A novel multi-mission platform for the development of applications, services, and new satellite data algorithms directly in orbit and on-demand, the Italian In-Orbit Space Lab

EDHPC 2023 - European Data Handling
& Data Processing Conference
October 3rd 2023
Vito Fortunato, Planetek Italia

P22S2245-28-v1

Finanziato
dall'Unione europea
NextGenerationEU

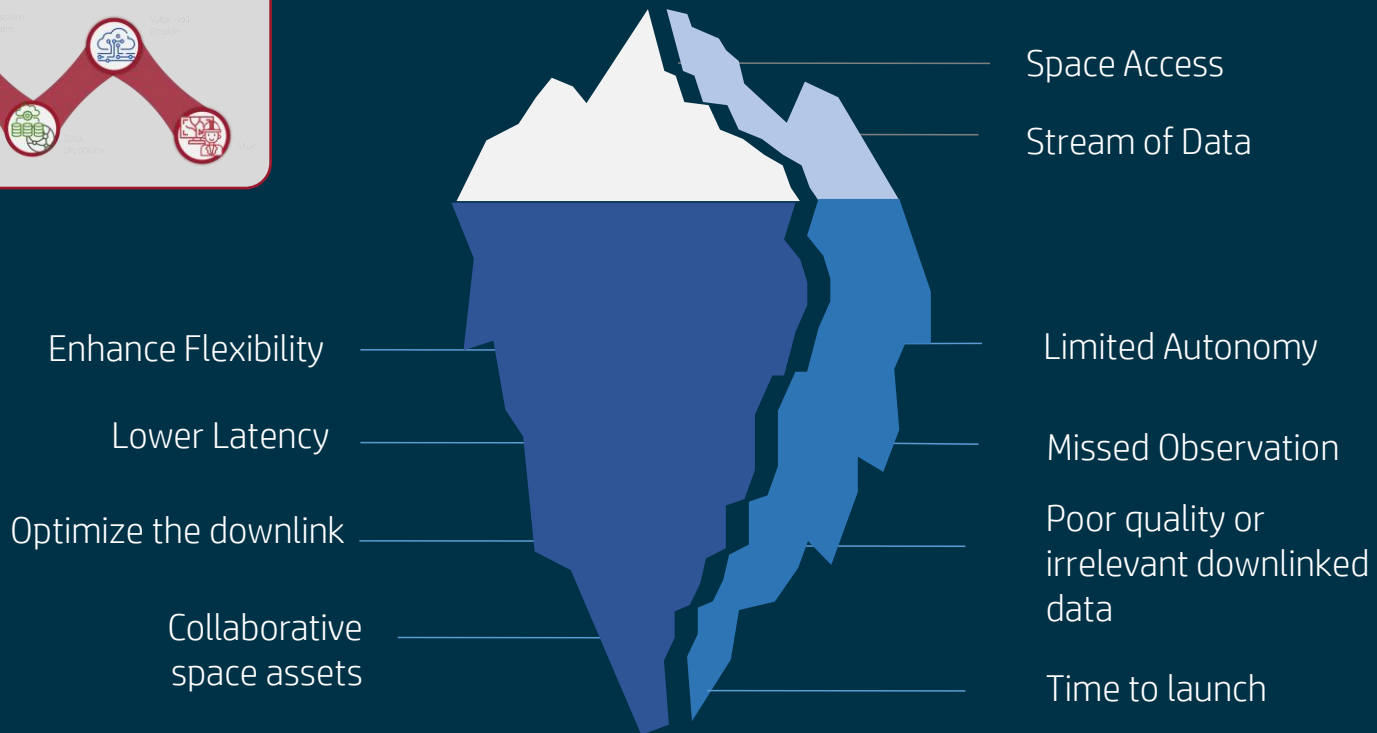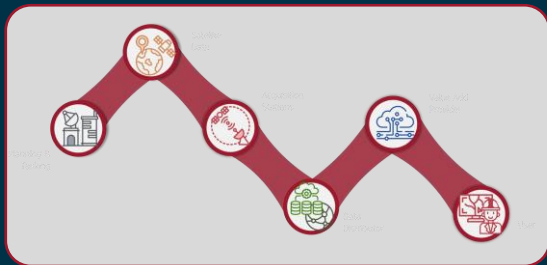ASI
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D-ORBIT
NEW SPACE SOLUTIONS

