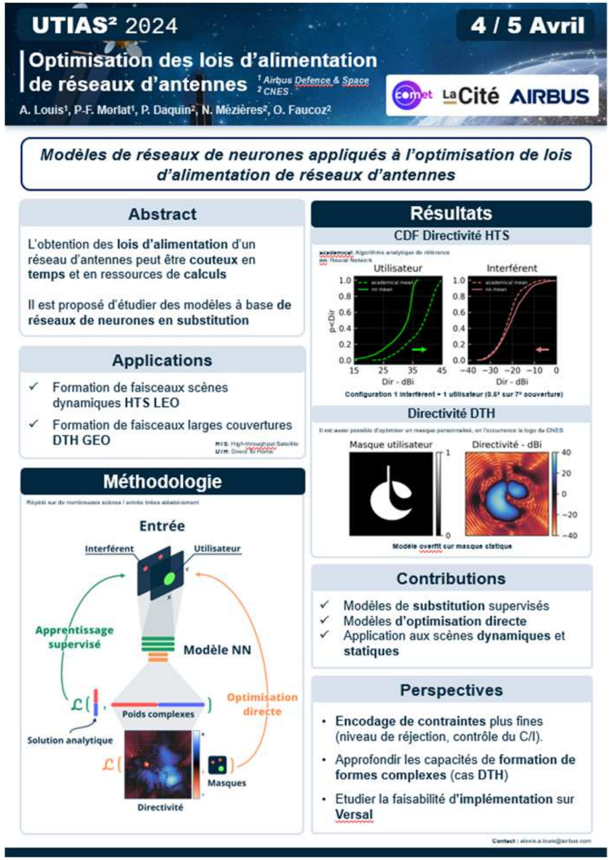
Airbus Defence and Space au forum UTIAS² 2024

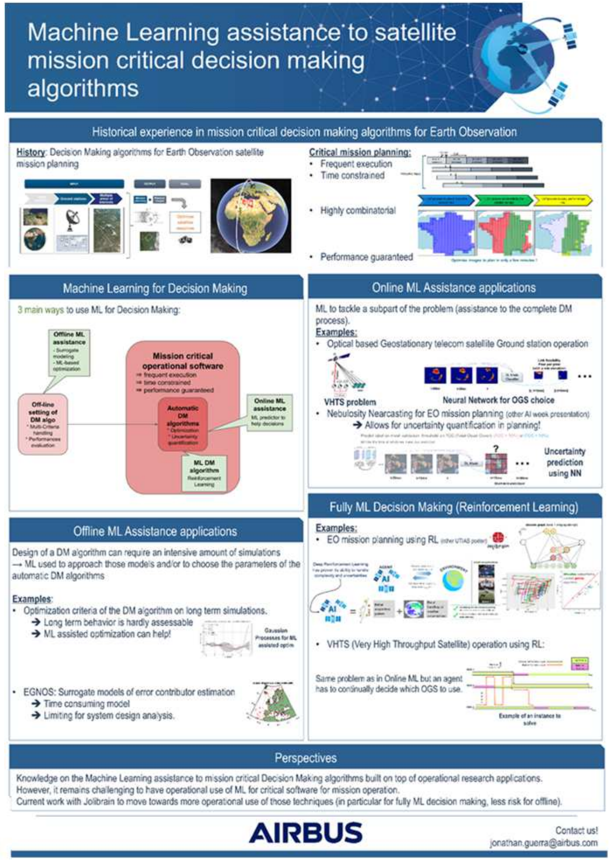


← Optimisation des lois d'alimentation des réseaux d'antennes

Assistance par *machine learning* d'algorithmes d'aide à la décision (application à la planification de satellites) →

\+ poster Jolibrain : étude jointe sur l'apprentissage par renforcement sur ce sujet.

jolibrain



AIRBUS

COMET – AI uses cases on EO satellites

Olivier CAMBON, Clement COGGIOLA, Fanny MOREL

DEFENCE AND SPACE

History

Edge computing is a distributed computing paradigm that brings **computation and data storage closer to the sources of data** WIKIPEDIA

First Space

New Space

New Space Constellation

Edge Space

1970

2010

2015

2020

COTS Smartphone

Automotive processes
High Reliability
Availability > 99%

5G

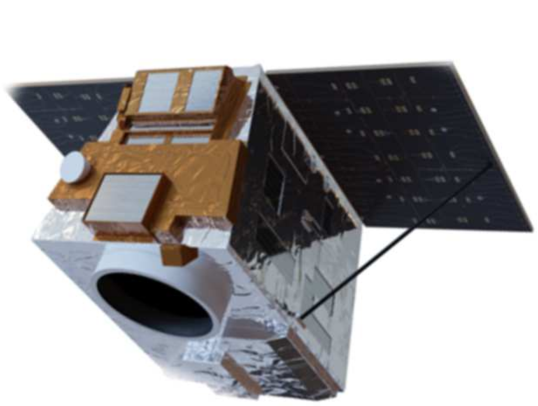
Cloud

EDGE COMPUTING

SDR# Software Defined Radio

AIRBUS

S250 product

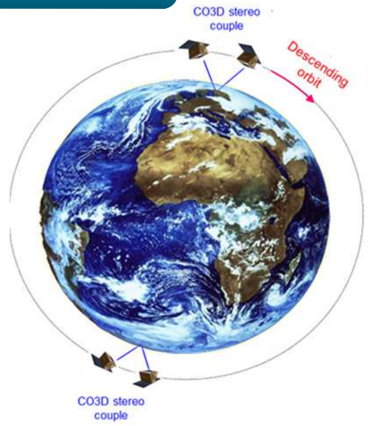


Product

Optical option

Radar option

- Alt: SSO 500km
- GSD: 50cm -> 40cm
- 7000 RGB img / day / Sat
- 7000 NIR img / day / Sat
- 250 000 km² / day / Sat
- Life time: 8 years



