AVIONIC SW

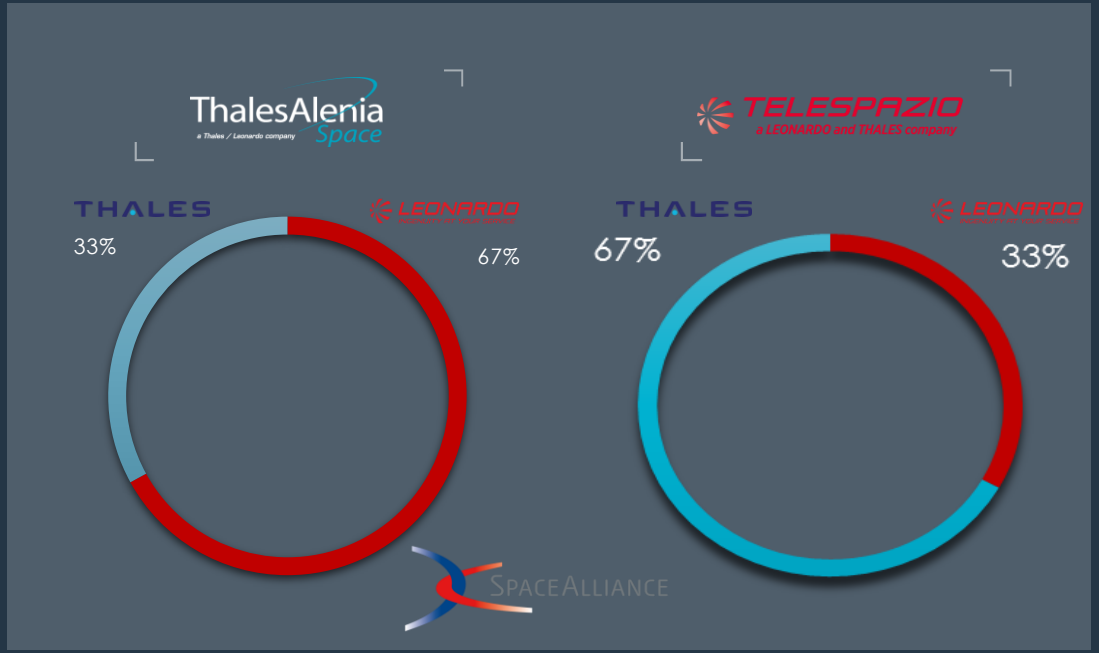
NEW SPACE TECHNOLOGIES

P. SERRI HEAD OF R&T&D

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

A JOINT VENTURE BETWEEN TWO BIG COMPANIES

A GREAT UNIQUE EXPERIENCE TEAM WHICH COVER THE WHOLE CHAIN VALUE



SYSTEMS

SERVICES

SATELLITES

PAYLOAD

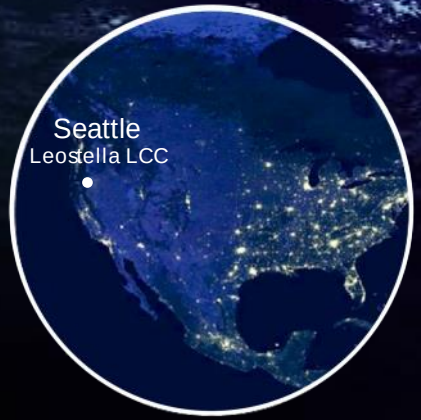
INSTRUMENTATION

A GLOBAL OFFER FROM INSTRUMENTATION TO SPACE SYSTEMS END TO END

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

ThalesAlenia Space
a Thales / Leonardo company

SERVING THE WORLD FROM EUROPE & THE USA



Belfast
Bristol
Harwell
Leuven
Hasselt
Charleroi
Luxembourg
Warsaw
Stuttgart
Zurich
Toulouse
Gorgonzola
Madrid
Turin
Cannes
L'Aquila
Rome

Date: 07/06/2021
Ref: xxxxx
Template: 83230347-DOC-TAS-EN-011

THALES ALENIA SPACE OPEN

ThalesAlenia Space
a Thales / Leonardo company

MISSIONS AND TYPES:

/// Earth Observation

- Sentinel 1 A/B
- Sentinel 1 C/D
- Cosmo Skymed
- Cosmo Second Generation
- PLATiNO

/// Space exploration

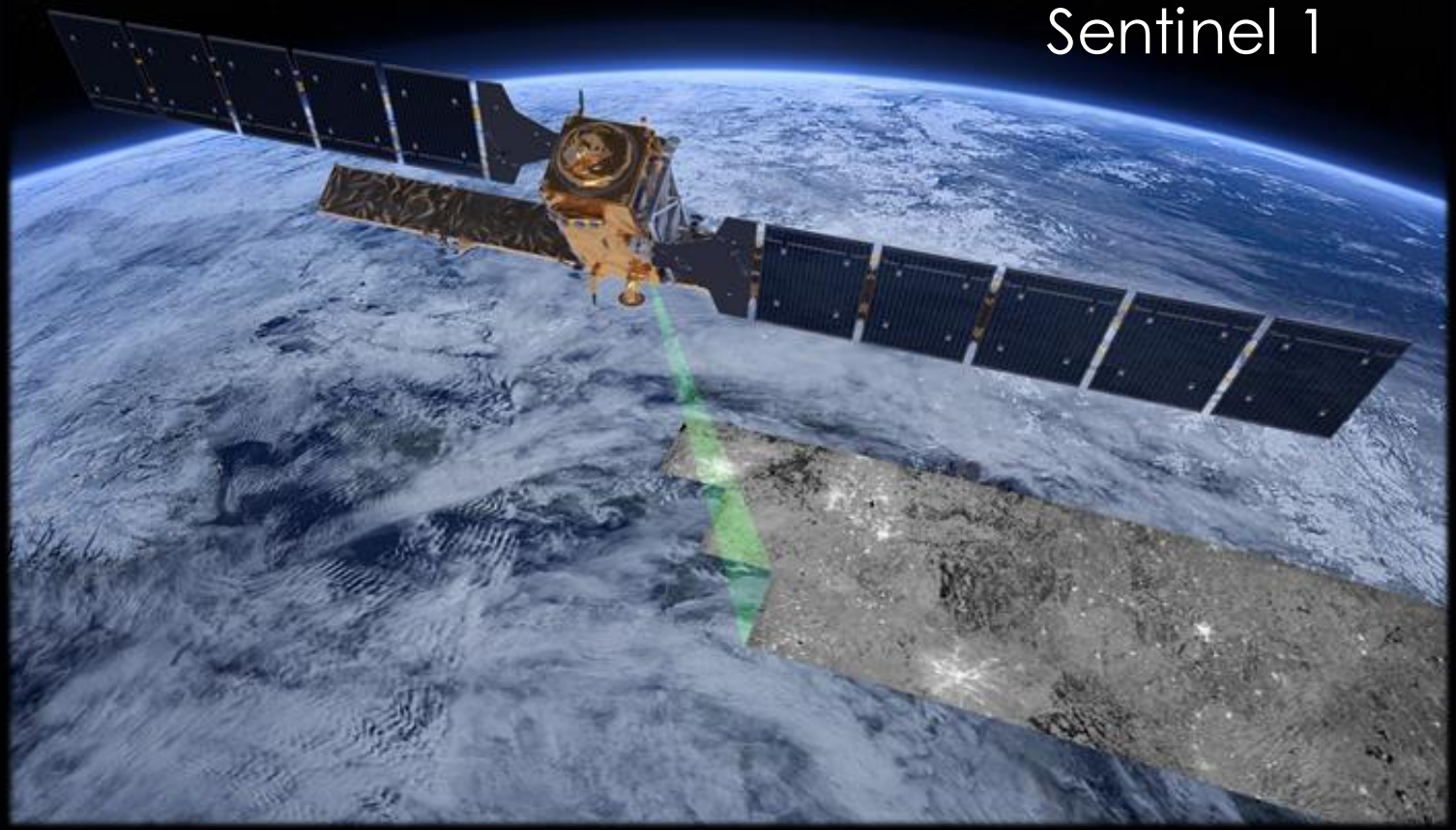
- Exomars 2016
- Exomars 2020
- METIS Solar Orbiter

