On-Board Data Systems

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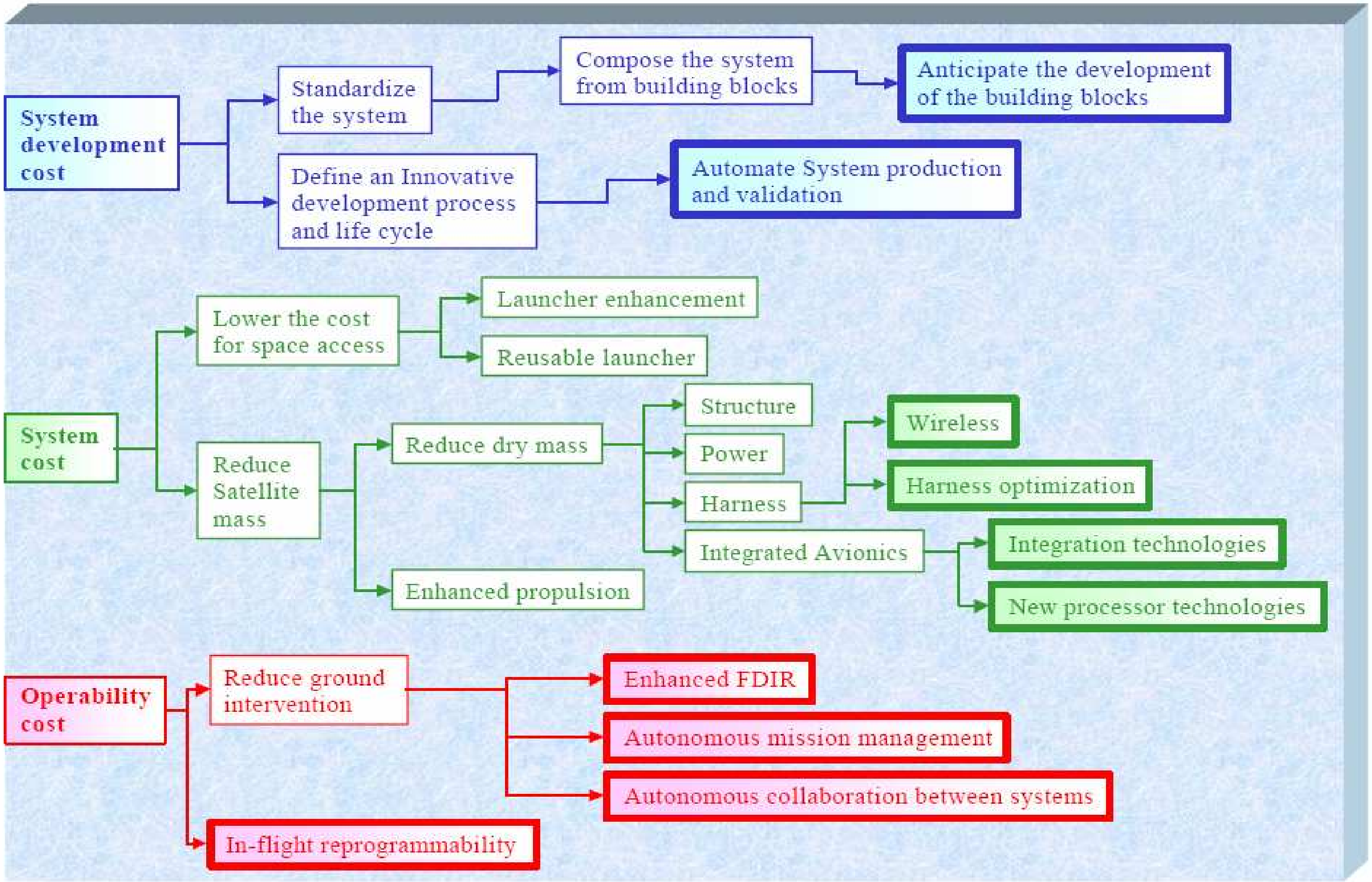
Avionics for multi-mission platforms, hard Facts

- Avionics take an important share of the platform cost
- Many building blocks have a high potential for a recurrent use (especially processor modules, I/Os) provided that :
  - Their development and procurement is **performed at program level** (not at project level)
  - They are compatible with an open system architecture capable of following technology evolution based on well accepted international standards
- Power and mass minimization are strong constraints
- Avionics are to a large extent independent of the platform structure of the S/C
- Harness minimisation and its control during project advancement is in some cases an important issue.

