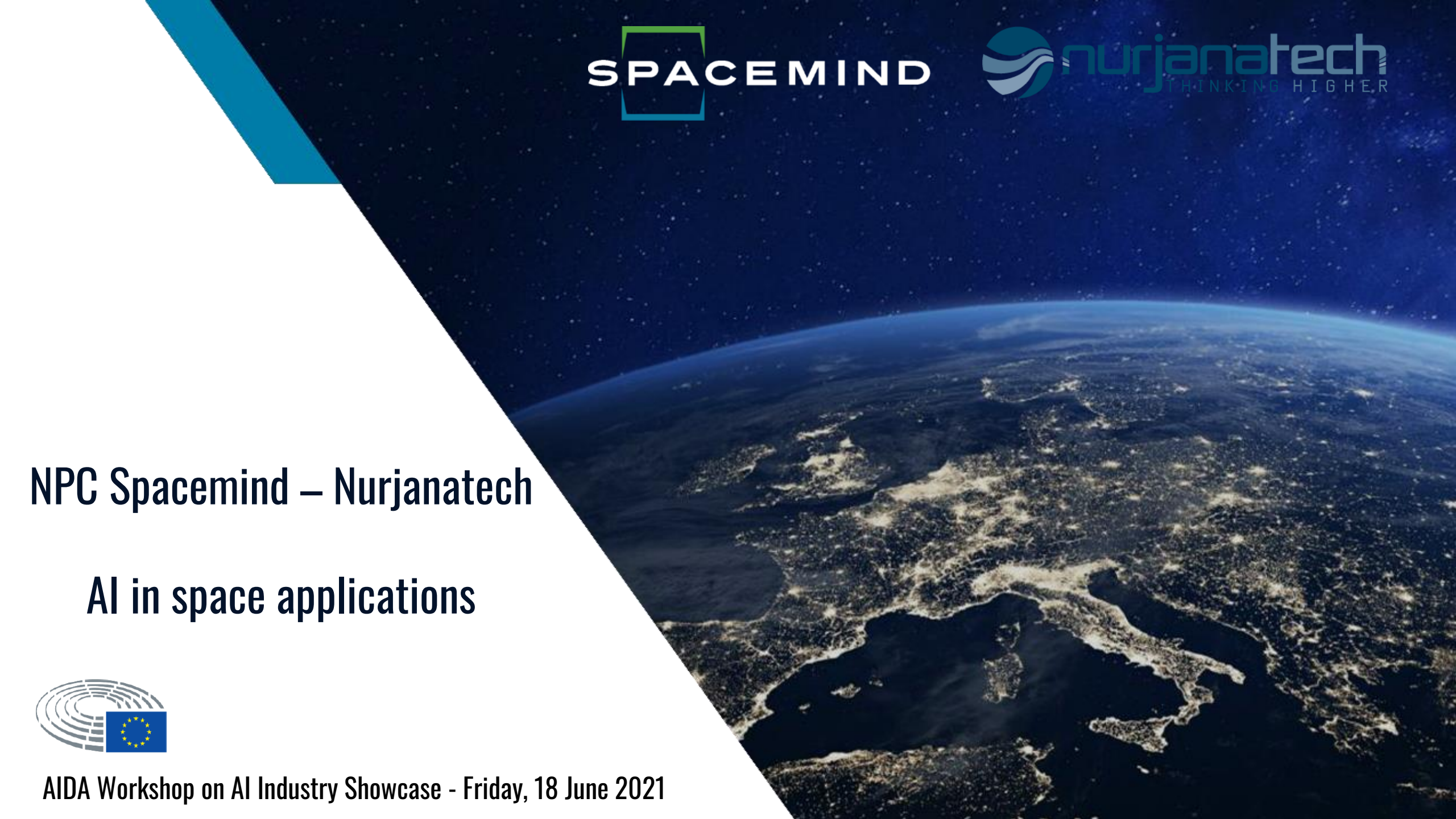


NPC Spacemind – Nurjanatech

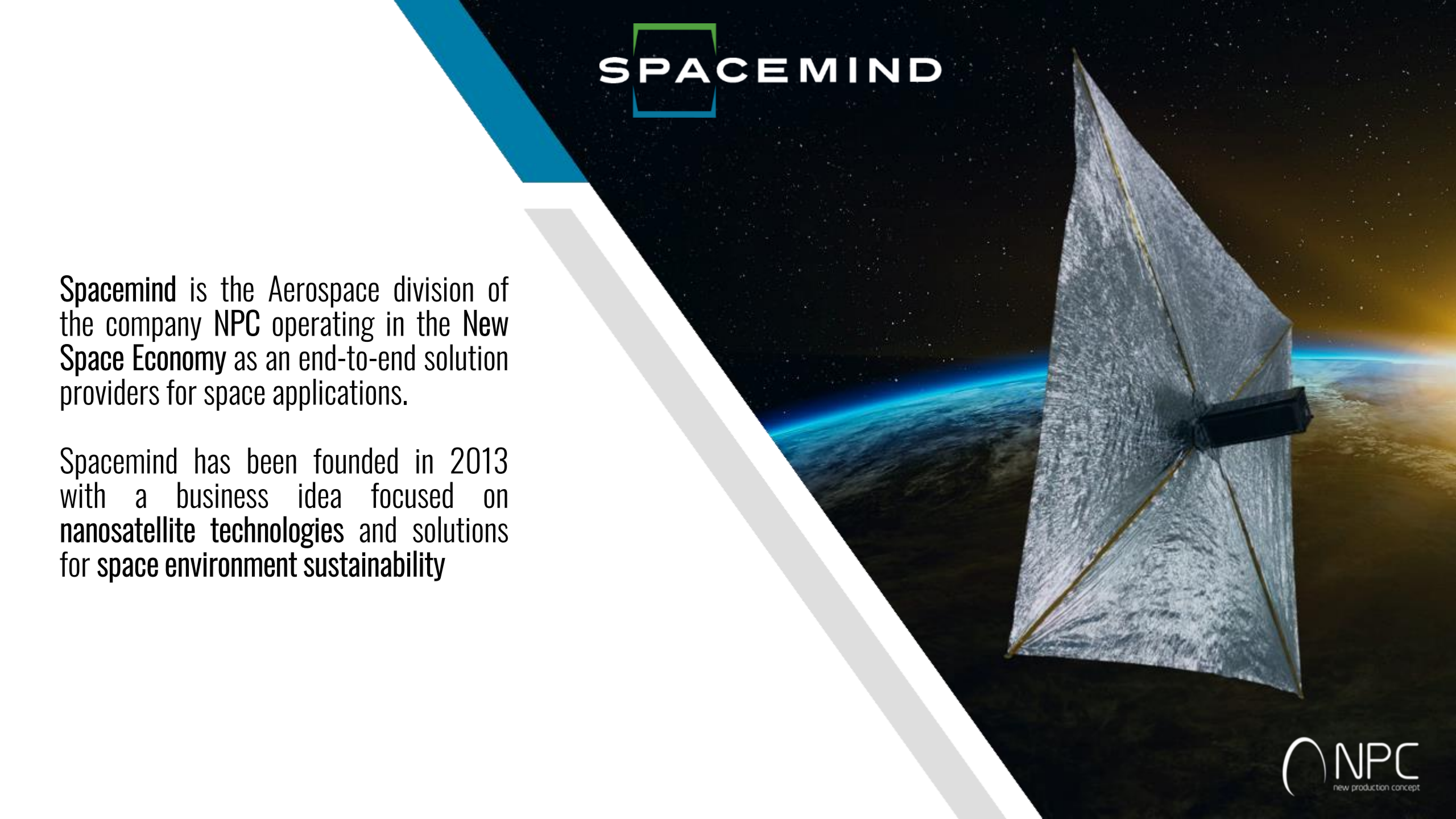
AI in space applications

AIDA Workshop on AI Industry Showcase - Friday, 18 June 2021

SPACEMIND

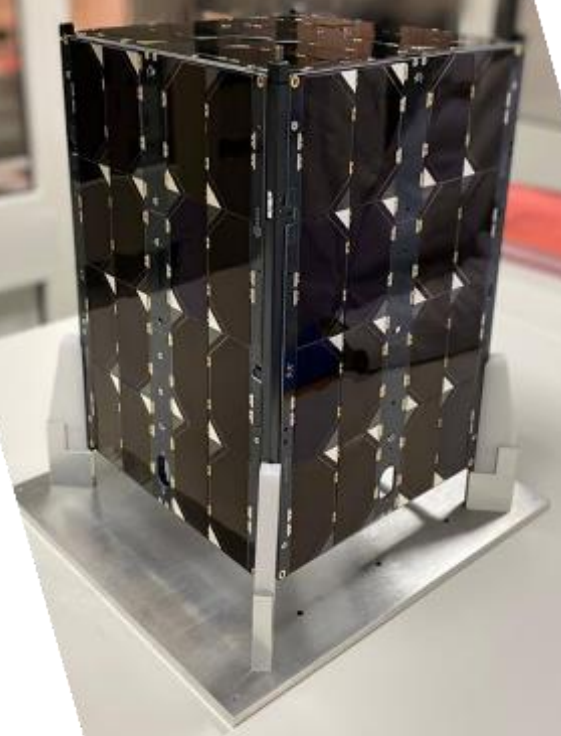
Spacemind is the Aerospace division of the company **NPC** operating in the **New Space Economy** as an end-to-end solution providers for space applications.