/// Earth Positioning

- GALILEO

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

Sentinel 1



Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

AVIONIC SW GOAL

/// To maintain the spacecraft operative and in orbit

- Geostationary -> Always on line -> possibility to operate from ground
- Orbiting/Space exploration-> Autonomous spacecraft management

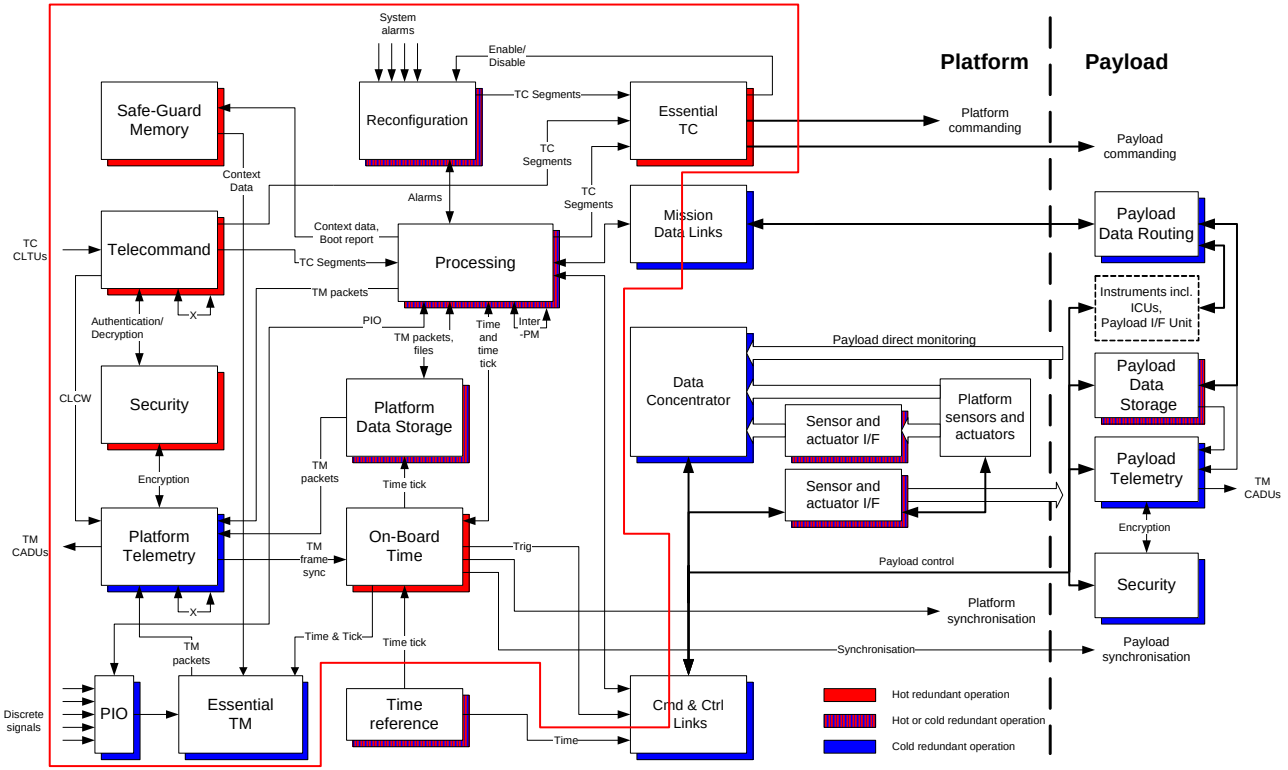
/// To perform the mission

- Maintain the payload in a operative state
- Execute the Mission Timeline

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

ON BOARD COMPUTER AND STANDARD HW ARCHITECTURE

The architecture (ESA SAVOIR reference) :



Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

ON BOARD COMPUTER

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

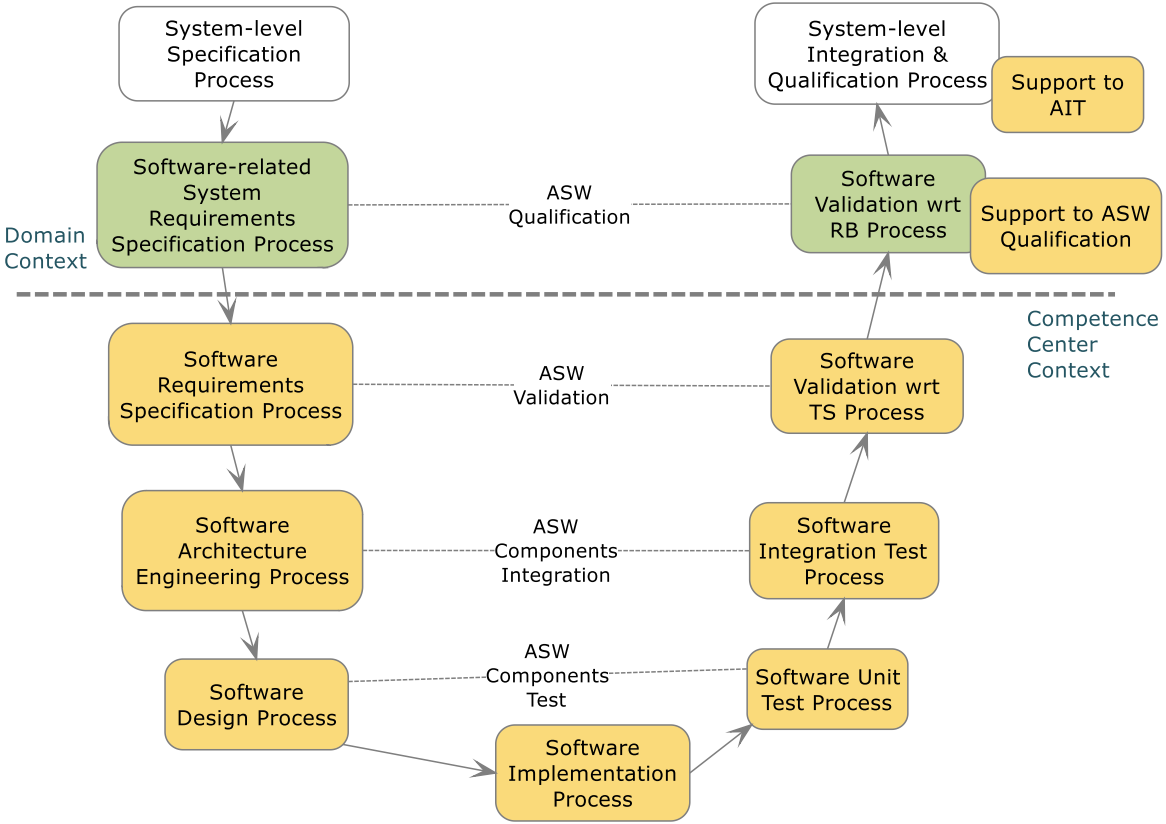
ON BOARD COMPUTER

/// Integrates :

- A SPARC V8 processor including a debug module (DSU), a high-performance FPU (GRFPU), large caches (2 * 64kB) and a MMU
- A CCSDS TC decoder
- A CCSDS TM encoder
- A CCSDS Time Management controller
- A number of * SpaceWire controllers, 2 of them being multiplexed and 7 of them supporting the RMAP protocol in HW
- 2 * 1553 BC/BM/RT controllers (each exclusive with the CAN controller that shares pins)
- 2 * CAN controllers (each exclusive with the 1553 controller that shares pins)
- 4 * UART controllers (3 * APB UART and 1 * AHB UART)
- 2 * memory controllers (One dedicated to CPU and one dedicated to the IO and TMTC modules)
- A Housekeeping module
- An AHB bus monitoring module
- MAP interfaces to cross-strap

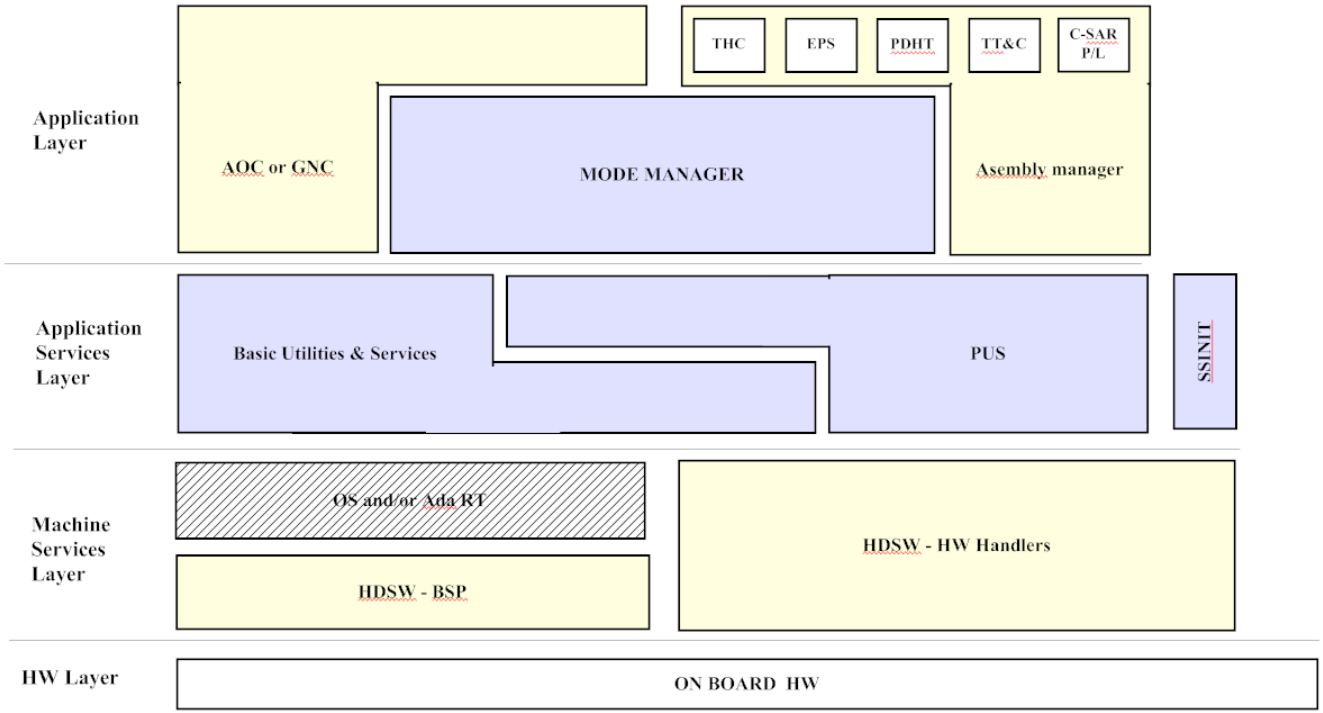
Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