Future Needs

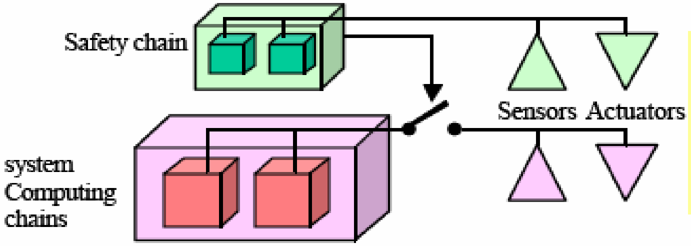
- Accommodate high resolution instruments: high data rate communication (on-board and TM), high capacity mass memories and high performance on-board processing capability
- Accommodate a set (suite) of very different instruments
- On-board intelligence/autonomy for exploration missions
- Constrained costs (with additional performance and complexity)

Data Systems : cost reduction



Classification of Data Systems

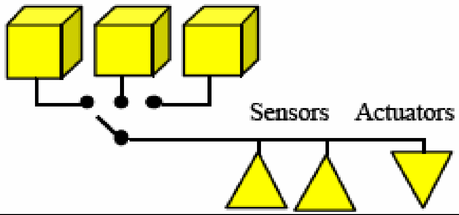
Safety oriented system



Life time in safety mode: 10 years
Interruption of service: 1 second
Error detection coverage: 100 %
Full segregation
Ground intervention not allowed

Safety chain CPU is 1750
Safety chain SW is 512 KB
System chain CPU is ERC32
System chain SW is 4 MB
Used in ATV, ISS
Future use: FLPP, CTV

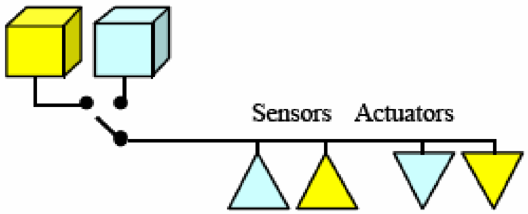
Availability oriented system



Limited life time: few hours or days
Interruption of service: 10 ms
Error detection coverage: 100%
No survival mode at system level
Ground intervention is not possible

CPU is 1750 or ERC32
SW is 4 MB
Not used
Future use: Science and as system chain of safety oriented systems

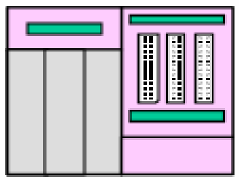
Reliability oriented system



Long life time: 15 years in orbit
Interruption of service: 1 minute
Error detection coverage: 90%
Survival mode at system level
Ground intervention always possible

CPU is 1750 or ERC32
SW is 4 MB
Used: EO, Telecom, Science
Future use: Science and
Next generation on Leon

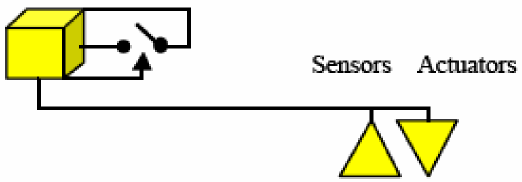
Ground technology oriented system



Medium life time: 3 years
Interruption of service allowed
Error detection coverage: 90%
Switch payload to safe state when error
Ground intervention always required

CPU is ERC32
SW is more than 4 MB
Used: payload for ISS
Future use: Science
Next generation: Leon, PPC

Cost oriented system



Medium life time: 3 years
Interruption of service allowed
Error detection coverage: 80%
Robust survival mode at system level
Ground intervention always required