Spacemind has been founded in 2013 with a business idea focused on **nanosatellite technologies** and solutions for **space environment sustainability**

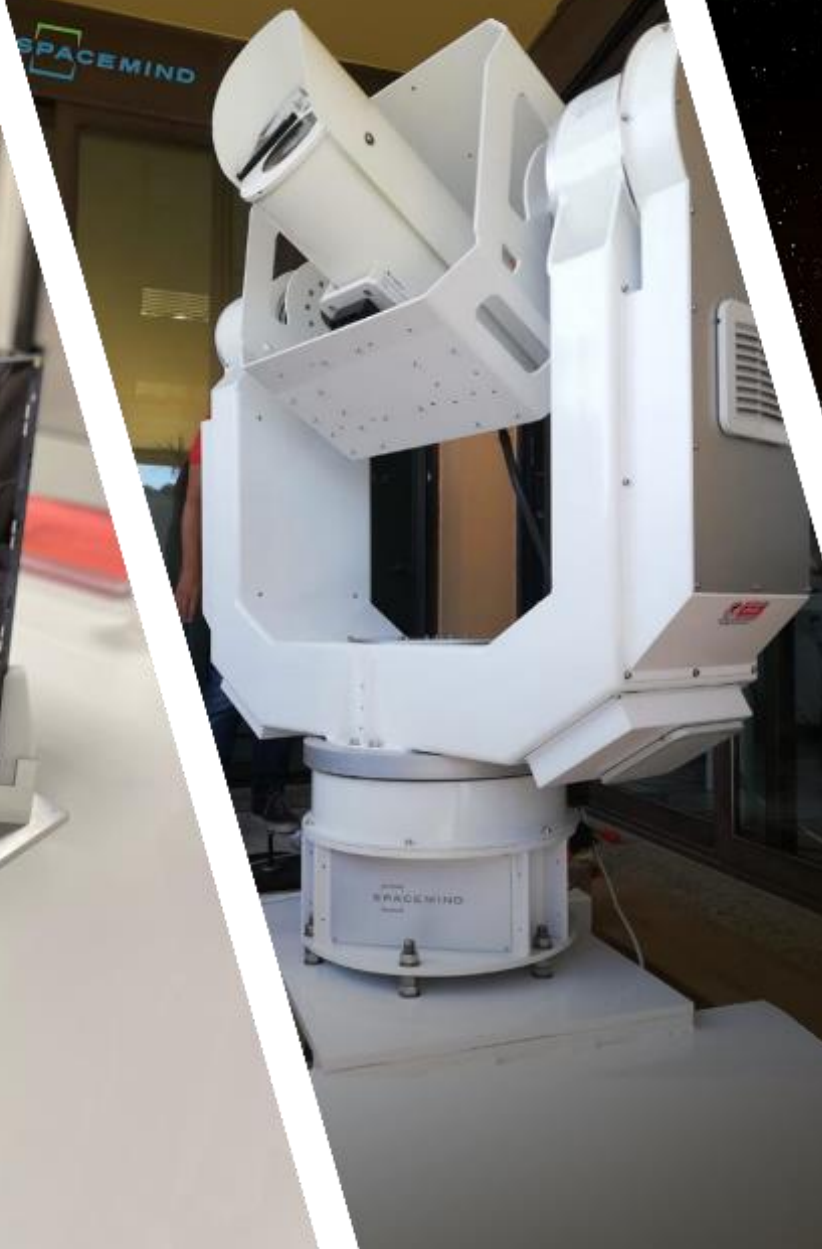


NPC
new production concept

SATELLITES



TRACKING MOUNTS



SPACE DEBRIS

nurjanatech
THINKING HIGHER

Nurjana Technologies is a niche player with a global reach providing innovative products and systems **solutions** for the **defense and aerospace industries**.

Leveraging on our 20+ years of expertise and team agility we design and develop state of the art system solutions integrating remote sensing technologies, such as optics, radars and telemetry, to deliver real time expert systems in support of the human decision process.

Our offering includes: Systems and Software Solutions for Real Time System Integration, Multi Sensor Data Fusion, Automatic Target Identification and Tracking, Artificial Intelligence for the mission critical systems and applications like Drone and Cubesat navigation, Command&Control, Situational Awareness, Remote Sensing

DEFENCE

CROSS INDUSTRY

SPACE

GOAL: turning the world into usable data

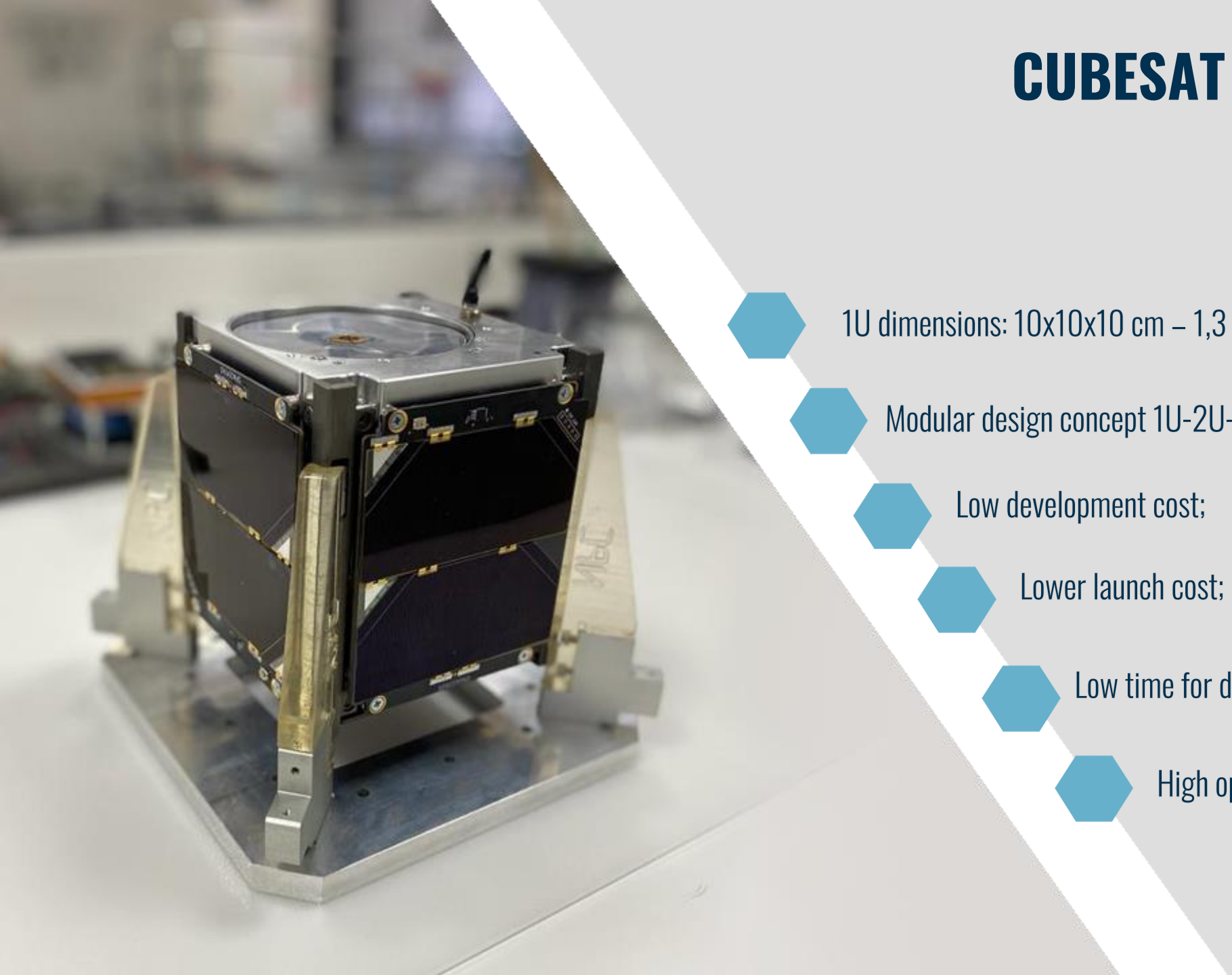
Why CubeSats?

