PRISMA:
La Missione Iperspettrale Nazionale

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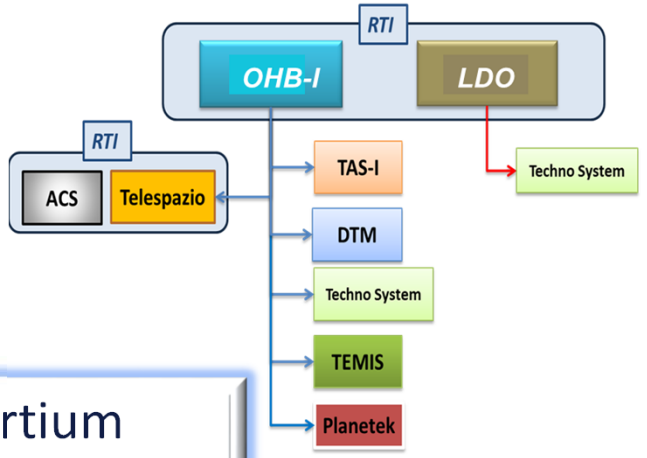
Responsabile della Missione
Responsabile del Ground Segment

Introduzione

PRISMA: PRecursore IperSpettrale della Missione Applicativa

- National EO hyperspectral Mission fully funded by ASI
- Mission conceived as:
  - Pre-operational and technology demonstrator
  - Focus on
    - Space qualification of PAN/HYP payload
    - Development and production of PAN/HYP products up to Level 2d



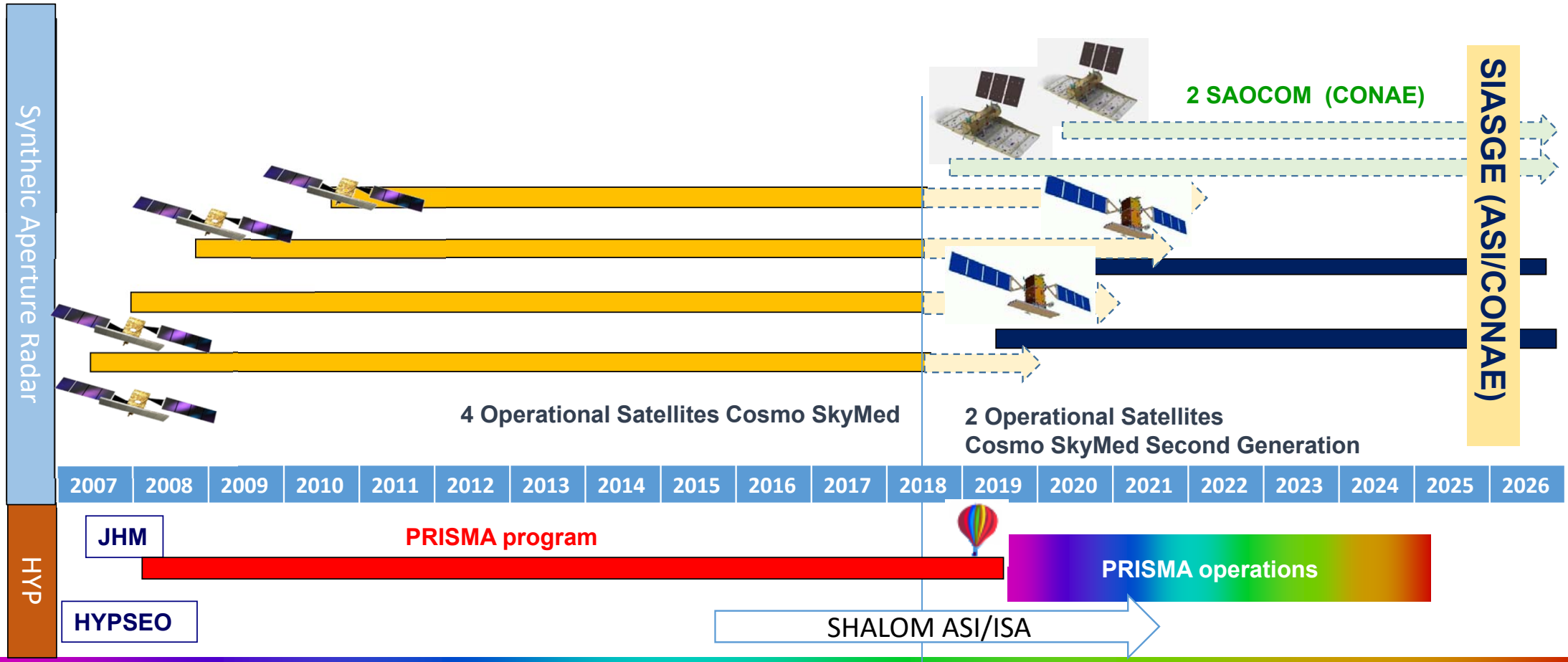
Contract signed between ASI and an Italian Industries Consortium

