

# EDHPC2023 – AI uses cases on EO satellites

Olivier CAMBON

# Curriculum

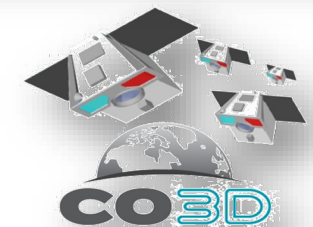
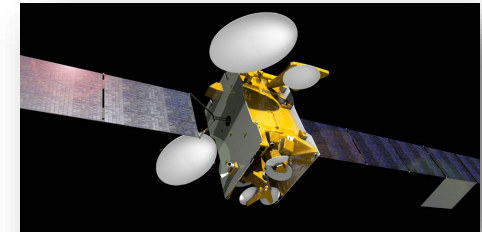
2006 : Engineer diploma HW / SW embedded systems

2007 : Telecom Flight Software development


2008 – 2015 : Test benches, simulator development  
Telecom Eurostar 3000 satellite  
Several Earth Observation satellite

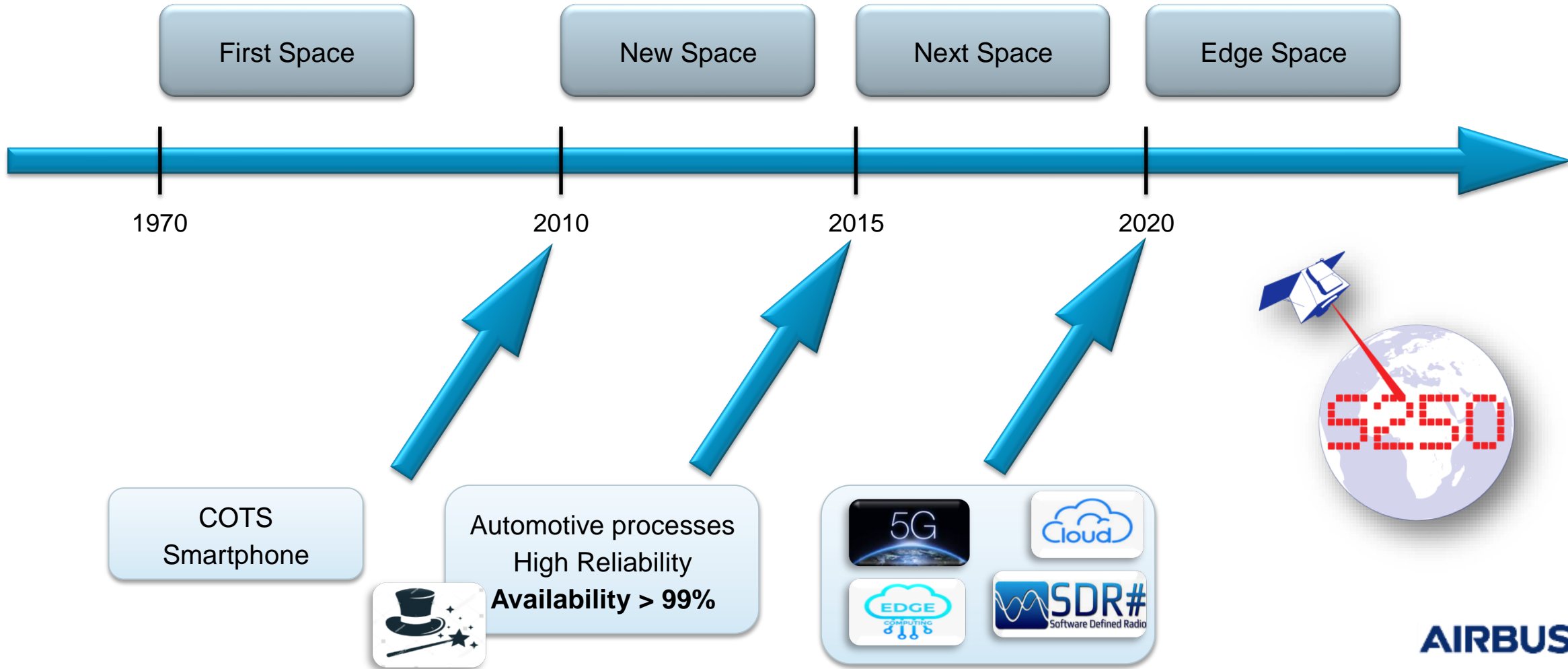
2015 – 2019 : Functional Validation Infrastructure Architect for OneWeb

2019 – today: Chief Engineer Earth Observation Satellite  
CO3D Satellite Validation  
Satellite Data Handling Focal Point for Chief Engineer



# History

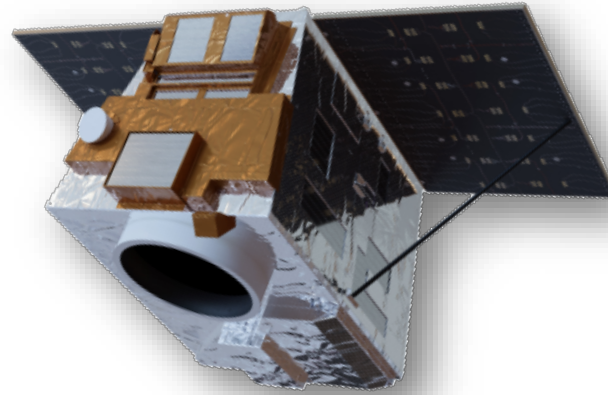
Edge computing is a distributed computing paradigm that brings **computation and data storage closer to the sources of data** 



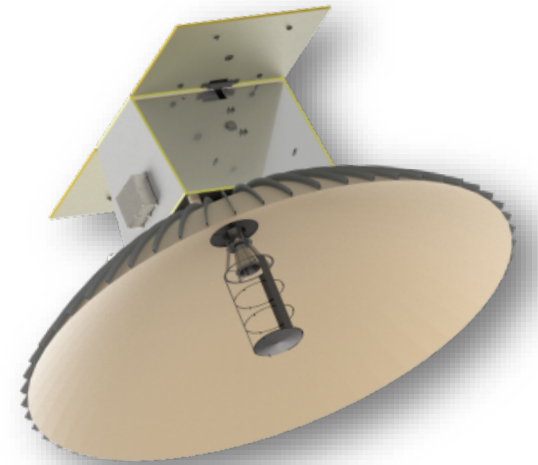
# S250 product



Product



Optical option



Radar option

- Alt: SSO 500km
- GSD: 50cm -> 40cm
- 7000 RGB img / day / Sat
- 7000 NIR img / day / Sat
- 250 000 km<sup>2</sup> / day / Sat
- Life time: 8 years



