

Advanced Data Handling Architecture (ADHA)

– Development Status & Roadmap

“Working towards a European solution for standardized Data Handling Systems”

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ADHA & APA: Executive Summary

The **Advanced Data Handling Architecture (ADHA)** and **Advanced Power Architecture (APA)** initiatives specify an end-to-end architecture for data-handling and power sub-systems, based on European **standardized** and **inter-operable** electronics modules and units, of common electrical and mechanical form-factors and interfaces.

This level of modularity, interoperability and standardization enables the streamlined and accelerated development, testing, integration and qualification of new configurable data handling units.

The **ADHA program** was initiated in 2019, in a partnership between ESA and key industry partners (SMEs, LSIs) across ESA Member States.

The **Advanced Power Architecture (APA)** initiative addresses the same objectives, for the Electrical Power Subsystem (EPS)

- Substantial commonalities and **synergies** between the **ADHA** and **APA** programs.

The aim of the **ADHA** and **APA** R&D programs is to deliver a **new generation of standardized data-handling and power equipment at TRL6 by 2027**, ready for use by institutional and commercial missions and constellations.



ADHA R&D Programme Organisation

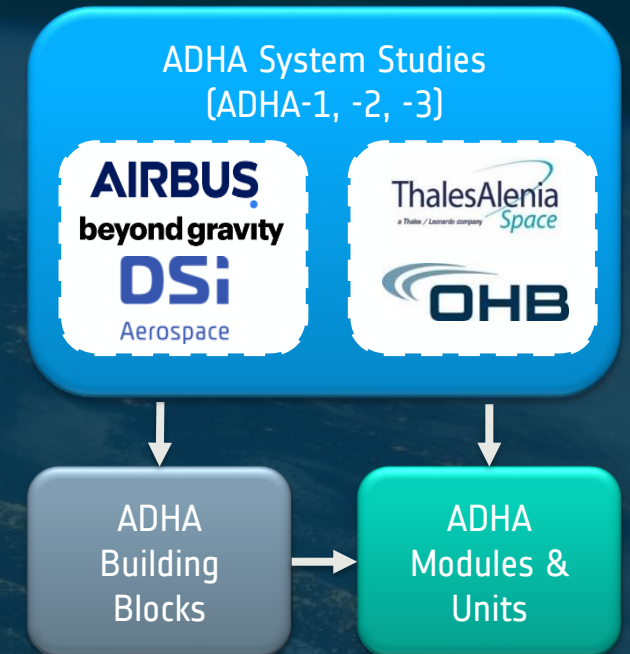
The ADHA Programme is divided into three types of activities:

1. **System-level studies [ADHA-1, -2, and -3]**
 - Define the **requirements specification** for ADHA elements
 - Perform **1st ADHA unit-level AIT campaigns**
 - Parallel contracts, led by: ADS (DE) and TAS (IT) as primes
2. **ADHA Unit and Module hardware development contracts**
 - Funded through ESA TDE, Preparation, GSTP, InCubed programs
 - **many initiated by industry!**
 - In total, **20+ development activities on-going**
3. **ADHA Building Block activities**
 - (e.g. **backplane connector** development and qualification)

In ESA, ADHA is led by **the Data Handling section** (TEC-EDD), in close collaboration with other technical domains in ESA D/TEC:

- Power, Microelectronics, Flight Software, Radiation Hardness Assurance, Components, Structures, Thermal, GNC/AOCS, Software Systems

These close collaborations are a real testament to the interdisciplinary nature of ADHA.



ADHA development programme – and ecosystem

The **ADHA program** has grown to an **ecosystem** of industrial partners, developing avionics and data handling equipment based on a standardized set of electrical and mechanical specifications.

Indicative statistics:

- **22+ MEuros** of capital raised so far by ESA funding programs (as per Q3 2025) –
 - Funded by Future EO, Preparation, TDE, GSTP, InCubed
- **17 industrial partners** involved in the ADHA ecosystem, from **13 different countries**,
 - Including companies' own capital investments
- **25 activities ongoing**, for ADHA module, unit and equipment developments (plus **10+ new activities** planned)

In the ADHA **ecosystem**, we are shaping the future of modular and interoperable avionics, by:

- Fostering **cooperation**, within industry, and with ESA
- Increasing **competitiveness**
- Leveraging **synergies**, between agency and industry, and between technical domains

...to advance **European leadership** and **innovation**.

ADHA is more than a standard...

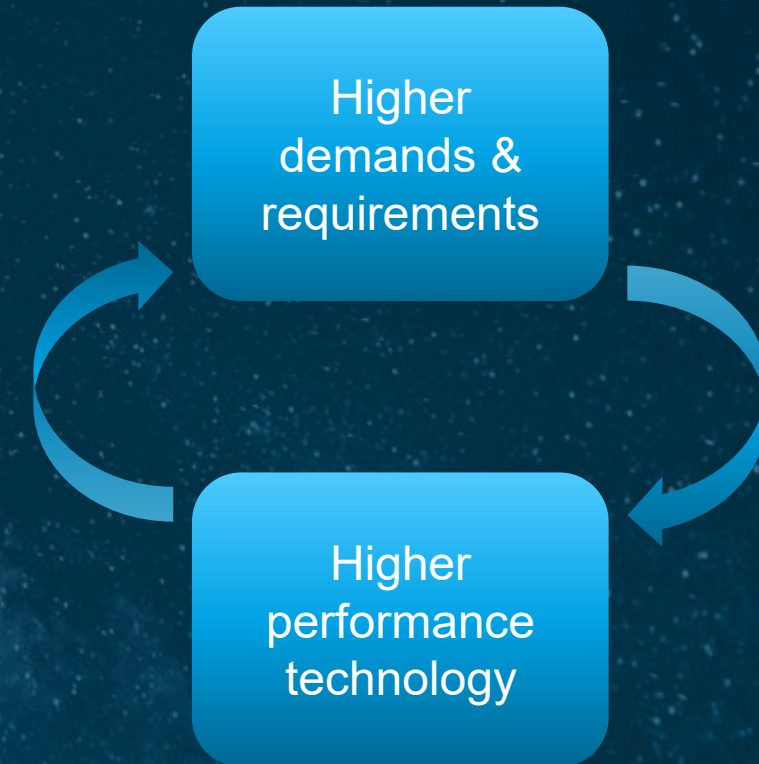
It is a foundation for flexibility, scalability, and European autonomy and sovereignty in space avionics systems.