- Single contract for all the ECSS B2/C/D/E1 phases
- Phase D (Qualification & AIV) in Progress
  - S-IRR (Integration Readiness Review) in progress

Lancio di PRISMA

PRISMA launch is scheduled on February 2019 with VEGA launcher

ASI Earth Observation Programs



The Space Segment

Single Small Class spacecraft

Mass of about 830 kg

Frozen Sun-Synchronous Orbit

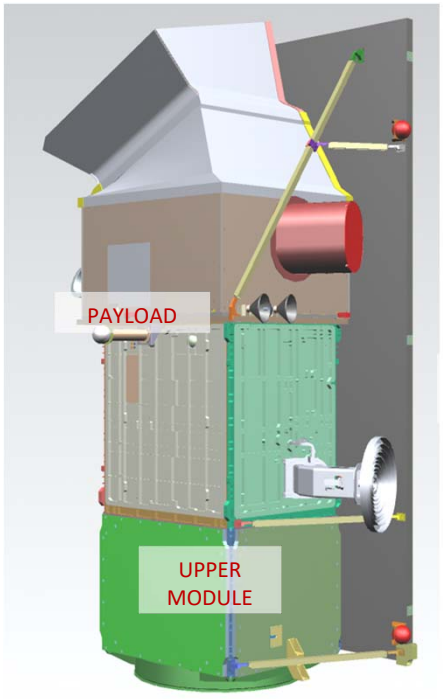
Repeat cycle of 29 days (430 orbits).

Orbit mean altitude of 614.8 Km

Mean inclination of 97.811°

Local Time of Descending Node 10.30 a.m.

