

ADHA - Advanced Data Handling Architecture

Kostas Marinis
On-board Computers & Data Handling
TEC-EDD, D/TEC

24/10/2022

1. Introduction of the ADHA Program

1. Technical context
2. Objective of the ADHA Program
3. Steps of the ADHA Program

2. ADHA Hardware Configurations

3. Development activities of ADHA Units and Modules

1. Units
2. Modules
3. Connectors

4. Conclusion

1. Introduction of the ADHA Program

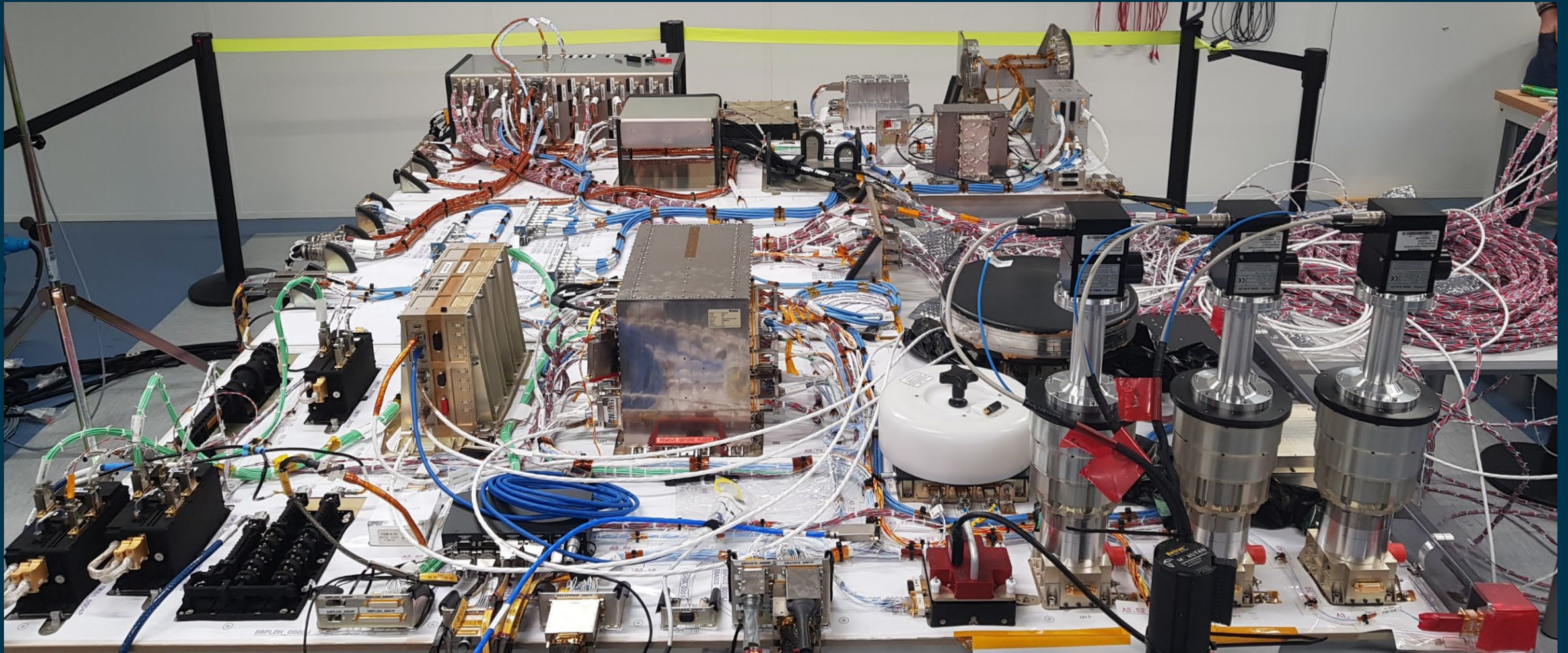
1. Technical context
2. Objective of the ADHA Program
3. Steps of the ADHA Program