Evolution of OBDH / DHS Equipment

In the last years, the requirements for on-board data handling equipment have evolved:

- **Increase in data-rate/performance requirements**
 - More data at faster rate to process and store on-board
 - More power / thermal dissipation needed
- **Increase in the number of missions to serve with a single product**
 - More demanding schedules, and less time for generic product developments
- **Higher level of on-board autonomy (e.g. for constellations)**
 - More advanced on-board functions required



At the same time the technology is evolving:

- More advanced high-performance microelectronics and sensors available for space
- Higher acceptance to use COTS components
- Very-high speed payload transmitters and optical transceivers have been demonstrated

ADHA aims to:

- **Meet the evolving performance requirements of OBDH / DHS equipment** – of the next generation of applications – by utilising the latest technologies (e.g. European UDSM technology)
- Increase European **competitiveness, serialisation and non-dependence** – and reduce Non-Recurring Engineering (NRE) in Data Handling Systems

ADHA has the following objectives:

- Deliver a **new generation of On-Board Data Handling equipment at TRL6 by 2027**
- Ensure **dual- or multi-sourcing of key On-Board Data Handling Equipment by 2028**

...to be available for institutional and commercial missions.

...both large-scale missions (ADHA-6U), mid- and small-sats / constellations (ADHA-3U).

ADHA Technical Perimeter & Scope

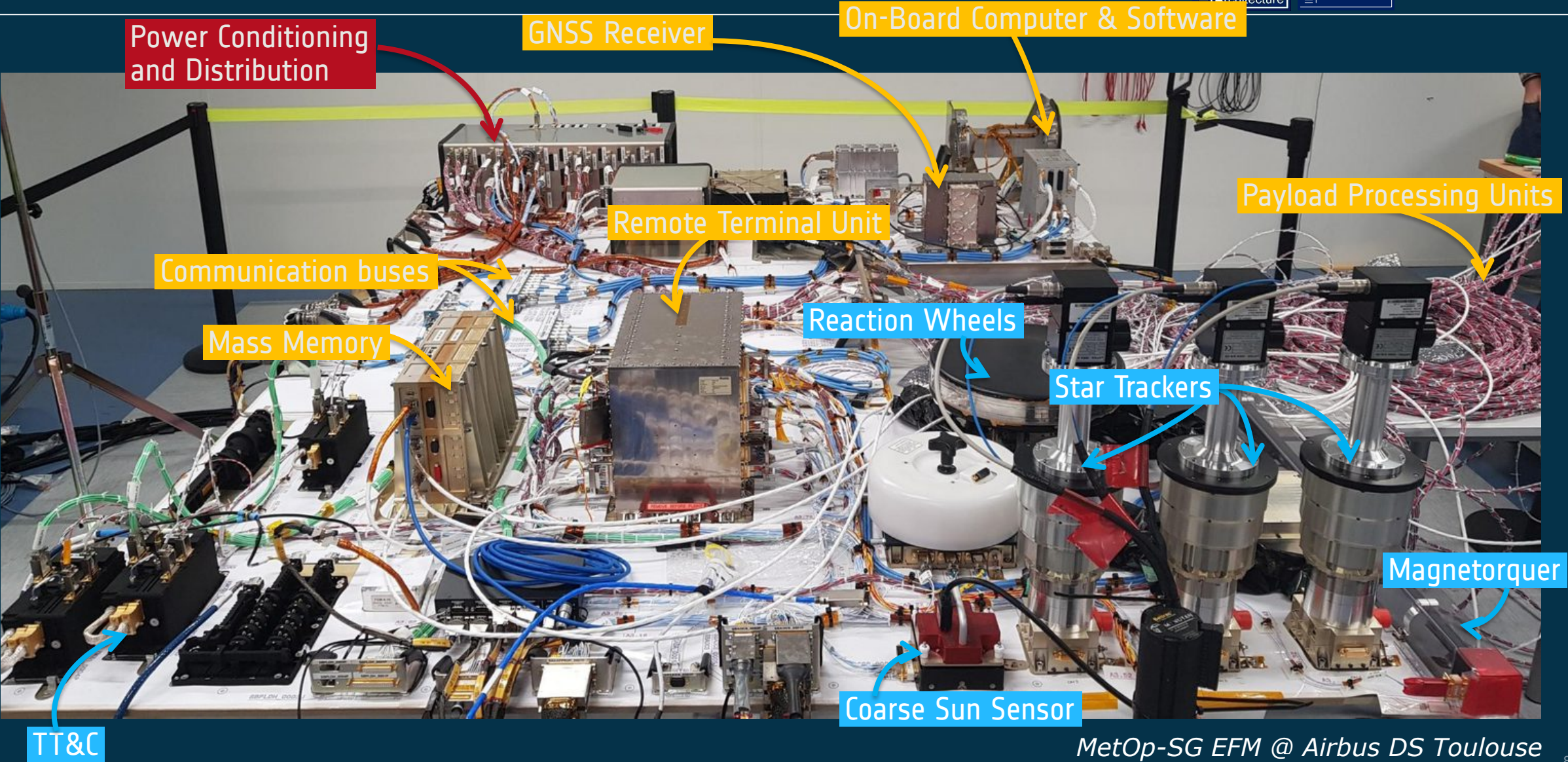
The ADHA program defines the following elements:

- **An end-to-end data handling architecture**
 - To ensure interoperability between data handling units
- **A standard backplane electrical interconnect between modules**
 - Based on the cPCI-Serial-Space standard
 - To allow interoperability of modules from different suppliers within the same unit
- **Standard mechanical form factor and interfaces**
 - For uniformity across the OBDH subsystem, more efficient qualification, assembly and integration
 - Compatibility between any ADHA-compliant modules, for faster unit integration and configuration
- **A standard procurement and PA (Product Assurance) approach**
 - To allow clear requirements based on expectations in different mission classes

All ADHA specifications have been agreed between the ADHA consortia members, including the three LSIs (ADS, TAS and OHB), ensuring that data handling equipment suppliers / SMEs have a consistent set of requirements.