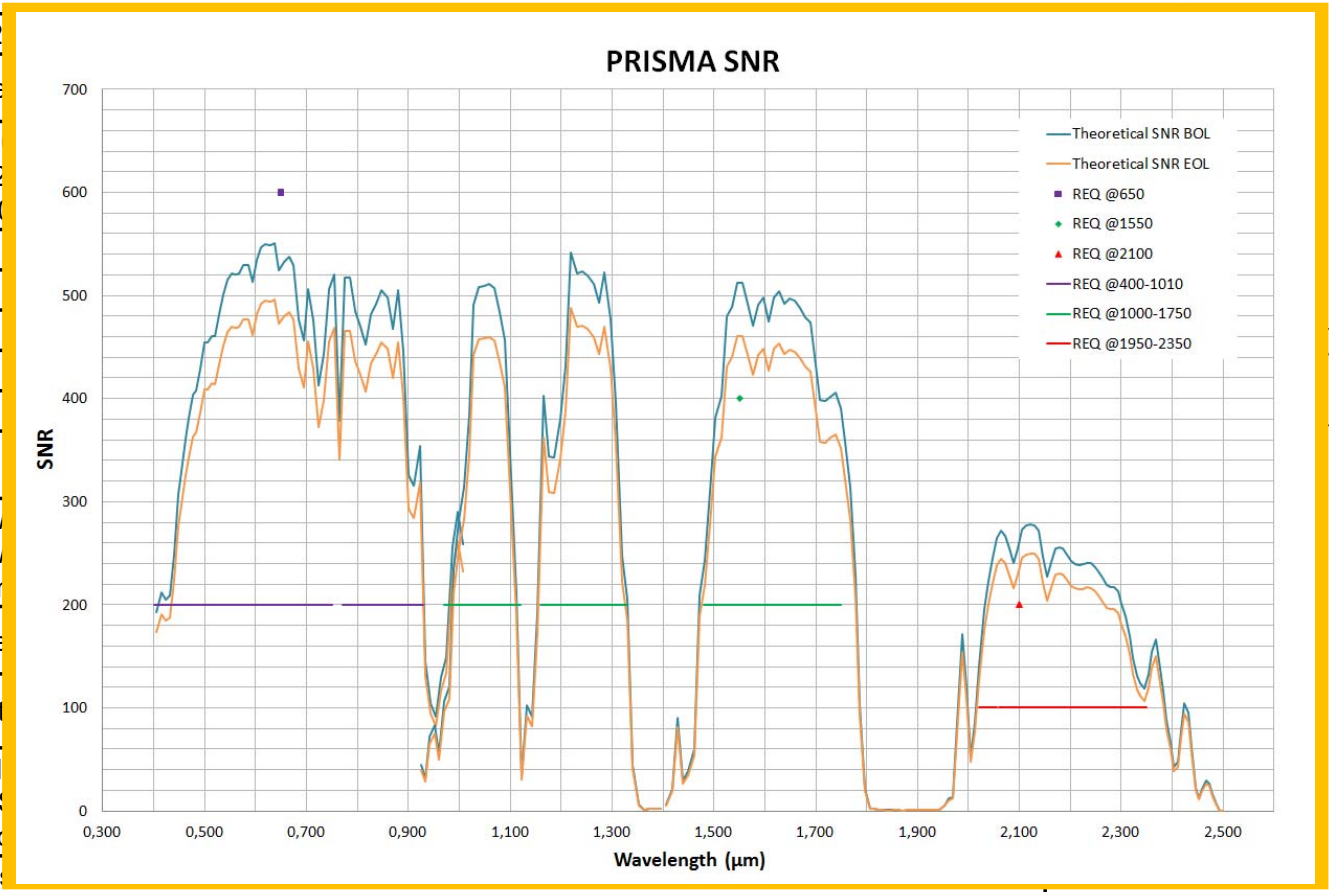
PRISMA Structural Model



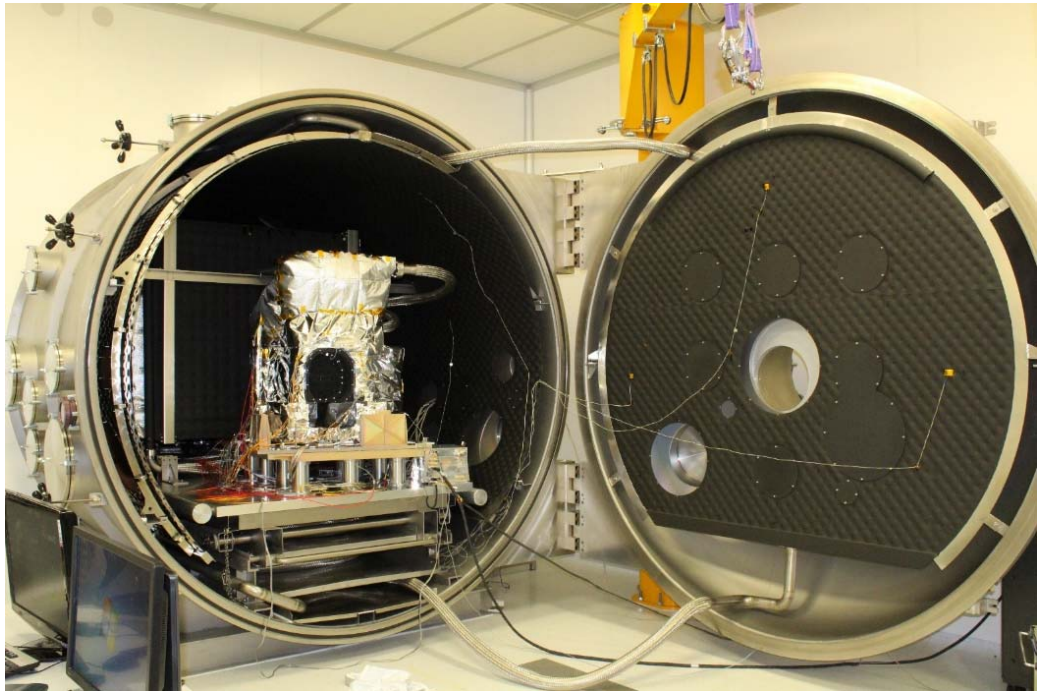
PAYLOAD: High spectral resolution spectrometer optically integrated with a medium resolution panchromatic camera