Project

AIRBUS

S250 concept

- Home made solutions HW and SW
- Custom data format
- Payload TC and TM
- Space only standard
  - Packet store
  - SpaceWire
- OBMP / OBCP
- Monolithic SW
- Some parts reprogrammable
- On-board computer
- Real-time OS
- Embedded SW developer

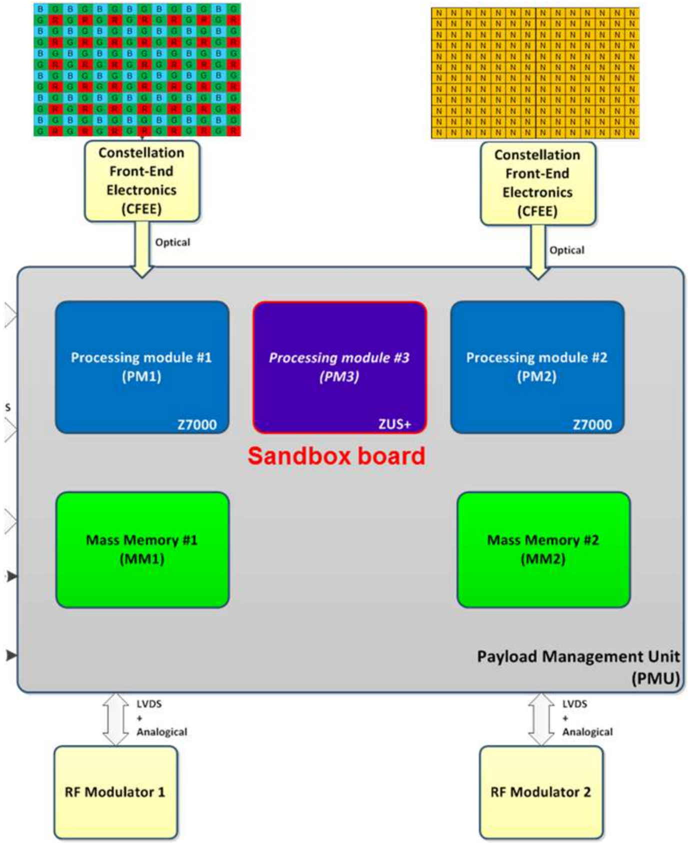
Simplify

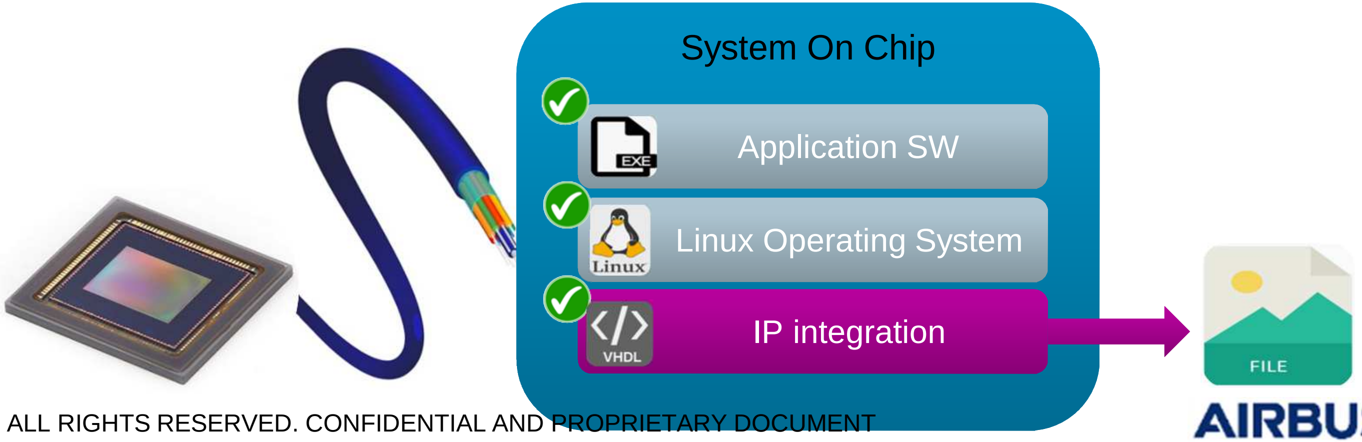
- Industry proven solutions
- Standard format
  - Command line, logs, timeseries DB
- Mainstream standards and tools
  - **Files (File based operations)**
  - Ethernet
  - Shell script
- Multi-applications, software center / smartphone
- **All reprogrammable**
- **Standard PC**
- Standard OS
- Industry SW developer