From 1 Billion €...

Technology
Miniaturization

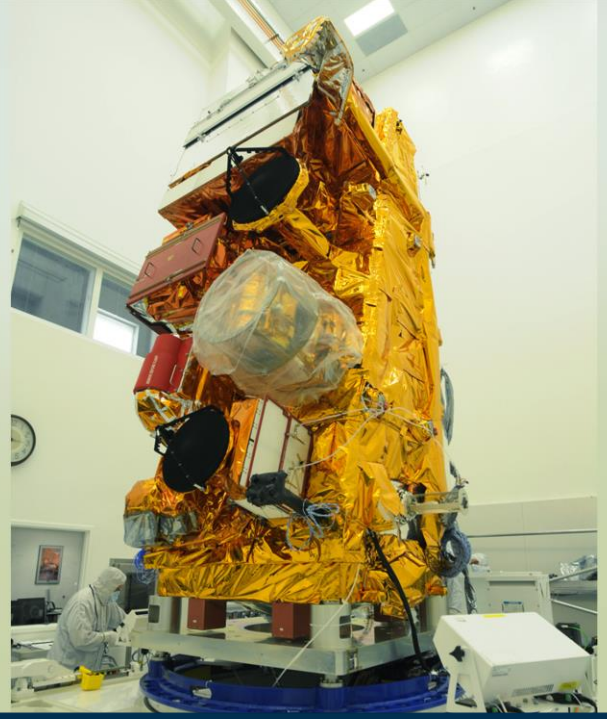
Satellite
Miniaturization

...to 1 Million €

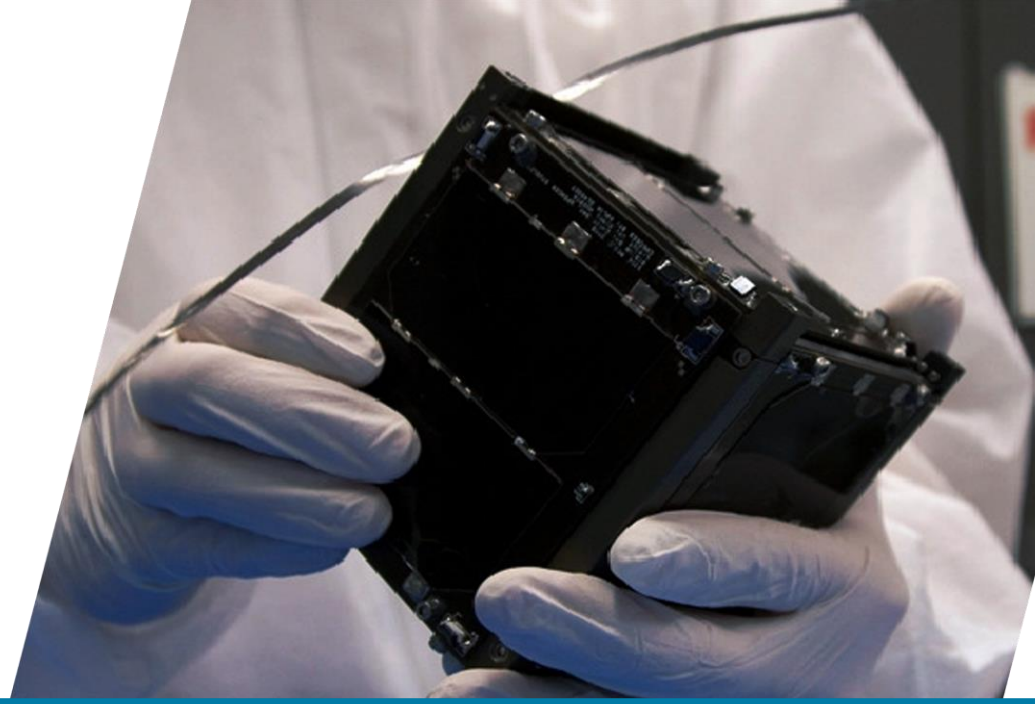


CUBESAT

- 1U dimensions: 10x10x10 cm – 1,3 kg
- Modular design concept 1U-2U-3U-16U-12U;
- Low development cost;
- Lower launch cost;
- Low time for development;
- High operative capacity



Comparison



Traditional large satellite

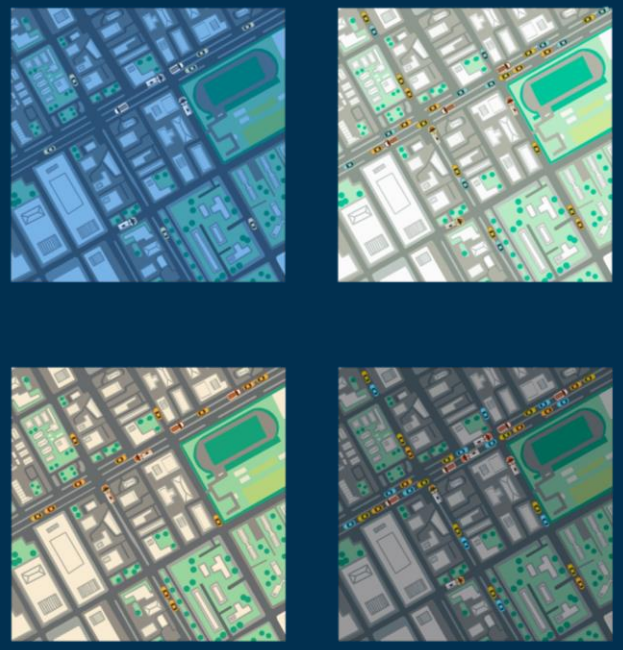
VS

CubeSat

- Traditional “large” spacecraft takes 5 to 10 years to build
- Technology can freeze years before launch
- Flight computer can be generations out of date at launch time

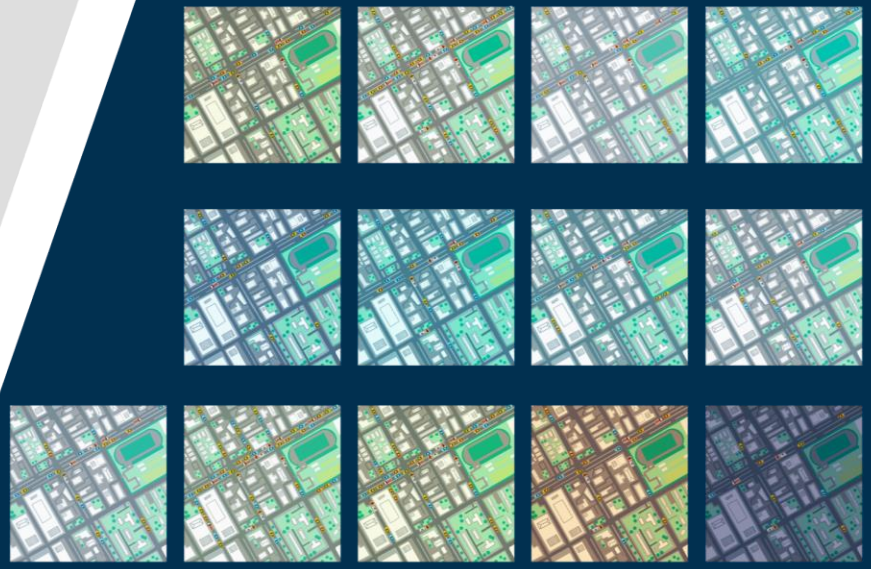
- Cubesats can be designed, built, tested and flown within 1 year
- Take advantage of the latest commercially-available technologies
- A satellite is threated the same way as smartphones

