CD03 Avionics
TDE 2021 - 2022

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Perimeter

Avionics systems

architecture, o/b communication, o/b autonomy, fdir, operability, o/b security, o/b gnss receiver, development process, verification, validation

TT&C E2E systems

space communication architecture, payload data modulator, transponder, TT&C o/b RF/optical & antenna

CD03

Control systems

aocs & pointing, gnc, enabling technologies, control techniques, sensors, RF and optical metrology

Data systems

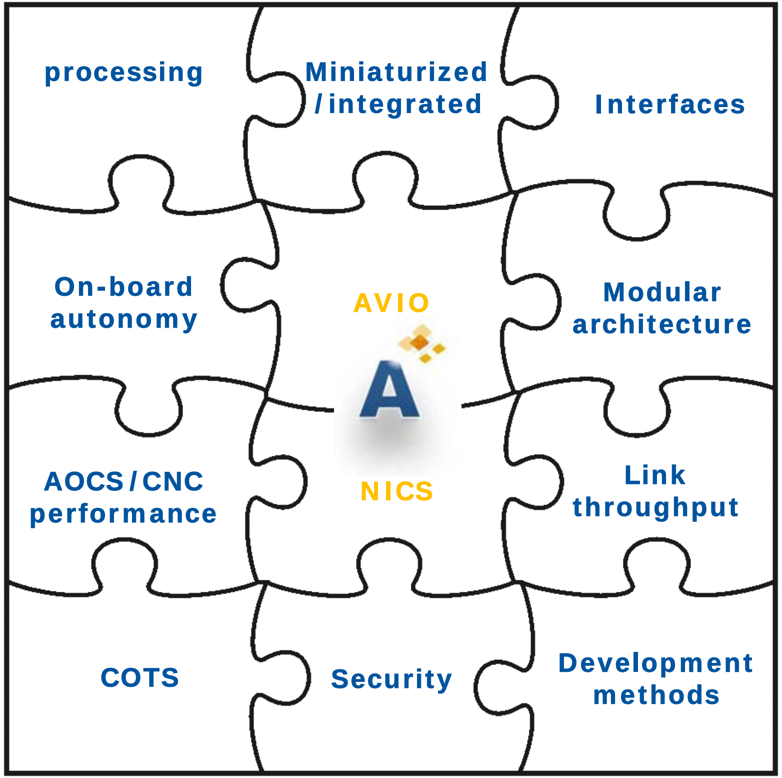
data processing, data management, payload/platform computers, data storage, on-board network, microelectronics (hw-sw codesign)

Software systems

flight software, software quality, dependability & safety

Strategic objectives

1. Processing solutions
2. COTS based solutions
3. Miniaturized / integrated solutions
4. Modular architecture
5. Interface solutions
6. On-board autonomy
7. On-board security
8. How to increase data throughput and improve performances for TT&C and payload data links
9. Increase AOCS/GNC Performance
10. Avionics development methods



Four Technology and Engineering Cornerstones

(30%) Improvement of s/c development **time** by (2023)

We develop key technologies to allow ESA to reduce the time from Phase B2 to launch from an average of 68 months to 46 months.

>10x improvement of **cost** efficiency with every generation

We develop key technologies to allow Europe to achieve one order of magnitude cost efficiency improvements with every spacecraft generation.

Develop **innovative** technology & **accelerate** its adoption enabling new applications

We develop processes, methods and technologies to allow Europe to take full benefit from the early introduction of new technologies into space systems.