CPU is 1750
SW is 512 KB
Used: specific
Next generation: Leon, PPC

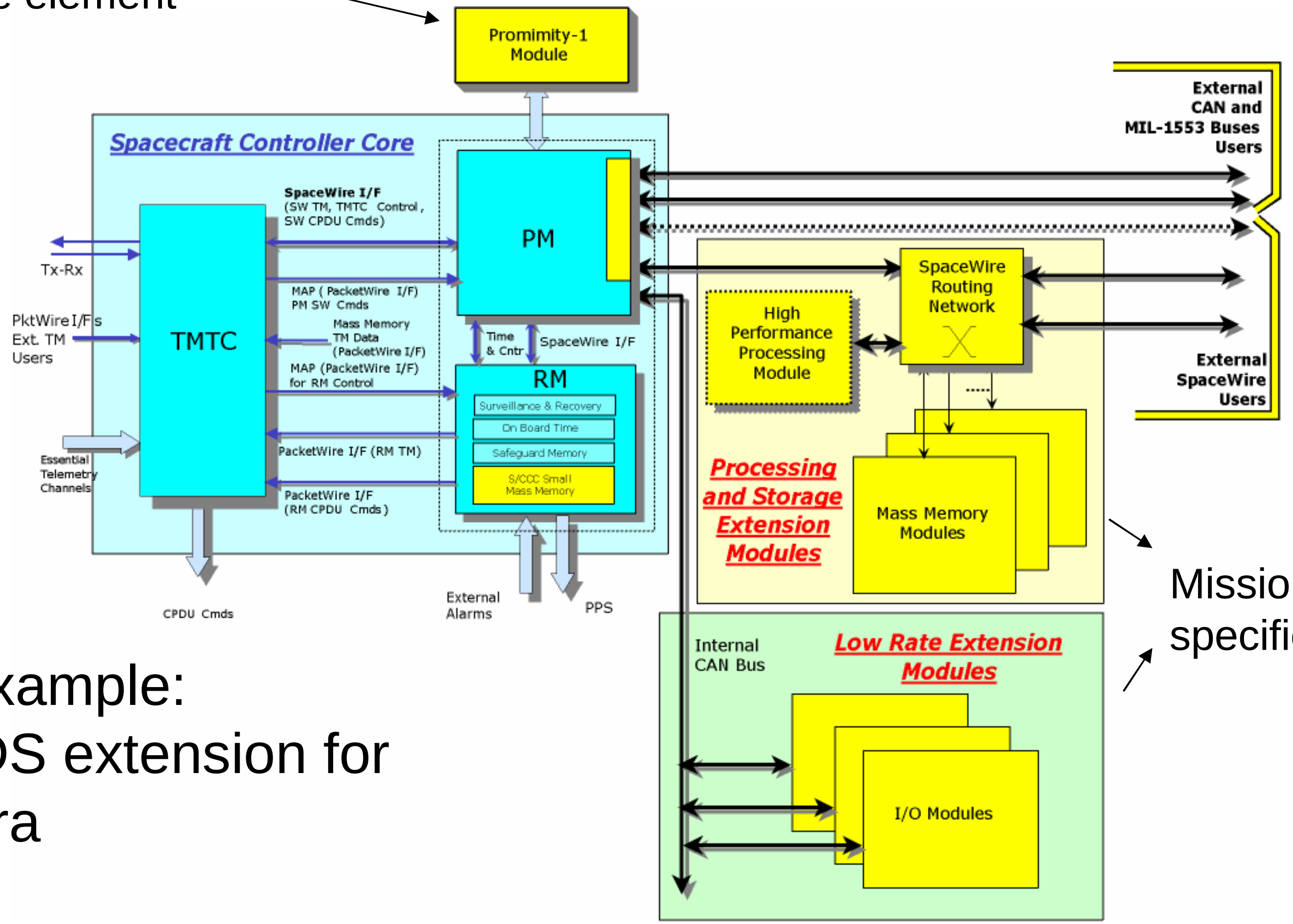
System classification and system architectural design

- Two complementary architectural options:
  - ➢ Highly Integrated Control and Data Systems, for small spacecraft Avionics
  - ➢ Distributed data and control systems, for medium to large satellites embedding demanding payloads in terms of on-board data processing.
- The two approaches share common building blocks and technologies (Processors, ASICs, Bus and network interfaces, microelectronics devices)
  - ✓ Can be made modular and scalable (on-board computers, mass memories)
  - ✓ Gap between platform Data Systems and Payload Data processing systems can be bridged (e.g. Astrium Unionics)
- Fault tolerance, Harness minimization, hierarchical networks, standardized interfaces and services (at HW and SW) are systematic objectives underlying all R&D activities in the field of data systems.