AIRBUS

V1

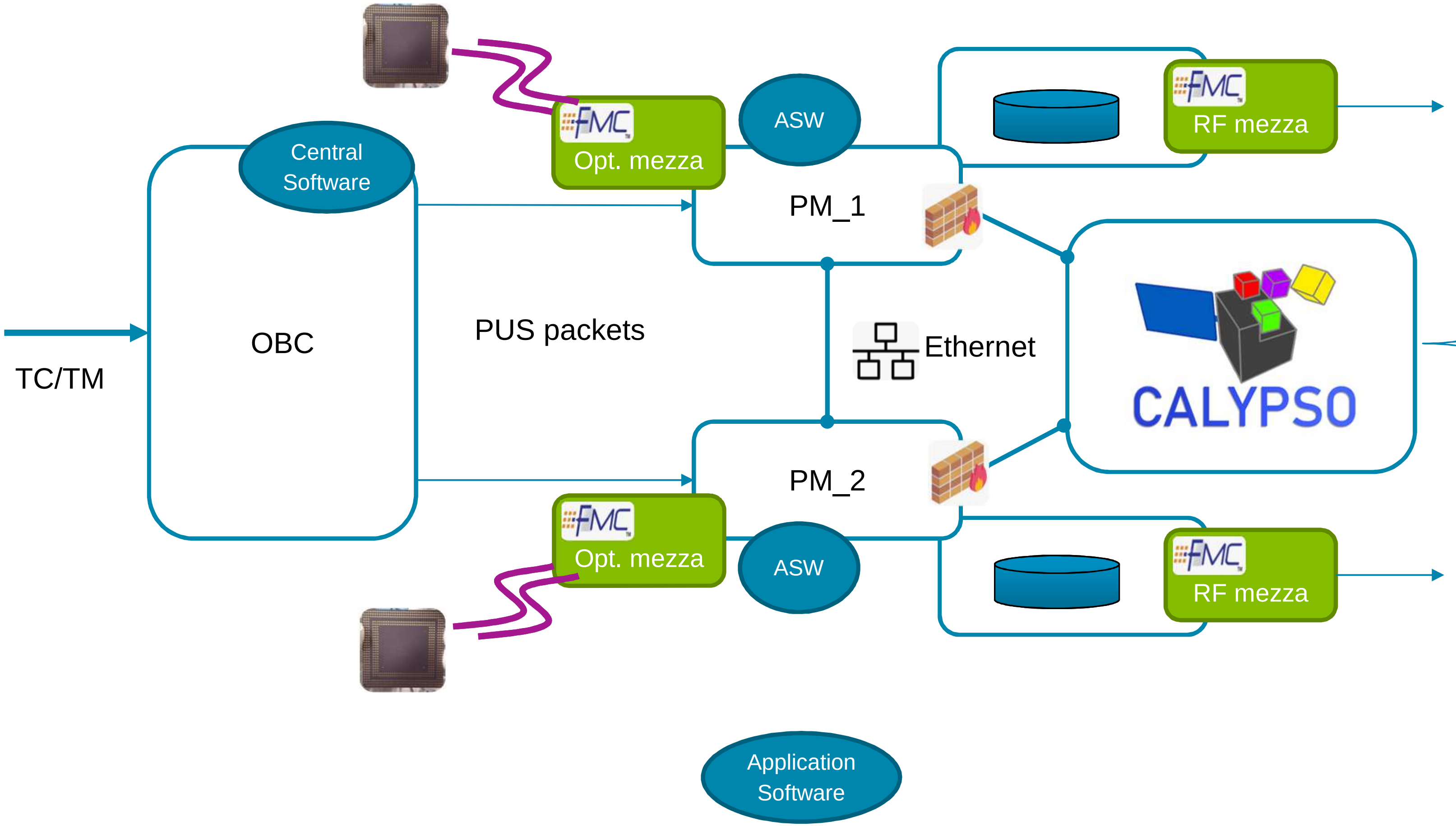
Payload focus





AIRBUS

Airbus S250 Data Handling architecture (File based)



- ❑ Mainstream standards and tools
  - ➢ **Files (File based operations)**
  - ➢ Ethernet
  - ➢ Shell script
- ❑ Standard format
  - ➢ Command line
  - ➢ Logs
  - ➢ Timeseries DB
- ❑ Multi-applications
- ❑ Software center / smartphone
- ❑ Containers
- ❑ Off the shelf libs
- ❑ All reprogrammable (including FPGA partial reprog.)

CALYPSO : Sandbox Objectives

Test applications and new functions on-board of the satellite…and become operational

Shorten time to market from app development

Light application **validation**

Dev. env. as PC: Linux, Python, Libs…

Easy portability

Downlink of only **useful information** (higher value information with lower data rate and short reaction times)

Bring non space labs to space

CALYPSO – Sandbox

Software Defined Satellite

CALYPSO
- Custom AppLYcation Processing Service in Orbit

Smart Idea for Data Processing
On Board
With or without AI
Web Applications

Link to a mission

Develop with SW PA and Security standards

Validate

Integrate/ Launch

Use on board

€€€
Long lead time (Years)
App/business case outdated @launch ?
No flexibility

Reuse Application
Adapt Interfaces
Quick Dev
No quality or security standards requested