AIKO

Activity overview

The Challenges of the current Space Value Chain

Space Access

Stream of Data

Limited Autonomy

Enhance Flexibility

Missed Observation

Lower Latency

Poor quality or irrelevant downlinked data

Optimize the downlink

Collaborative space assets

Time to launch

In-Orbit Space Lab
An Innovation Accelerator

What

- IOSL to enable the evolution of the approach to Space missions & the validation of new concepts in a real environment

- IOSL to enable multi-purpose' systems that can also be reconfigured during their operational life and can benefit from real-time data processing on board the orbiting laboratory

Where

- ASI's Centro di Geodesia Spaziale Bepi Colombo in Matera

Made for

- Researchers, Start-ups and Innovative Industries

IOSL as a strategic asset

developing, testing and verifying HW/SW developed through the Agency's programmes and related applications of interest to the national community in the field (scientific community, institutional and private users);
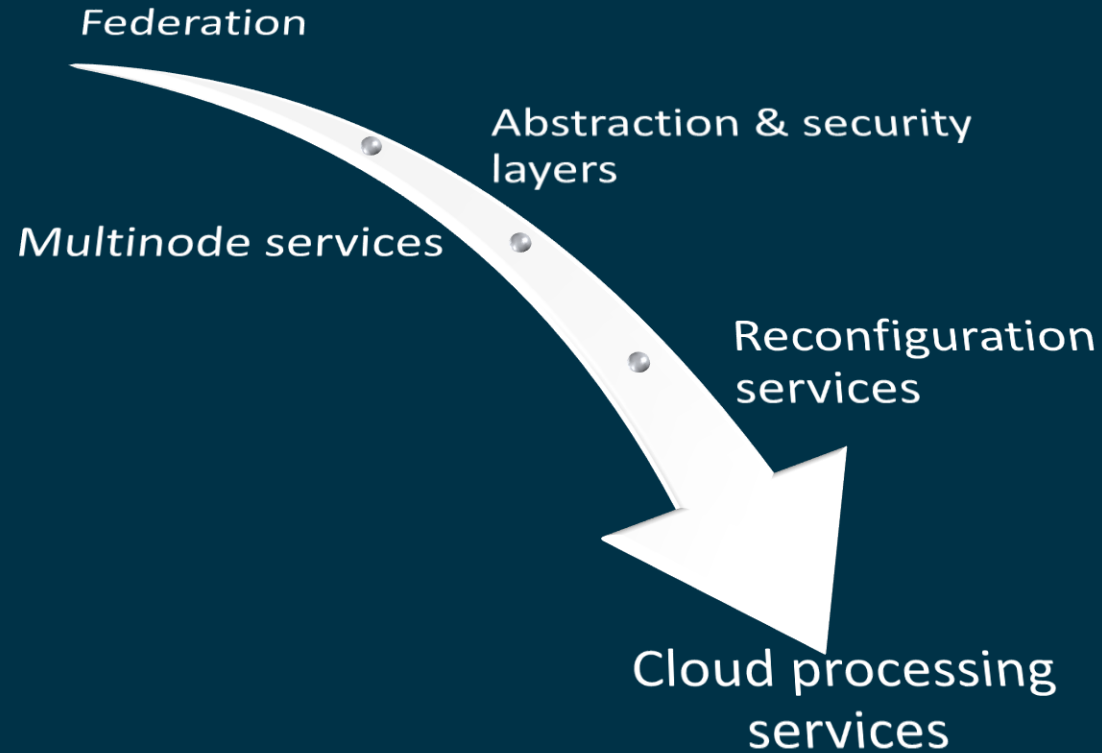
provide access to information acquired directly from assets in orbit exploiting and privileging a service-based approach