Avionics for multi-mission platforms

Platform I/O

Communication with surface element

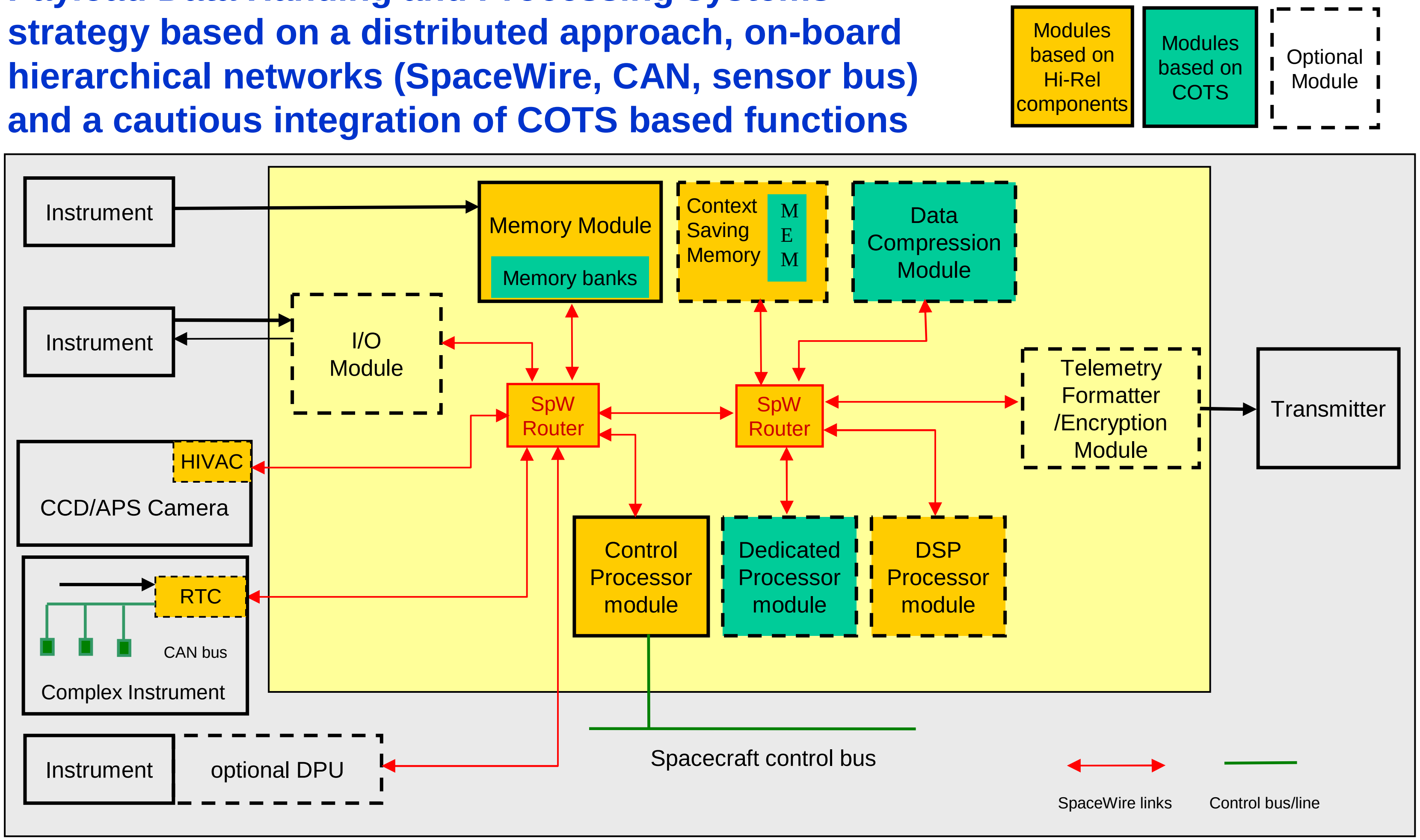


Mission specific/tailored

An example:
HICDS extension for Aurora

Data Handling systems

Payload Data Handing and Processing systems strategy based on a distributed approach, on-board hierarchical networks (SpaceWire, CAN, sensor bus) and a cautious integration of COTS based functions



TopNet: Pilot activity, decentralised integration

Involvement of different actors (industry, university, agency) in a *pilot activity* for *decentralized integration* of SpW-based data handling sub-systems that are geographically separated