Coming soon

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Studies and Early Technology Developments

- The campaign on "New concepts for On-Board Software" led to the initialisation of
    - 7 studies: About to finish
    - 7 Early Technology Development activities: will end in 2024

- Results will be made available on the knowledge bank of ESA's R&D programmes (https://nebula.esa.int/)

- New innovative ideas can always be proposed on https://ideas.esa.int/ in different channels:
    - Open Discovery: Co-sponsored researches, Studies, Early Technology Development
    - GSTP Element 1 Building Blocks Framework
    - GSTP Element 1 De-risk Technology, De-risk Portfolio, Advanced Manufacturing, Quantum Technology
    - GSTP Element 2
    - NAVISP Elements 2 and 3
    - …

Technology Development

- Activities are identified in the Harmonisation Dossiers and selected in the TDE roadmap endorsed by IPC.

- The current roadmap (2023-2024) identifies the following activities in the domain of Avionics:

Reference	Title	Budget	Duration
T701-807ES	On-board Quantum Random Bit Generation technology enhancement	500	24
T706-803ES	TT&C Time Transfer in Deep Space	400	24
T701-802ED	Evaluation of neuromorphic computing technologies for very low power AI/ML applications	350	24
T705-802SA	Advanced Control Techniques for increased on board autonomy	350	18
T701-804ED	Next-generation protocol for optical high-speed links	350	18
T702-801SW	LLVM for space applications	350	18
T701-801QQ	AI-based Failure Prediction to Improve Operational Payload Availability	350	18
T705-803SA	End to end digitalisation of GNC/AOCS development	400	12
T705-801SA	Multi-objective optimisation of thruster layout under constraint	350	15
T705-805SA	Real Time System Identification for Complex System Modelling and Autonomy Operations	300	15
T709-805SW	Automating the transition from System to Model Based Software Engineering	400	18
T701-805EF	IP Cores for High-Speed ADC & DAC Interface	400	18
T702-803SW	Verification and Validation Methods for Machine Learning Algorithms	400	18
T702-802SW	Software validation using Artificial Intelligence techniques to automatically generate tests	400	18
T701-806ED	Model-Based Systems Engineering (MBSE) applied to Advanced Data Handling Architecture (ADHA) products	300	12

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GSTP Element 1

- Activities are identified in the Harmonisation Dossiers. Some of the activities are placed in a specific compendium.

- Latest compendia have been issued in November 2022 on esa-star.
  https://esastar-publication.sso.esa.int/news/details/737
    - Generic Technologies
    - Artificial Intelligence
    - Digitalisation
    - Quantum Technologies
    - Cybersecurity

- Activities are subject to support from delegation(s)

GSTP Element 1 compendia 2022 edition

Title	Budget	Duration	Compendium
Machine learning for attitude and orbit control systems failure detection isolation and recovery applications	650	18	Artificial Intelligence
Artificial intelligence techniques for spacecraft attitude control and estimation	750	18	Artificial Intelligence
Advanced verification and validation techniques for neural network-based AOCS/GNC systems	600	18	Artificial Intelligence
Deep neural network for robust satellite model matching	500	18	Artificial Intelligence
Robust real-time constrained optimal control using machine learning	600	18	Artificial Intelligence
AI-based GNC/AOCS systems validation and verification evolution	1000	18	Artificial Intelligence
On-board detection of space weather events	500	12	Artificial Intelligence
Qualified software machine learning toolkit for space hardware	900	15	Artificial Intelligence
Architecture for offline processing and machine learning in mass-memories	800	24	Artificial Intelligence
Reference onboard datasets for evaluation of machine learning models	800	24	Artificial Intelligence
Closed loop AI cognitive synthetic aperture radar	1200	18	Artificial Intelligence
AI based end-to-end satellite failure management and prognostic	1400	18	Artificial Intelligence
On board processing enablers for AI for operations	500	18	Artificial Intelligence
Advanced heterogeneous inference data processing module	2000	24	Artificial Intelligence
Intrusion detection prevention module for secure avionics bus	2500	36	Cybersecurity
Confidential computing: implementing spacecraft operations using trusted execution environments	2000	24	Cybersecurity
Security segregation and isolation in a satellite	2000	36	Cybersecurity
Agile post-quantum space data link security protocol hardware module	3300	36	Cybersecurity
End-to-end supply chain protection	3000	42	Cybersecurity
CCSDS delay-tolerant networking BPSec module	2000	36	Cybersecurity
IP over CCSDS including internet protocol security module	1200	18	Cybersecurity
Model-based execution platform for space applications	1000	30	Digitalisation
Image processing and navigation module	750	24	Generic Technologies
End-to-end on-board data handling architecture based on optical high-speed links	1200	24	Generic Technologies
OBPMark benchmarks for on-board data processing	800	18	Generic Technologies
Reliable attitude determination and control system development for nanosats	1000	18	Generic Technologies
Data relay RF simulator system	900	24	Generic Technologies
RISC-V instruction set architecture simulation model and emulation in virtual platform for hardware-software codesign	500	18	Generic Technologies
Low-SWaP hybrid deep-space transponder	1200	36	Generic Technologies
RTEMS SMP extensions qualification	700	24	Generic Technologies
Satellite mode definition, RAMS, FDIR and autonomy engineering tool	800	24	Generic Technologies
GNSS antenna for lunar applications	1000	18	Generic Technologies
High performance COTS processor and module for machine learning applications	3750	32	Generic Technologies

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ARTES AT 2024

Issued

• Implementation of software mitigation solutions for radiation-induced single event effects, closing 9/1/2024

2024: The ARTES Advance Technology 2024 plan includes several activities related to Avionics:

Activity Ref.	Activity Title	Cost (k€)	Classification	Cost (k€) (Classification B)	Cost (k€) (Classification R)	Proc. Policy
	2.7 Command and Data Handling					
4G.044	Onboard data handling sub-system for autonomous satellites	1,400	B	1,400	0	C
4G.045	Standalone satellite telemetry recorder and transmitter	700	R	0	700	C1
4G.046	Software defined satellite avionics development environment	700	B	700	0	C
4G.047	Software execution environment for intelligent applications	700	B	700	0	C1
	3. SPACE SEGMENT - PAYLOAD					
	3.1 Payload - System and Architecture					
5A.089	Model-based approach for software defined payload applications	800	B	800	0	C
	1.3 Small Satellites					
3E.024	In orbit experiment of autonomous deployment and early operations for telecom constellation satellites	7,000	R	0	7,000	C

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