Run/ Validate in Software Development Kit

Uplink to satellite

CALYPSO

Update

€
Short lead time (Months)
Adapt App to changing business needs

AIRBUS

Software Development Kit for Flight-Application

Develop on Evaluation Bord

Package

SW + HW accelerator

Upload

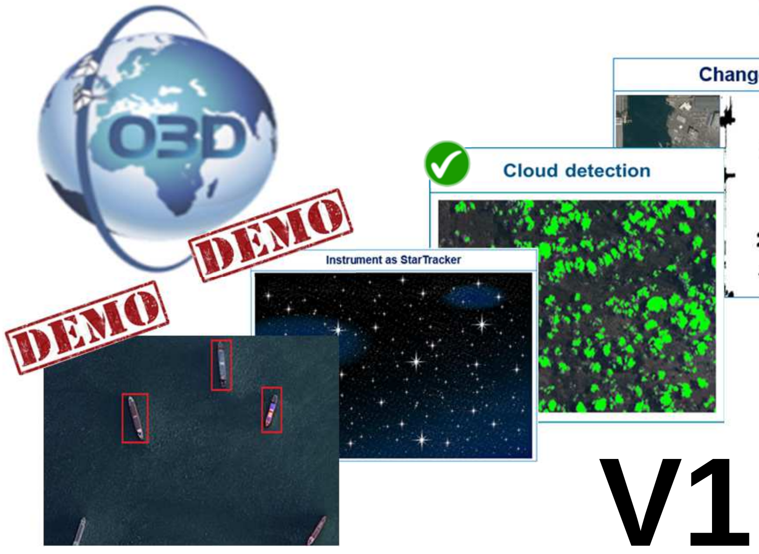
like **ANDROID STUDIO**

Designed for our Smart Payloads

Bringing the smartphone revolution to our satellites

AIRBUS

Use Cases

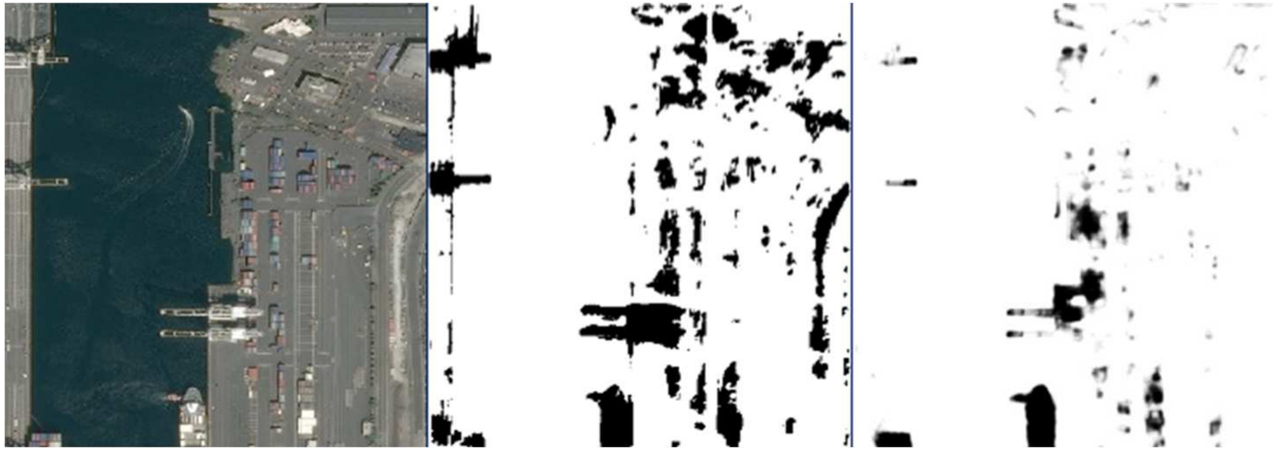


- Linux Operating System
- VHDL Framework
- Sandbox (CALYPSO)
- AI hardware

- Multi process SW
- File Based Payload
- Std Ethernet Network
- Mezza std form factor
- High processing power

- Std libraries
- SW Center
- Software Defined Radio
- Low bitrate coms

Activity Monitoring



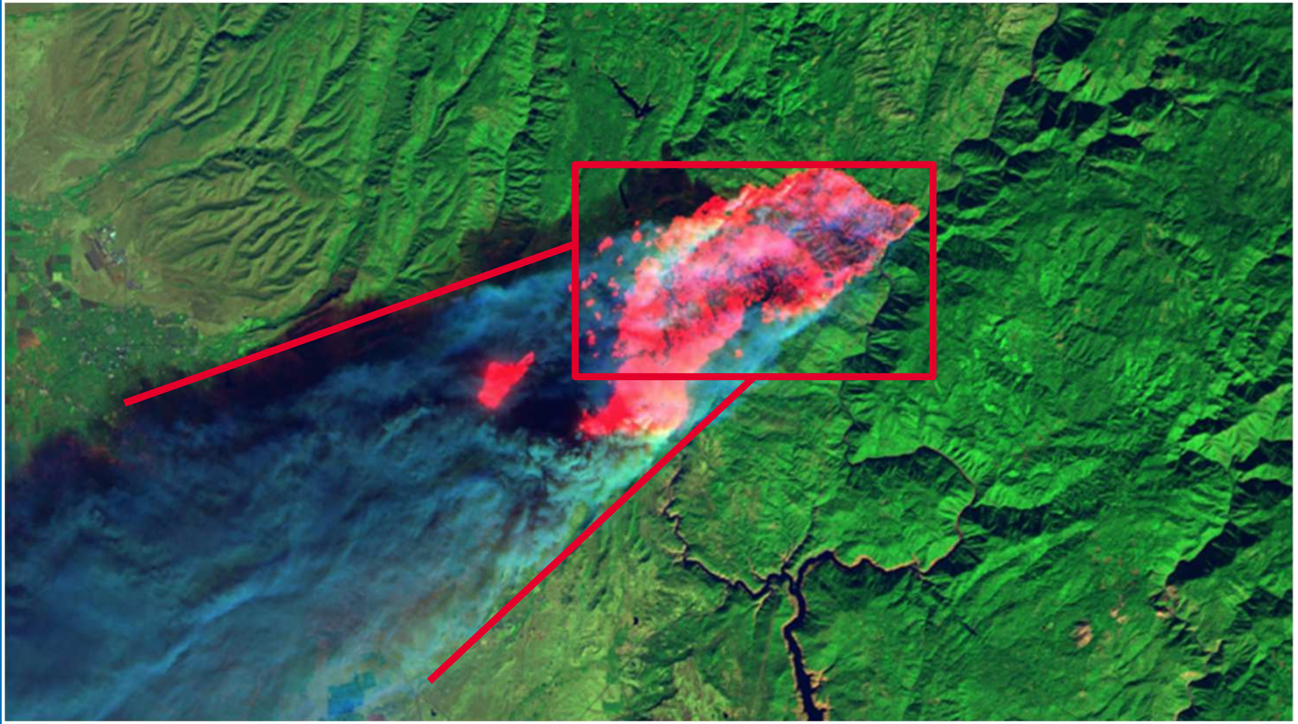
- ❑ Ship detection (CNES)
- ❑ Traffic measurement