V LIFE CYCLE



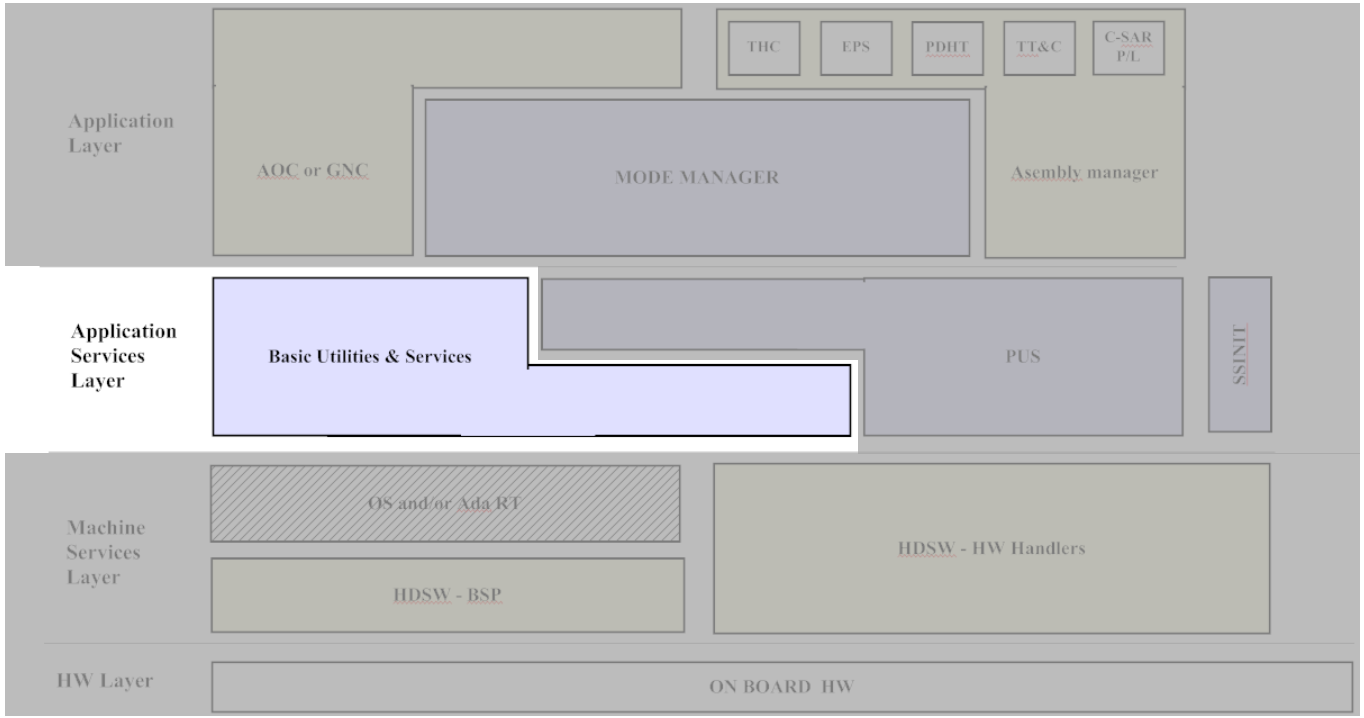
Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

OBSW LAYERED ARCHITECTURE



Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

OBSW LAYERED ARCHITECTURE



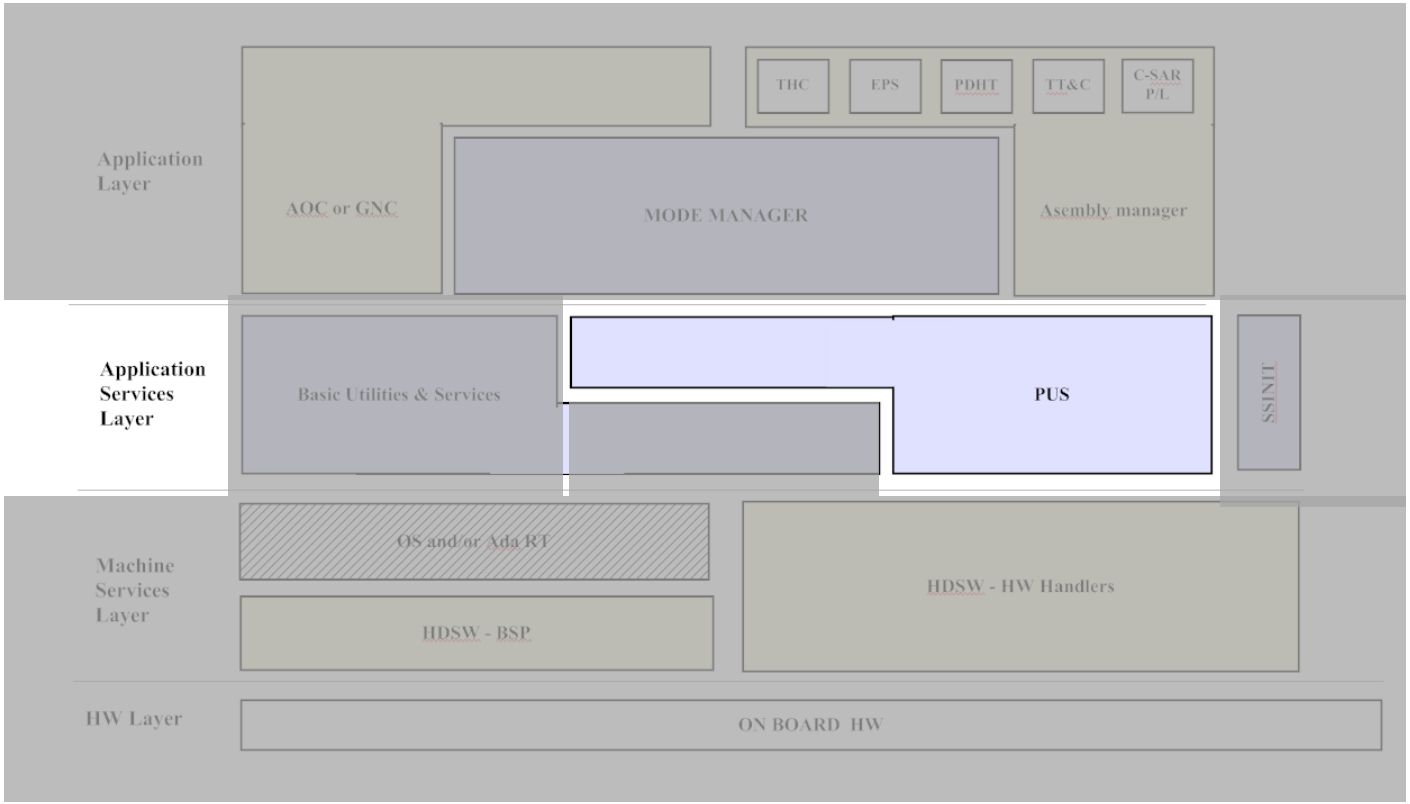
Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

BASIC UTILITY SERVICE (BUSV)

/// Abstracts the underlying driver layer

- Communication link management
  - Errors Handling
  - TC and TM queuing management
- On Board Time management
- Offers API to access all the computer memory areas
  - Registers
  - Non volatile memories
- Interrupt Manager