2. ADHA Hardware Configurations

3. Development activities of ADHA Units and Modules

1. Units
2. Modules
3. Connectors

4. Conclusion



MetOp-SG EFM @ Airbus DS Toulouse

Technical Context

GNSS Receiver

On-Board Computer & Software

Payload Processing Units

Remote Terminal Unit

Communication buses

Mass Memory

Reaction Wheels

Star Trackers

Magnetorquer

Coarse Sun Sensor

TT&C

MetOp-SG EFM @ Airbus DS Toulouse

1. Introduction of the ADHA Program

1. Technical context
2. Objective of the ADHA Program
3. Steps of the ADHA Program

2. ADHA Hardware Configurations

3. Development activities of ADHA Units and Modules

1. Units
2. Modules
3. Connectors

4. Conclusion

Main Objective of the ADHA Program



Develop a new generation of Platform and Payload Data Handling units, based on **standardized, interoperable and inter-changeable modules** that can be potentially procured from **different suppliers**, using latest **micro-electronics technologies**, and be **integrated by different ADHA Unit integrators**.

The need for module standardization (to meet the ESA Technology Development Targets) associated to new technologies (multicore processors, ML/AI, COTS, etc.) will make **ADHA a disruptive approach** to obtain in 3 years **highly integrated and scalable units ready to fly (TRL 6)**.

TARGET 1 30% improvement of spacecraft development <u>time</u> by 2023	TARGET 2 One order of magnitude improvement of <u>cost</u> efficiency with every generation
TARGET 3 30% faster development and <u>adoption</u> of <u>innovative</u> technology	TARGET 4 Inverting Europe's contribution to space <u>debris</u> by 2030

ESA Technology Development Targets



1. Introduction of the ADHA Program

1. Technical context
2. Objective of the ADHA Program
3. Steps of the ADHA Program

2. ADHA Hardware Configurations

3. Development activities of ADHA Units and Modules

1. Units
2. Modules
3. Connectors

4. Conclusion

Steps of the ADHA Program

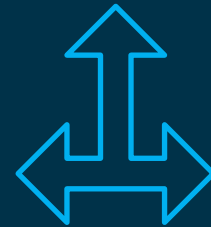
Part 1: ADHA documentation preparation -> ADHA-2 study Phase 1

Full set of contractual, technical, PA and environmental documentation, including specs at Unit, Module and Backplane levels

Part 2: ADHA product development (Unit/Module/backplane/connector). -> ADHA-2 study Phase 2 + several R&D contracts

Overview will follow

To achieve the ADHA objectives, 2 industrial consortia were formed, both interacting with ESA:



Consortia 1

AIRBUS

beyond gravity **DSI** Aerospace Technology **AIRBUS**

ADS-DE (as lead team)
&
RUAG-SE, RUAG FI, RUAG AT, ADS-FR, DSI (as members).

Consortia 2

ThalesAlenia Space
a Thales / Leonardo company

ThalesAlenia Space **OHB**
a Thales / Leonardo company

TAS-I (as lead team)
&
TAS-FR, TAS-BE, TAS-UK and OHB-DE (as members)

1. Introduction of the ADHA Program

1. Technical context
2. Objective of the ADHA Program
3. Steps of the ADHA Program

2. ADHA Hardware Configurations

3. Development activities of ADHA Units and Modules

1. Units
2. Modules
3. Connectors

4. Conclusion

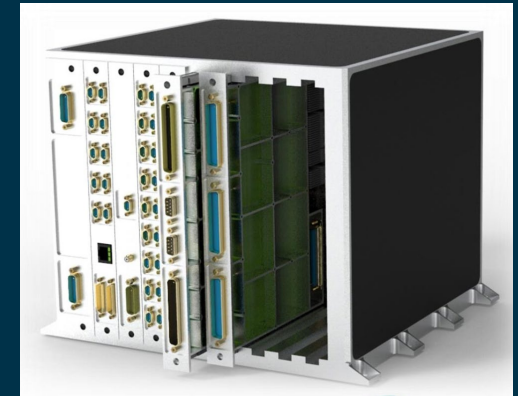
ADHA HW Configuration – Units and Modules