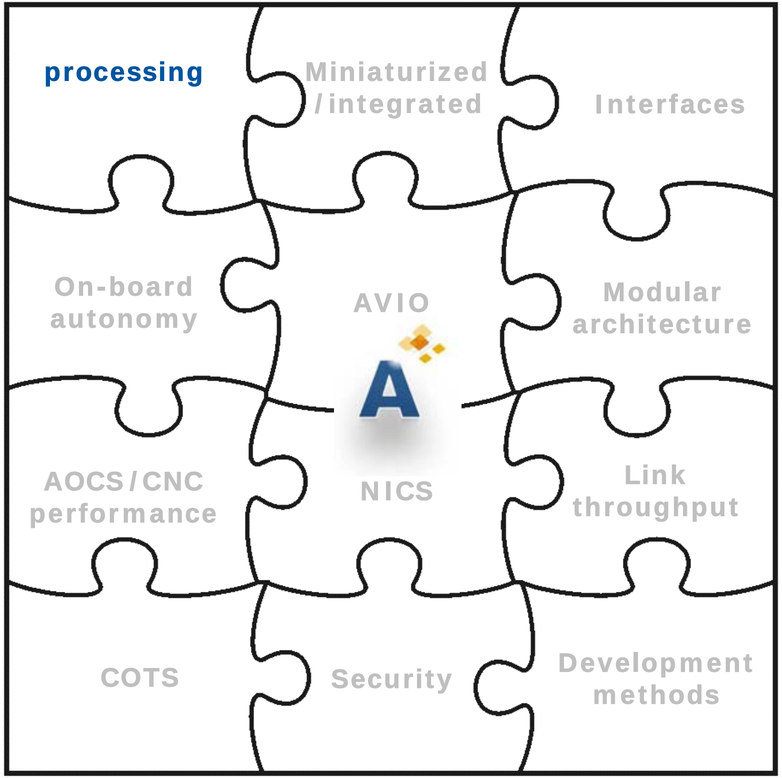
Inverting Europ. contributions to space **debris** by 2035

We develop the technologies that allow us to leave the space environment to the next generation in a better state than we have inherited it.

Strategic objectives

1. Processing solutions

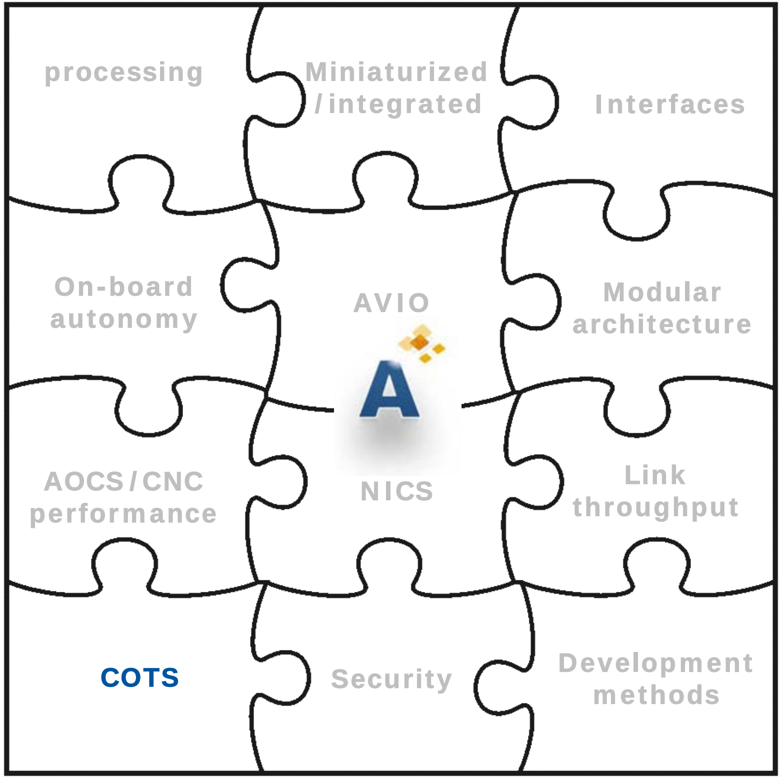
Lossy multi/hyperspectral compression IP core	250 k€
Efficient Video Compression for space	350 k€



