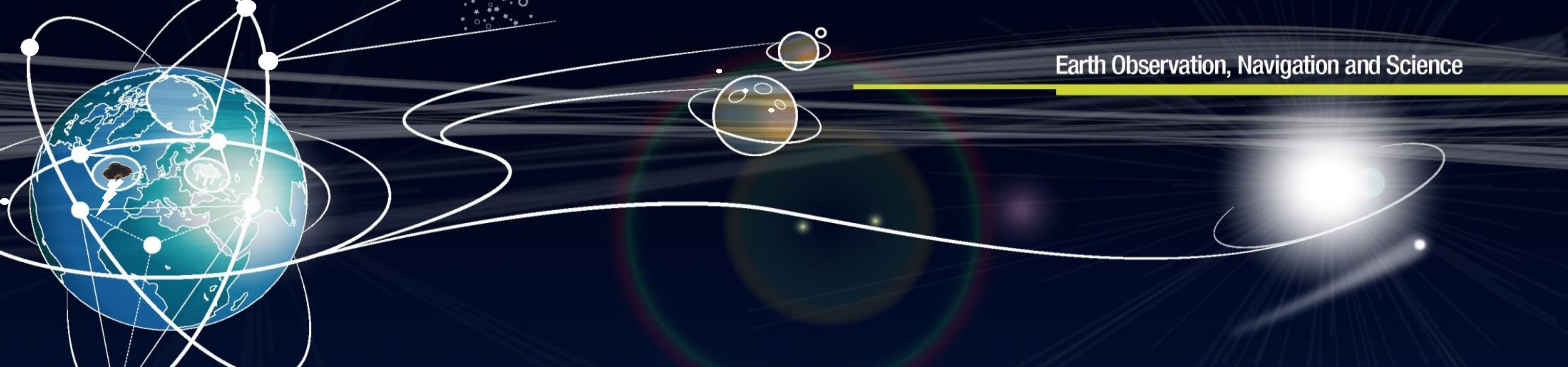


Earth Observation, Navigation & Science
Future Mission Needs, Trends and Opportunities

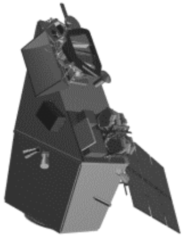
Workshop on High End Digital Processing Technologies and EEE Components for Future Space Missions

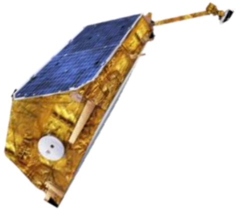
ESA/ESTEC 1 October 2018

AIRBUS

ENS Current and Future Missions

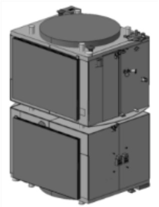
Institutional Earth Observation
(e.g. Copernicus)

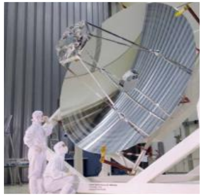




RADAR Satellites and Instruments

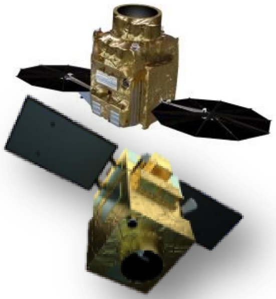
Future Navigation Satellites

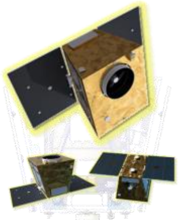




Scientific satellites and Instruments

Optical commercial observation
Satellites and Instruments





Optical constellations

Key expectations for future ENS missions implementation

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
  - A new generation modular software architecture which will be more performance demanding and more open to commercial standards
  - Performing processes and tools along the end-to-end engineering chain (from mission to FPGA)
- Minimise equipment recurring cost, e.g.
  - HW standardisation : to build units around a small set of configurable modules to enable batch procurement
  - HW minimisation : save HW, taking advantage of multiple cores and FPGA matrices
  - Co-engineering and co-development between Primes and suppliers
- Maximise added value and minimise ground segment operational costs :
  - Enable new applications and operations modes
  - increase on-board processing and overall spacecraft autonomy

High end processing enablers

High performance building blocks

- MPSoCs
- Large FPGAs
- Related peripheral support components, e.g. non volatile memories, POL, oscillators, PLLs,…

Adequate end-to-end processes and tools

- Brilliant EEE components are not enough !
- Simulation / HW/SW co-simulation
- Affordable commercial equivalent units for SW developmen,t and validation if simulation ius not achievable

Some high end processing use cases (1/2)

An MPSoC based generic processing module could be deployed in a more generic way across satellite avionics, while today each unit relies on its own set of building blocks :

- ICU (Instrument Control (& Processing) Unit)
  - the General Processing Module and the Specific Processing Module(s) (e.g. as in Sentinel-5 ICS) could be replaced by a single module built around a single MPSoC
    ➔ several ASICs + FPGA replaced by a single configurable component
- CDMU (Central computer)
  - A similar general purpose MPSoC based module could be used as CDMU, including centralization of Star Tracker and GNSS processing
- MMFU (Mass Memory & Formatting Unit)
  - A similar general purpose module could used as standard building block for mass memories : either one attached to CDMU or several combined as standalone equipment.
  - It could also run mission specific added value applications performing in–orbit processing

Some concrete high end processing use cases (2/2)

Other high end processing applications :

- On-board networking
  - on-board network switches with as many virtual channels as what would be required by a new generation software architecture. A key objective is to maximise software independence wrt physical HW architecture and connectivity, potentially leading to a significant number of virtual networks.
  - Intersatellite links : e.g. to route downlink data across a constellation up to the node currently under ground station visibility to minimise data latency
  - High speed downlink (RF or optical)

- Navigation sensors
  - Application : object capture (Mars Sample Return, debris removal), rendez-vous (space tug)

Other points to be considered

Not to forget :

- European independence : support maintenance/emergence of a European industrial network around NG high performance digital components. “Large” user base is key.
- Non dependence on specific vendors : avoid proprietary solutions, align to standards
- Develop high density electrical power components and the digital means to take benefit of them (e.g. GaN and digital control)
- Evolution of Quality standards to facilitate introduction of non space high quality EEE (e.g. Automotive) ?