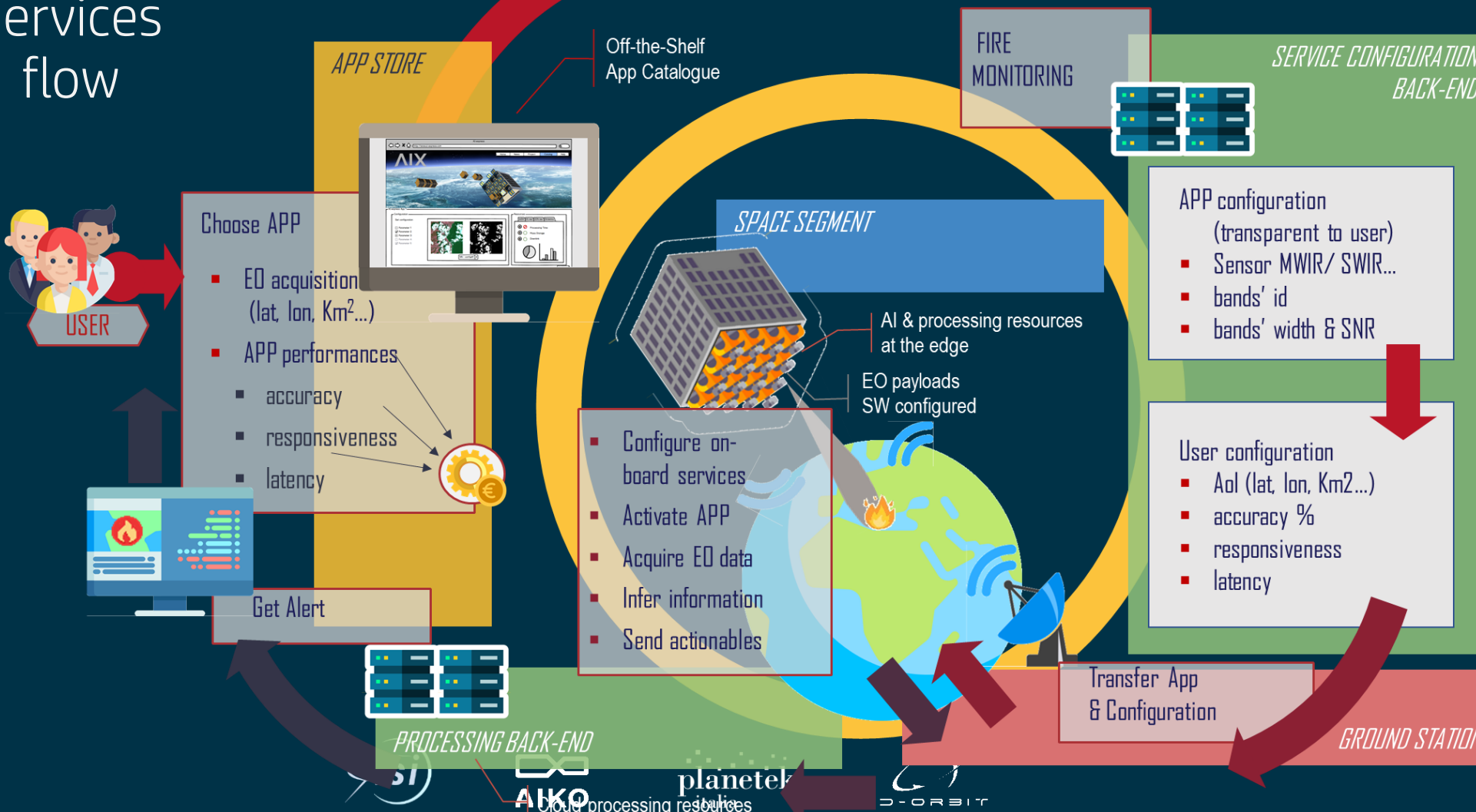_improving the implementation and validation of space services, with effects on time-to-market, operational and commercial efficiency_

devising and testing new mission concepts in orbit

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Service framework & Lab infrastructure