Example DHS Flat-Sat (before ADHA/APA)



MetOp-SG EFM @ Airbus DS Toulouse

ADHA: Benefits at System Level

Interoperability at module level allows integration of multiple functions in same unit

- Overall **reduction in harness mass** – and **fewer electronics boxes per mission**
- **Uniformity across platform (and payload)** units dimensions facilitates **placement and harness optimisation** within the S/C

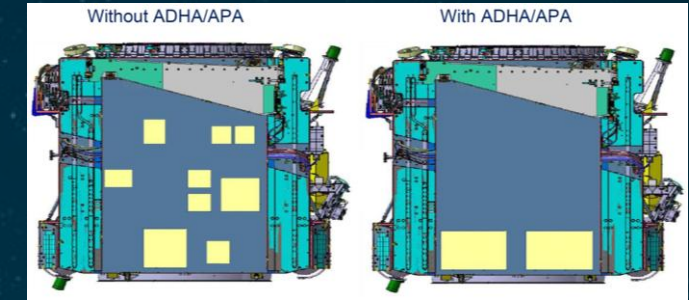


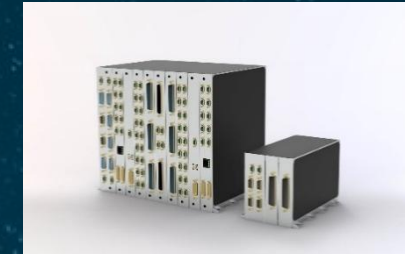
Image source: Airbus, DASIA2024

Use of recurring equipment products lowers project risk

- Allows **schedule optimisation** and **early testing of mission critical functions**

Scalability and modularity provide flexibility in unit configuration and allows expansion of functions

- Allows adoption for specific mission needs, reducing expensive and risky NRE – i.e. less chance of an equipment development being on the critical path of the mission schedule



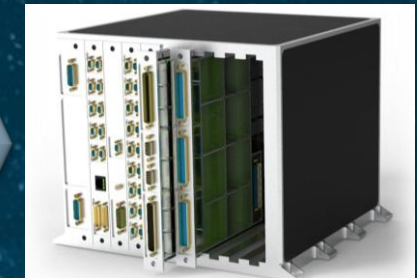
Flexibility in implementation of **georeturn** requirements

- Allows **dual- and multi-source of same equipment** (important for constellations)

Supplier #1



Supplier #2



ADHA: Benefits for Equipment Suppliers (incl. SMEs)

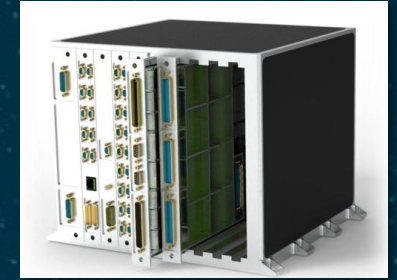
Standardisation of interfaces, functions and verification approach

- Promotes reuse of products across different flight projects/customers



Iterative upgrades of products and use of the latest technology

- Modularity allows upgrading of specific functions (e.g. as new microelectronics becomes available) – without losing TRL level of other functions, allowing European companies to stay competitive to increasing data handling requirements to increasing data handling and performance requirements



Interoperability at unit level allows integration of 3rd party products

- Allows expansion of product portfolio beyond in-house products
- Lower entry threshold into programmes with geo-return constraints

All of these benefits contribute to promote less risky and costly NRE per mission

- Freeing up supplier's engineering resources to focus on recurring products



1. The standardised ADHA Backplane
2. ADHA Modules – with standardised functions
3. ADHA Units

- 6U: 220x233mm, 3U: 220x100mm

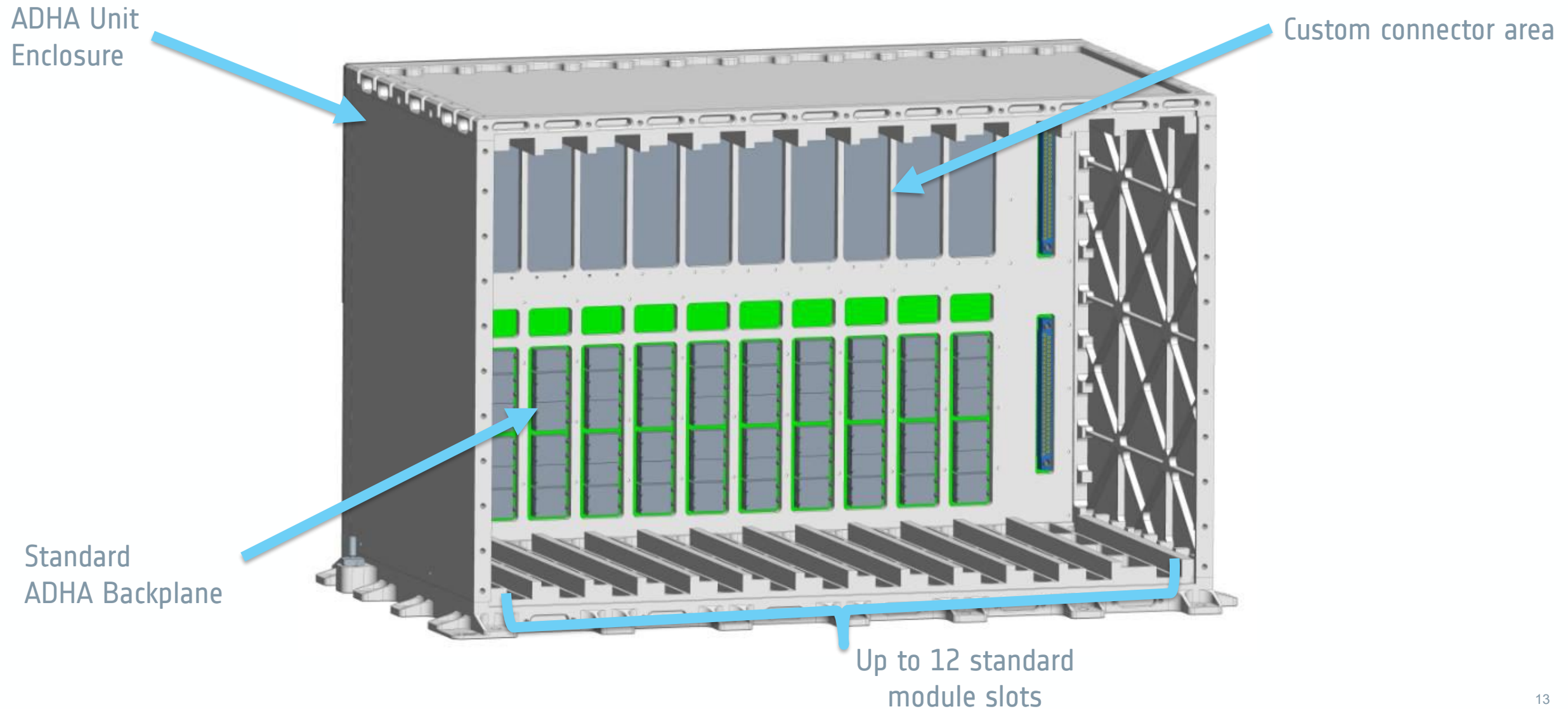
We show an example using 6U in the next slides