Single satellite



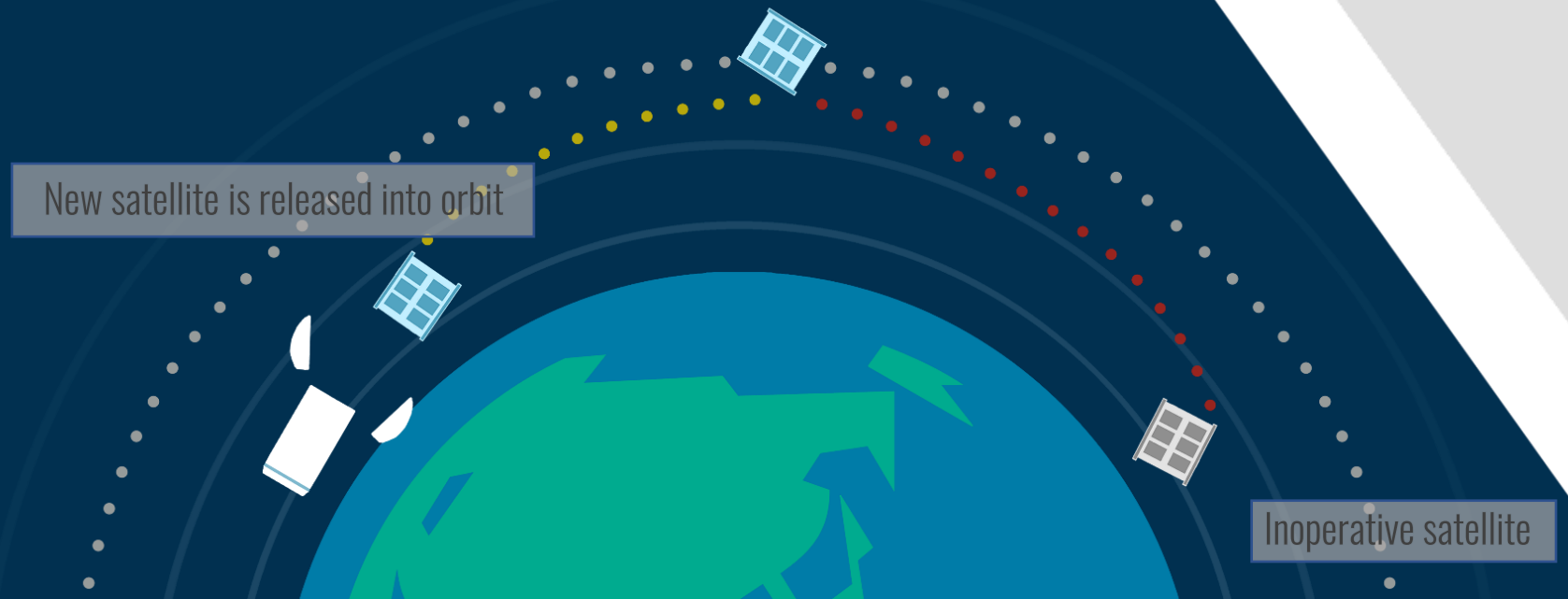
- Each satellite makes a complete round trip of the Earth every **90 minutes** in LEO orbits
- During its orbit, due to the rotation of the Earth the satellite will pass over different areas at every passage
- With CubeSats it is easier to create **constellations of satellites**: it is possible to increment highly the number of passages over the area of interest

Constellation

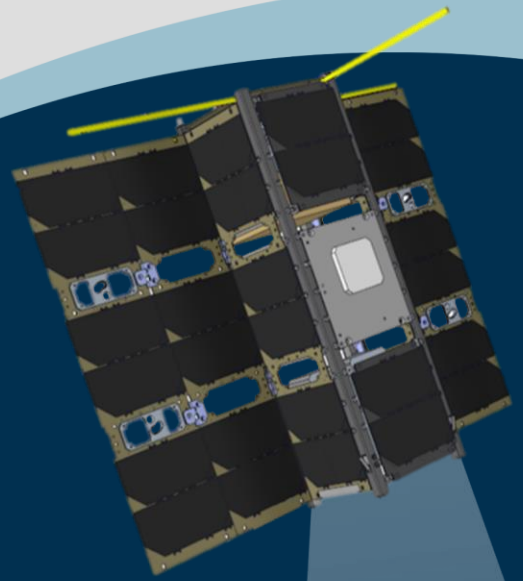


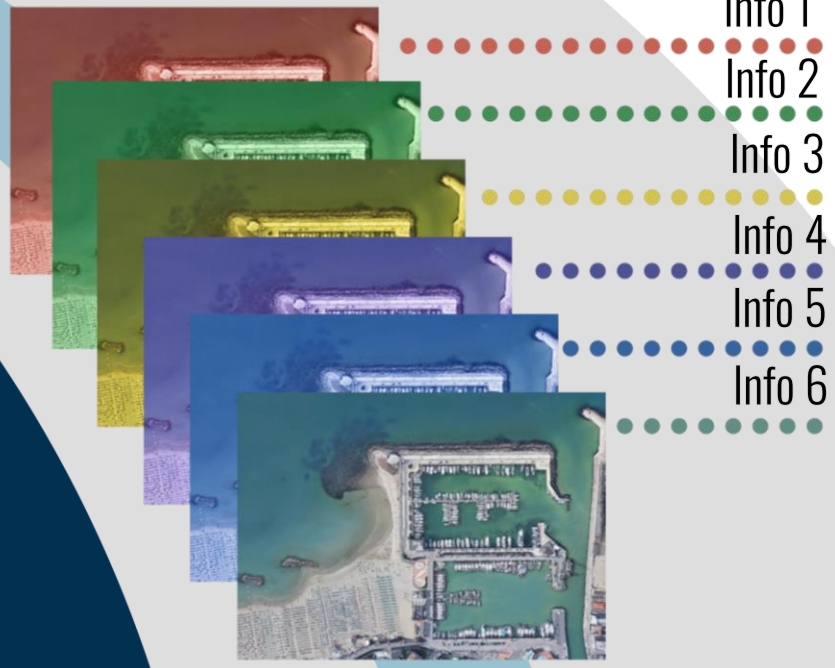
Update of the constellation

- Typical operational life of a CubeSat is below 5 years
- With CubeSats it is possible to apply a fast and smart replacement approach
- When a satellite of the constellation is no longer operative **it can be substituted in short time with a new one**, updated with the state of the art of the technology



