

# OSL

## IN ORBIT SPACE LAB

Il laboratorio spaziale multi-missione per lo sviluppo di applicazioni, servizi e algoritmi innovativi direttamente in orbita e on-demand



P22S2245-100-v1



Finanziato  
dall'Unione europea  
NextGenerationEU



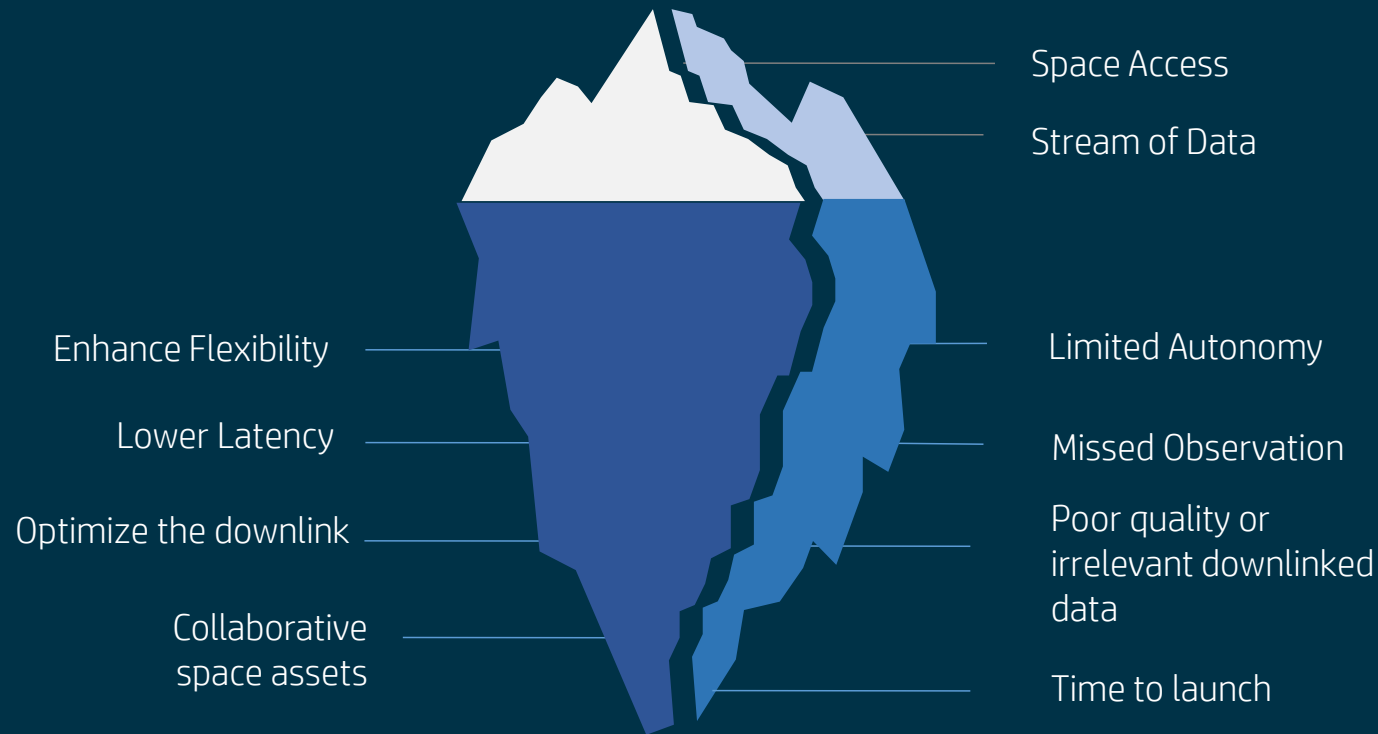
Agenzia Spaziale Italiana

planetek  
italia



AIKO

# The Challenges of the current Space Value Chain



# In-Orbit Space Lab

*as an innovation accelerator*

## What

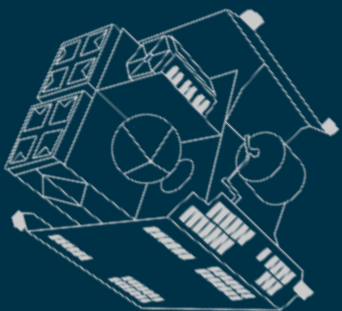
- enable **the evolution** of Space missions design & the validation of **new concepts** in a real environment
- by **multi-purpose systems** that can be **reconfigured during their operational life** and can benefit from **real-time data processing on board**