Project



# S250 concept

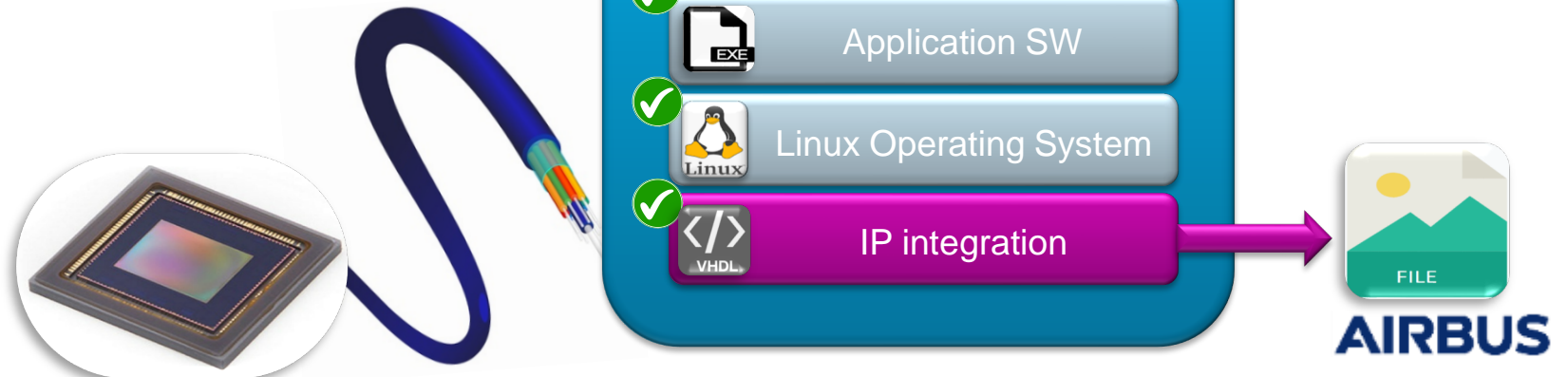
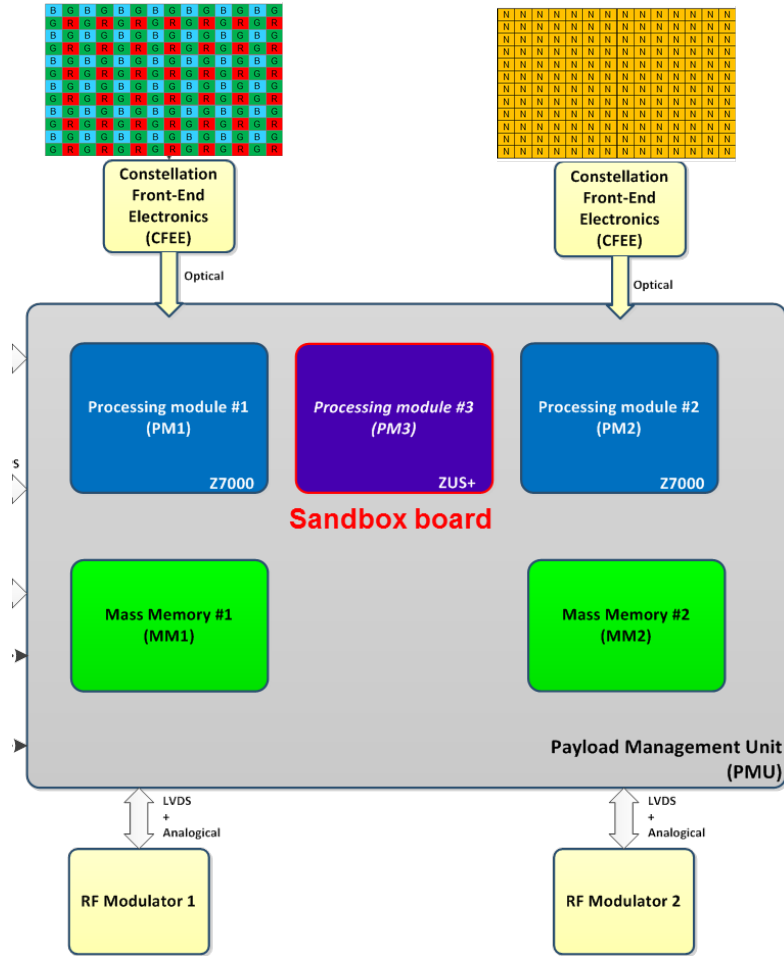
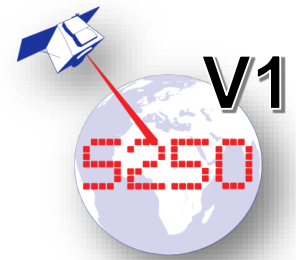
- Home made solutions HW and SW
- Custom data format
- Payload TC and TM
- Space only standard
  - Packet store
  - SpaceWire
- OBMP / OBCP
- Monolithic SW
- Some parts reprogrammable
- On-board computer
- Real-time OS
- Embedded SW developer