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

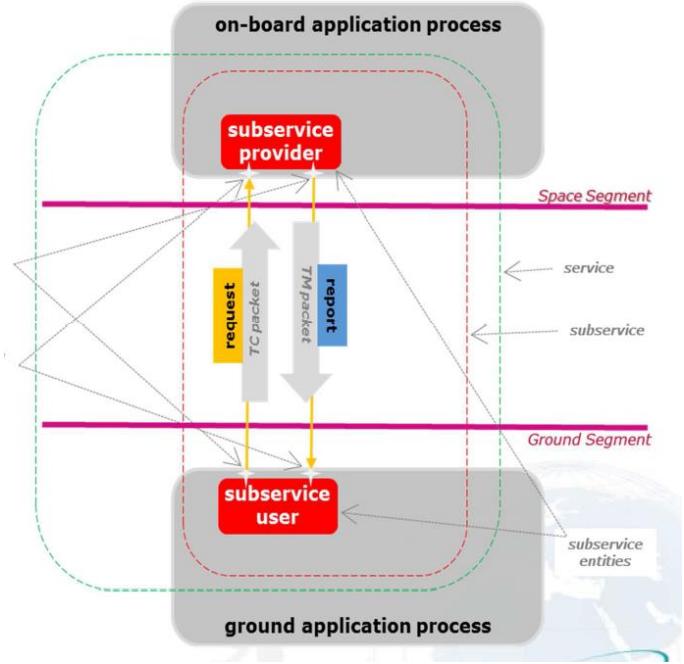


Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

PACKET UTILIZATION STANDARD (PUS)

/// Reference standard: ECSS-E-ST-70-41

- Specify the high level behavior of standard satellite's services
- All the avionic applications exploit standard services
- Standard services grant harmonic ground interface
- Standard services can be configured and tailored to mission needs



Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

PUS SERVICES OVERVIEW

PUS 1 (telecommand verification)
PUS 2 (device commanding),
PUS 3 (housekeeping & diagnostic reporting)
PUS 4 (statistics reporting)
PUS 5 (events reporting),
PUS 6 (memory management)
PUS 9 (on-board time management),
PUS 11 (time-based schedule management)
PUS 12 (on-board monitoring),
PUS 14 (packet transmission management)
PUS 15 (on-board storage & retrieval),
PUS 17 (connection test)
PUS 18 (OBCP management)
PUS 19 (evant-action management)
PUS 130 (command database management),
PUS 131 (orbit management)
PUS 132 (position-based schedule management),
PUS 133 (two-step TC management)
PUS 134 (TC batch management),
PUS 160 (RM oscillator management)

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

SERVIZI PUS OVERVIEW

PUS 1 (telecommand verification)

PUS 2 (device commanding),

PUS 3 (housekeeping & diagnostic reporting)

PUS 4 (statistics reporting)

PUS 5 (events reporting),

PUS 6 (memory management)

PUS 9 (on-board time management),

PUS 11 (time-based schedule management)

PUS 12 (on-board monitoring),

PUS 14 (packet transmission management)

PUS 15 (on-board storage & retrieval),

PUS 17 (connection test)

PUS 18 (OBCP management)

PUS 19 (evant-action management)

PUS 130 (command database management),

PUS 131 (orbit management)

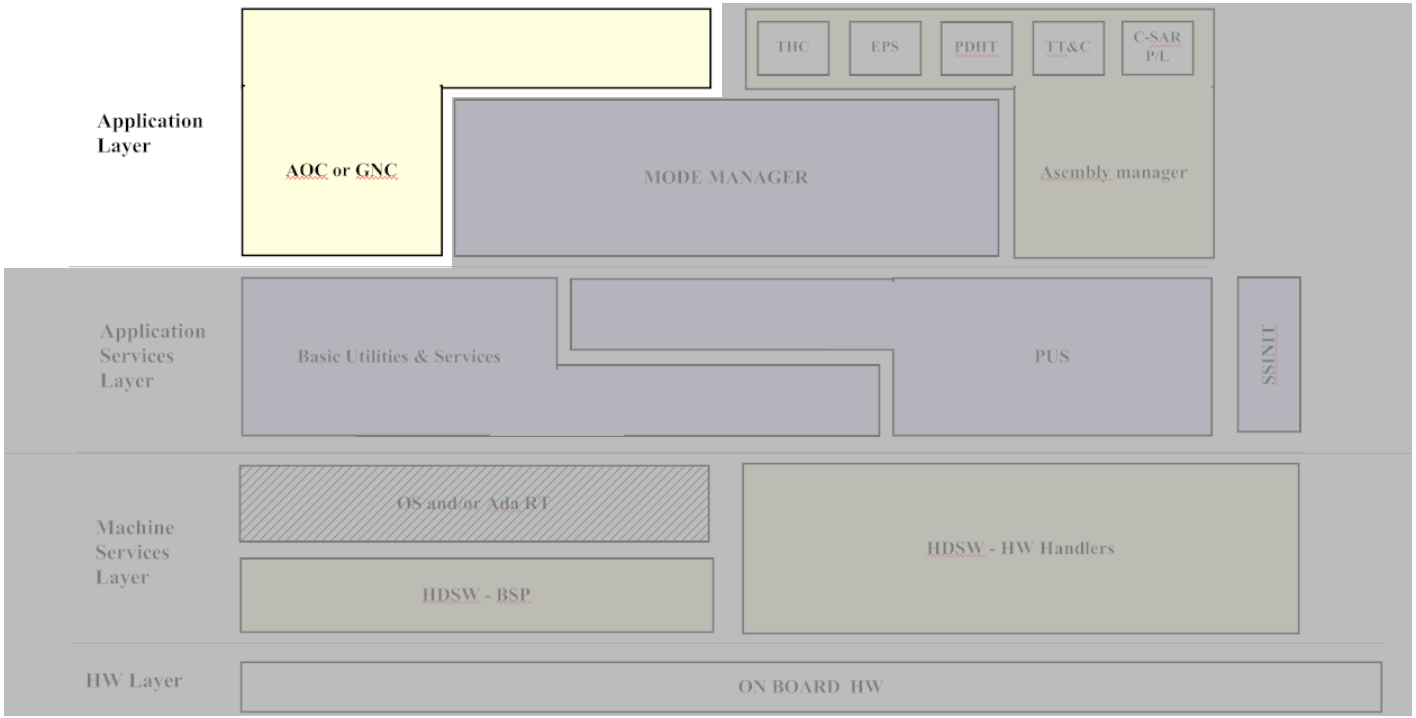
PUS 132 (position-based schedule management),