## Who

- Users: Researchers, Start-ups and Innovative Industries

## Where

- Site: Centro di Geodesia Spaziale Bepi Colombo, Matera



# In-Orbit Space Lab

*as a strategic asset*

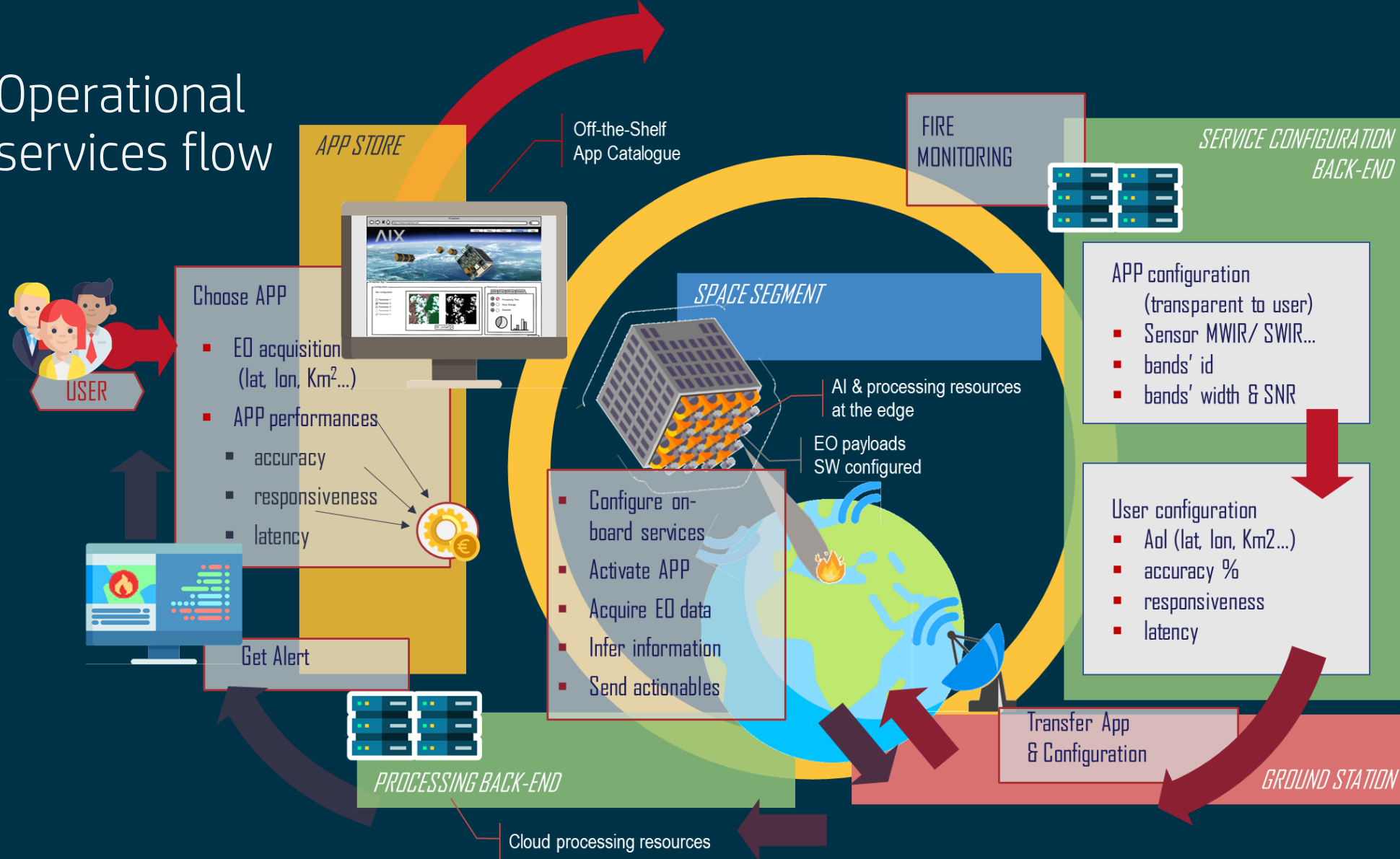
developing, testing and verifying HW/SW developed through the Agency's programmes and related applications of interest to the national community in the field (scientific community, institutional and private users);