THE KISS PRINCIPLE  
**KEEP  
 IT  
 SIMPLE,  
 STUPID**

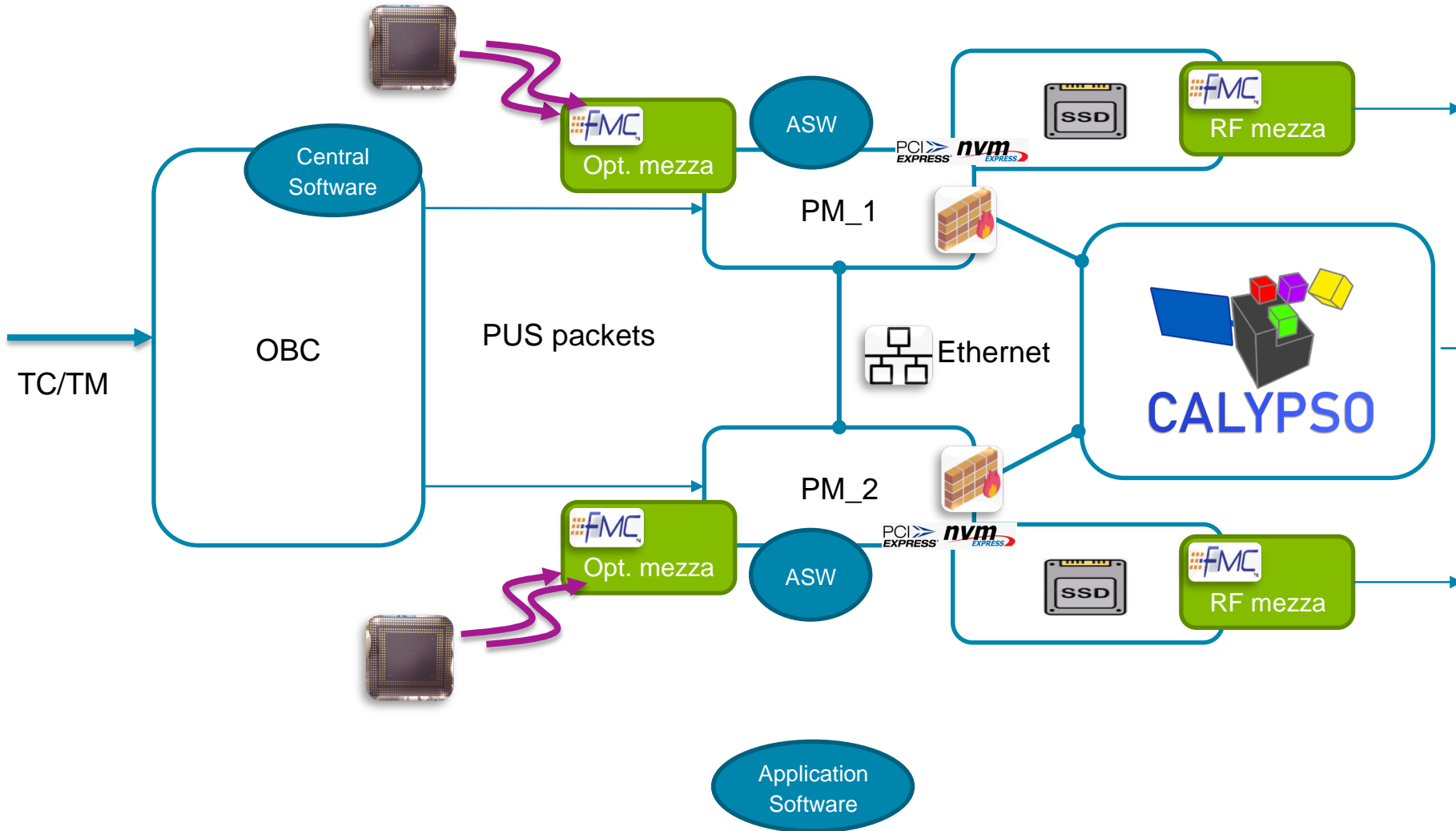
- Industry proven solutions
- Standard format
  - Command line (**TC Invoke**), logs, timeseries DB
- Mainstream standards and tools
  - **Files (File based operations)**
  - Ethernet
  - Shell script
- Multi-applications, software center / smartphone
- All reprogrammable**
- Standard PC**
- Standard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