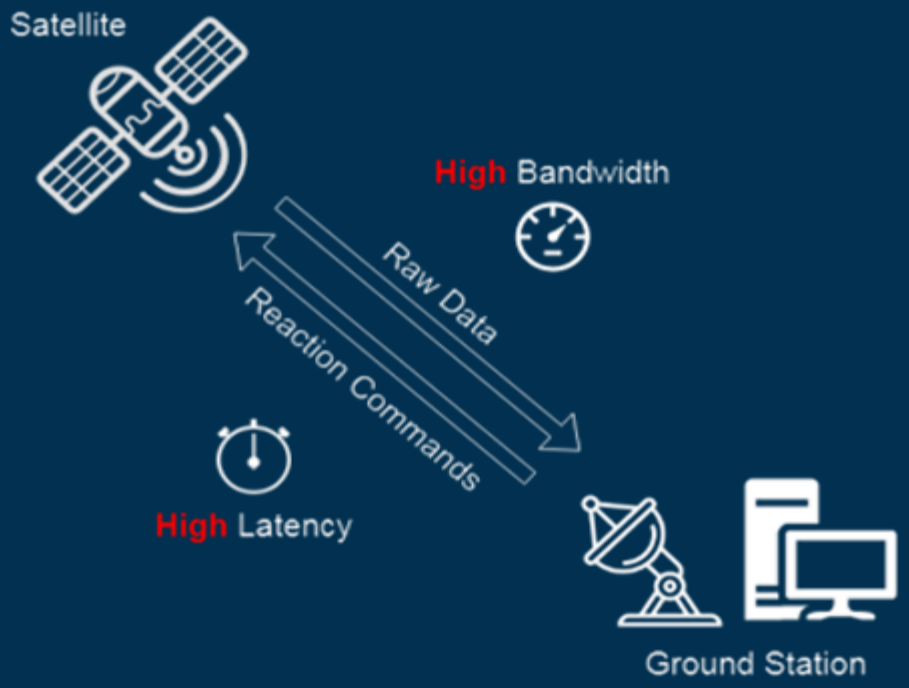
Hyperspectral imaging



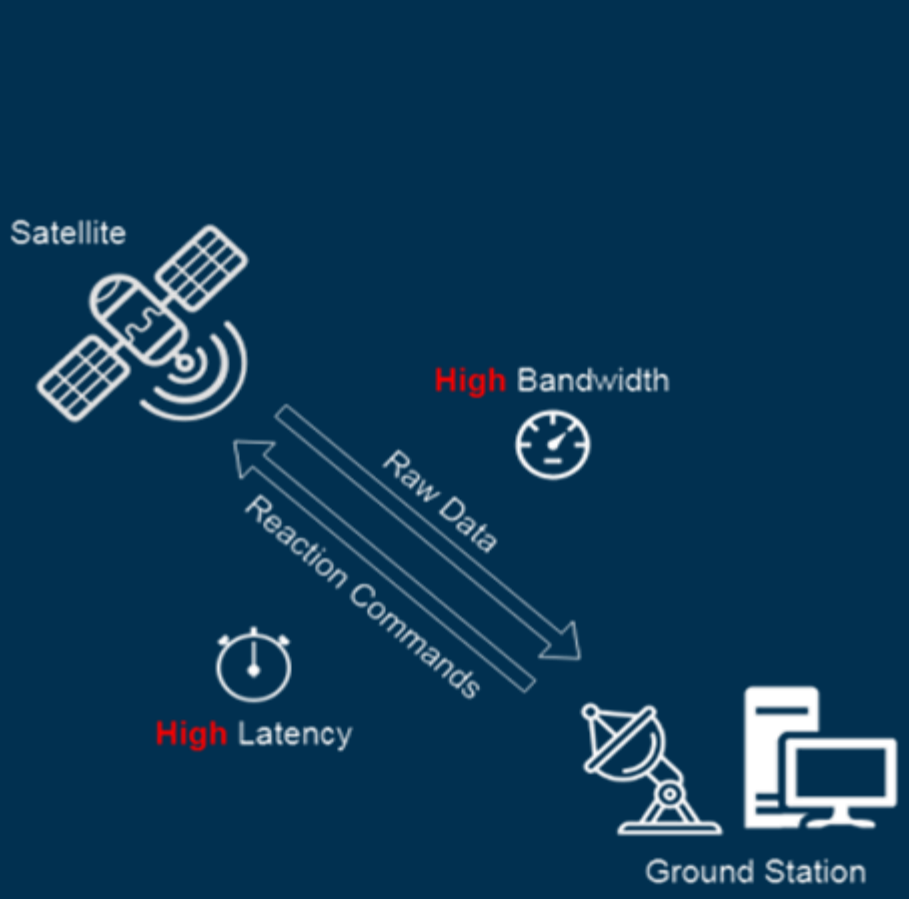


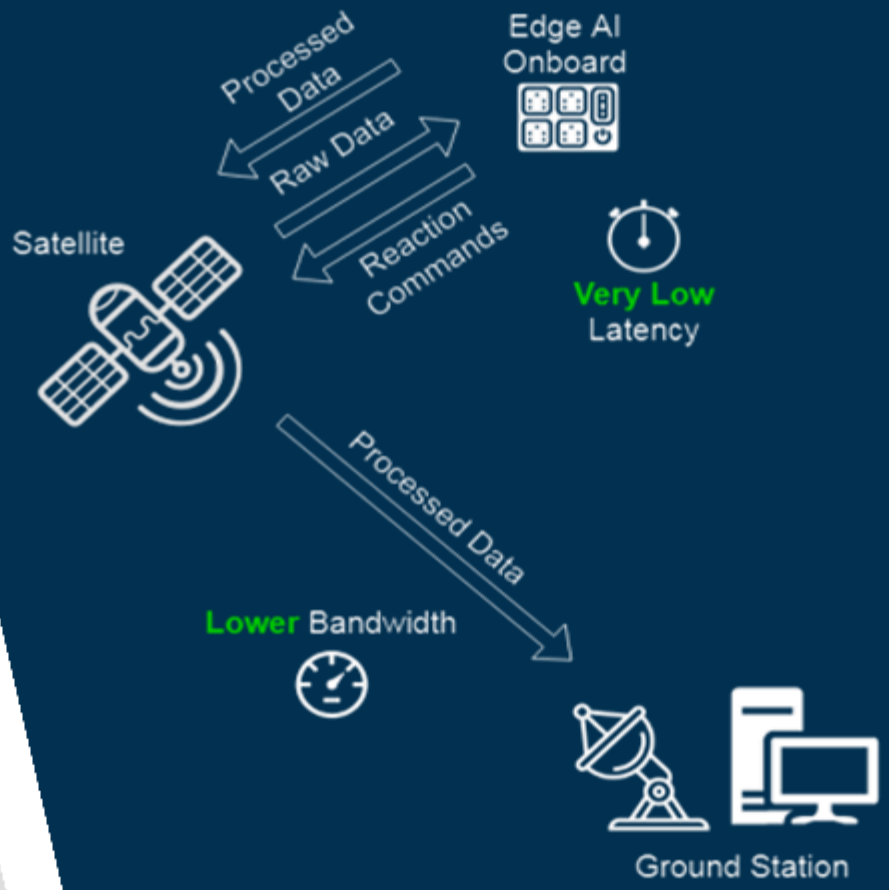
Combing spectral bands it is possible to extract different information from the captured scene

Edge AI #1

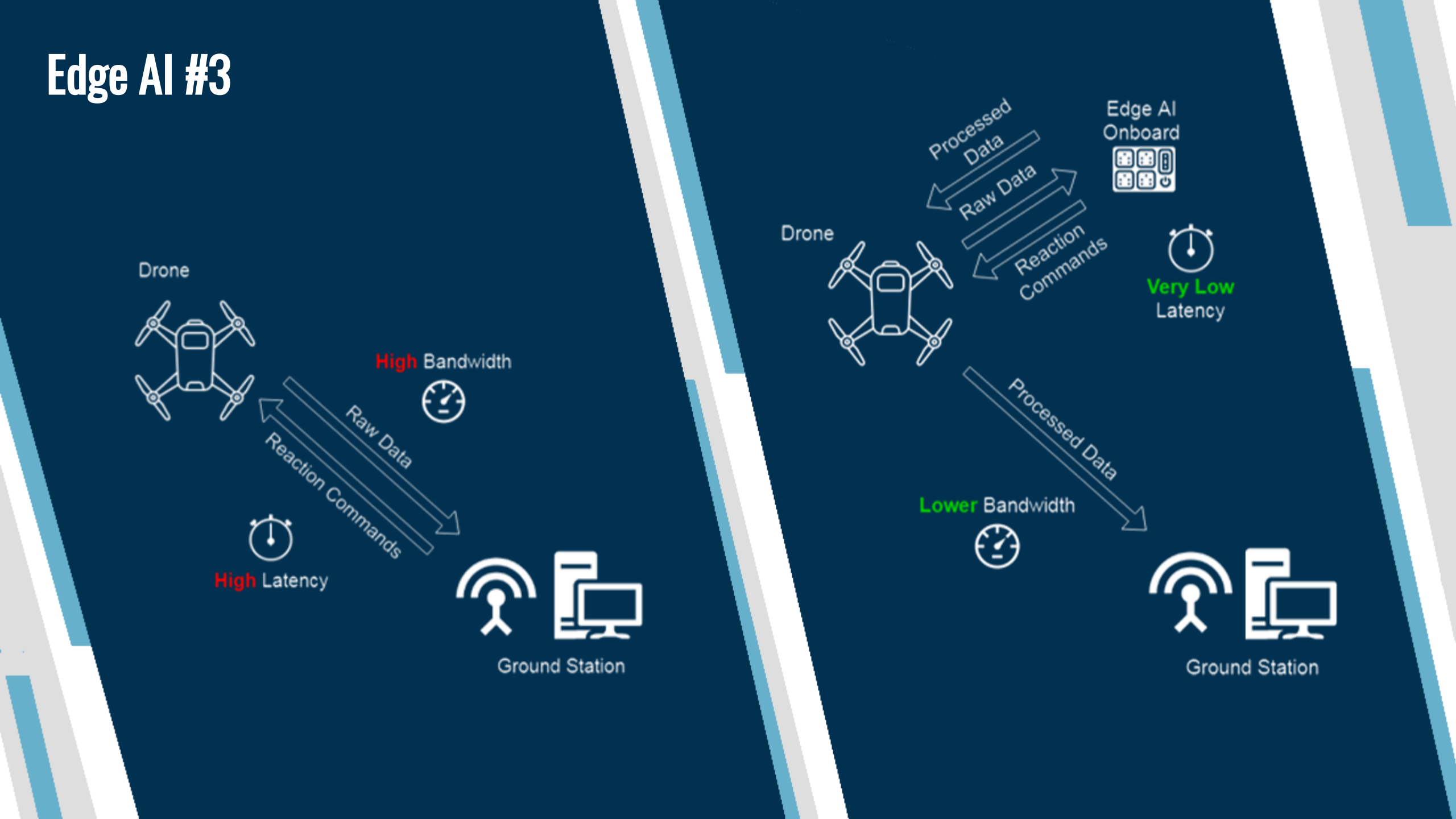

Satellite
High Bandwidth
Raw Data
Reaction Commands
High Latency
Ground Station

Edge AI #2


Satellite
High Bandwidth
Raw Data
Reaction Commands
High Latency
Ground Station


Processed Data
Raw Data
Reaction Commands
Edge AI Onboard
Satellite
Very Low Latency
Processed Data
Lower Bandwidth
Ground Station