Principali Caratteristiche

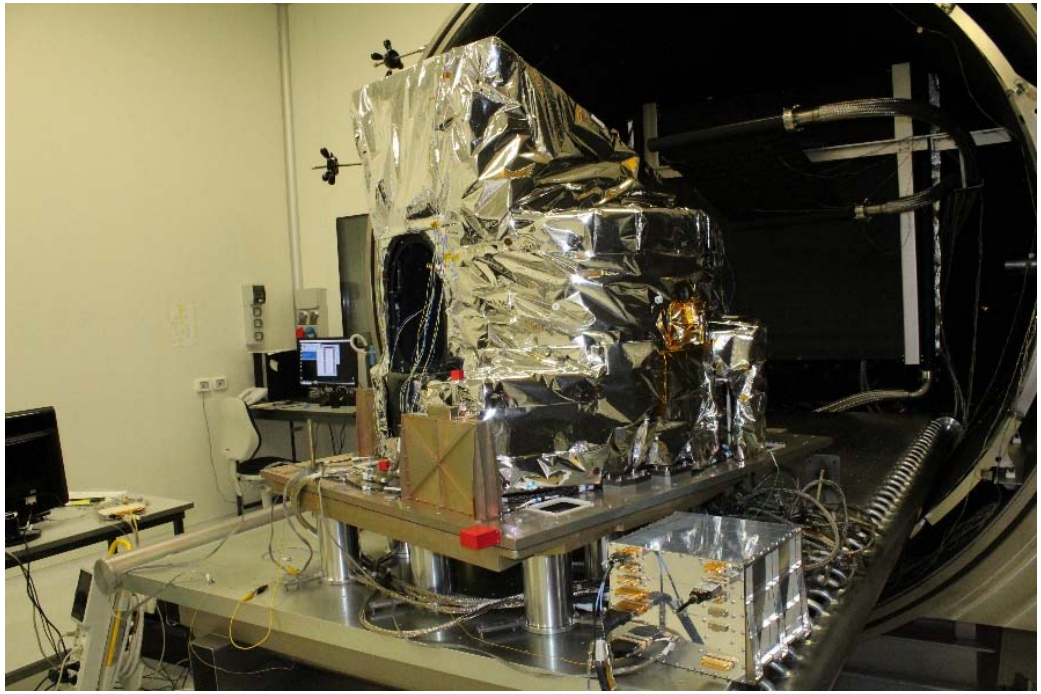
Swath / FOV /IFOV	30 km / 2
Ground Sampling Distance (GSD)	Hyperspe
Spectral Range	VNIR: 40 SWIR: 92 PAN : 40
Spectral Width (FWHM)	≤ 12 nm
Radiometric Quantization	12 bits
VNIR SNR	> 200:1
SWIR SNR	> 100:1
PAN SNR	> 240:1
Absolute Radiometric Accuracy	5%
MTF@ Nyquist freq.	VNIR/SW VNIR/SW PAN alor
Co-registration (Keystone, Smile)	≤ 0.1 pixe
Thermal Control System	Double st
Mass	Optical H Thermal Main Elec
Power Consumption	Earth Obs Idle: 80W



PRISMA Payload



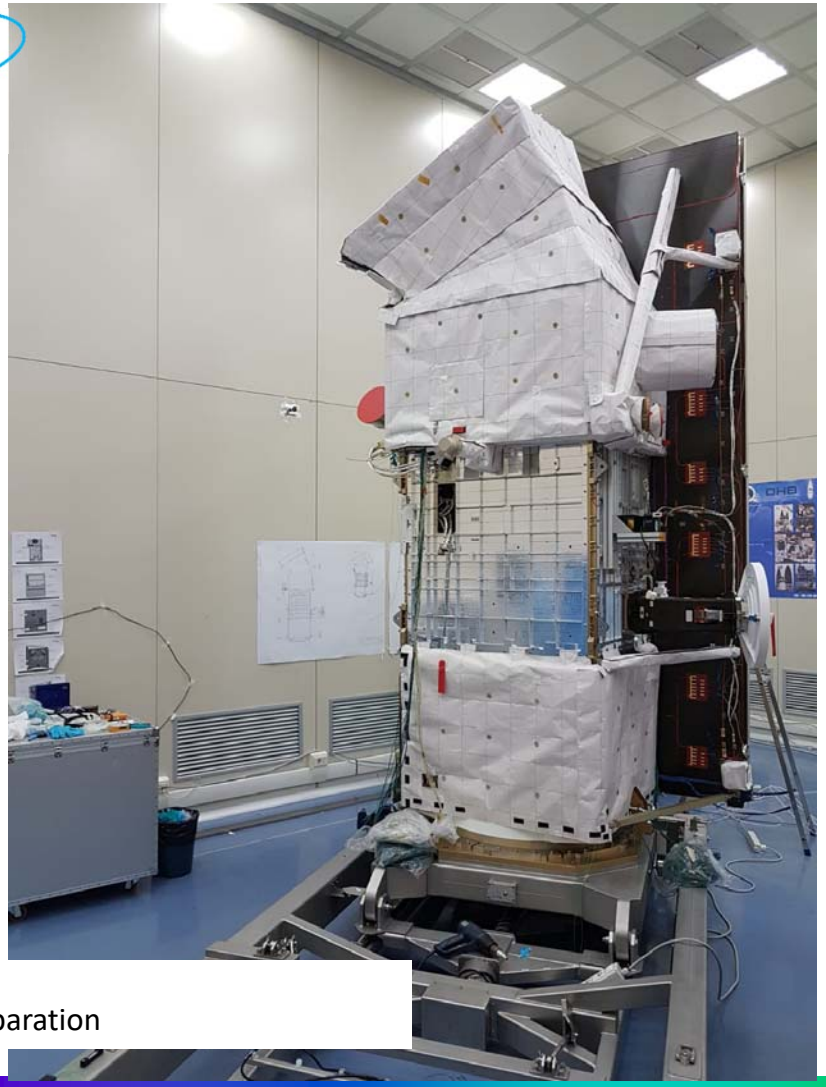
PRISMA Payload in the Leonardo TVC in Campi Bisenzio (Florence)