PUS 133 (two-step TC management)

PUS 134 (TC batch management),

PUS 160 (RM oscillator management)

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011



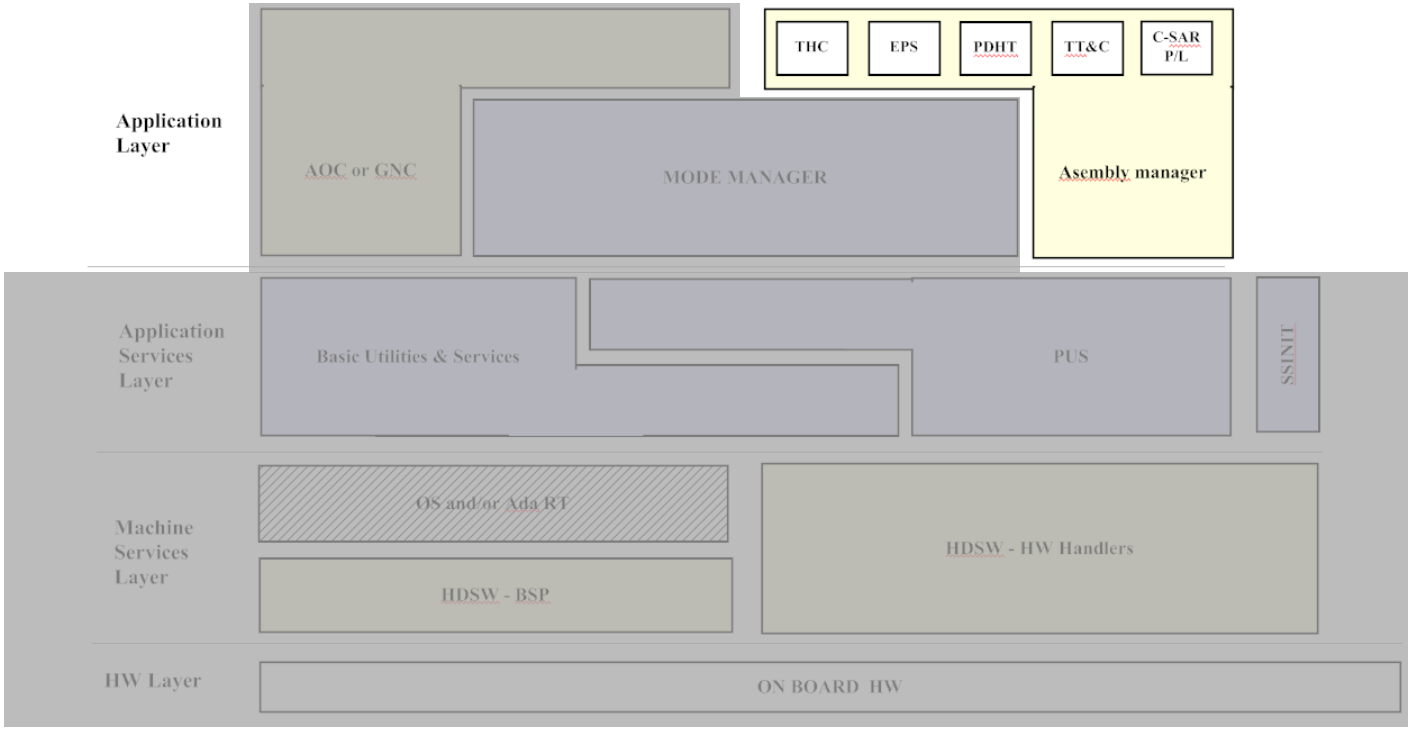
Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

ATTITUDE & ORBIT CONTROL (AOC)

/// This component implement the system control law that permits to maintain the planned orbit or navigation path

- Complex navigation algoithm are SW implemented
- All the attitude and orbit data computation are based on
  - Star Tracker
  - GPS
  - Gyroscop
- All the orbit correction eploits
  - Thruster
  - Reaction wheels
  - Magnetotorquers

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011



Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

ASSEMBLY MANAGERS (AM)

/// They manage the satellite's subsystem

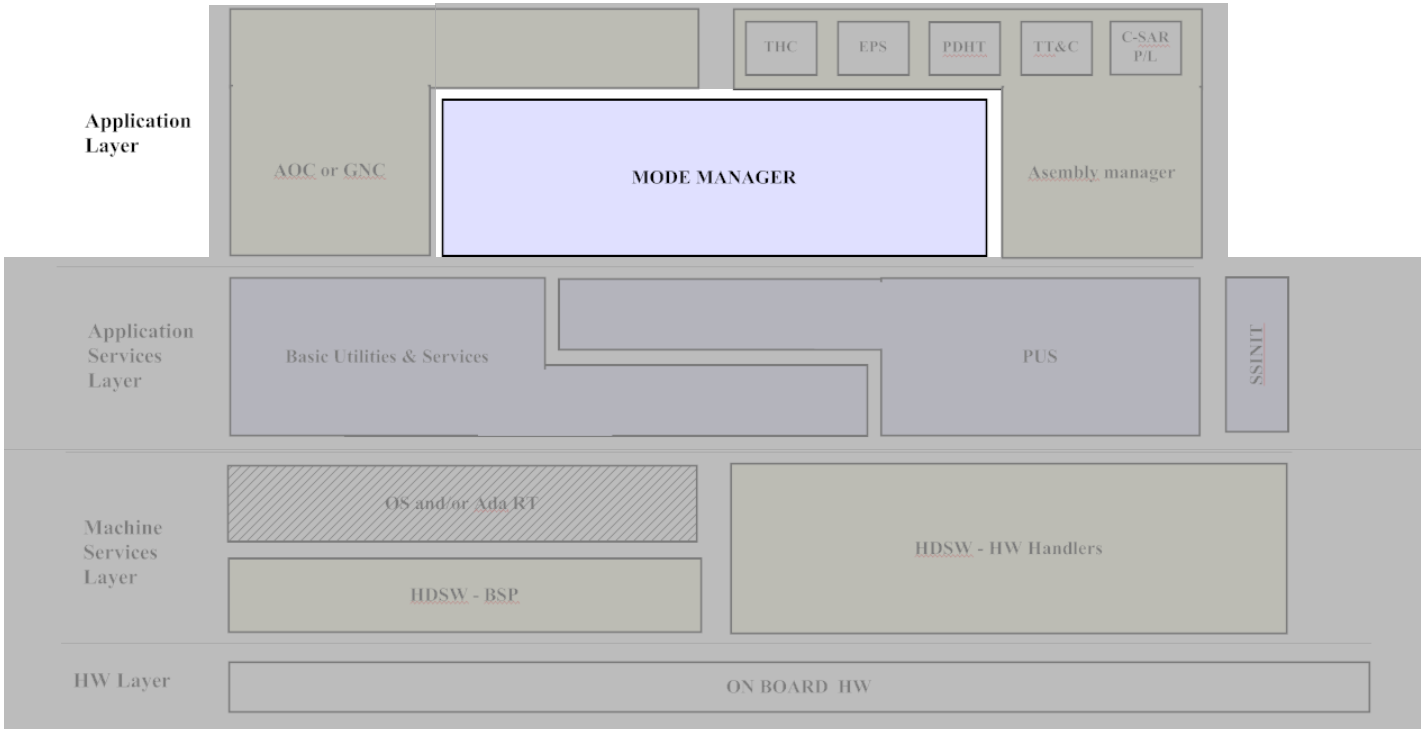
/// They deal with the management of some on-board Thermical subsystem