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

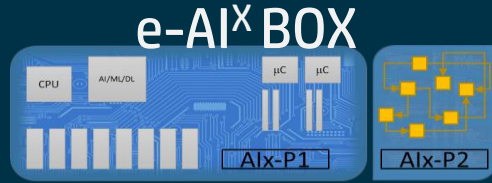
devising and testing new mission concepts in orbit

# Operational services flow



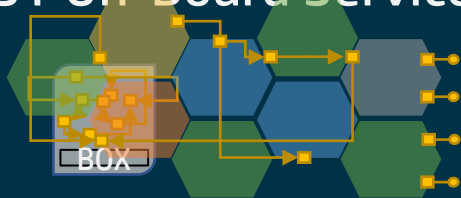


# enhanced AI-eXpress



Includes the AI<sup>x</sup>-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



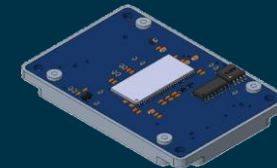
The AIX-BOX is embedded in a satellite Carrier (e.g. D-Orbit's ION) and provides its services to payloads hosted onboard. In this way several payloads can pay-per-use the access to the AIX capabilities, services and environment

## S1a & S2 App Library



A set of services à la carte based on AI<sup>x</sup> 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.

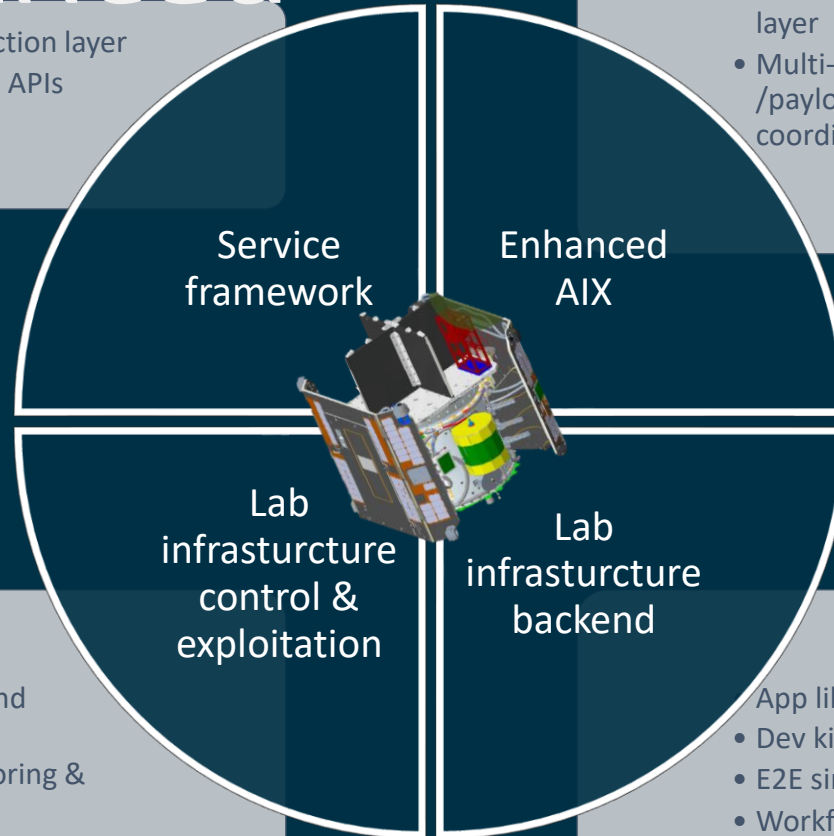
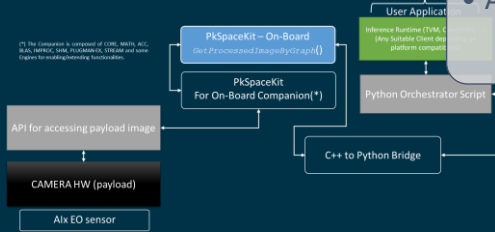
## e-AI<sup>x</sup> Dev kit