Advanced Data Handling Architecture (ADHA): Architecture Overview: ADHA Module (6U)



Advanced Data Handling Architecture (ADHA): Architecture Overview: ADHA Unit (6U)



Advanced Data Handling Architecture (ADHA):



ADHA On-Board Computer (Thales Alenia Space)

ADHA Power Module (Airbus DS)

ADHA Instrument Controller (Airbus CRISA)

ADHA Reference Modules (Beyond Gravity

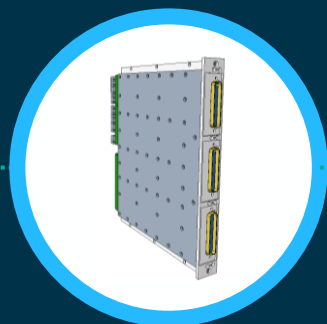
PHASES OF THE ADHA DEVELOPMENT PROGRAM



1 Technical and Procurement Requirements Spec.



2 Engineering Model (EM) Modules Development



TRL4

3 Engineering Model (EM) Unit Integration / Testing



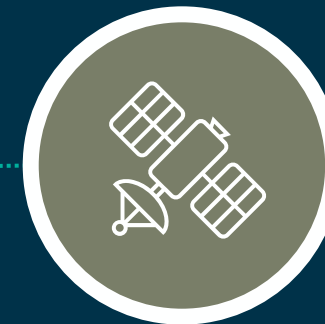
TRL5

4 ADHA Unit Qualification



TRL6

5 IOD & Flight Opportunities



TRL7-9

We're here

2026

2027

ADHA R&D Programme Organisation

The ADHA R&D Programme is divided into three types of activities:

1. **System-level studies (ADHA-1, -2, and -3)**

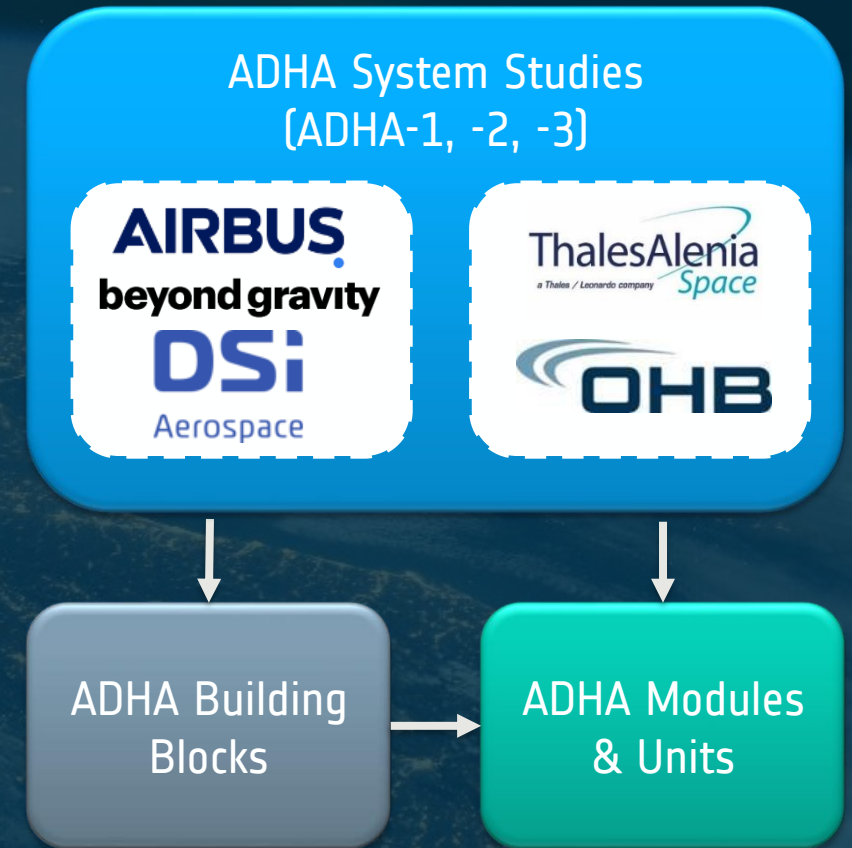
- Define the **requirements specification** for ADHA elements
- Perform **1st ADHA unit-level AIT campaigns**
- Parallel contracts: ADS (DE) and TAS (IT) primes

2. **ADHA Unit and Module hardware development contracts**

- Core modules: OBC, MM, Power and GNSS funded through TDE
- Others funded through GSTP, Incubed, etc - **many initiated by industry!** In total, **ca 20 development activities on-going**

3. **ADHA Building Block activities**

- [e.g. **backplane connector** development and qualification]



The On-Board Data Handling System (DHS/OBDH)

