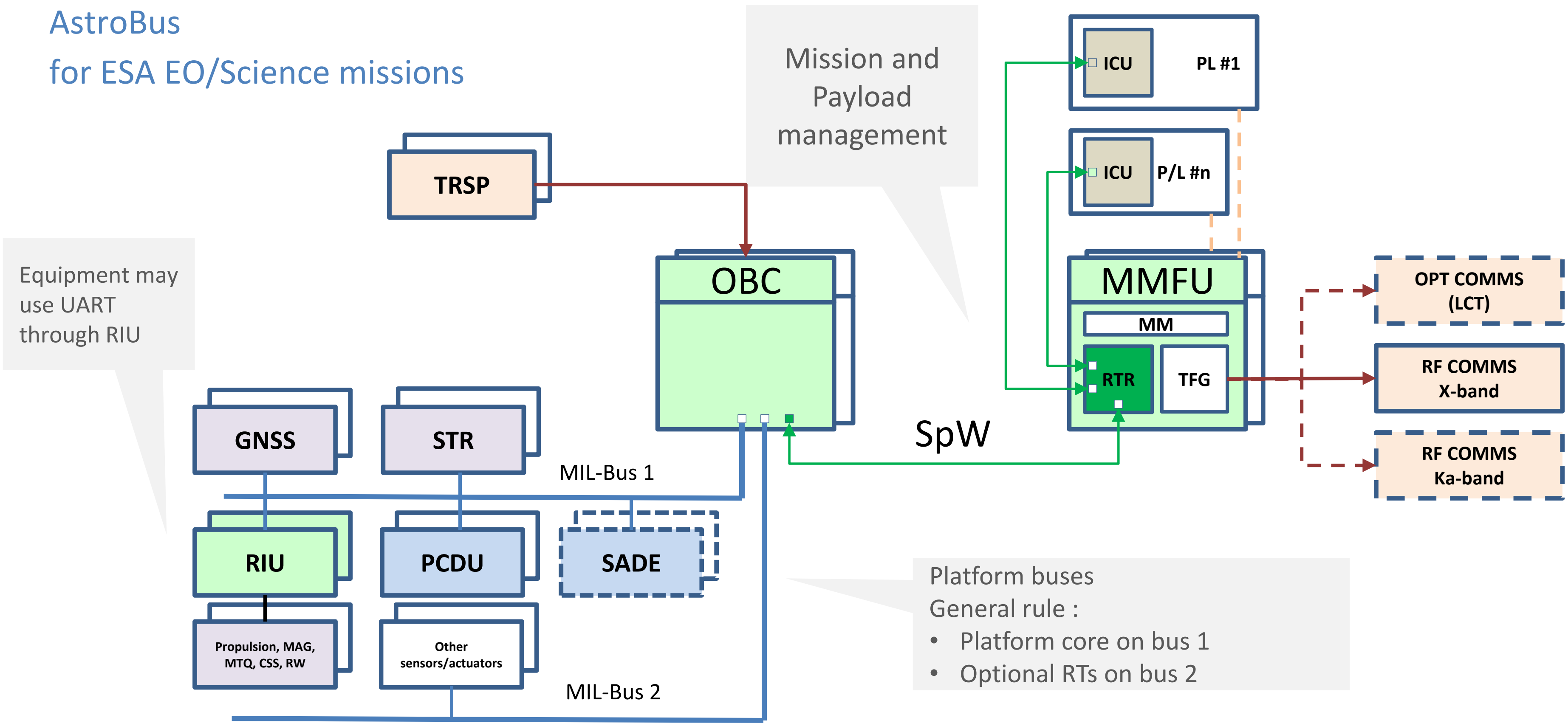
Contents

ENS

- Recall of current Airbus AstroBus architectures (and others)
- Future ENS missions and impact on o/b data links
- Conclusion and way forward

Current Airbus interconnection architectures (1/2)