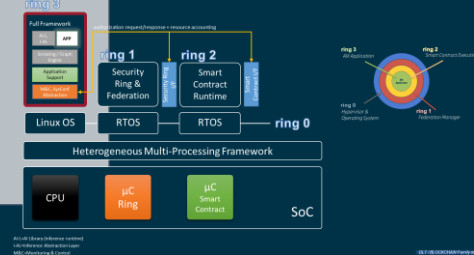
A development kit (SW only) intended to the implementation of applications that are based on the AISF framework and that can be run on any AIX On-Board Service. This will enable the “app-store” selling model.

# BSL enhanced

- P/L abstraction layer
- Processing APIs
- AI APIs



- Federated service layer
- Multi-node /payload coordination

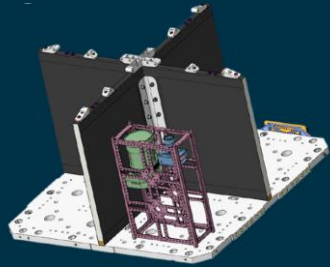


- Mockup and frontend
- Sat monitoring & control
- Flatsat

- App library
- Dev kit
- E2E simulation
- Workflows manager



# Sensor in-the-loop



1:

Wide Field of View optical head  
Forward looking

Low-res (120-250m GSD)

2:

Narrow Field of View optical head  
Nadir looking

8,5m GSD

8 spectral bands



# Building blocks & Dev Kit

## Image manipulation blocks

- ROI and multi bands ops
- Morphological operators
- Color mapping
- ...

## Data pre-processing blocks

- Radiometric calibration
- Atmospheric correction
- Accuracy refinement
- Pan-sharpening

## Features extraction blocks

- SIFT (and derived)
- keypoints
- ...

## Image segmentation blocks

- Watershed
- ...

## Image classification blocks

- Classifiers (SVM, RF)
- Clustering (K-means, GMM)
- Object based
- ...

## Change detection block

- Local metric based
- Multivariate
- Supervised classification

## EO data processing verticals

- Dimensionality reduction / estimation
- Unmixing

### LAB DEV KIT (e-AIX)

get cal image #EO

task data acq #EO

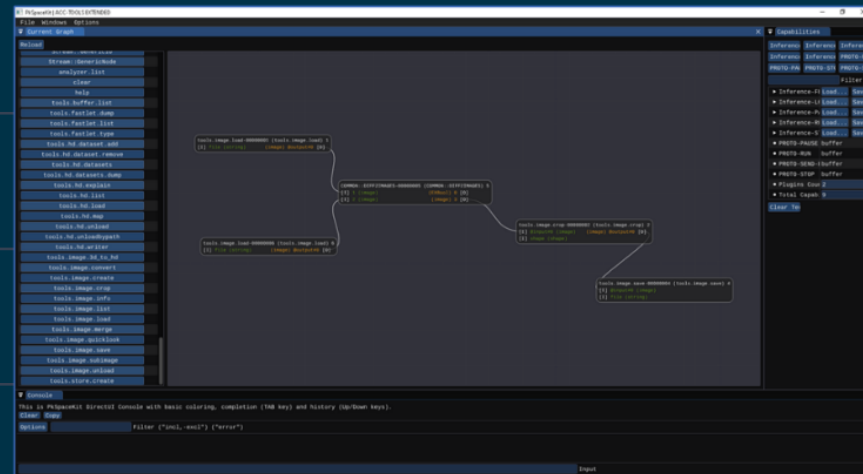
get data stream #EO

get data buffer #EO

get buffer #GPS

get buffer #ATT

...