- Temperature control based on the usage of heaters managed on the basis of acquired temperatures.

- Electrical subsystem
  - Managemet of power supply network
  - Monitoring of current, voltage and power production
- Payloads subsystem
  - Payload configuration
  - Commanding
  - Telemetry acquisition to grant observability
  - Operational data monitoring (FDIR)

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

OBSW LAYERED ARCHITECTURE



Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

MODE MANAGER

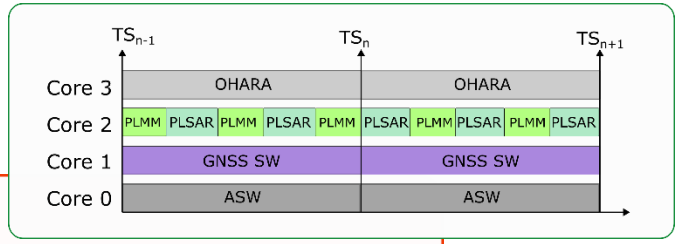
/// Manage the satellite's mode configuration following the mission phases

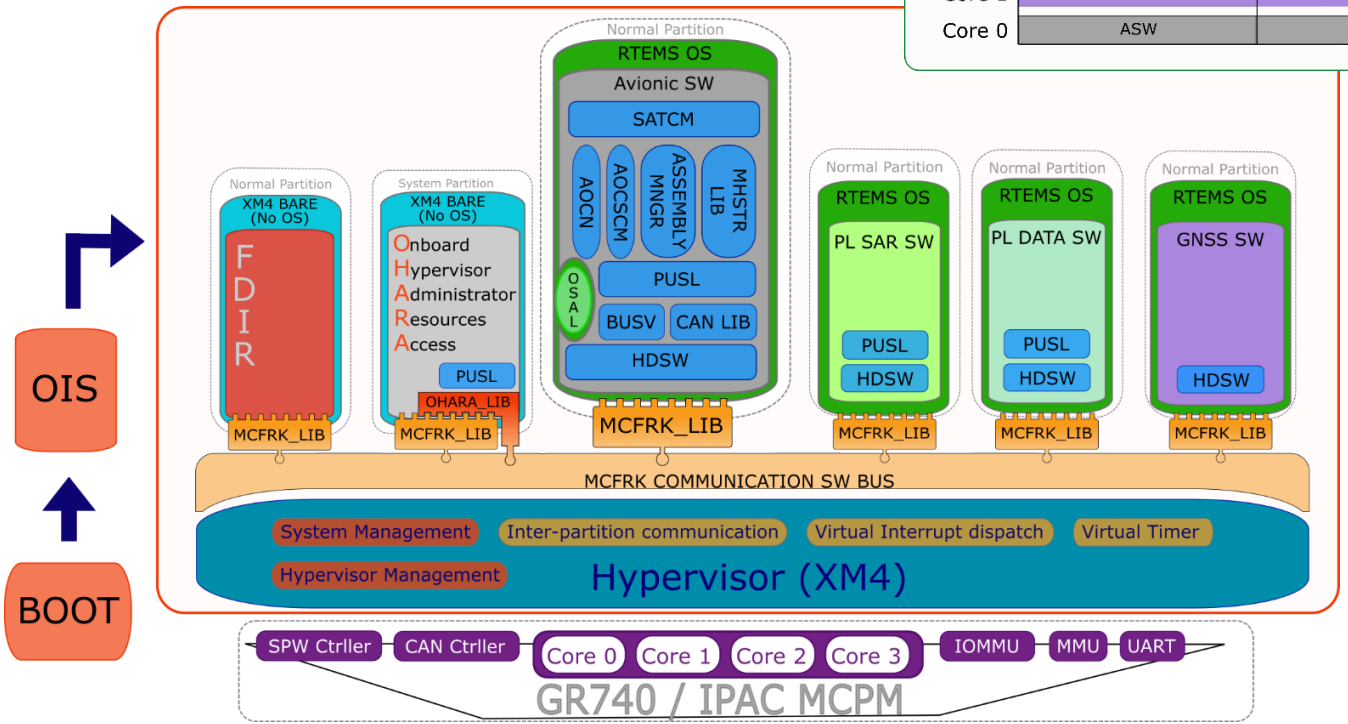
/// They deal with the transitions between operative ways

- Executes autonomous mode transitions
  - E.g. it detect the separation from the launcher
- Executes mode transition on ground request
- Checks the final satellite's configuration status
  - The final configuration is a set of AM's data and AOC modes
- Before to execute the Ground commanded transition checks the transition feasibility
  - Only a subset of transitions are allowed
- It manage all the satellite's recovery transitions
  - The mode manager is configured with the operation to isolate and recovery and maintain the spacecraft in a safe state