AstroBus
for ESA EO/Science missions



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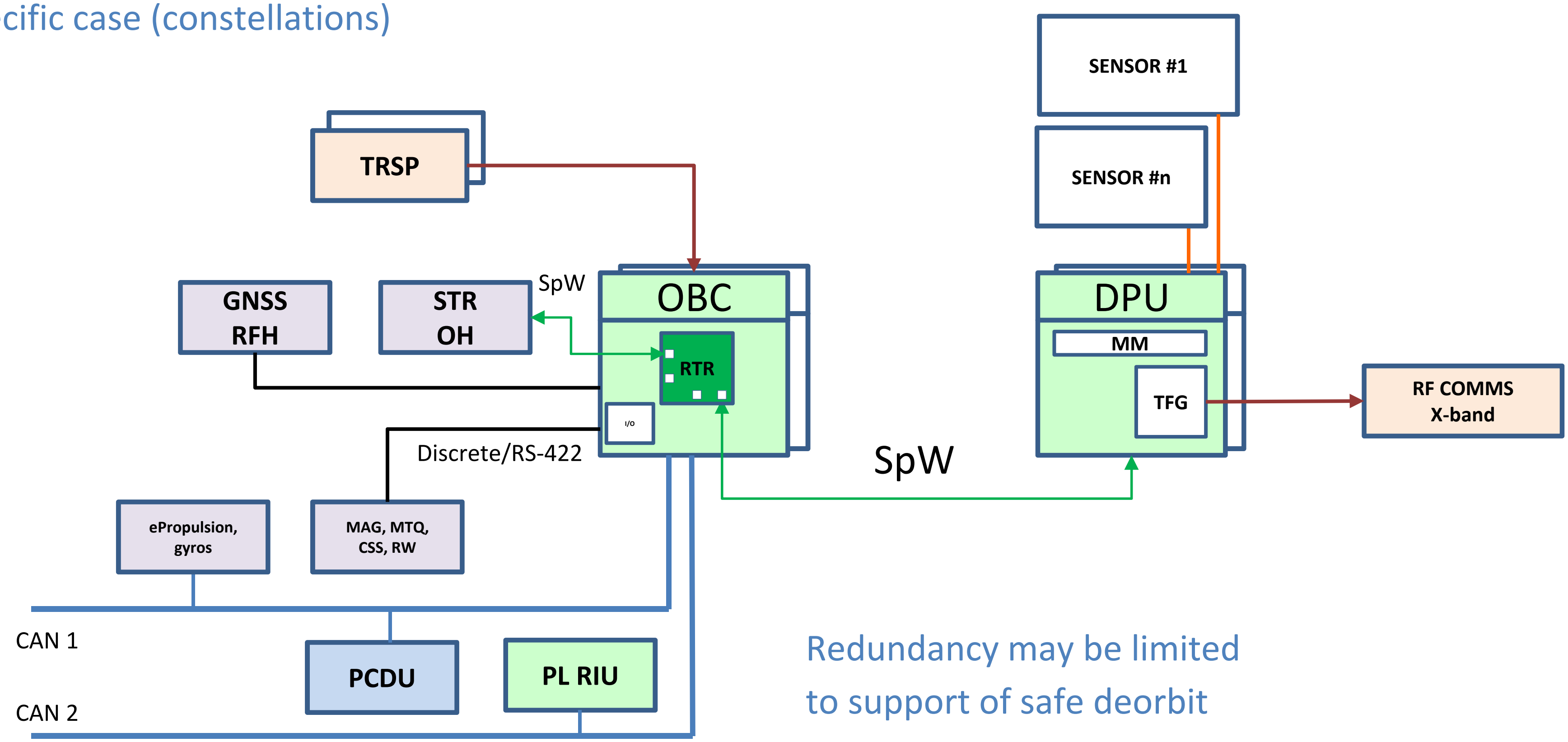
Current Airbus interconnection architectures (1/2)

Specific case (constellations)