An ADHA Unit will host up to 13 modules (incl. redundancy) in a cPCI-Serial-Space (cPCI-S-S) 6U or 3U rack and interconnection backplane

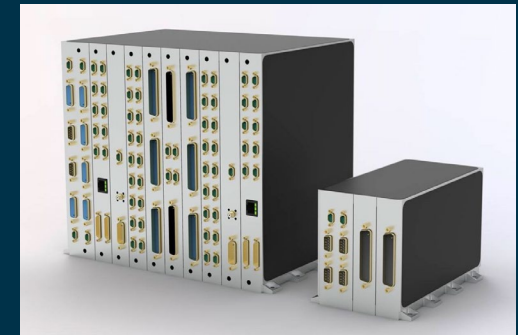
- Standardized mechanical form factors,
- Standardized electrical and communication interfaces (intra-unit), via ADHA backplane

Each ADHA unit may consist of different modules, depending on configuration:

- System Controller (OBC modules),
- Power module,
- Mass Memory module,
- High performance Payload Data Processing module,
- AOCS module,
- GNSS module,
- Propulsion control module,
- Generic I/O,
- other peripheral modules



ADHA Units (6U and 3U)



ADHA Module

1. Introduction of the ADHA Program

1. Technical context
2. Objective of the ADHA Program
3. Steps of the ADHA Program

2. ADHA Hardware Configurations

3. Development activities of ADHA Units and Modules

1. Units
2. Modules
3. Connectors

4. Conclusion

ADHA HW Development – ADHA Units and Modules (1/2)

Development of the first ADHA-U1 EM unit (ADHA-2 study (phase 2) and TDE activities)

Development of several EM ADHA 6U modules – TDE WP21/22

- 6U ADHA Power Module
- 6U ADHA OBC Module
- 6U ADHA Mass Memory Module

MAIT of the 6U ADHA-U1 EM unit (one unit per consortia) - ADHA-2 study.

Study about mechanical and thermal design of ADHA units (GSTP with Beyond Gravity)

uRTU activity (GSTP with Beyond Gravity)

Development of an ADHA EM 3U Unit, with several ADHA EM 3U modules:

- ADHA Power Module; ADHA System Controller Module; ADHA Generic I/O Module;
- ADHA AOCS Module; Propulsion Control Module.

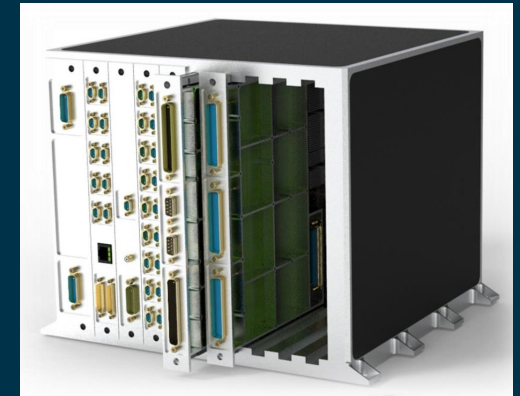
MAIT of the EM 3U-ADHA-U1 unit

HiperPro Module (GSTP)

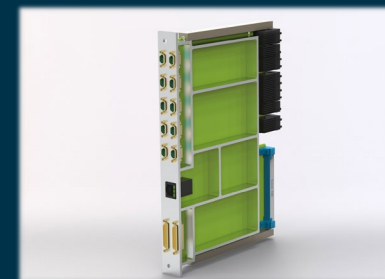
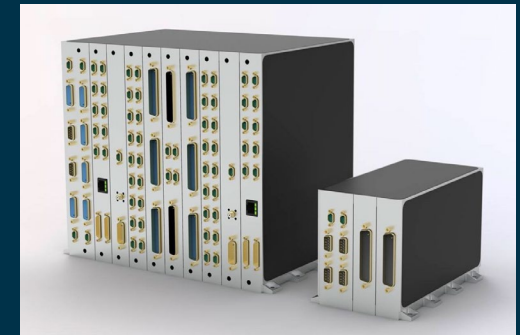
Development of an EM ADHA 6U high performance co-processing module