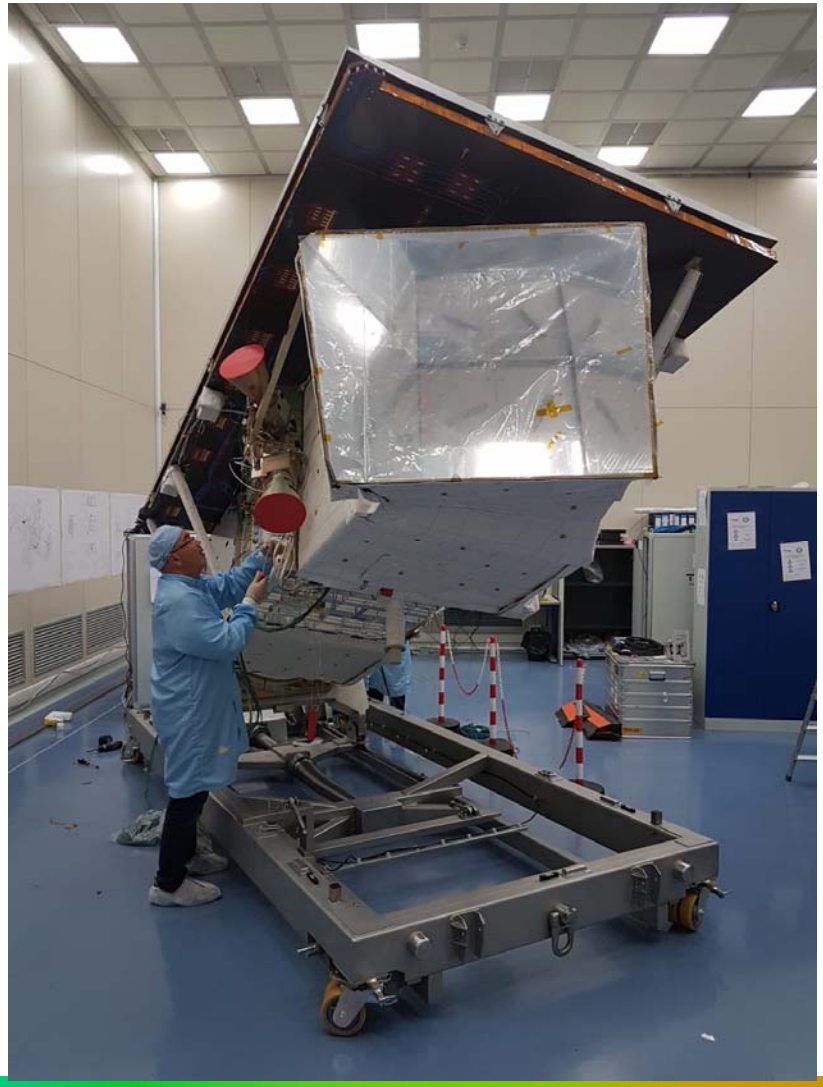


PRISMA Optical Head and Main Electronics in the Leonardo clean room in Campi Bisenzio (Florence)