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

IPAC OBSW





Multicore Architecture

GR740: Quad Core Leon4

Hypervisor Technology

Space and time segregation

Services centralization

MCFRK_LIB: uniform approach

OHARA: server like approach

Date: 04/11/2019
Ref: TAS-I CCSS
Template: 83230347-DOC-TAS-EN-011

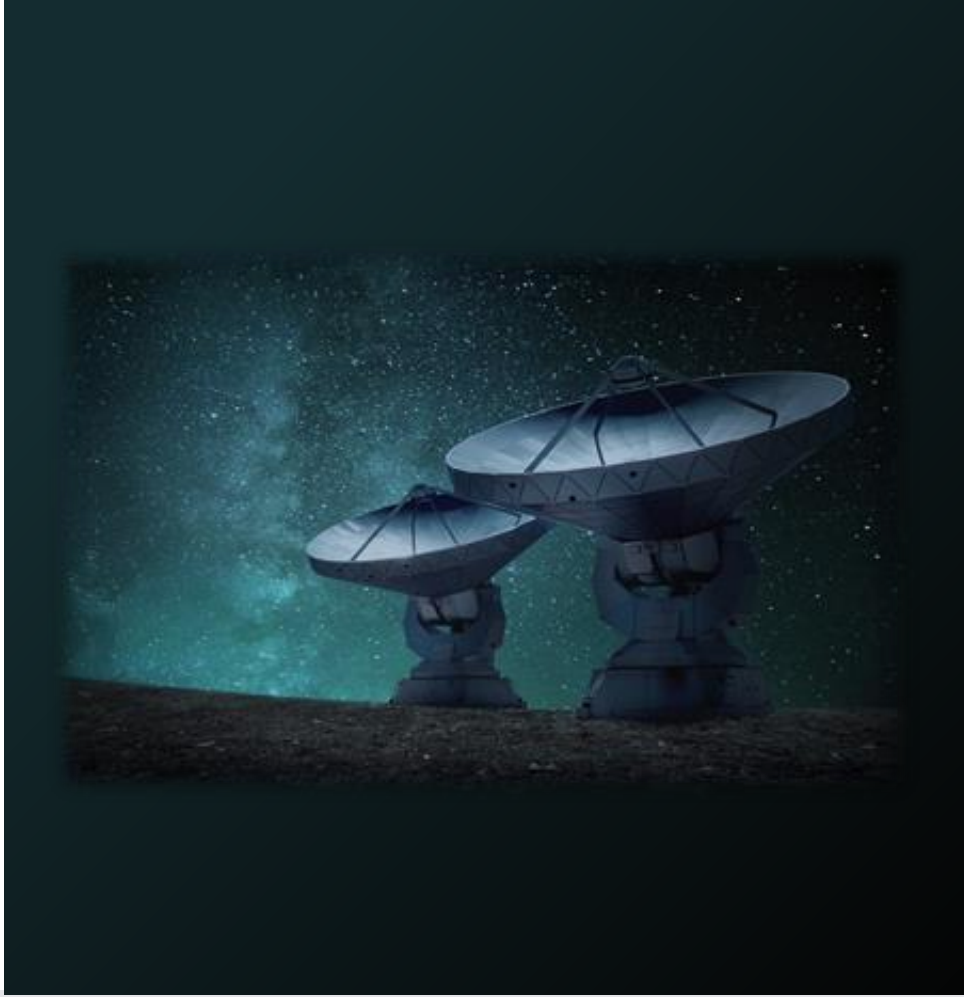
AI IN THE SPACE

/// Why AI?

- Faster data analysis
- NP algorithms avoided
- Less time domand for large dataset

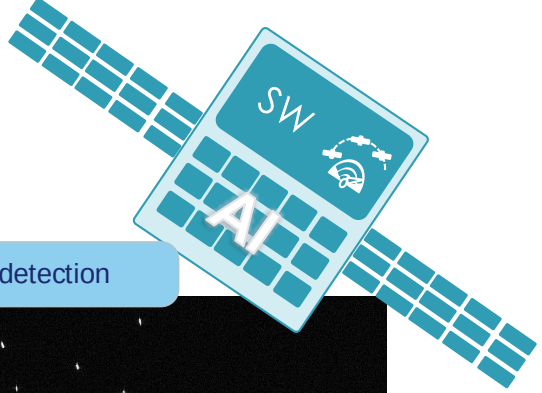
/// EDGE space computing

- Move the data processing where information are generated to reduce the response time
- Advantages:
  - Less latency
  - Less cost
  - Final service supplied to the ground
  - Possibility of more complex services



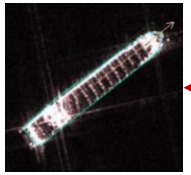
Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

MAIN GOALS AND HARDWARE TARGETS

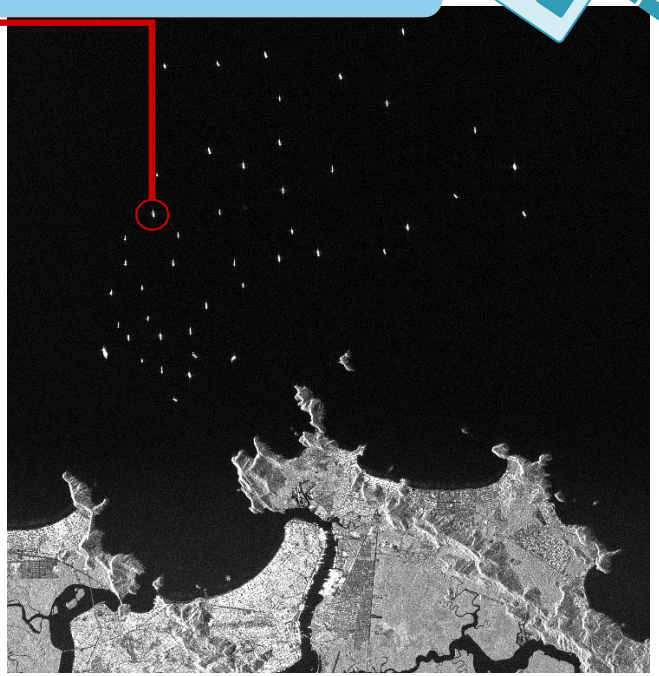


/// Goals

- Take innovation for staying updated
- Keep up with the market
- Automated focusing
- Compression
- Autonomous tracking
- Workload balancing



Non cooperant ship detection



/// Targets HW

- Versal ACAP
- Miryad 2

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011

THALES ALENIA SPACE OPEN

ThalesAlenia Space
a Thales / Leonardo company

OPPORTUNITIES WITH US

/// Thesis and collaborations

- New space technologies studies
  - Xilinx Versal ACAP
  - RISC V
  - Myriad 2
  - Software defined approach
  - AI Applications
  - Open CL and Open MP projects
  - Embedded Linux
  - Hypervisor technologies

Please contact Paolo Serri:

paolo.serri@thalesaleniaspace.com

/// Join with US take part to the next space technology

- Thales Alenia Space Italy is looking for a **Junior Embedded SW Engineer** to join the Research and Development team located in **L'Aquila**. The team is focused in development of **satellite's on board computer SW** and integration of new SW based technologies (like Artificial Intelligence, constellation management ad dedicated high performance computation HW).

Go to the **link below** for checking the **open position** and apply for it:

https://thales.wd3.myworkdayjobs.com/en-US/Careers/job/LAquila/Embedded-SW-Engineer_R0198909

Date: 26/01/2023
Ref: Not referenced
Template: 83230347-DOC-TAS-EN-011