– Scope of ADHA System Studies

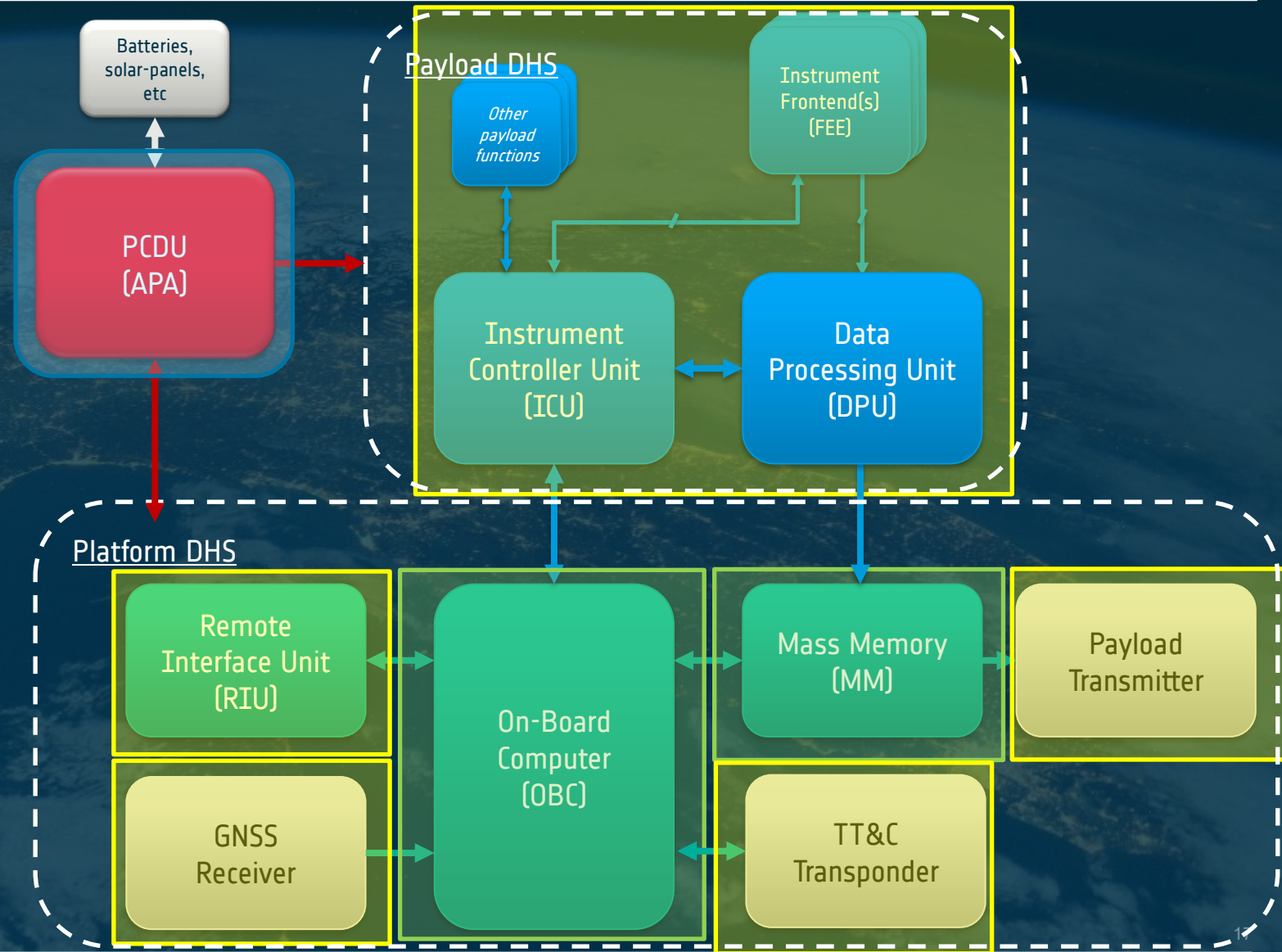
In **green**:
within the scope of the ADHA-2 System Study

In **yellow**:
within the scope of the ADHA-3 System Study

In addition ADHA-3 covers:

- Standardisation of software and protocols
- Standardisation of EGSE and module testers
- PA tailoring for Class Gamma/Delta
- ...and other topics

In **blue**:
within the scope of the APA Study



ADHA-3 Phase-1 Tasks

Task #	Task	Common or single consortium	ADS/DSI/BG consortium	TAS/OHB consortium
1	ADHA-3U Specifications	Common	X	X
1a)	Class Gamma missions analysis and DHS requirements	Lead by TAS consortium		X
1b)	Update of specifications for 3U	Common	X	X
2	Payload Module/Unit Specifications	Common	X	X
2a) / 2b)	Payload mission analysis	Lead by ADS consortium	X	
2c)	Payload module specifications	Common	X	X
3	Additional ADHA Module Specifications	Common	X	X
4	ADHA Data and Software Interfaces	TAS		X
5	EDS Format and MBSE Architecture	ADS	X	
6	Structural/Thermal Study	ADS	X	
7	ADHA EGSE Architecture	TAS		X
8	End-to-End Use Case Analysis	Common	X	X
9	Industrial Roadmaps	Separate	X	X
10	ADHA Verification approach	ADS	X	
11	ADHA-U1 DHS Use-Case Analysis and FDIR	TAS		X