Design pillars

Federation

Abstraction & security layers

Multinode services

Reconfiguration services

Cloud processing services

Operational services flow

APP STORE

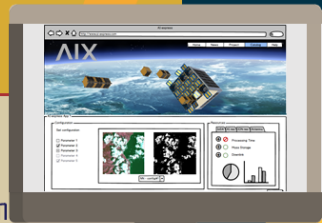Off-the-Shelf App Catalogue

FIRE MONITORING

SERVICE CONFIGURATION BACK-END

SPACE SEGMENT

USER

Choose APP

- EO acquisition (lat, lon, Km²...)
- APP performances
  - accuracy
  - responsiveness
  - latency

Get Alert

AI & processing resources at the edge

EO payloads SW configured

- Configure on-board services
- Activate APP
- Acquire EO data
- Infer information
- Send actionables

APP configuration (transparent to user)
- Sensor MWIR/ SWIR...
- bands' id
- bands' width & SNR

User configuration
- AoI (lat, lon, Km2...)
- accuracy %
- responsiveness
- latency

Transfer App & Configuration

GROUND STATION

PROCESSING BACK-END

Cloud processing resources

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Evolving the «Simulation to flight»* concept
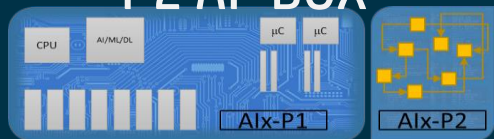
(*) credits: NASA
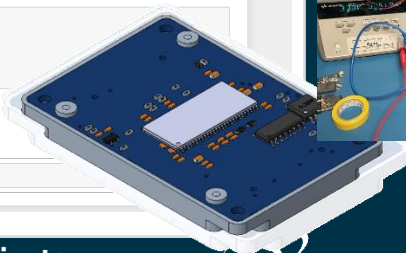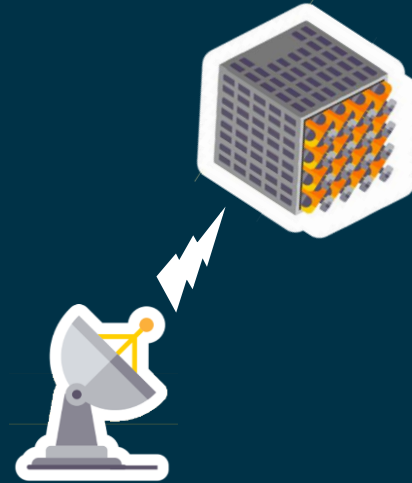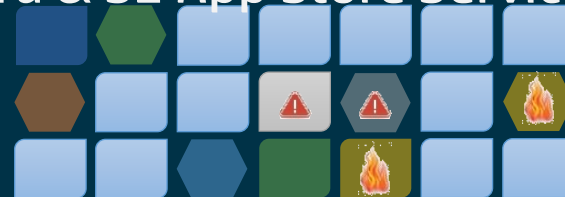
User functions e2e management
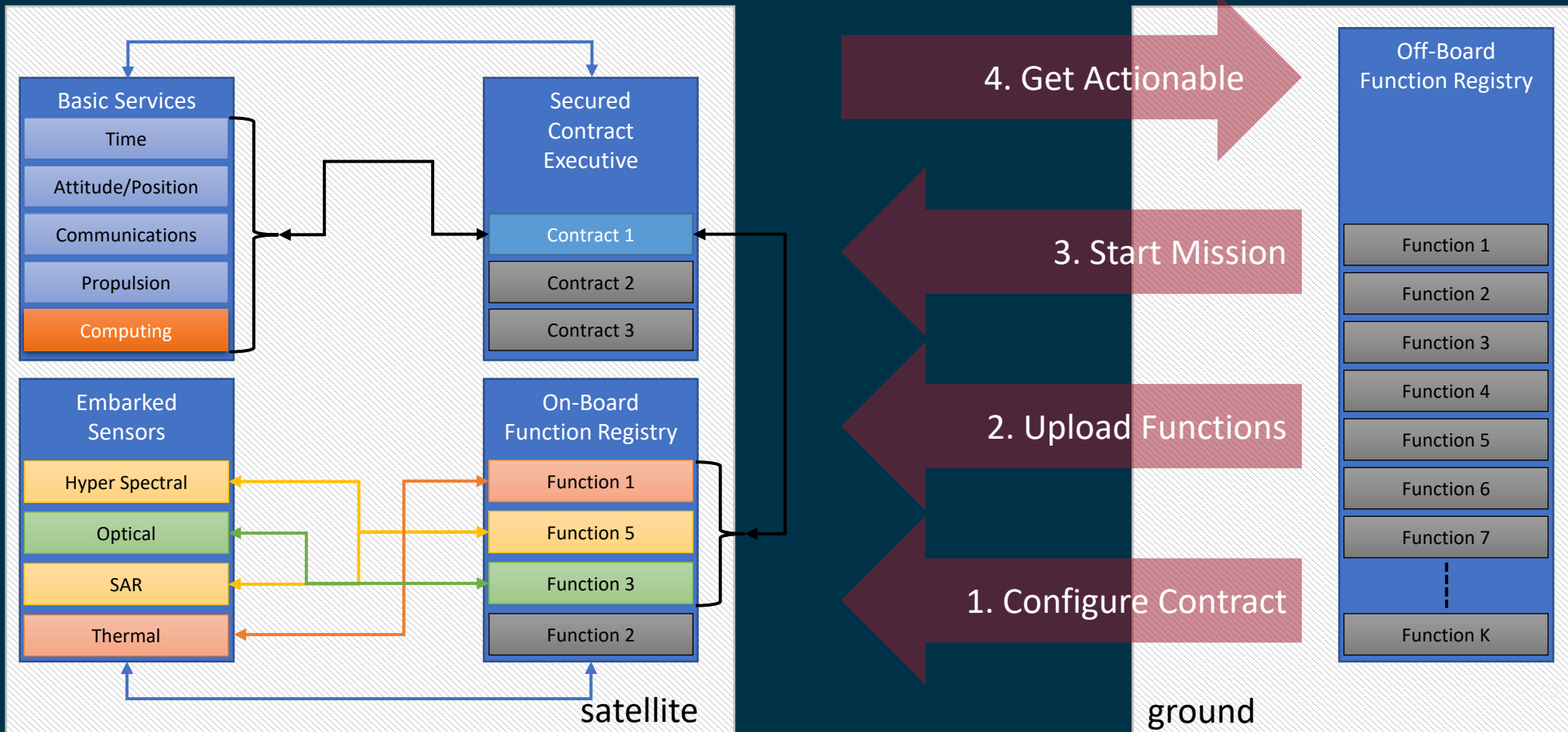
The foundation of the *(E-AIX)* service
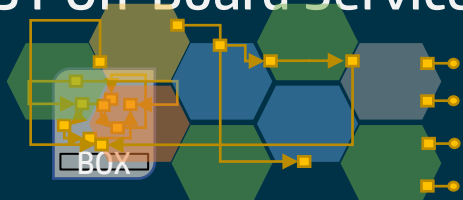
P2 AI^X BOX

Includes the AI^X-BOX and a software framework enabling the **on-board services** intended to the other sub-systems and payloads. It includes also the SW development kit, with a set of ready-made applications, and the tools allowing the development of new ones
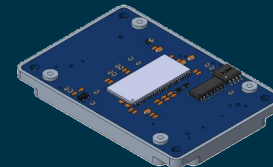
S1 On-Board Services