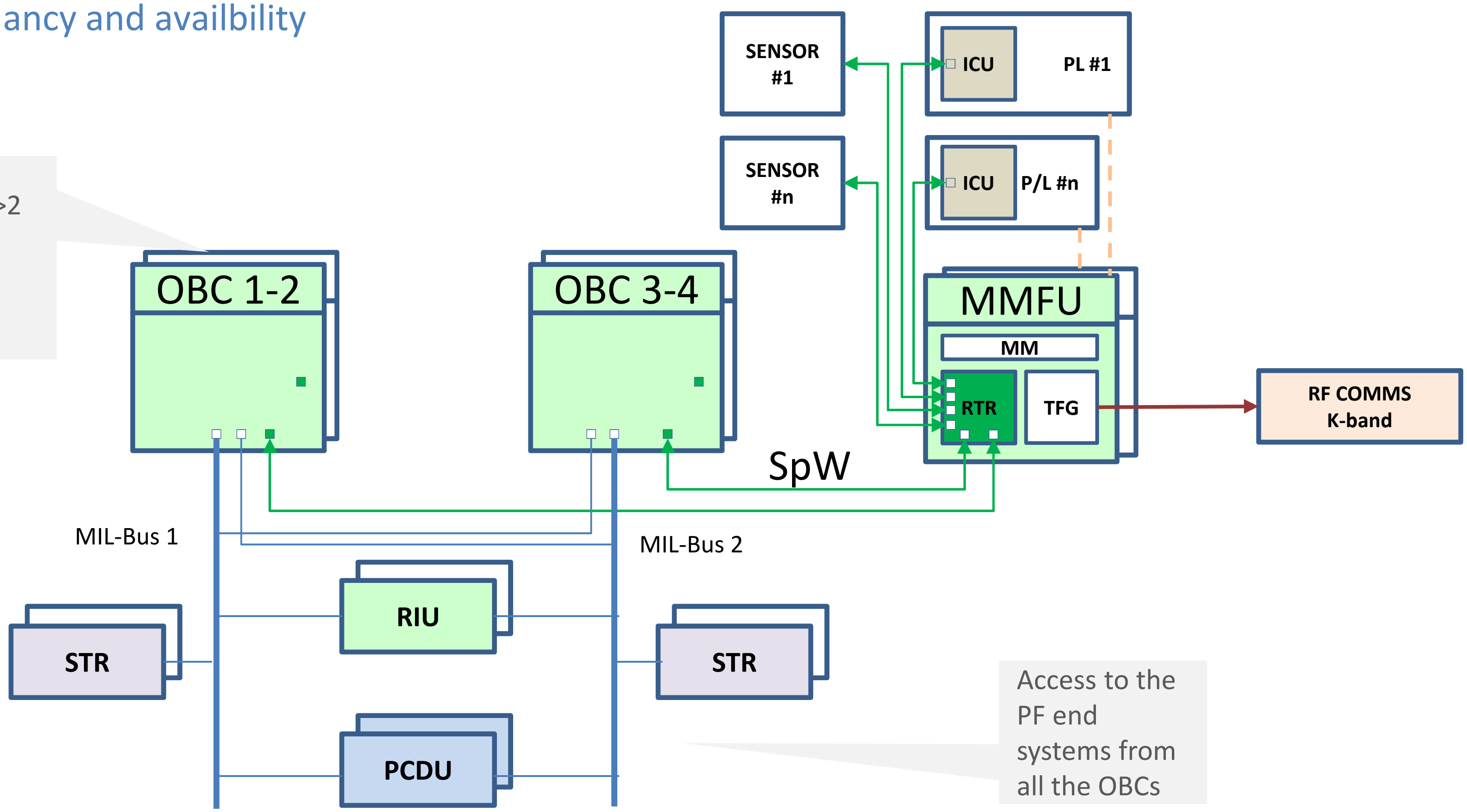


Redundancy may be limited to support of safe deorbit

Example of architecture for exploration missions

Specific redundancy and availbility constraints

Redundancy level >2 (HWCC) to cover specific mission phases



Access to the PF end systems from all the OBCs

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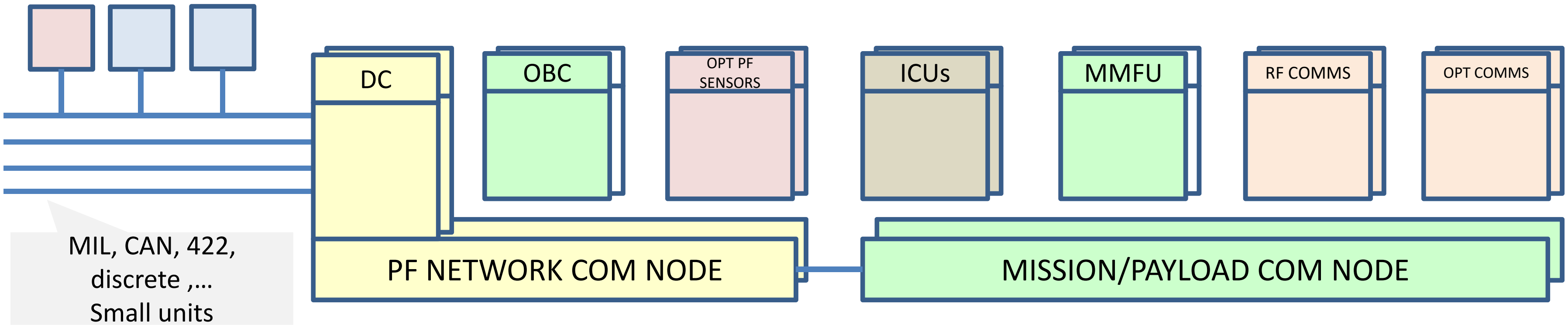
Future ENS missions and impact on o/b data links

For the next decade most ENS missions, whatever the market segment (e.g. optical commercial, RADAR, institutional EO) will share a common set of core needs :

- Minimise adaptation cost for each mission, even with significant functional variability
- Minimise equipment recurring cost
- Maximise added value and minimise system operational costs through new applications, increased on-board processing and overall spacecraft autonomy

Primes will change their existing product lines only for a significant benefit wrt the a.m. areas

Future o/b architecture option 1 – Single network (1/2)



“Flat” on-board network

Multi protocol data concentrator to accommodate various types of serial data links : buses such as CAN and 1553 and point-to-point. Decentralised discrete I/O acquisition via the a.m. local buses.

Single high speed mission-oriented network interconnecting OBC, AOCS front-ends (STR, Navcam optical heads), Data concentrator, MMFU, ICUs and (TBC) downlink terminals (RF, laser/relay, laser/downlink), uplink terminals (for independent hosted payloads)

Future o/b architecture option 1 – Single network (2/2)

Advantages

- Minimization of interfaces.
- Logical/physical topology separation
- Capability to accommodate various redundancy levels