# Payload focus





# 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)

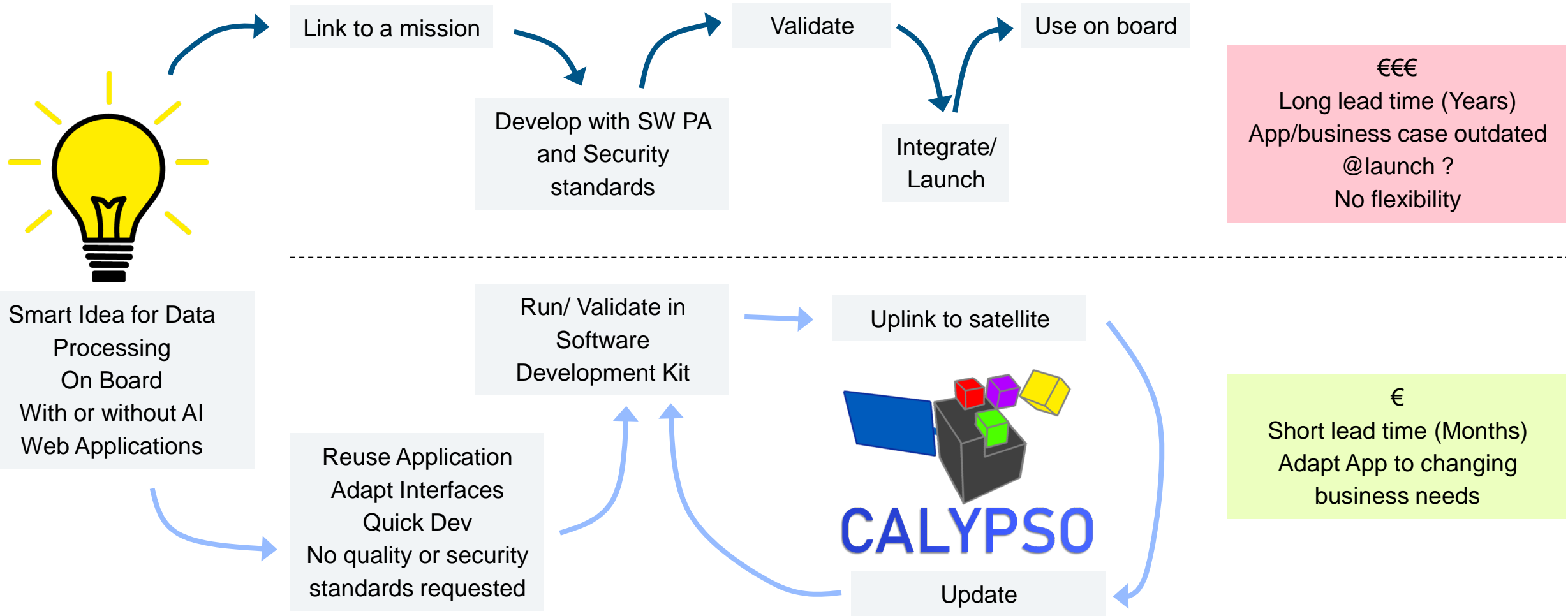
Bring non space labs to space



# CALYPSO – Sandbox

## Software Defined Satellite

**CALYPSO**  
- Custom AppLYcation  
Processing Service in Orbit





# Software Development Kit for Flight-Application

**Develop on Evaluation Board**



**Package**



**Upload**

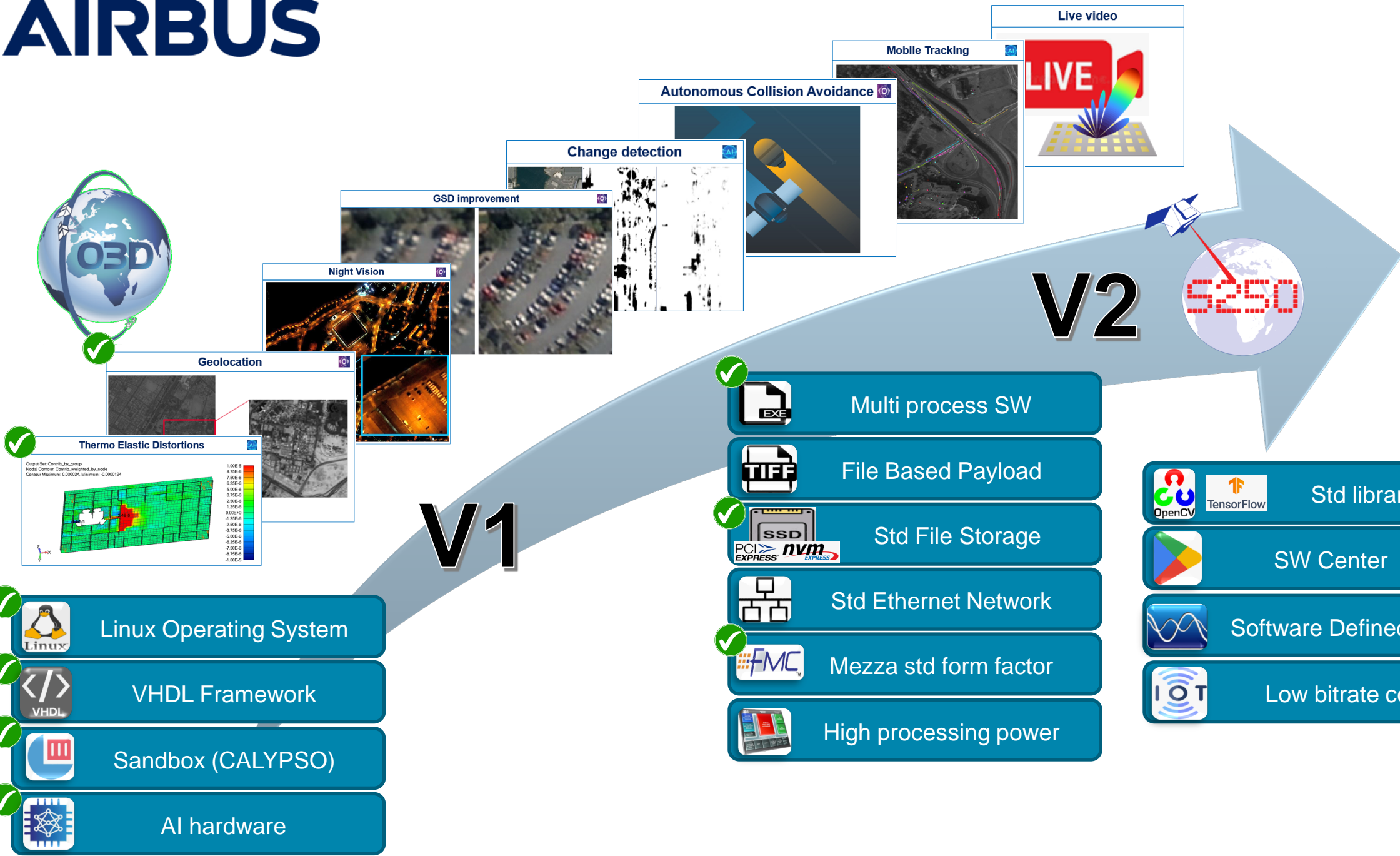


**SW + HW accelerator**

like **ANDROID STUDIO**  Designed for our Smart Payloads

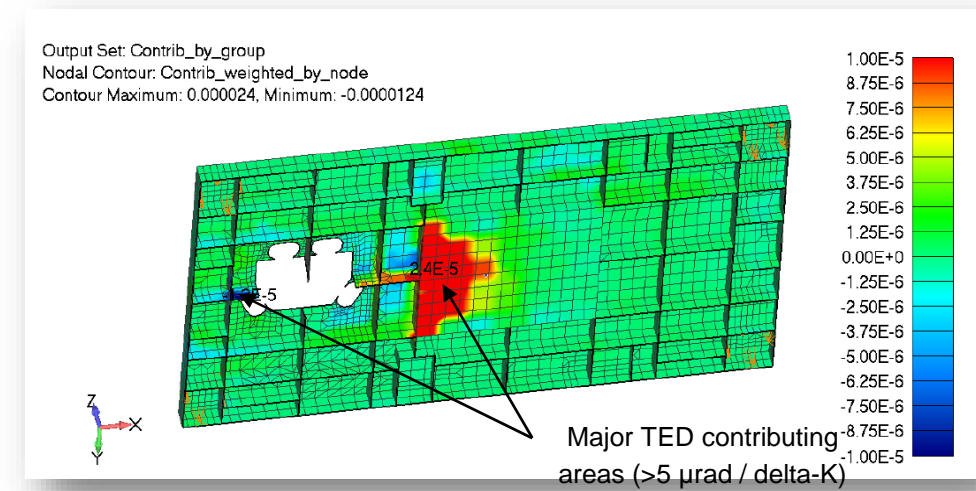
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Bringing the smartphone revolution to our satellites