The AIX-BOX is embedded in a satellite Carrier (e.g. D-Orbit's ION) and provides its services to payloads hosted onboard. In this way several payloads can pay-per-use the access to the AIX capabilities, services and environment

S1a & S2 App Store Services

A set of services à la carte based on AI^X On-Board framework with a public catalogue and an "app store" approach. Services will include EO data acquisition, processing (actionable info extraction) and downlink. They can be combined together to build custom applications. Ready-made applications (e.g. fire detection and warning service) are available on the app-store.
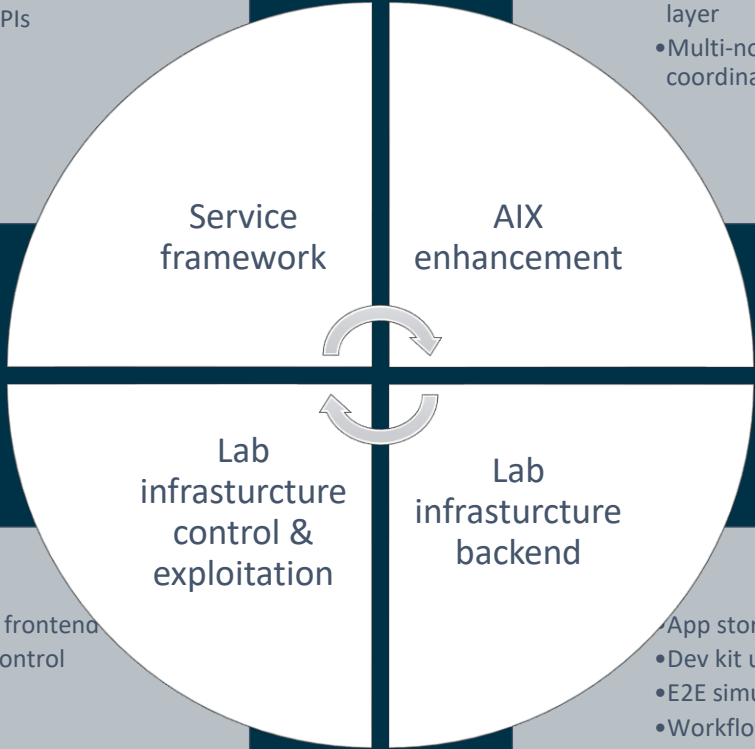
P3 AI^X Dev kit

A development kit (SW only) intended to the implementation of applications that are based on the AISF framework and that can be run on any AIX On-Board Service. This will enable the "app-store" selling model.

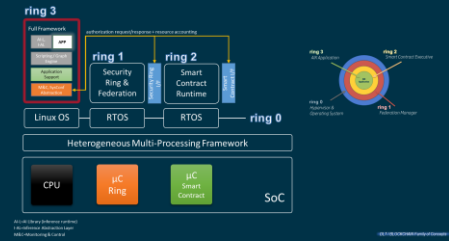# E-AIX for the Lab: generalizing the design
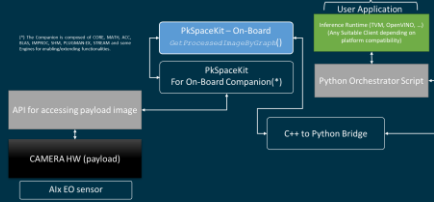
- P/L abstraction layer
- Processing APIs
- AI APIs