Edge AI #3


Drone
High Bandwidth
Raw Data
Reaction Commands
High Latency
Ground Station
Drone
Processed Data
Raw Data
Reaction Commands
Edge AI Onboard
Very Low Latency
Processed Data
Lower Bandwidth
Ground Station

Drone on board sensor processing #1
Target Detection and Localization and Human Action Recognition

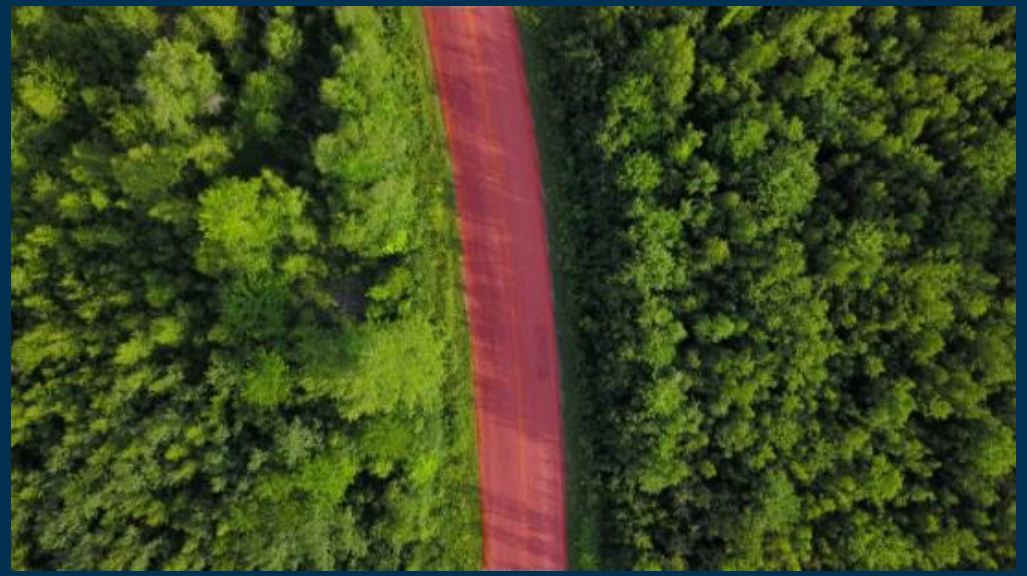
Applications:

- Autonomous Target Detection Identification, Localization and Tracking
- Border Control And Surveillance
- Restricted Area Monitoring
- Threat Identification
- Behavioral Analysis

Drone on board sensor processing #2
Semantic Segmentation and Human Body Segmentation

Applications:

- Autonomous Navigation
- Crowded Area Monitoring
- Smart Agricolture and Precision Farming

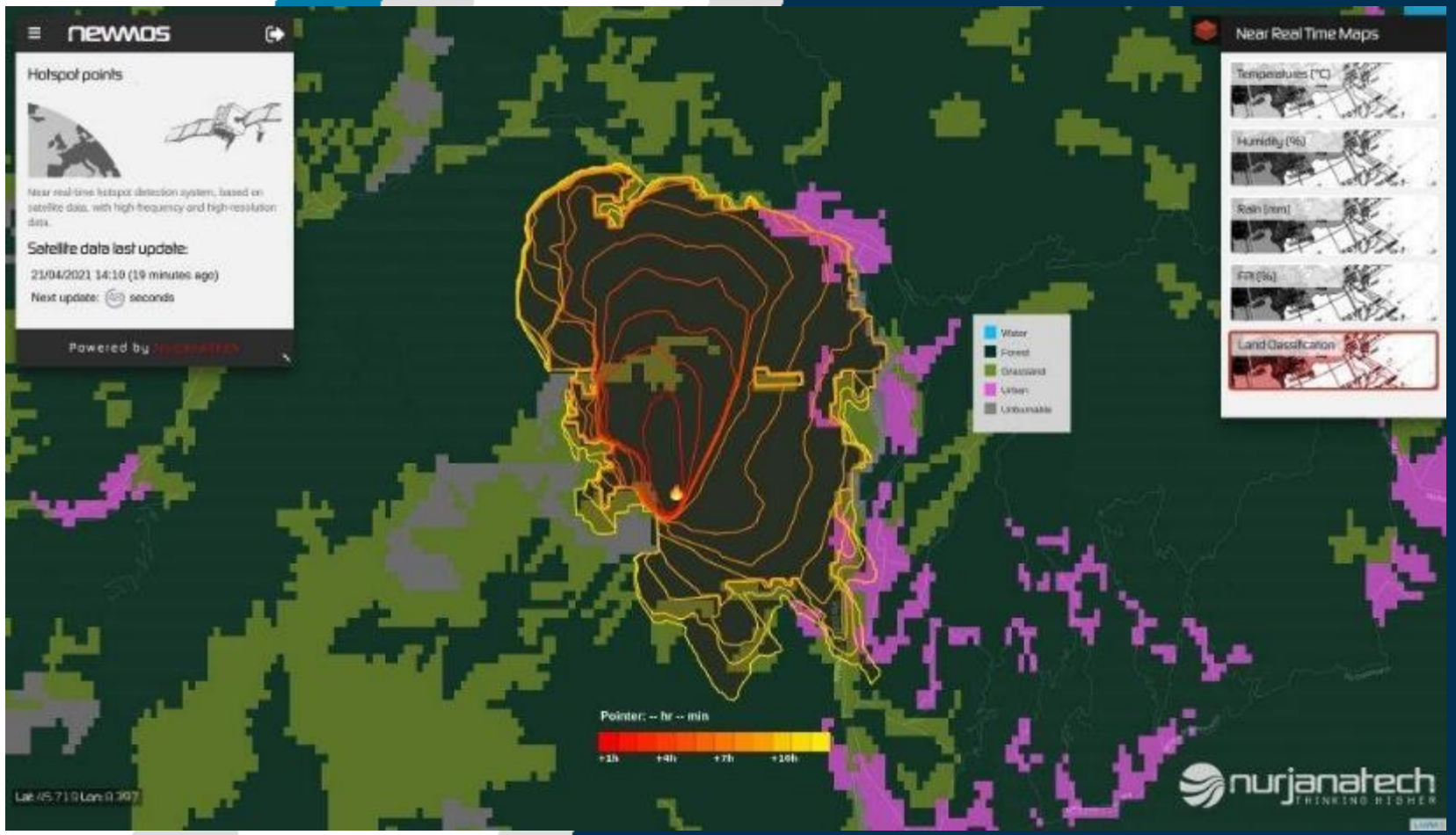


Deep Learning on Satellite Hyperspectral Images #1
Wildfires Hotspot Early Detection

Applications:

- Environmental Control
- Pollution Monitoring
- Smart Agricolture and Precision Farming

Deep Learning on Satellite Hyperspectral Images #2
Up to date Land Cover Classification for Fire Propagation Simulation

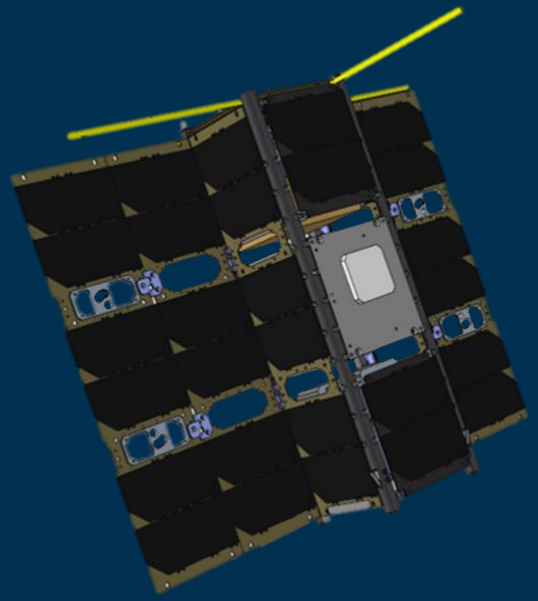


Applications:

- Land Cover Automatic Classification
- Cloud Detection and Segmentation
- Land Usage Control

WILDFIRES MONITORING

- Spacemind and Nurjana Technologies have proposed a CubeSat mission to ASI for the monitoring of wildfires and hotspots based on a 3U CubeSat



Credits NASA

OBJECT IDENTIFICATION

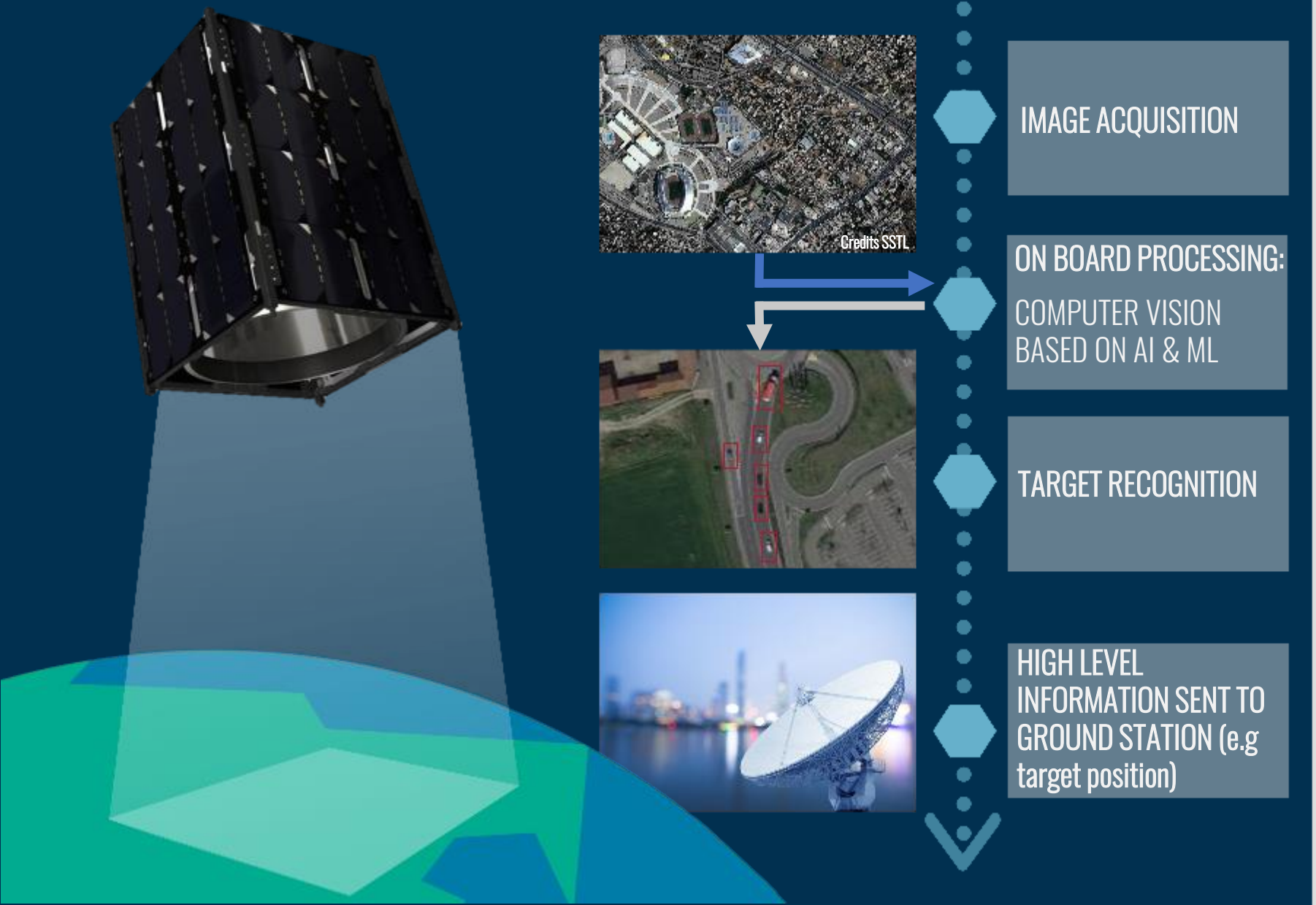


IMAGE ACQUISITION

ON BOARD PROCESSING:

COMPUTER VISION BASED ON AI & ML

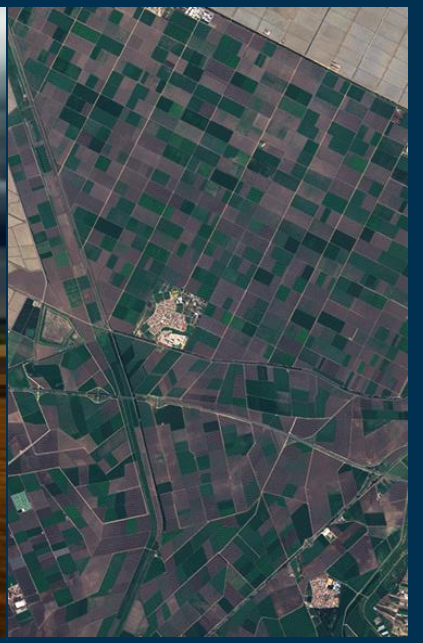
TARGET RECOGNITION

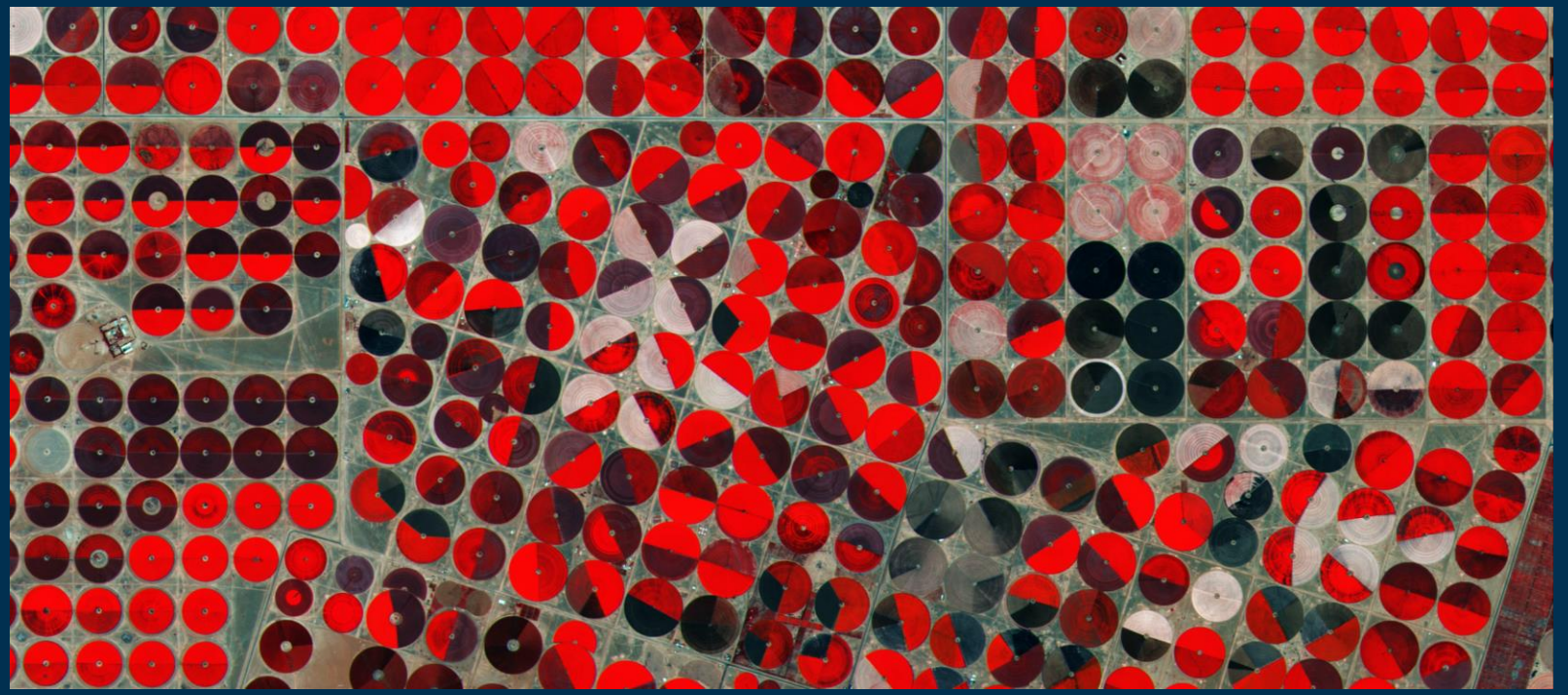
HIGH LEVEL INFORMATION SENT TO GROUND STATION (e.g target position)

- Spacemind and Nurjana Technologies have presented a project for Italian Ministry of Defence
- The project aims at validating a Hardware + Software module equipped on Cubesat platforms in Leo to support **Intelligence Surveillance Target Acquisition and Reconnaissance** through the automatic extraction of high-level information content.