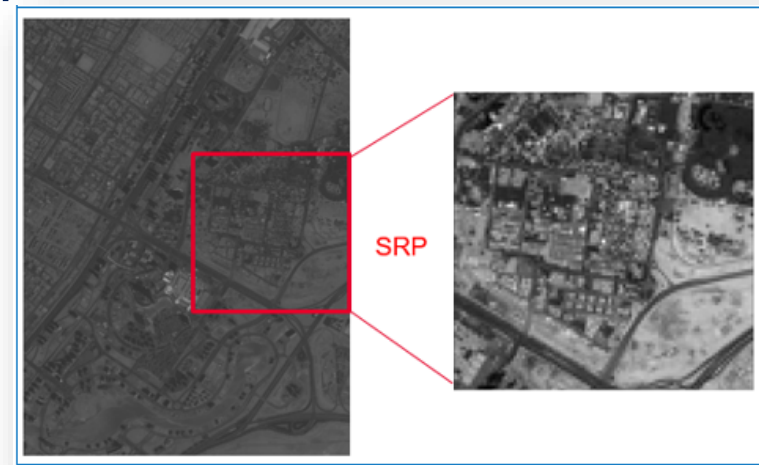


# Geolocation improvement

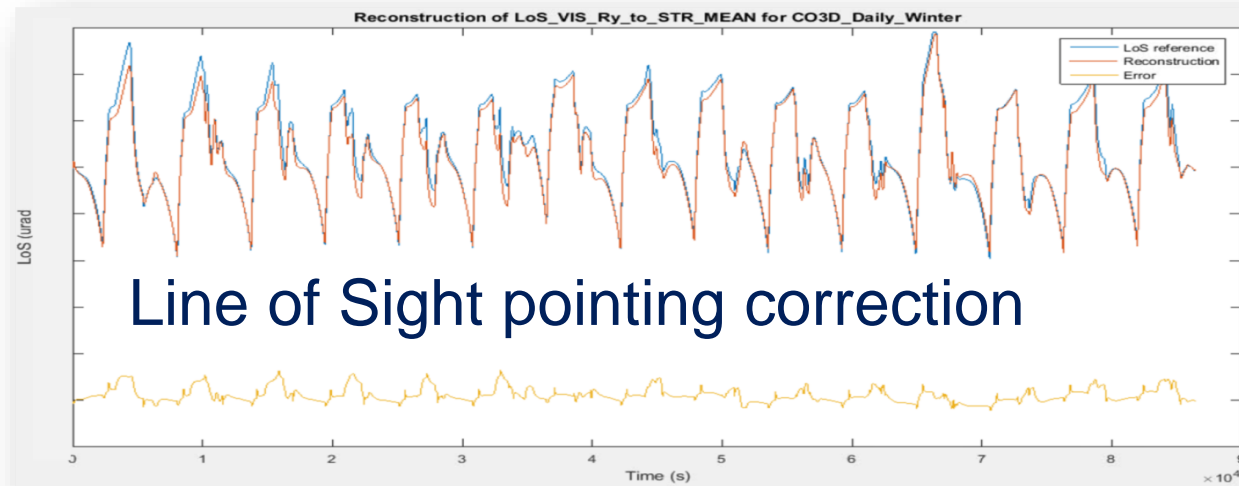
## Thermo Elastic Distortion Learning



## Space Reference Points Database



+



Pointing error  $< 10\text{m}$

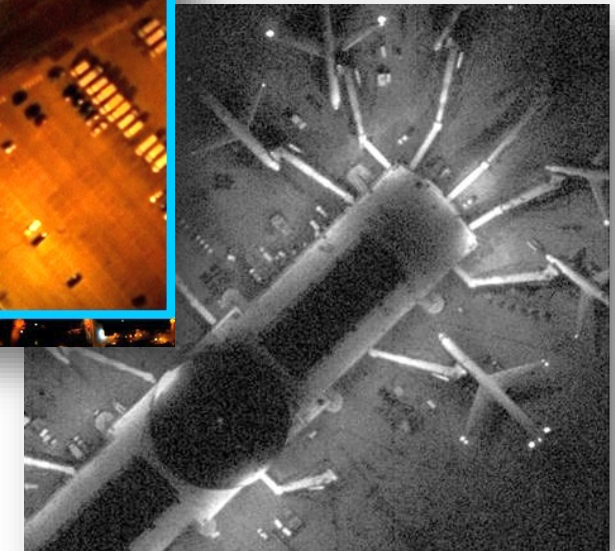