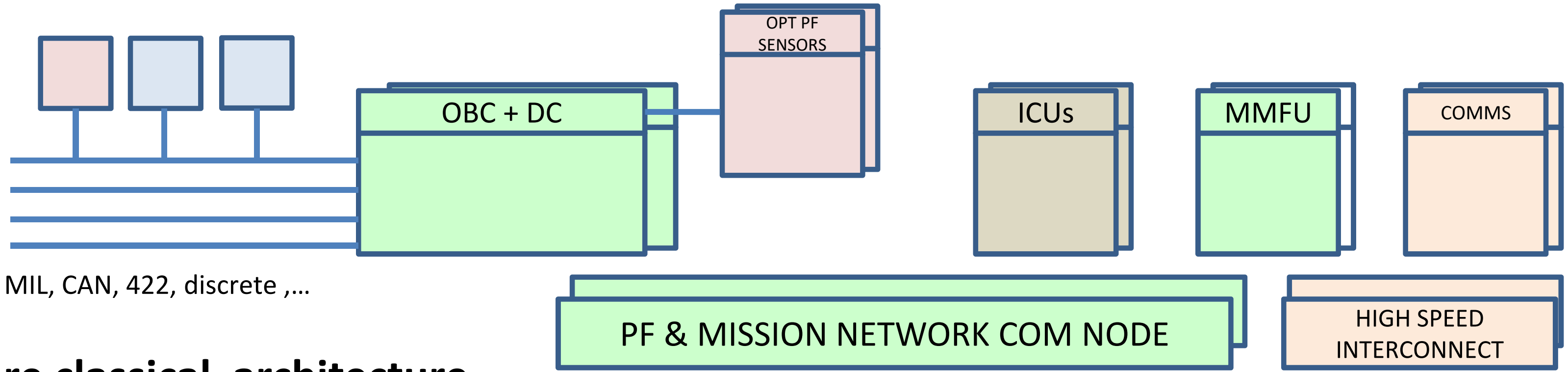
Drawbacks

- High throughput technology (align on most demanding interface))
- Need for high number of virtual links (or similar concept) : switch complexity

Open points

- Complex definition and validation. Europe is most likely able to develop only one solution
- Which (non Space) standard ? Take advantage of the fact that other domains are able to invest more and progress faster than Space

Future o/b architecture option 2 – mixed network (1/2)



More classical architecture

Centralised OBC
- Multi protocol data concentrator with various types of serial data links : CAN and 1553 and point-to-point.
- Decentralised discrete i/O acquisition via the a.m. local buses..
- Interface to AOCS front-ends (STR) on dedicated links
- Execution platform SW providing segregation between platform and mission management SW.

Medium speed mission-oriented network interconnecting OBC, MMFU, ICUs

High speed links/network only for high throughput instruments and downlink terminals (RF, laser/relay, laser/downlink)

Future o/b architecture option 2 – mixed network (2/2)

Advantages

- Less technology demanding
- Platform interface and management functions are grouped inside OBC and its local buses and therefore segregated from mission variability
- Some level of functional segregation of payload data flows (between them, HK vs science data,…) can be achieved via network protocol and switch features

Drawbacks

- No real improvement wrt today in terms of reduction of interfaces and number of tiers
- Intra OBC communications : network constraints move from inter-box to intra-box

Conclusion and perspectives (1/3)

Low speed networks

- CAN, MIL bus and other serial buses will remain in our architectures
- Unification is not desired to take benefit of available sensors/actuators in the various “grades” available on the market : established suppliers targeting global classical market, new space, academics…
- Forget the “single technology paradigm” and consider RTU/RIUs as multiprotocol equipmebt

Conclusion and perspectives (1/3)

Medium/High speed network

- A structural choice not driven by pure data communication properties
- Impacts the end-to-end functional avionics digitalization chain
- Long term investment in one reference solution for satellites, ideally addressing all market segments

Conclusion and perspectives (2/3)

Which unified network technology ?

SpFi:

- Components are definitely useful to master the complexity of the internal architecture of high performance of Instruments, sensors and processing units.
- Ensure availability of IP to European Space community with adequate performance with European FPGAs
- But, are European resources sized to make it a full world class command & control network ?

TTE

- A real tangible achievement
- Rather complex to deploy (feedback from other domains)
- Performance above satellite needs for command & control and likely too low for payload /mission applications
- Multiple sourcing to be put in place and demonstrated
- Is recurring cost affordable for small sats ? Licence ? Need IPs and not only ASICs

Conclusion and perspectives (3/3)

Which unified network technology ? (cont'd)

TSN :

- The potentially ideal candidate
- Public , future large user basis
- Availability of COTS components
- Not very well known, to be understood and evaluated with its full industrial landscape
- Build a potential development and validation roadmap before deciding

- We must target a sustainable solution (for the next 30 years !) (Option 1)

- In the meantime, the mixed network (Option 2) meets all project needs