- ❑ Change detection with alert
- ❑ Object counting

AIRBUS

Forest fires

Forest Fire Detection



F-APP

Location

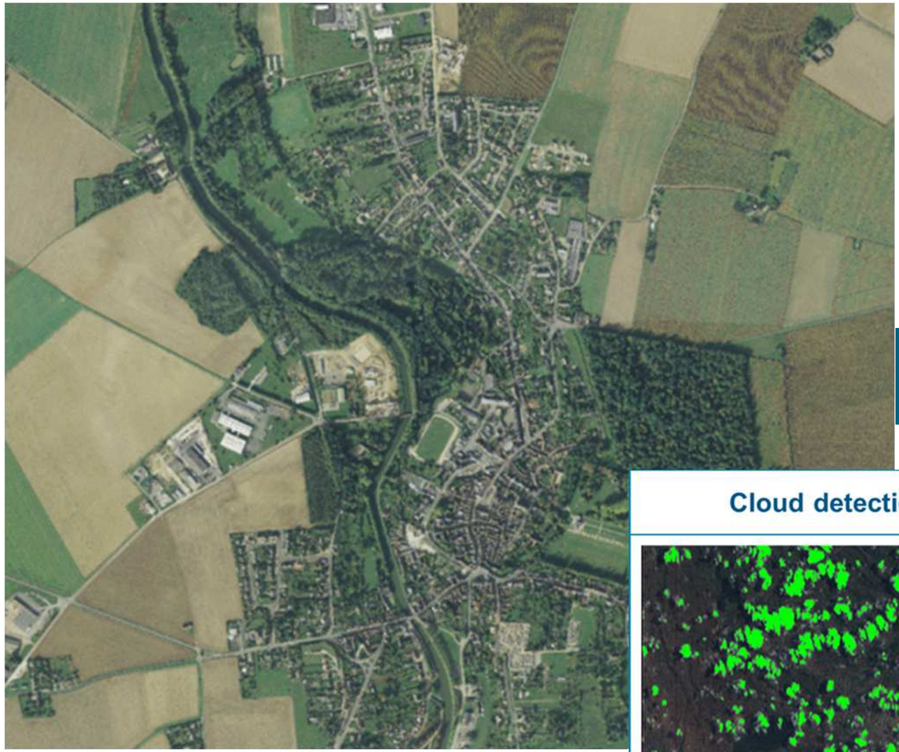
Intensity

Wind direction

AIRBUS

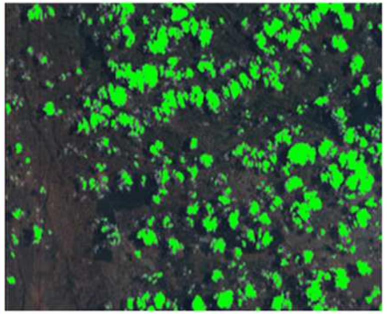
Vehicle Tracking

Details extraction, higher compression

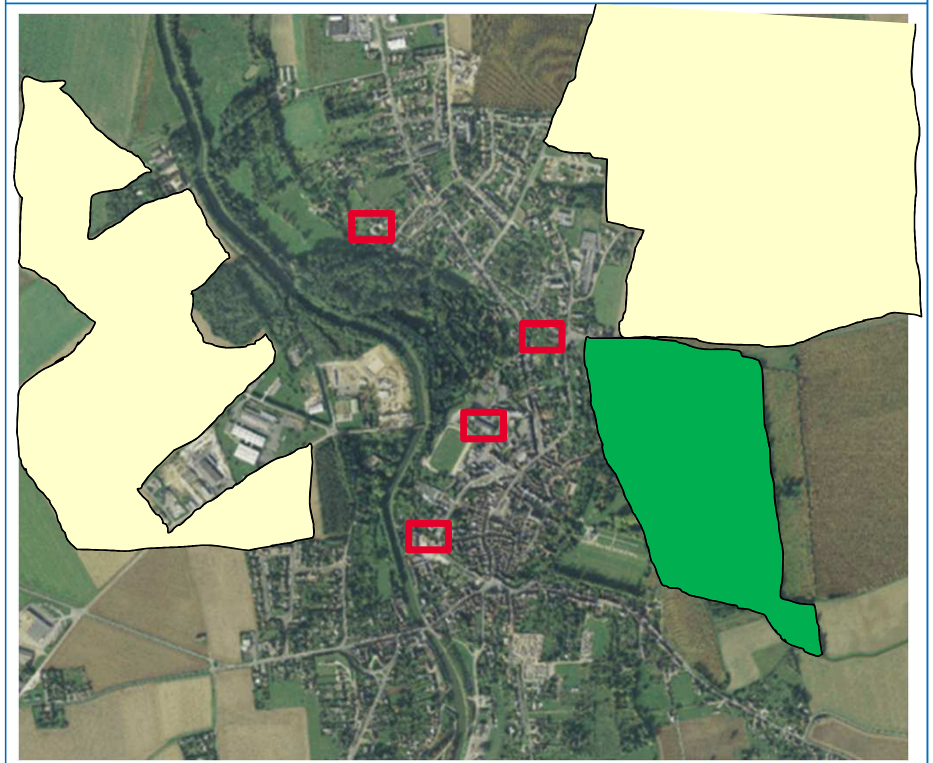


F-APP

Cloud detection



Mask – Better Compression



AIRBUS

Applications on CO3D Satellite (1/2)
Application by CNES : Ship detection

Clément Coggiola

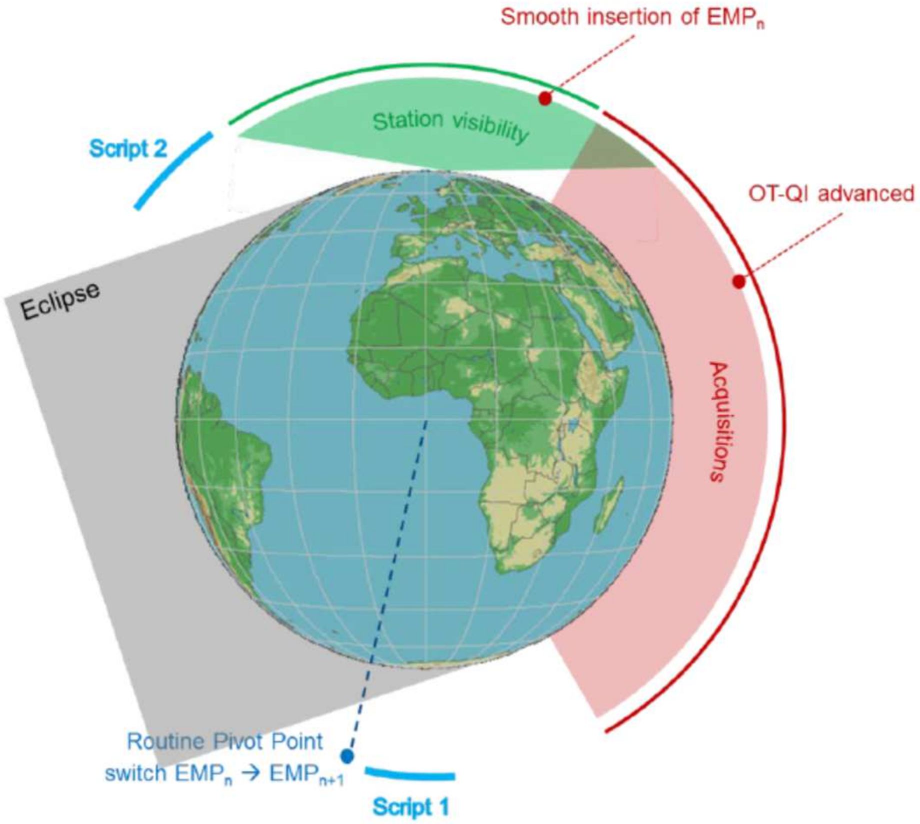