# Post Integration (SNR improvement)

## GSD Improvement

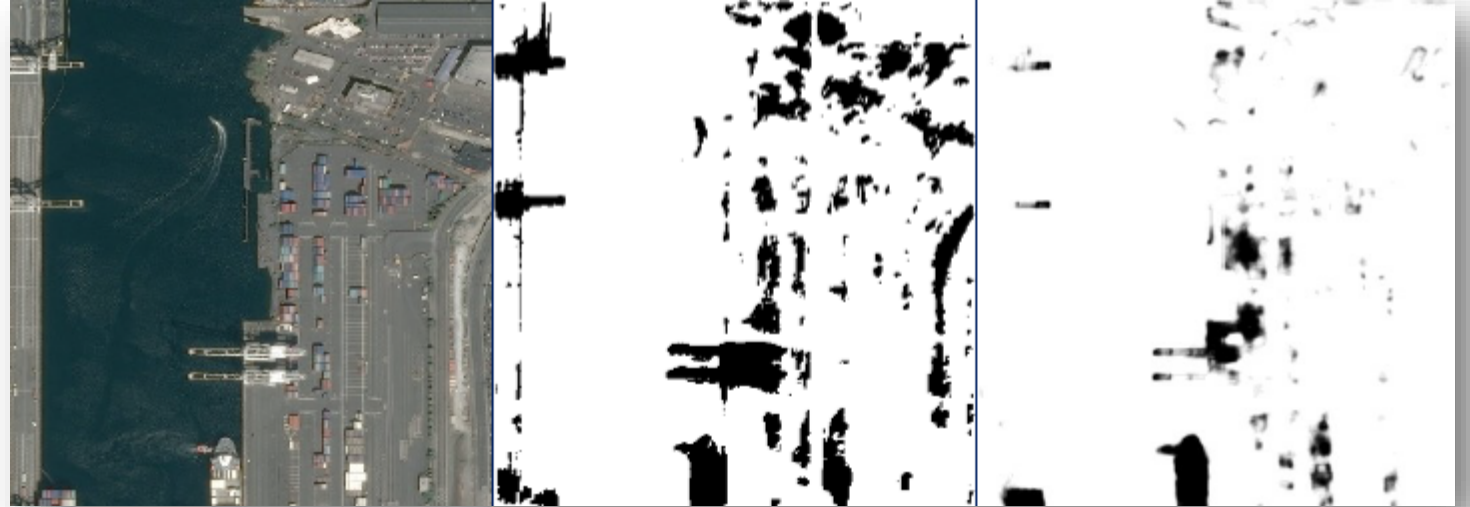


## Night Vision



# Activity Monitoring

- Boat detection
- Traffic measurement

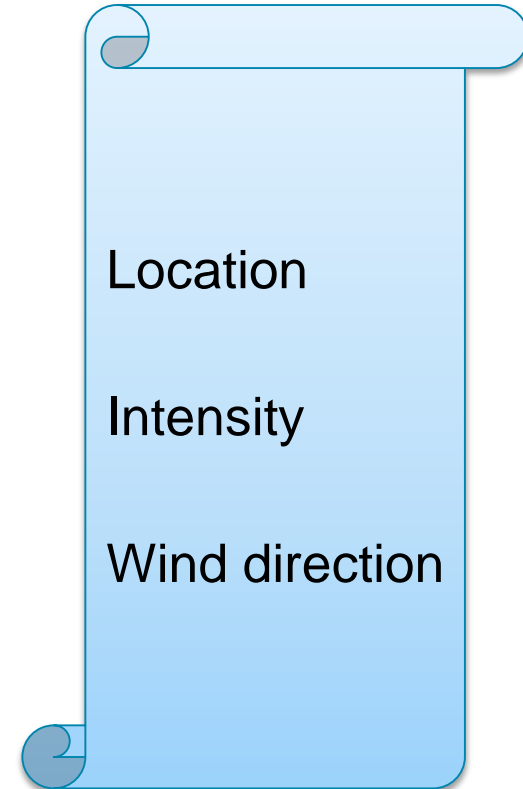
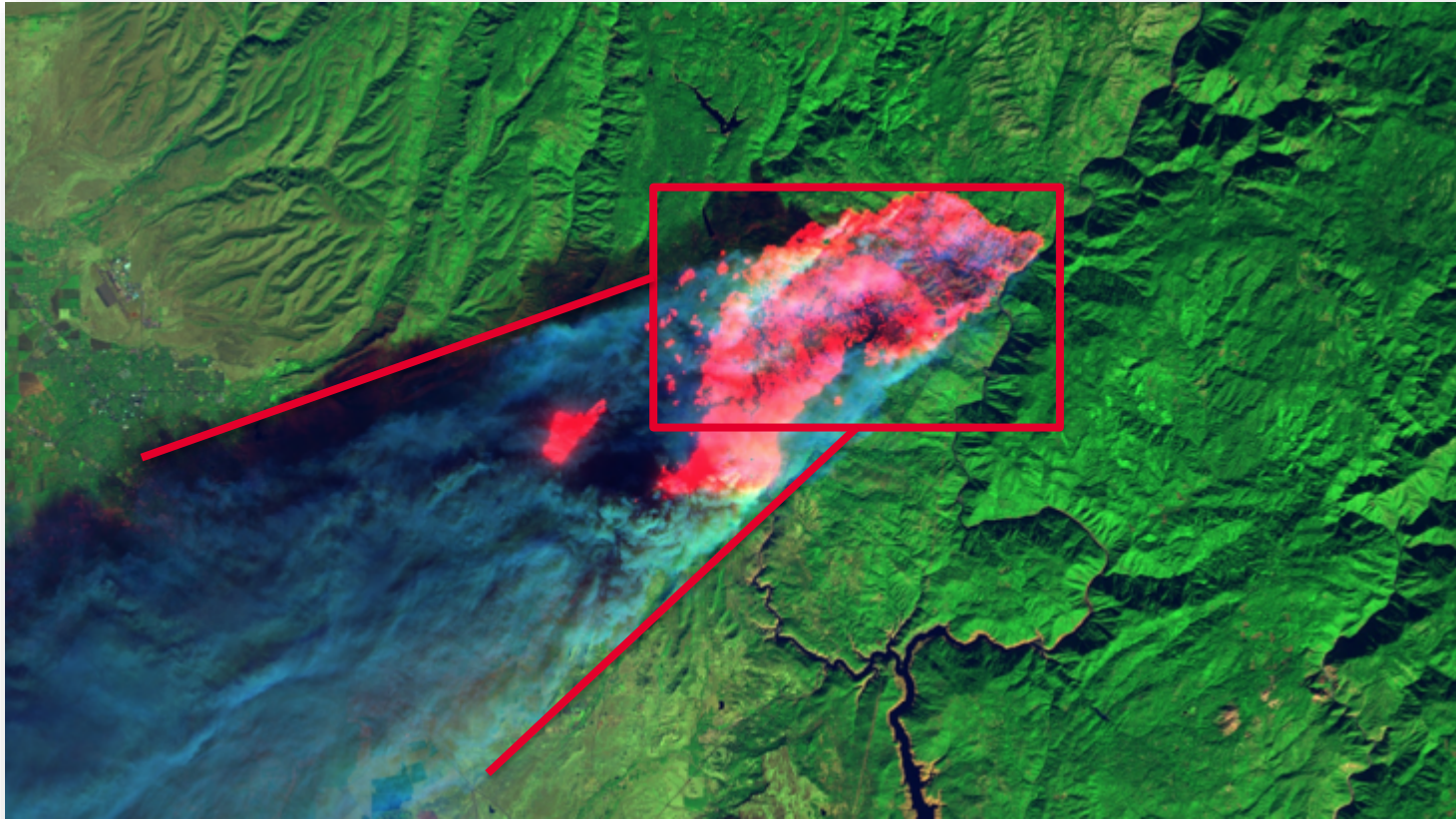