Strategic objectives

1.
2. COTS based solutions

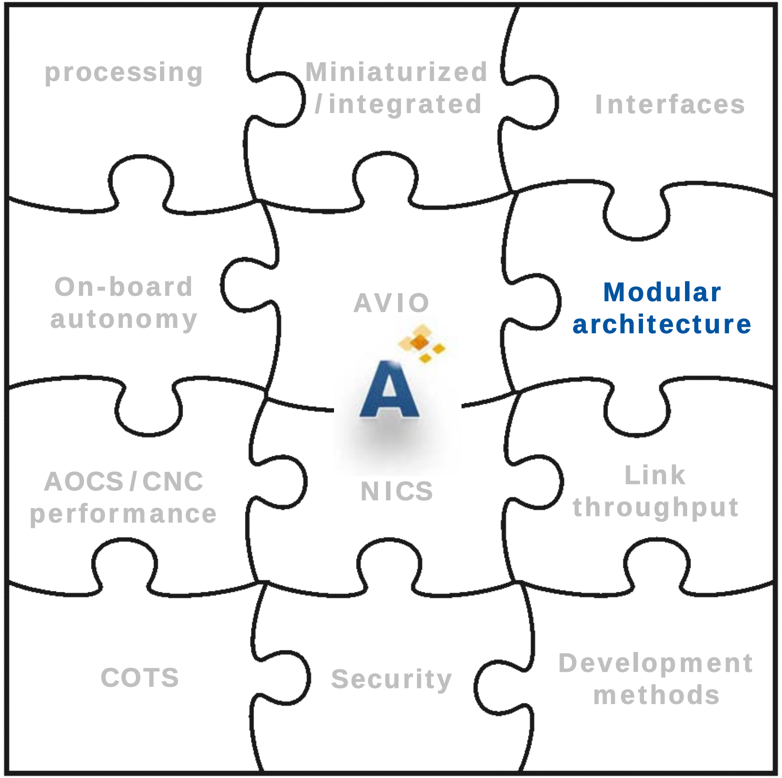
Reference Avionics Processing Module using COTS Reconfigurable Systems-on-Chip	750 k€



Strategic objectives

1.
2.
3.
4. Modular architecture

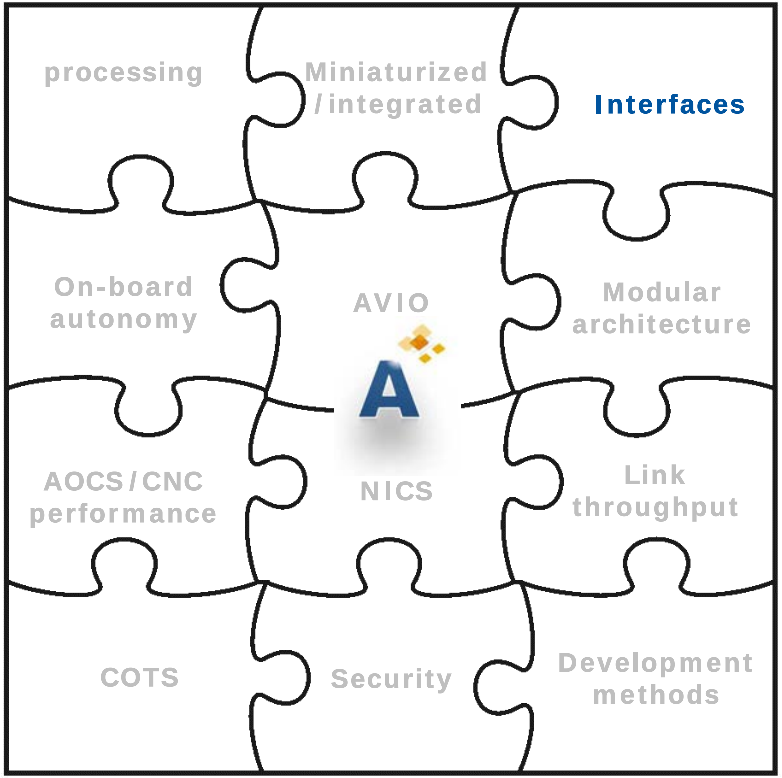
ADHA Mass Memory Module (A3M)	500 k€
ADHA On-Board Computer Module (AOBCM)	500 k€



Strategic objectives

1.
2.
3.
4.
5. Interface solutions

SpaceTSN Definition and Demonstration	350 k€
SAVOIR File Management System	450 k€