CNES demo application on CO3D

Objectives

- CNNs training, distillation and on-board implementation
- Semantic segmentation: targets of interest in **very-high resolution images**
- PoC: a client provides an algorithm

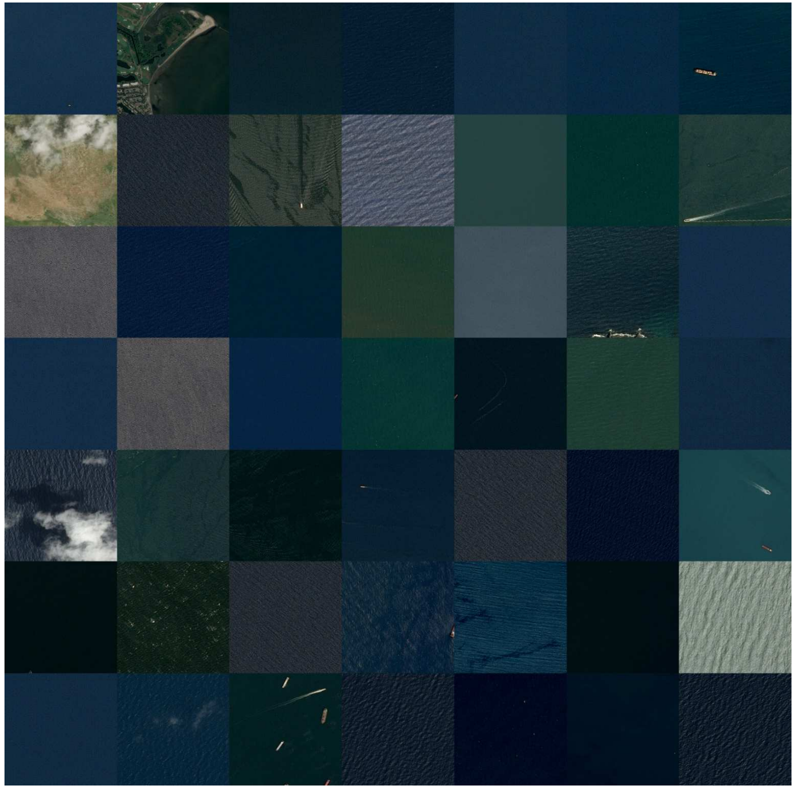
Why?

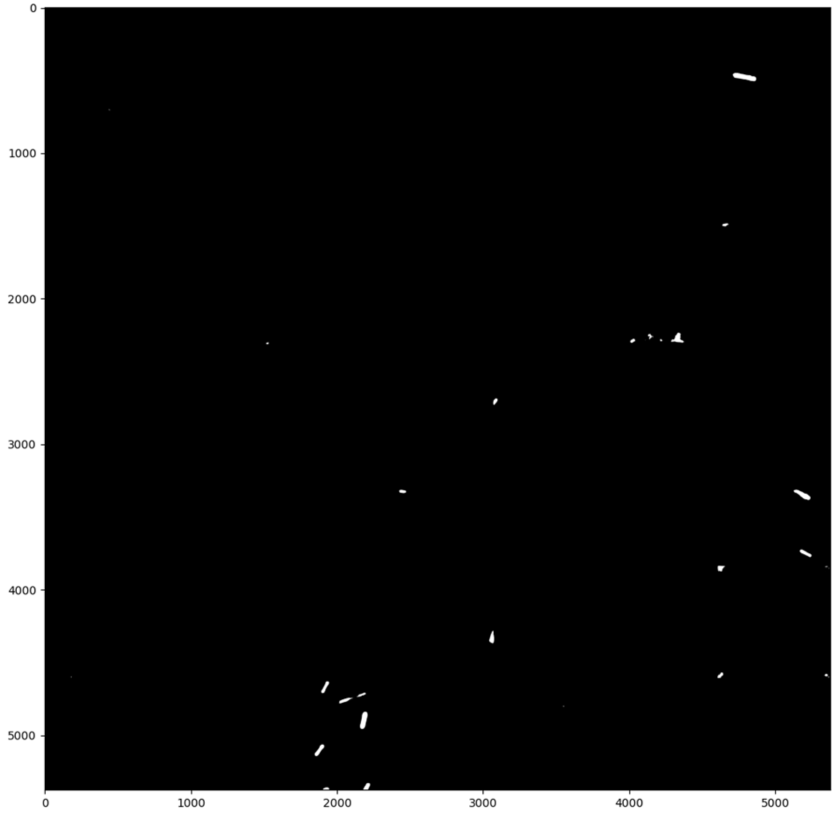
- New space system capabilities
- Optimized downlink: data reduction as compression
- Reactivity (which needs constellations)



CNES demo app: results (*work in progress*)

Ship detection (200k parameters, run on hardware)