- Change detection with alert
- Object counting





# Forest fires

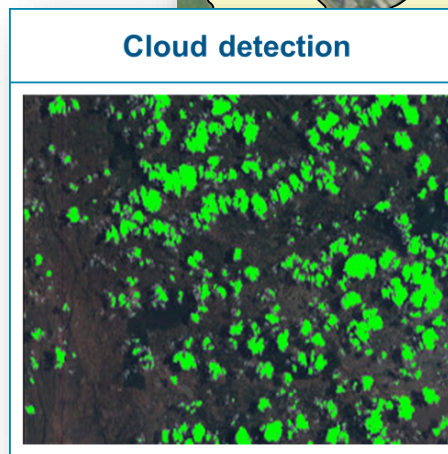
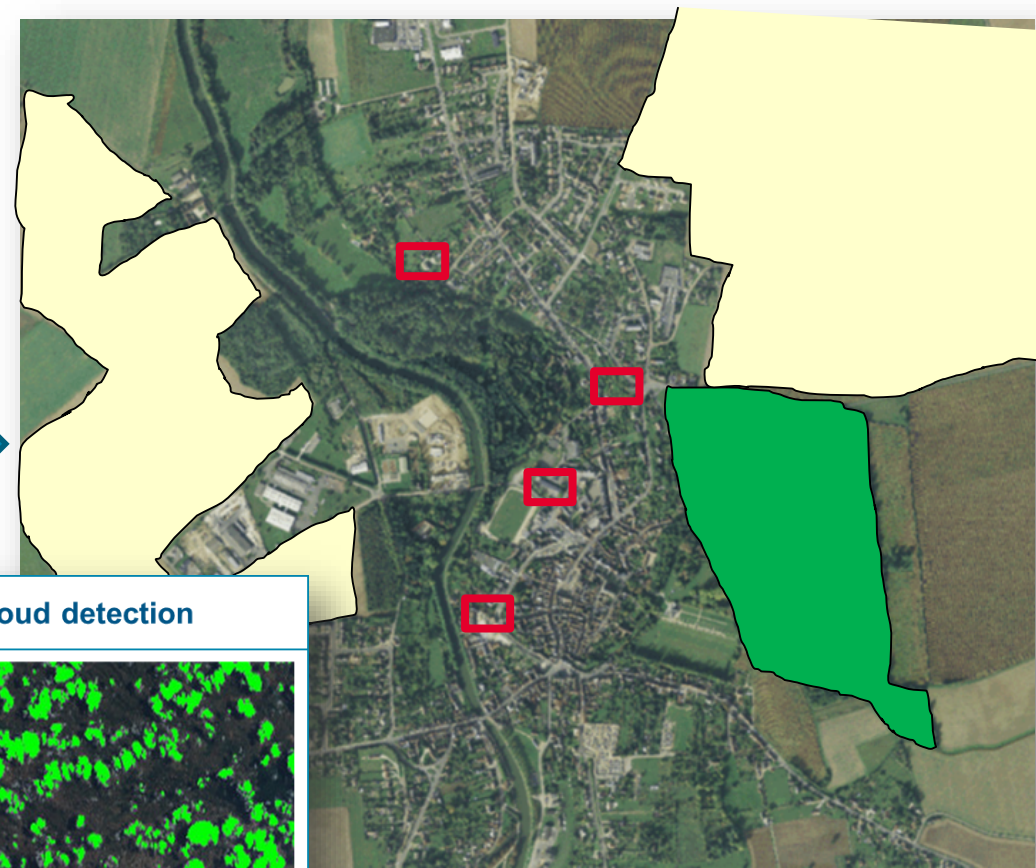