AGRICULTURE MONITORING

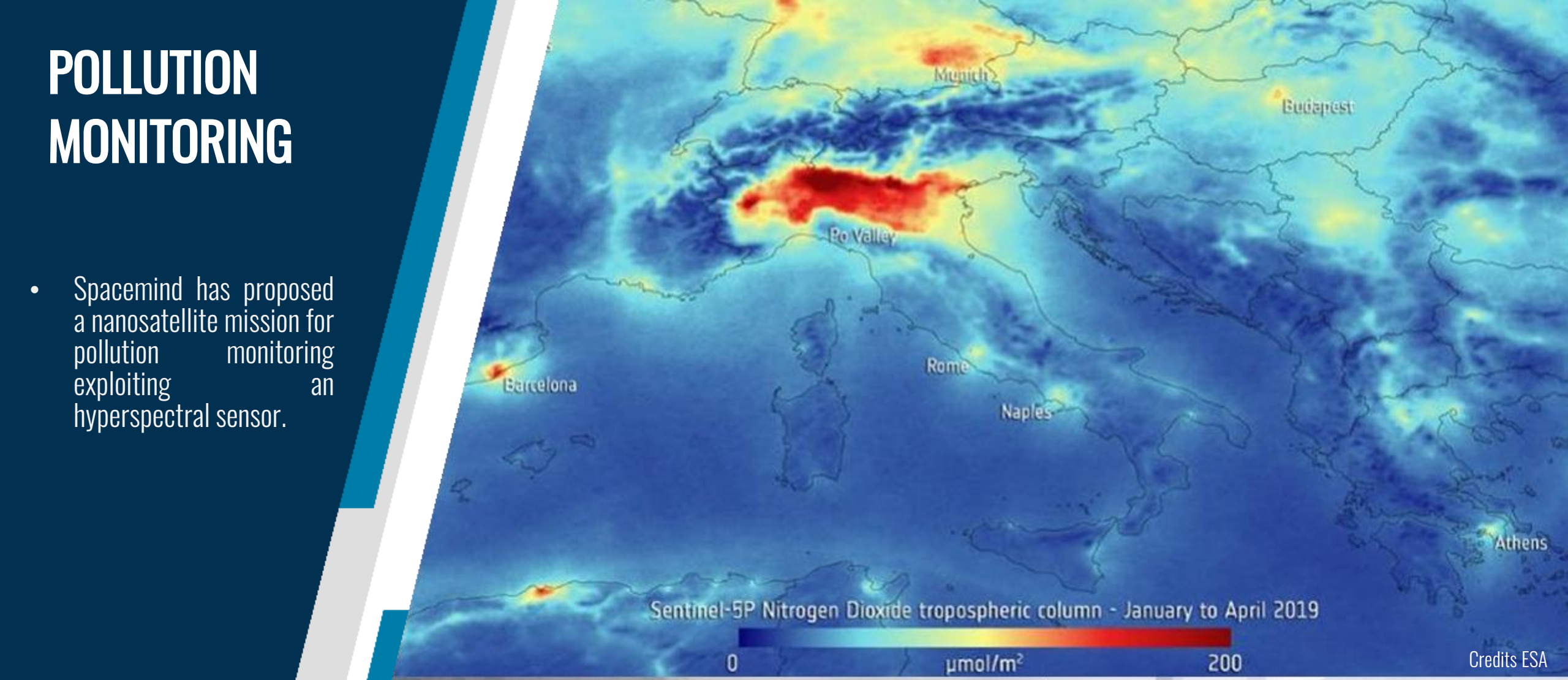
- Spacemind has proposed a nanosatellite mission for agriculture monitoring exploiting an optical sensor.





POLLUTION MONITORING

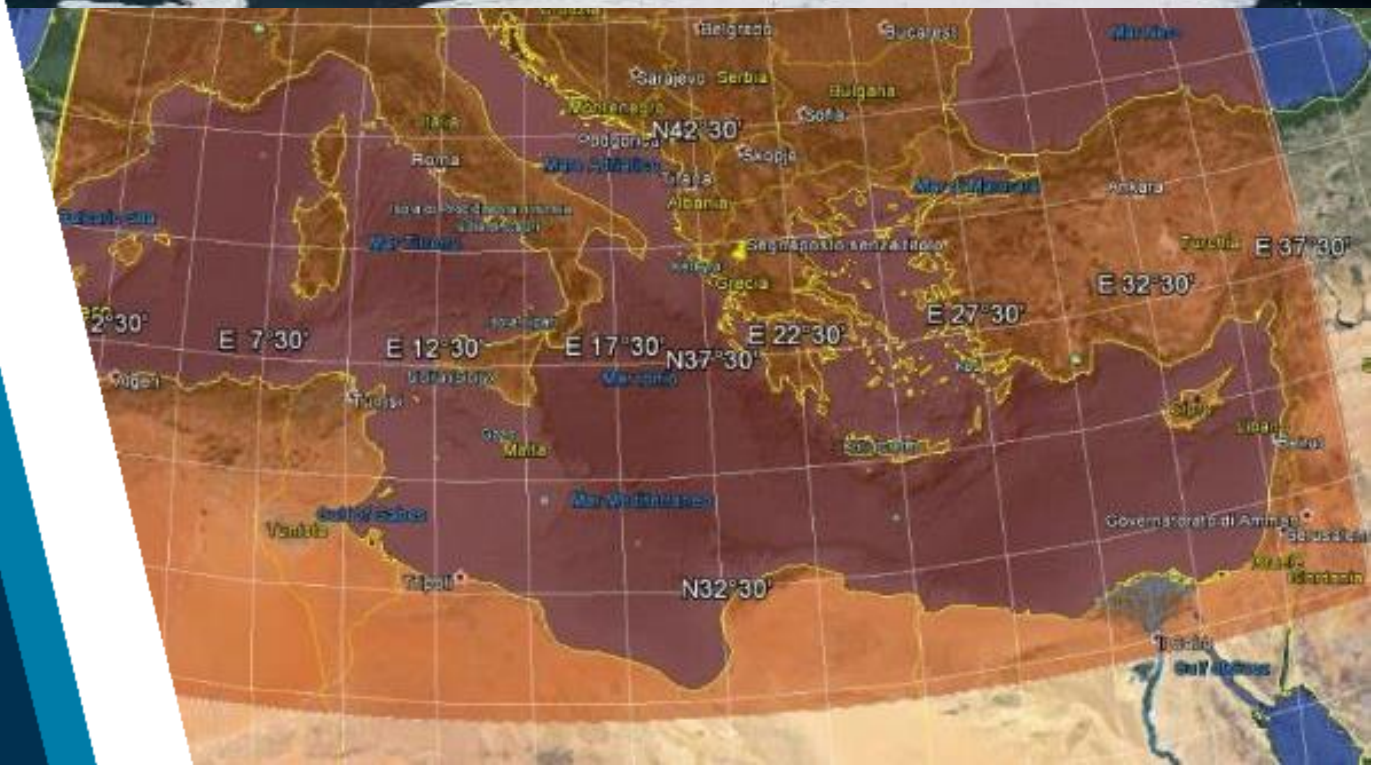
- Spacemind has proposed a nanosatellite mission for pollution monitoring exploiting an hyperspectral sensor.



Credits ESA

MARITIME TRAFFIC MONITORING

- Spacemind has performed a preliminary study for a nanosatellite based constellation for the monitoring of the Mediterranean sea,
- Main objective was the capability to detect small non-cooperative boats ensuring a high frequency data update : the revisit time goal was set to less than 1 hour between two consecutive data (e.g. pictures taken on the same area or target)
- The mission can provide an efficient and cost effective measure for the migration emergency in the Mediterranean sea.

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