Strategic objectives

1.
2.
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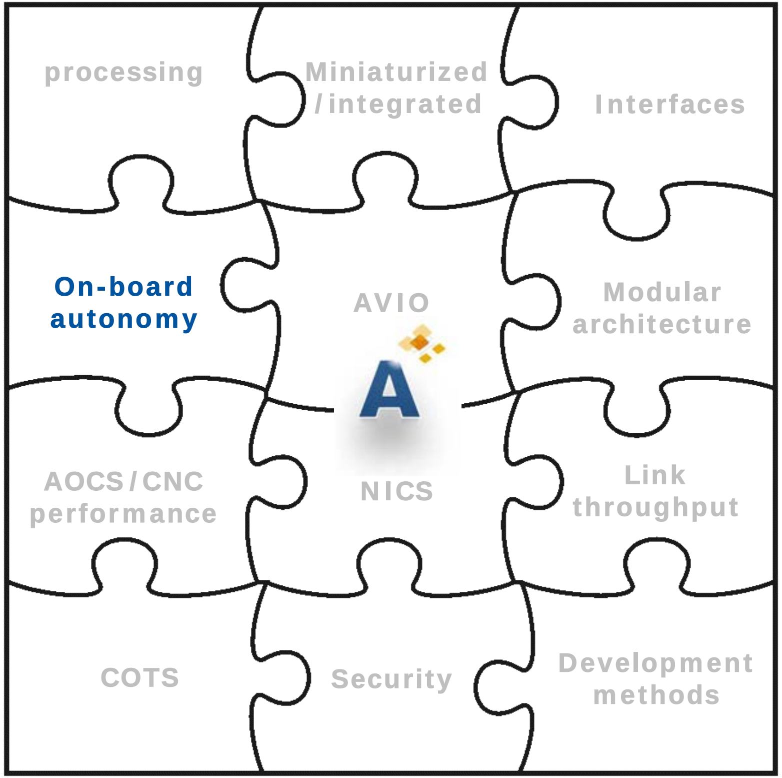
4.
5.
6. On-board autonomy

Increase RAMS of Complex Missions with constraints (smallsat)	400 k€
Study on SW PA for autonomous on-board SW	250 k€



Strategic objectives

1.
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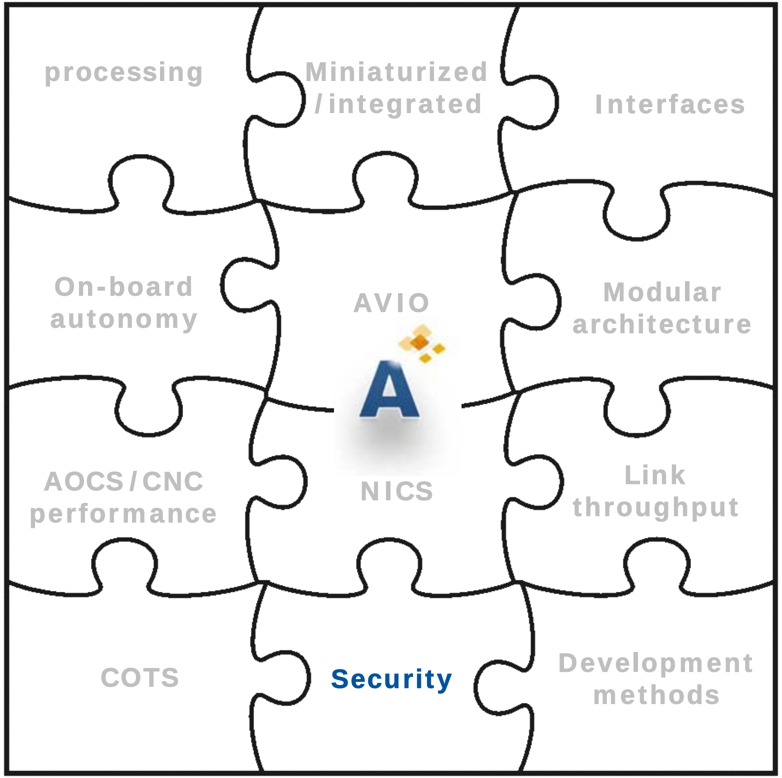
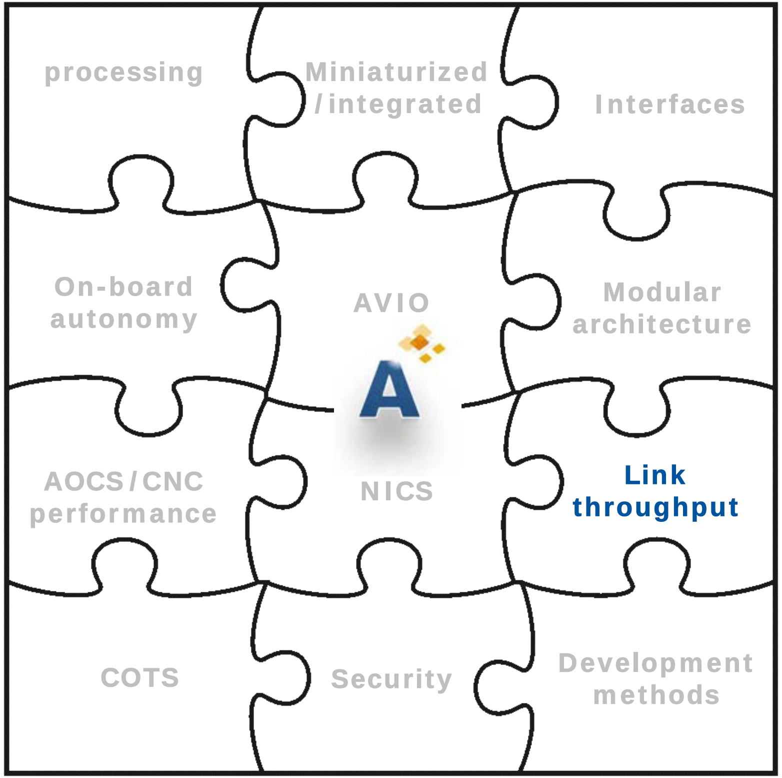
6.
7. On-board security