- Federated service layer
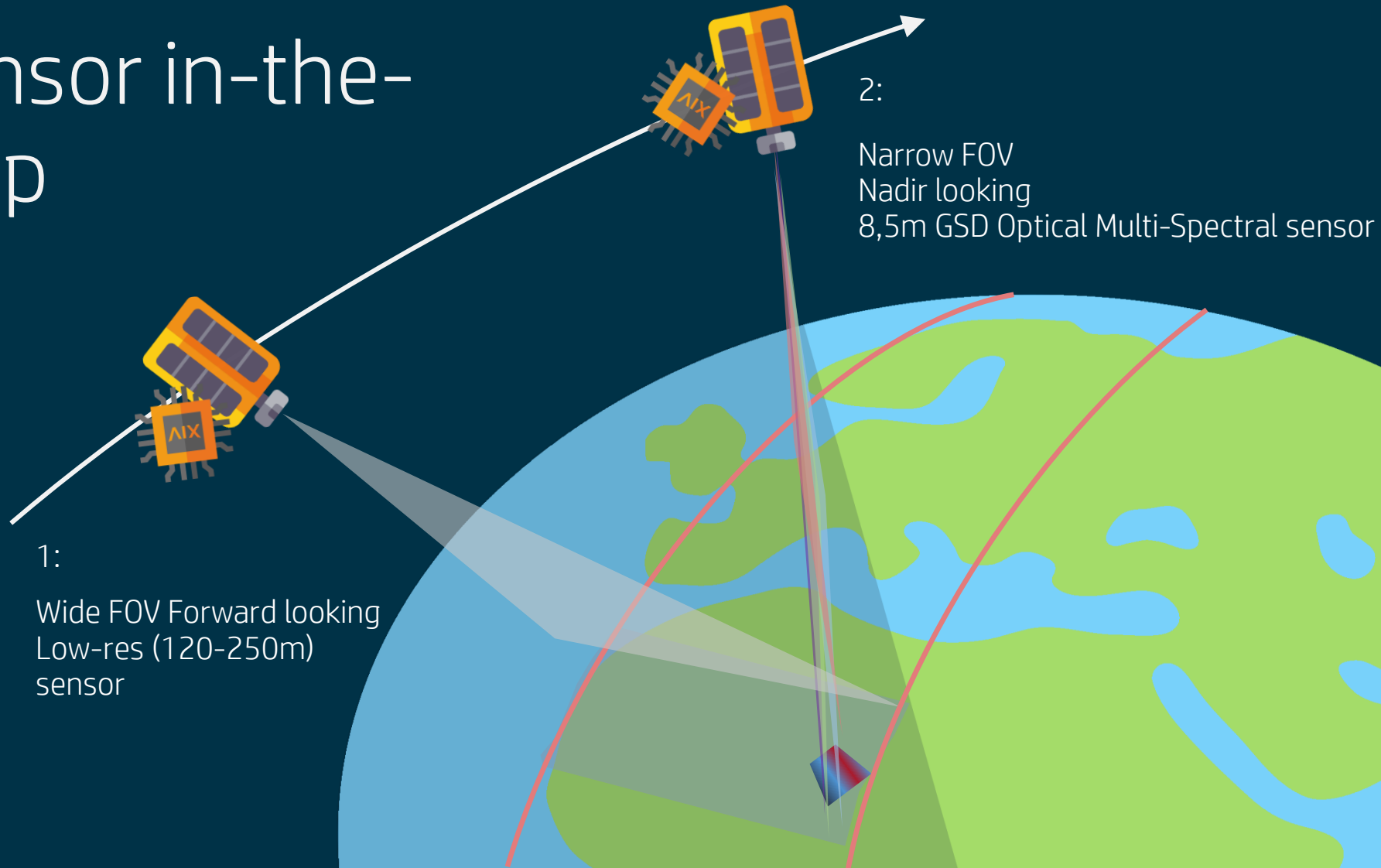- Multi-node /payload coordination

Service framework

AIX enhancement

Lab infrasturcture control & exploitation

Lab infrasturcture backend

- Mockup and frontend
- Command, control and observe
- Flatsat

- App store upgrade
- Dev kit upgrade
- E2E simulation
- Workflows manager

Sensor in-the-loop

2:

Narrow FOV
Nadir looking
8,5m GSD Optical Multi-Spectral sensor

1:

Wide FOV Forward looking
Low-res (120-250m)
sensor

Dev Kit GUI

Q&A