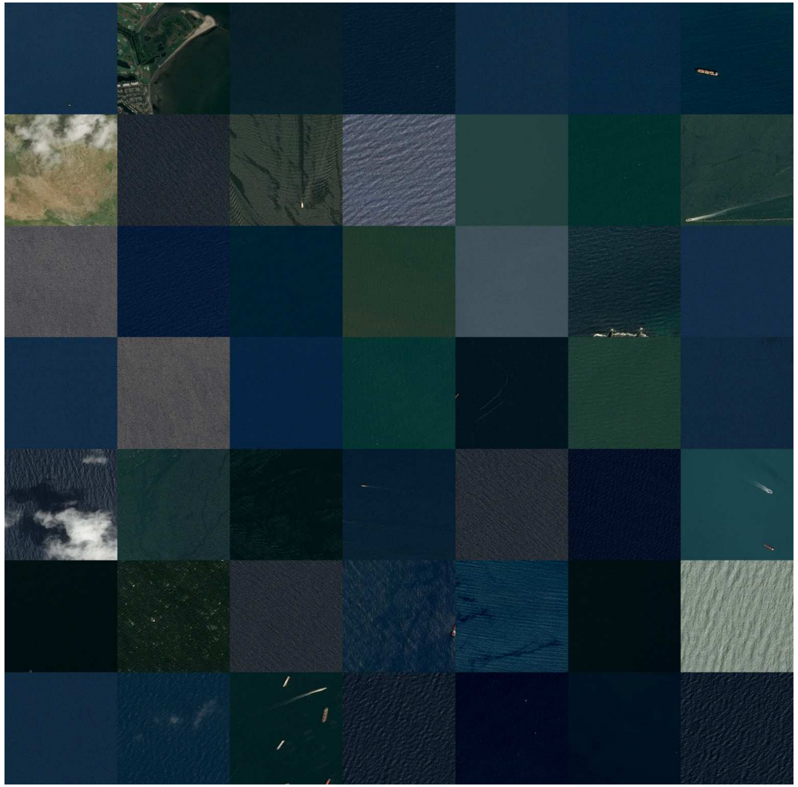


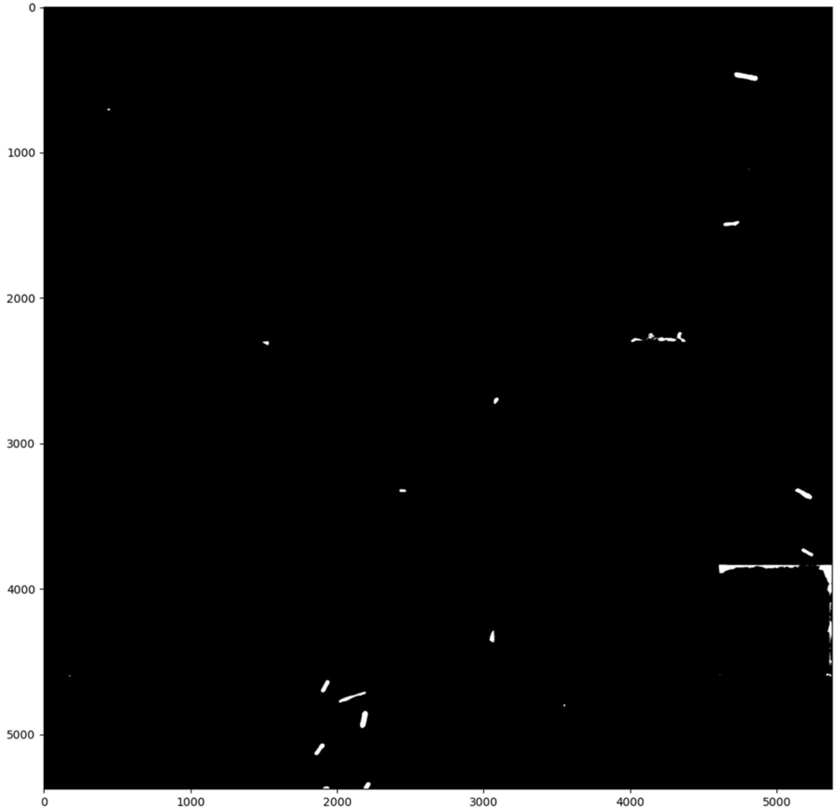


CNES demo app: results (*work in progress*)

cnes

Ship detection (100k parameters, run on hardware)





AIRBUS

Demonstration on CO3D Satellite (2/2)
Application by ADS : MobIA 1 et 2

Fanny Morel

Application de demonstration Airbus Defence and Space sur CO3D - MobIA1&2

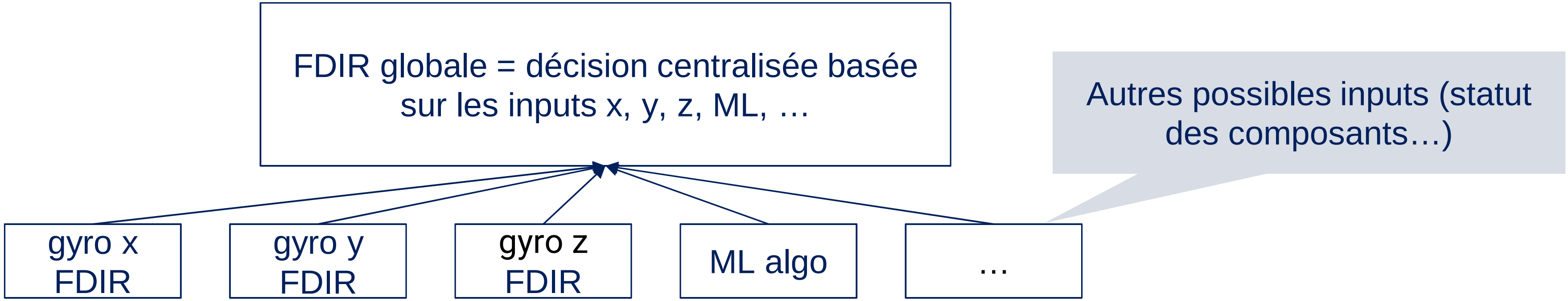
En collaboration avec le CNES depuis 2020

Objectifs :

- MobIA 1 : Prouver l'intérêt de l'utilisation d'IA embarquée pour la détection automatique de pannes, en complément de la FDIR
- MobIA 2 : Une fois cet intérêt confirmé, prouver la possible industrialisation de cette IA embarquée, via la Sandbox Calyspo.