Definition of process assessment and improvement approach for cybersecurity	200 k€



Strategic objectives

1.
2.
3. | High data rate, adaptive, internetworked proximity communications for Space | 400 **k€** |
4.
5. | SCCC receiver IP Core for High Data Rate PDT downlinks and uplinks/forward links | 400 k€ |
6.
7.
8. How to increase data throughput and improve performances for TT&C and payload data links



Strategic objectives

Advanced Methodologies for Entry Descent and Landing Reconstruction	400 **k€**
Attitude Guidance Using On-Board Optimisation	300 k€
Fast Reconfiguration Technologies for Recurrent Space Transportation Flight	450 k€

6.

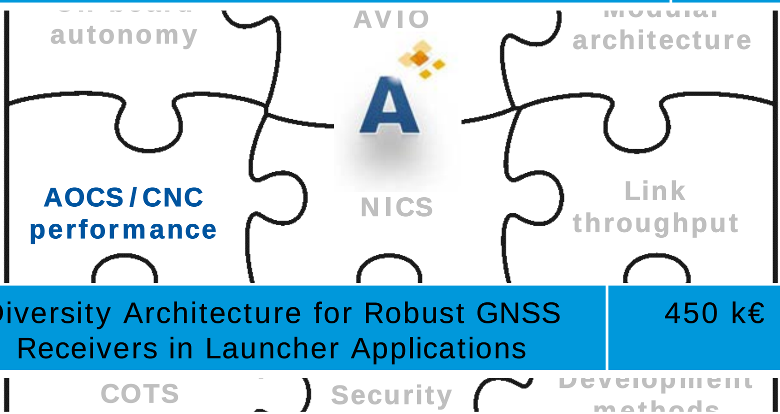
7.

8.

9. Increase AOCS/GNC Performance

Fault Tolerant Control of Clustered Rocket Engines	300 k€

Adaptable Attitude Control and Estimation with Guaranteed Robust Performance	500 k€
Autonomous and optimized agile attitude control with CMGs for small satellites platforms	250 k€
Virtual AOCS sensors and actuators for an All-in-1-mode AOCS	350 k€



Diversity Architecture for Robust GNSS Receivers in Launcher Applications	450 k€
Algorithms for space GNSS guaranteed positioning: Integrity for space corridor	300 k€

Strategic objectives

Verification and validation of real-time optimized safety-critical GNC & SW Systems	350 k€
Verification and Validation of Rendezvous and Proximity Operations	500 k€
Digital Twin for hardware unit in Model Based developments - Maturity Scale	350 k€