High Performance Compute Board (HPCB) Module (TDE with Cobham Gaisler)

EM ADHA 6U high performance processing module using Myriad chip



ADHA Units (6U and 3U)



ADHA Module

13

- ADHA GNSS Module, **proposed for TDE WP23/24**
- ADHA OBC Module based on COTS, **proposed for TDE WP23/24**
- ADHA Front End Electronic Modules, **proposed for TDE WP23/24**
- ADHA Instrument Power Distribution Module for ADHA ICU
- ADHA OBC Module based on the NanoXplore NG-ULTRA FPGA
- ADHA On-Board Processing Module based on RISC-V processor
- ADHA On-board data co-processing modules for high processing capability needs
- ADHA Motor Drive Electronic Modules for rotative part of payloads and/or platform Solar Array Drive.

1. Introduction of the ADHA Program

1. Technical context
2. Objective of the ADHA Program
3. Steps of the ADHA Program

2. ADHA Hardware Configurations

3. Development activities of ADHA Units and Modules

1. Units
2. Modules
3. Connectors

4. Conclusion

ADHA HW development (Connectors activities)

Procurement and Reliability Assessment of High Data Rate Press-Fit cPCI-Serial-Space (cPCI-S-S) Connectors, e.g. commercial AirMax® , HyperBits™ S-FECT

– On-going TDE activities -

Development of High Density Modular Electrical Interconnections for High Data Rate Applications

– Proposed for ARTES AT -

- Compatible with cPCI-S-S standard

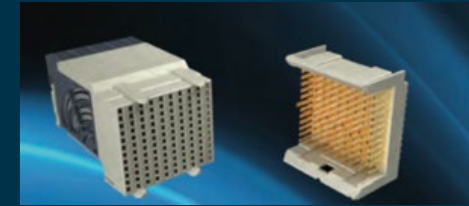
- Enabling routing of HSSL channels

- Achieve interface bit rates of at least 25 Gbit/s, with a goal of 56Gb/s for long-term missions.

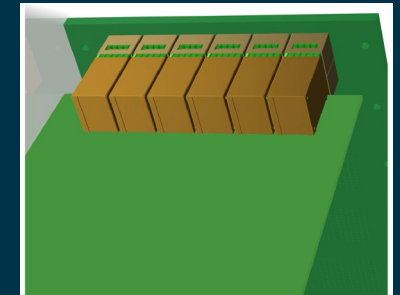
Board Interconnections for High Data Rate applications

– Proposed for TDE WP23/24 – 250k€

Solderless interconnect solutions to support future high data rate requirements (56Gbps)



AirMax



HyperBits S-FECT

1. Introduction of the ADHA Program

1. Technical context
2. Objective of the ADHA Program
3. Steps of the ADHA Program

2. ADHA Hardware Configurations

3. Development activities of ADHA Units and Modules

1. Units
2. Modules
3. Connectors

4. Conclusions

- The aim of the ADHA program is to deliver in 2025 a **new generation** of Platform and Payload Data Handling units, based on **standardized, inter-operable and inter-changeable modules** from **multiple suppliers** (incl. SMEs and multiple sourcing) that can be **integrated in ADHA units** by different **ADHA unit integrators**.
- It is an **ambitious** project and a **unique opportunity** for the **Satellite Electrical Engineering domain** that will reduce **cost & integration time**, and allow to direct the **resources** on specific modules for new and **challenging applications (Payloads)**.
- ADHA documents have been organized per levels with a **top down approach** (L0: ESA, L1: Units, L2: elements, L3: EGSEs).
- **ADHA Unit requirements (L1)** have been recently agreed among **all ADHA parties**. ADHA teams are currently working on ADHA Unit **Elements** requirements. The **ADHA 2022 Workshop** is planned (22-23 November 2022, ESTEC; <https://indico.esa.int/event/427/>) to present all ADHA documentation.
- **HW development** is starting at Unit, Module and connector levels.

Questions?

Feedback:
Kostas.Marinis@esa.int