ADHA: Current Contracts, Industry and Budgets



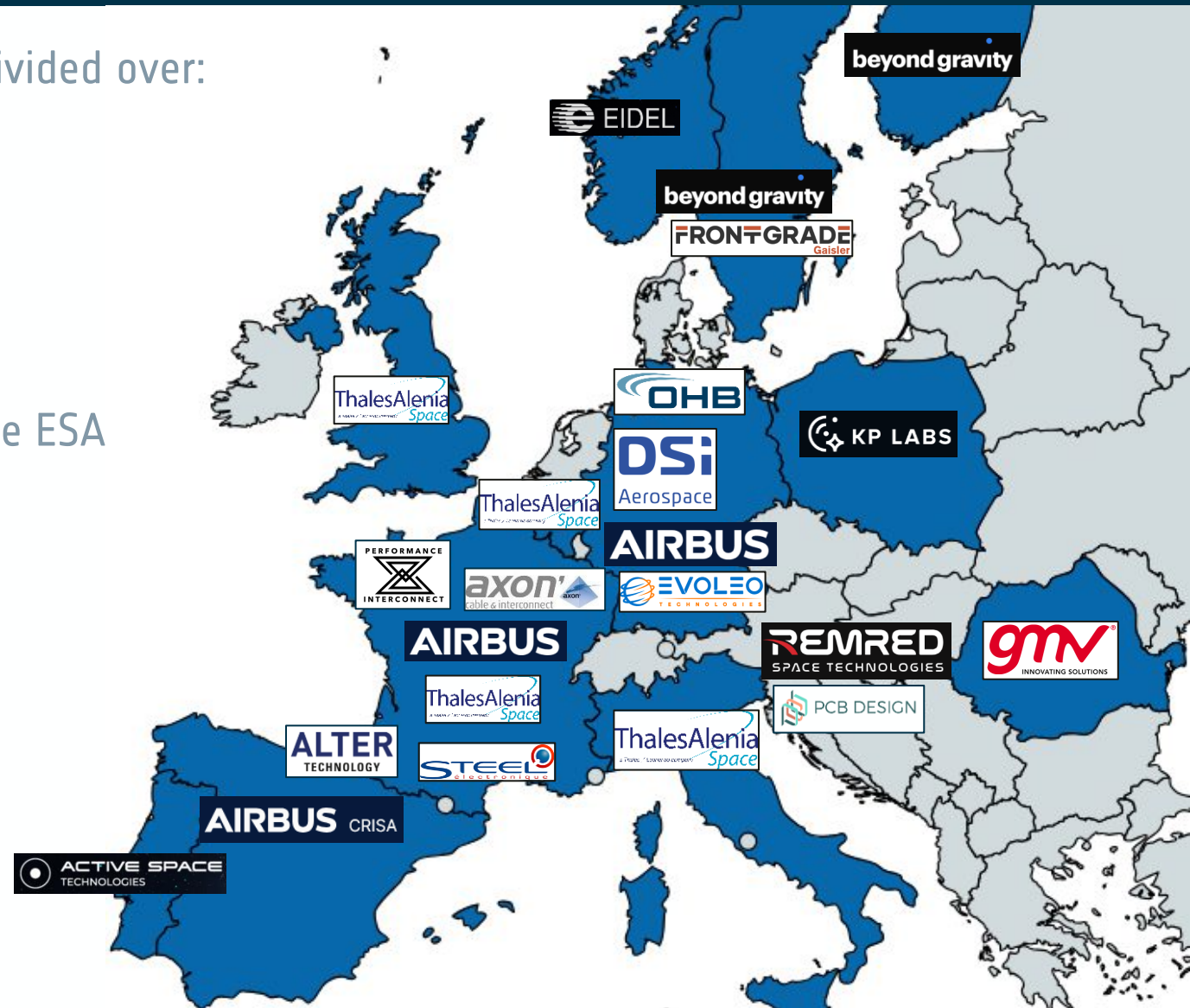
The overall ADHA development ESA activities are divided over:

...18 companies and groups

...in 14 European countries

...for a total ESA budget of ca 22MEUR from multiple ESA funding programs

(FutureEO, Discovery/Preparation, TDE, GSTP, InCubed, ARTES)



ADHA Industrial Working Group (ADHA-IWG)



An **ADHA Industrial Working Group (ADHA-IWG)** has been initiated

The ADHA-IWG will be **responsible for the future maintenance and updates** to the standard.

- The ADHA standardisation effort was funded by ESA, and performed by European Industry – and the **ADHA standard will be led by industry**

Very positive early response from European Industry

- More than **30 entities from 15 different European countries** have agreed to participate
- In particular **SMEs see the benefit**, and savings in effort by adopting the standard

The ADHA-IWG is open to entities in ESA Member States, and will also invite **participation from technical experts in national space agencies and technology providers.**

ADHA Industrial Working Group (ADHA-IWG) – Members



AIRBUS

beyond gravity

ThalesAlenia
a Thales / Leonardo company
Space

DSi
Aerospace

OHB

EVOLEO
TECHNOLOGIES

KP LABS
Mission Complete

gmv
INNOVATING SOLUTIONS

EIDEL AS

Crisa
AIRBUS
DEFENCE & SPACE

STEEL
électronique

teletel

INGENiArs

ACTIVE SPACE
TECHNOLOGIES

EREMS

OHB
LUXSPACE

PCB DESIGN

DELTATEC

FRONTGRADE
Gaisler

TELESPAZIO
a LEONARDO and THALES company

ZAITRA

Aurora
Avionics

RAMON.SPACE

AAC
CLYDE
SPACE

COROS SPACE

SPiN
Space Products and Innovation

AROBS
Polska

STAR-Dundee

REMRED
SPACE TECHNOLOGIES

esa

PERFORMANCE
INTERCONNECT

axon'
cables & connectors

Positronic
an Amphenol company

cnes

DLR

The ADHA Industrial Supply Chain



Technology, Component, and EEE/microelectronics providers benefit from the standardisation provided in ADHA
→ allowing to promote products towards the ADHA eco-system

Example: backplane/connector suppliers

ADHA Module Suppliers benefit from the standardisation and common functional/interface definitions
→ allowing to promote modules within the ADHA eco-system, to end-users or ADHA unit integrators

Example: mass-memory module suppliers

ADHA Unit Suppliers benefit from the standardisation and reuse of standard modules
→ allowing to promote module/scalable ADHA units towards mission primes

Example: payload data handling unit provider

Note: unit supplier can also be a module supplier

Mission primes benefit from the standardisation – reduces the specification work per mission
→ allowing to procure standard functions from multiple sources

Note: spacecraft bus provider can also be ADHA unit supplier/integrator

→ THE EUROPEAN SPACE AGENCY

Examples of ADHA modules/units under development



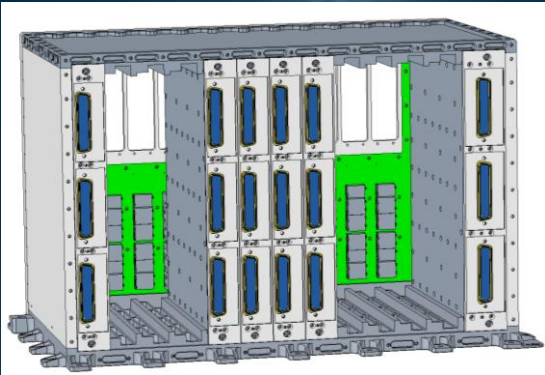
ADHA 6U Instrument Control Unit (ICU)
ADS CRISA