Intérêts identifiés :

- Optimisation de la FDIR (Failure Detection, Isolation and Recovery) via IA à bord, pour des pannes ciblées
- Meilleure réactivité de l'IA embarquée (vis à vis d'une solution IA au sol)



Application de demonstration Airbus Defence and Space sur CO3D - MobIA1&2

En collaboration avec le CNES depuis 2020

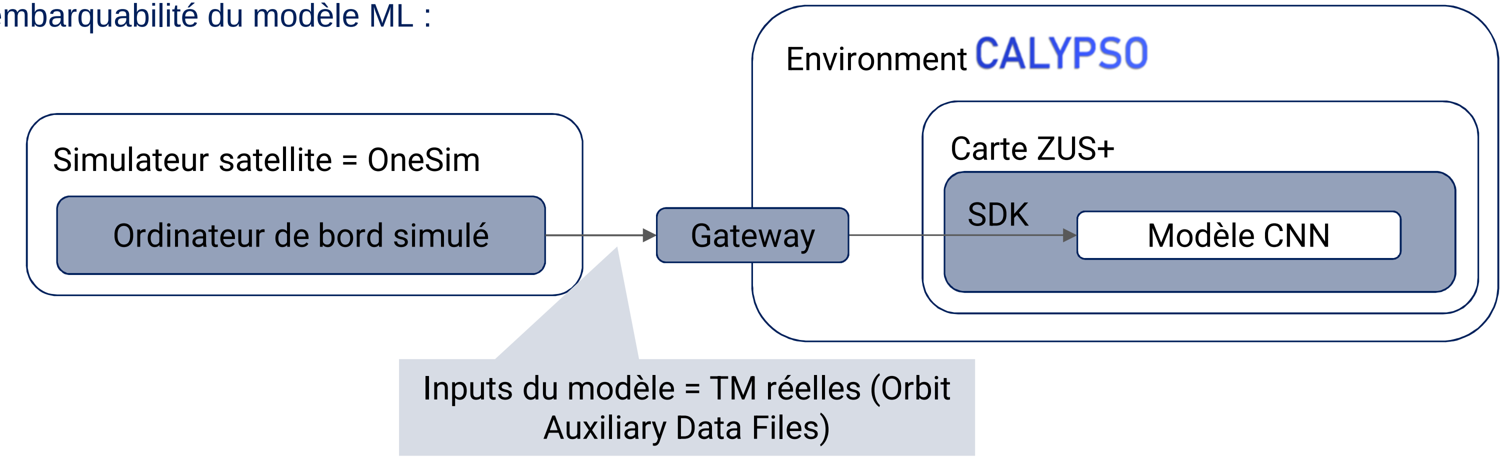
Objectifs :

- MobIA 1 : Prouver l'intérêt de l'utilisation d'IA embarquée pour la détection automatique de pannes, en complément de la FDIR
- MobIA 2 : Une fois cet intérêt confirmé, prouver la possible industrialisation de cette IA embarquée, via la Sandbox Calyspo.

Intérêts identifiés :

- Optimisation de la FDIR (Failure Detection, Isolation and Recovery) via IA à bord, pour des pannes ciblées
- Meilleure réactivité de l'IA embarquée (vis à vis d'une solution IA au sol)

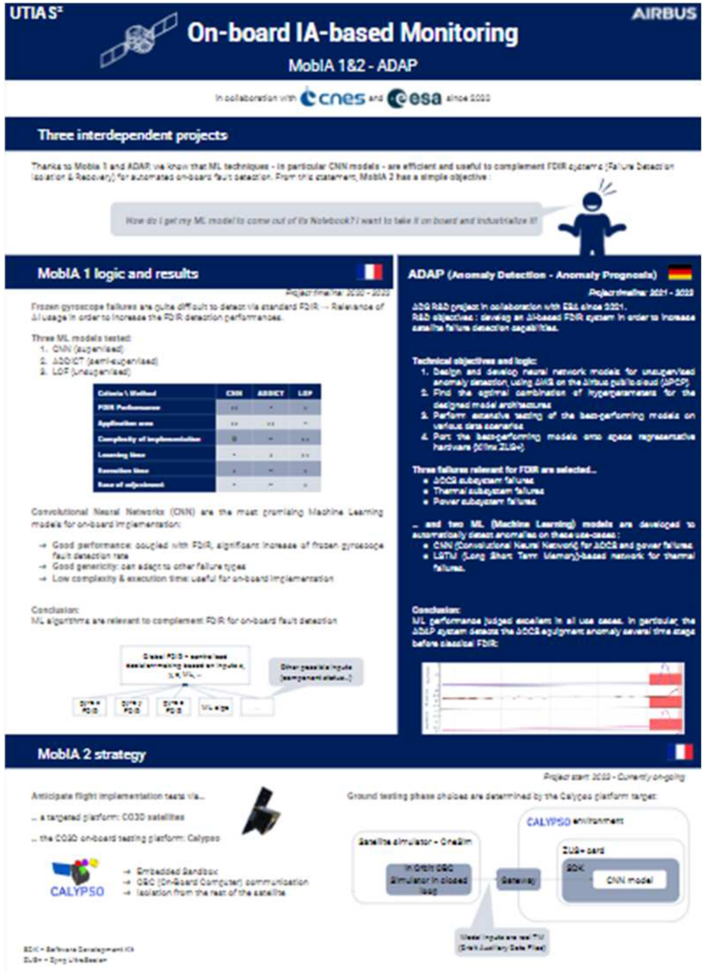
Opportunité d'utilisation de la **Sandbox Calypso**
pour démontrer l'embarquabilité du modèle ML :



Application de demonstration Airbus Defence and Space sur CO3D - MobIA1&2

En collaboration avec le CNES depuis 2020

Pour en savoir plus => venez nous rencontrer devant notre poster !



AIRBUS

Welcome to Edge Space !

Questions and Answers