# Vehicle Tracking

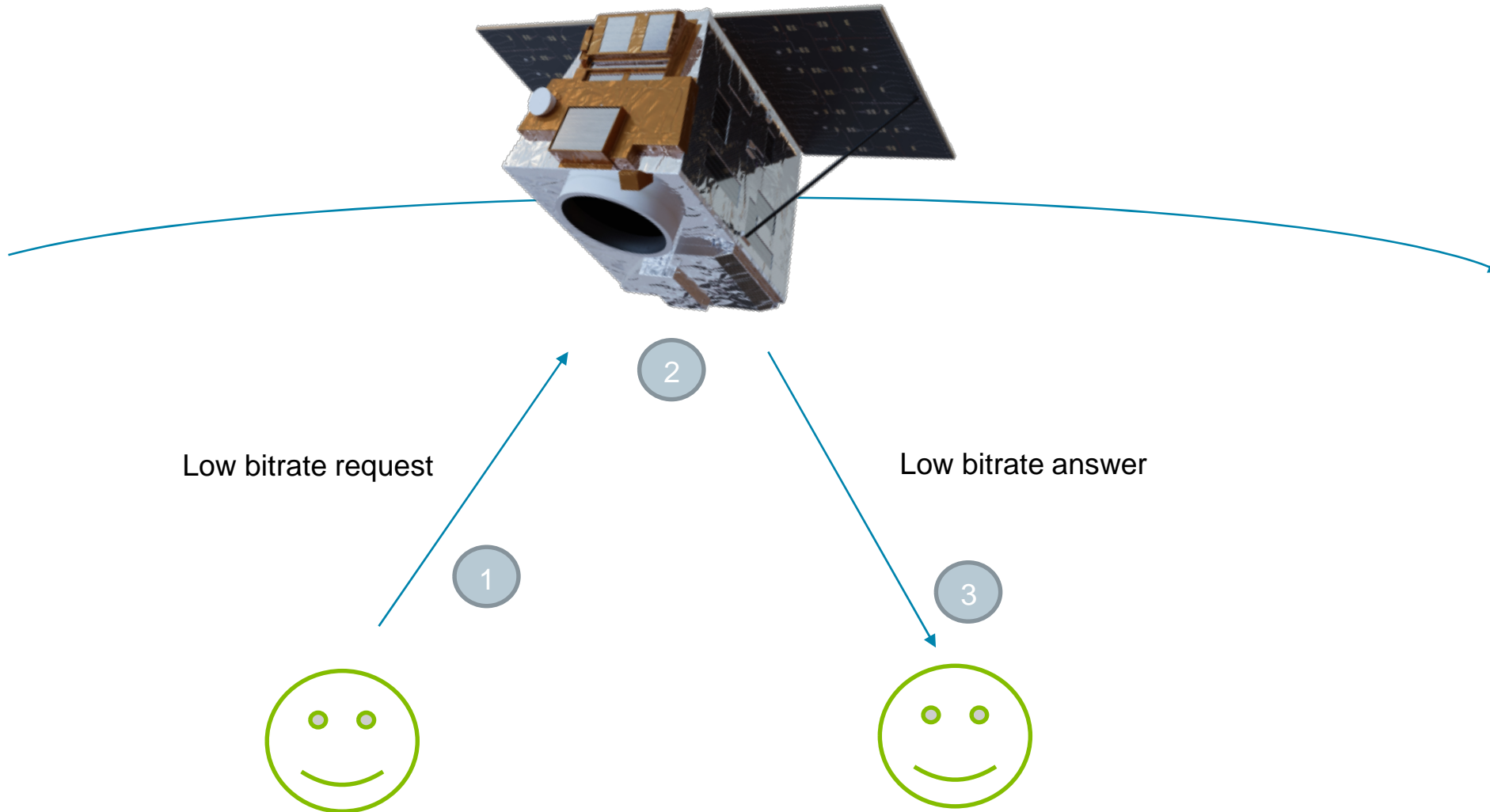




# Details extraction, higher compression

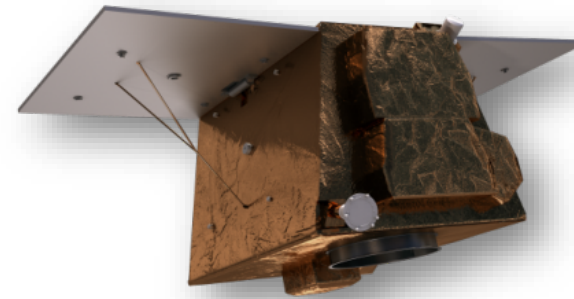
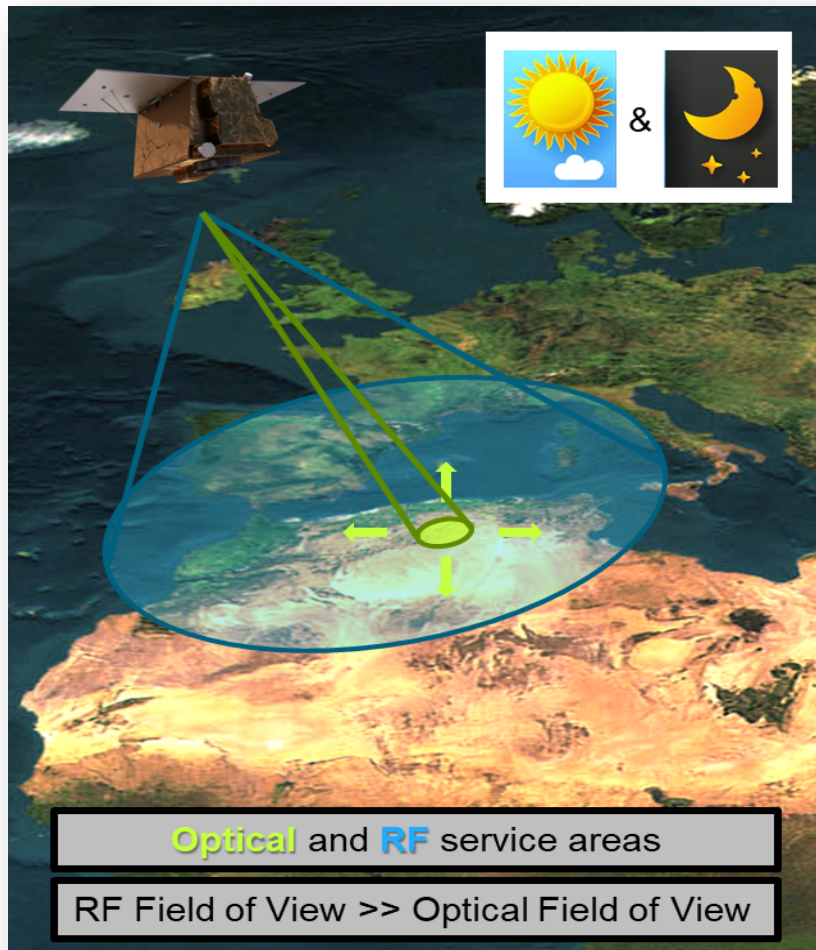


# Satellite as a service



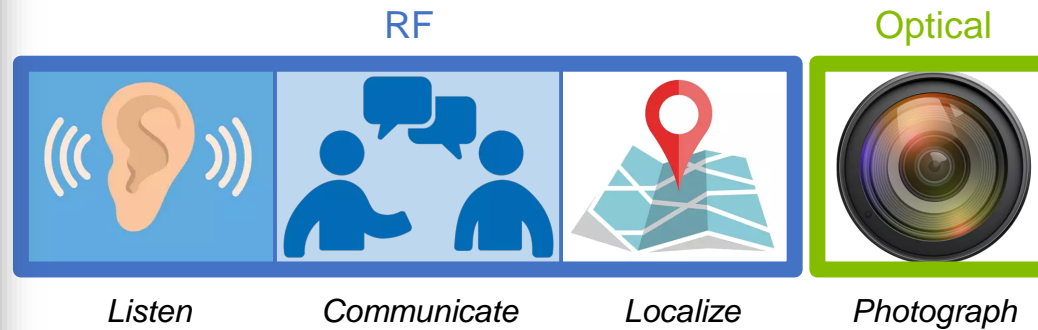
# Hybrid Optical and Radiofrequency Satellite Evolution

A smart satellite that combines **RF** & **Optical** capacities



**AIRBUS**

Optical platform



**Listen, chase & stare concept**

**AIRBUS**

# Welcome to Edge Space !

Questions and Answers