# Programmable AI based functions

Cloud  
Detection



Change  
Detection



Ship  
Detection



Flood  
Detection



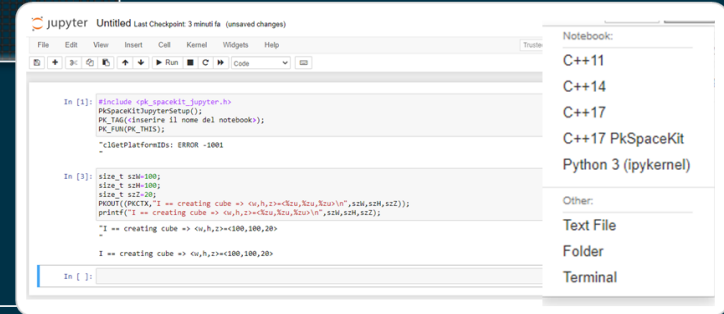
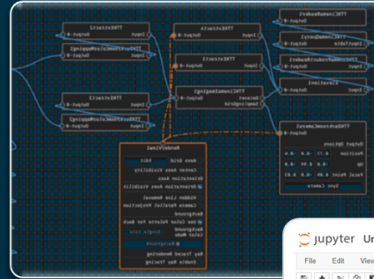
Fire  
Detection



Data  
Compression



# Development Environment (delta)

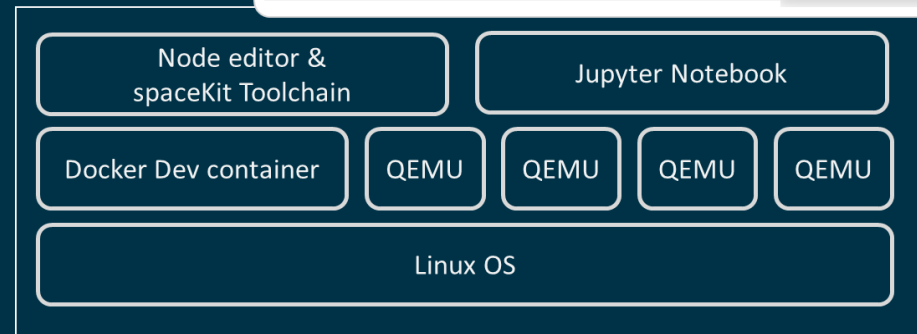


## developers and power users

- develop & deploy custom solutions
- implement custom pre/post processing of sensor data
- implement custom alerts
- security / vulnerability analysis
- performance analysis
- software stack optimization

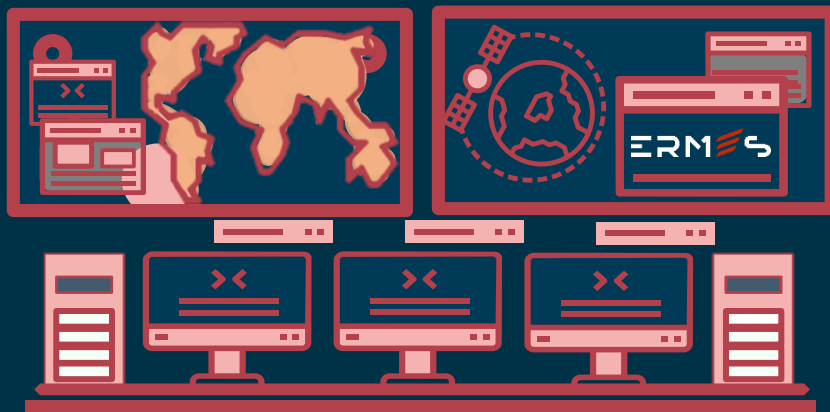
## final users

- Test drive using built in AI models
- Assess available features
- Quick deploy



# ERM S GS Operations

- Cloud-based infrastructure
  - Cross-platform
- Ground Stations Network I/Fs
  - Payload Data processing
  - Data dissemination
- SCOS2000 MDB Compliant
  - PUS Management
  - CSP Management
- Planning & Real-time Operations
  - Predictive anomaly detection
  - Procedures automation



EARTHNEXT



SPEYE  
INNOVAOR  
BISS



SWA instrument suite  
solar orbiter

WORKSHOP “L’IMPEGNO ITALIANO NEL SETTORE  
DEI CUBESAT: TECNOLOGIE E MISSIONI FUTURE” –  
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Q&A

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