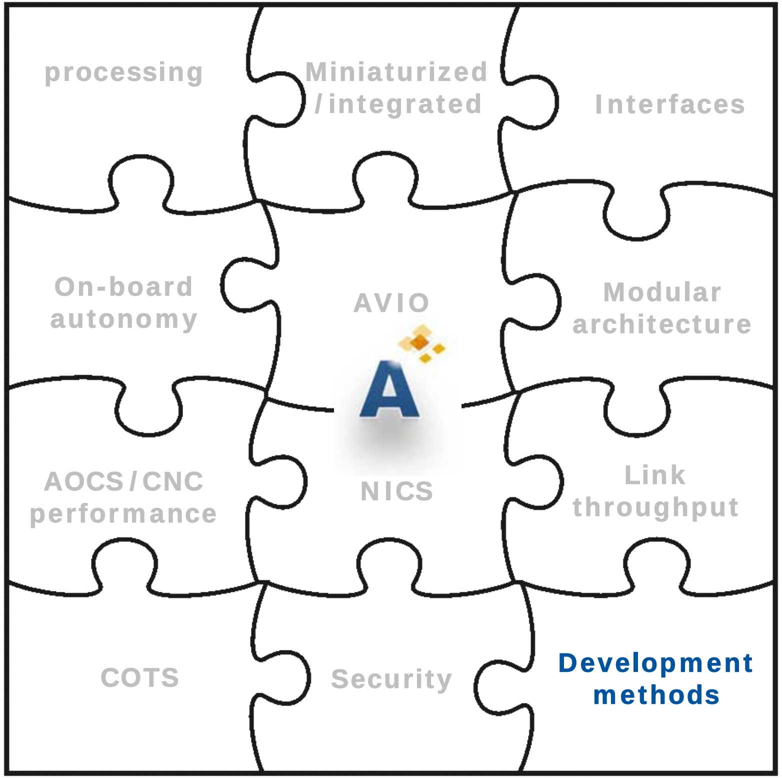
7.

In-Flight maintenance for future Flight Software	350 k€

9.

10. Avionics development methods

Platform Optics and Electronic equipment demisability	900 k€



CD-03 Activities for TDE 2021 - 2022

To this end, the following axes of development have been considered:

- Emphasis has been given to an ensemble of activities to equip future spacecraft with an integrated Data handling System (DHS). This solution framed by the new Advanced Data Handling Architecture (ADHA) concept, in opposition to traditional federated architectures, supports a compact, flexible, scalable, and high-reliability avionics product family that provides both turnkey DHS solutions based on cPCI Serial Space as well as individual modules augmenting and extending the capability of existing spacecraft platforms. The plan support the computing and the Storage modules for which a file based operation software solution is addressed. The communication of this very compact DHS is investigated through the very promising Space TSN network technology for its deterministic capability deemed required for reliable on-board communication.
- Development of TT&C building blocks allowing Variable Coding and Modulation (VCM) and, potentially, Adaptive Coding and Modulation (ACM) bringing to communication link/bandwidth efficiency and dynamic optimisation.
- Exploration of AOCS and GNC novel techniques such as:
  - Usage of Linear Parameter Varying (LPV) techniques in the definition, tuning and validation of AOCS to cope with faster development times
  - Innovative control techniques (namely model predictive control, nonlinear or convex optimisation techniques) to tackle the GNC functional complexity and criticity, with implementation by powerful and numerically efficient code.
- Security is supported through the development of a defined and standardised approach to asses SW suppliers by extending the existing software process assessment and improvement model (ECSS S4S) to also cover cyber security
- Autonomous software for complex systems, as well as artificial intelligence components in on-board software, are supported with the definition of new SW product assurance methods when existing methods are difficult to apply.
- Small satellite platforms (e.g cubeSats) bringing a high scientific return, but with limited resources, are not outdone through the investigation of adequate interconnection and balance between their autonomy requirements, dependability and FDIR to allow them to accomplish succefully their mission objectives.

This development plan covers COTS, Digitation and Space Safety calls with ad-hoc activities as well.

Your new CD03 Leads from now on!

Olivier Mourra

Christophe Honvault