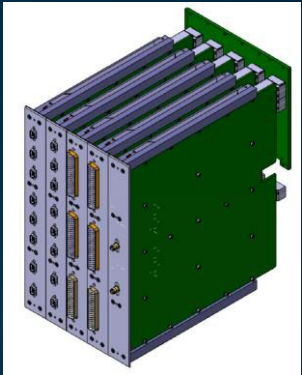
ADHA 6U RIU module,
Airbus CRISA



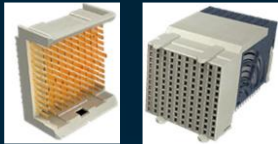
ADHA 6U Payload Control Module (PCM),
Airbus CRISA



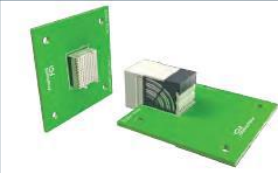
ADHA 6U Unit,
Beyond Gravity



ADHA 6U OBC,
Thales Alenia Space



ADHA Backplane Connector, Axon



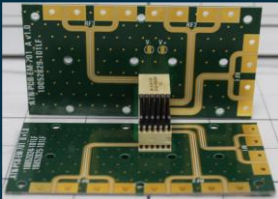
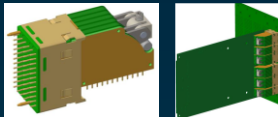
ADHA 3U bread-board, EVOLEO



ADHA 3U avionics suite, EVOLEO



Lion DPU, KP Labs



ADHA Backplane Connector, Alter / Performance Interconnect

ADHA Activities Roadmap Overview – Current activities

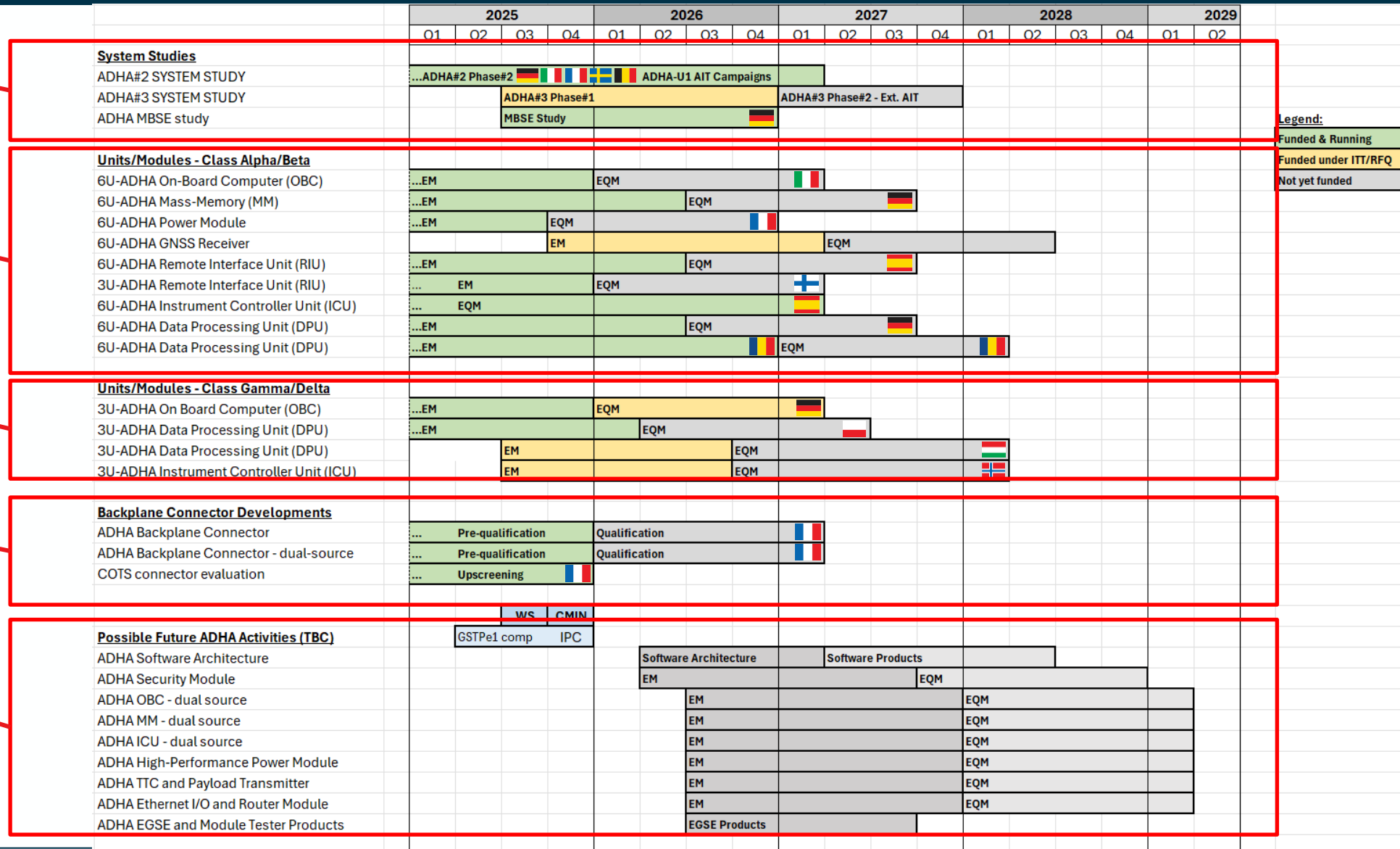
1. System-level study activities

2. Class Alpha/Beta hardware developments

3. Class Gamma hardware developments

4. Key building blocks

5. Future activities (dual-sources)



Legend:

Funded & Running

Funded under ITT/RFQ

Not yet funded

ADHA Activities Roadmap Overview – Current activities

1. Extended AIT campaign

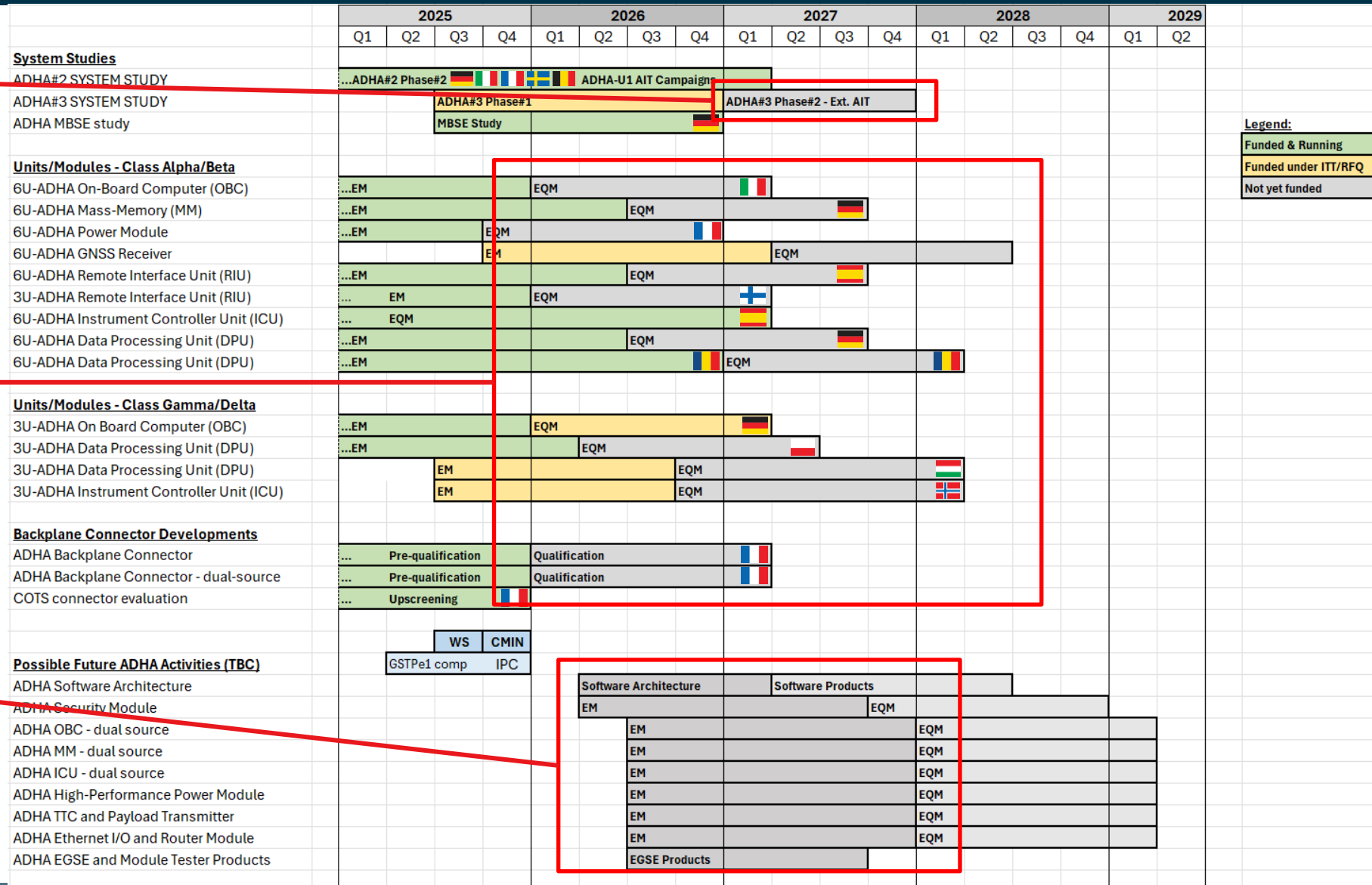
- CCN to ADHA system study contracts, under GSTP
- Open to ADHA equipment suppliers

2. EQM developments & hardware qualification

- Proc. policy: DN
- Same suppliers as EMs
- Estimated total budget 15-20MEUR 2025-2027

3. Future TDE/GSTP activities (TBC)

- Proc. policy: ITTs (open competition)
- Activities TBC (pending internal ESA evaluation)



ADHA Future Activities – GSTP Element 1 Compendium

Dual-source and additional EM activities:

- Either: open ITTs through GSTPe1 [compendium]
- ...or industry-initiated through optional programme(s)
- Estimated required budget (2026-2027): **ca 8.3 MEUR**
- **Parallel activities are desirable for dual sourcing of functions**

GSTP Element 1 Compendium includes both:

- **2nd source activities (OBC, Mass-Memory, Instrument Controller)**
- **...and new functions under standardisation (e.g. TTC module and payload transmitter module)**

Advanced Data Handling Architecture (ADHA)

Avionics & EEE

Programme Reference	Activity Title	Budget (k€)
GT1M-800ED	ADHA on-board computer	1,500
GT1M-801ED	ADHA instrument controller unit	1,500
GT1M-802ED	ADHA mass-memory modules and unit integration	1,500
GT1M-803ED	ADHA EGSE and common module testing products	800
GT1M-804ED	ADHA Ethernet I/O and router module	1,000
Total ADHA - Avionics & EEE		6,300

RF Payloads & Technology

Programme Reference	Activity Title	Budget (k€)
GT1M-805EF	ADHA TTC transponder and payload transmitter module(s)	1,200
Total ADHA - RF Payloads & Technology		1,200

Power Systems, EMC & Space Environment

Programme Reference	Activity Title	Budget (k€)
GT1M-806EP	ADHA high-performance power module	800
Total ADHA - Power Systems, EMC & Space Environment		800

Total Advanced Data Handling Architecture (ADHA)		8,300
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ADHA Status & Roadmap Summary

- The growing **ADHA** ecosystem, and increasing number of industrial partners interested in developing **ADHA** -compliant equipment creates new opportunities
- Requirements of different mission criticality classes can be addressed via different ADHA unit formats and configurations (6U/3U, etc).
- Expanding the target applications beyond EO will further enhance the business opportunities: Science, Exploration, Navigation, etc.
- **ESA has clearly and actively demonstrated the support in the ADHA program**
 - Significant and continuing investments in **ADHA** program by ESA programs
 - Future EO, Discovery/Preparation, TDE, GSTP, InCubed
 - 22 MEuros in total, as per Q3 2025



Advanced Data Handling Architecture (ADHA): Project Status, Background and Roadmap

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