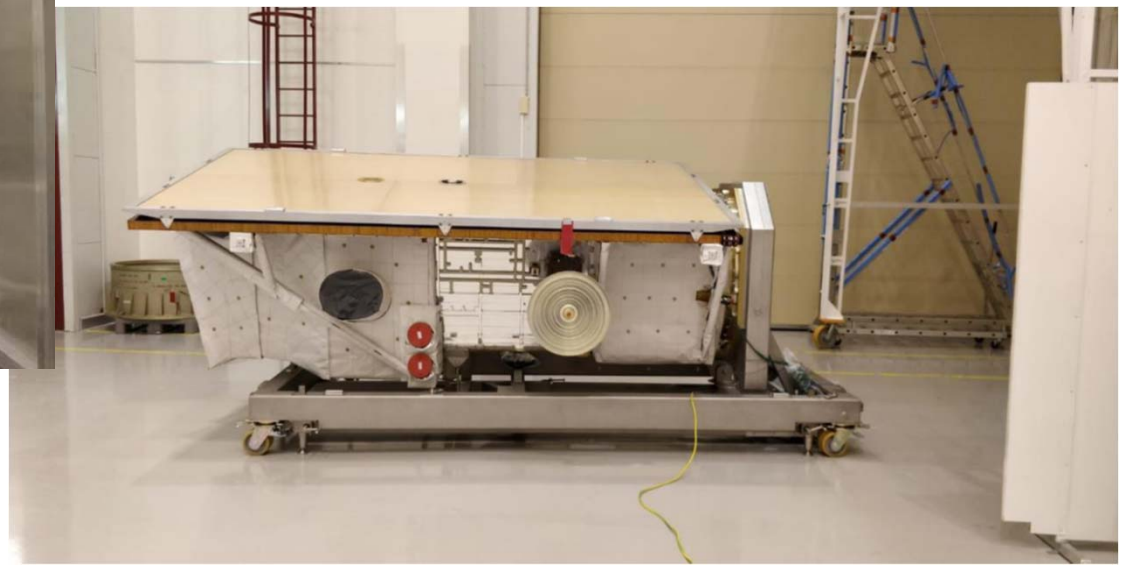
Tortona, 25/7/2018 - Payload a Tortona

Tortona, 10 /8/2018
Payload Integrated





Tortona, 6/9/2018
Satellite Loading preparation



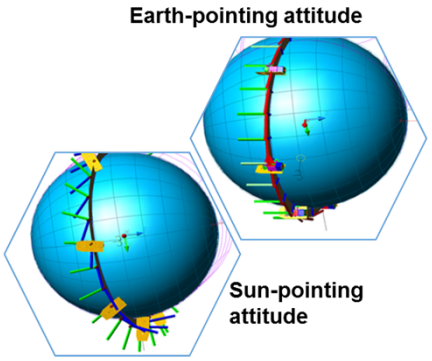
Toulouse, 11/09/2018

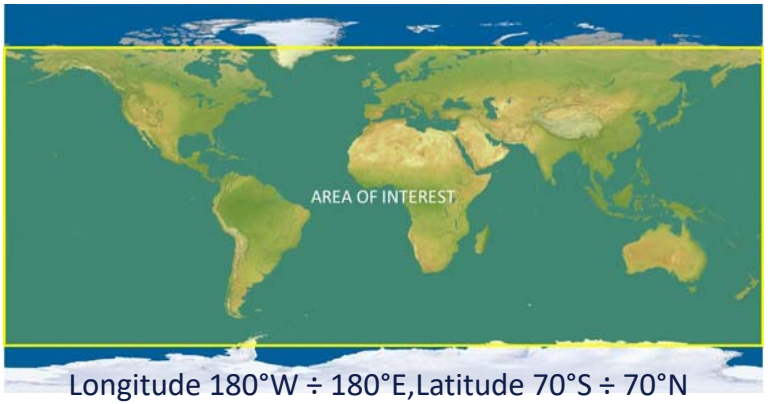
Satellite in Toulouse for per EVT Environmental campaign

Orbit and Opportunity

Orbit and lifetime:

- ❑ LEO SSO, 620km, 10.30 LTDN
- ❑ 5 years lifetime

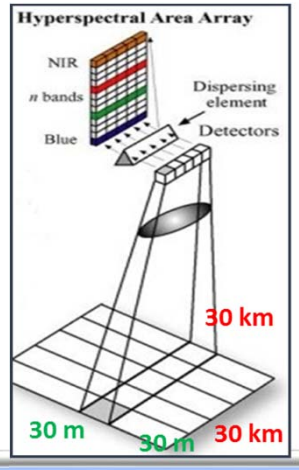




Longitude 180°W ÷ 180°E,Latitude 70°S ÷ 70°N

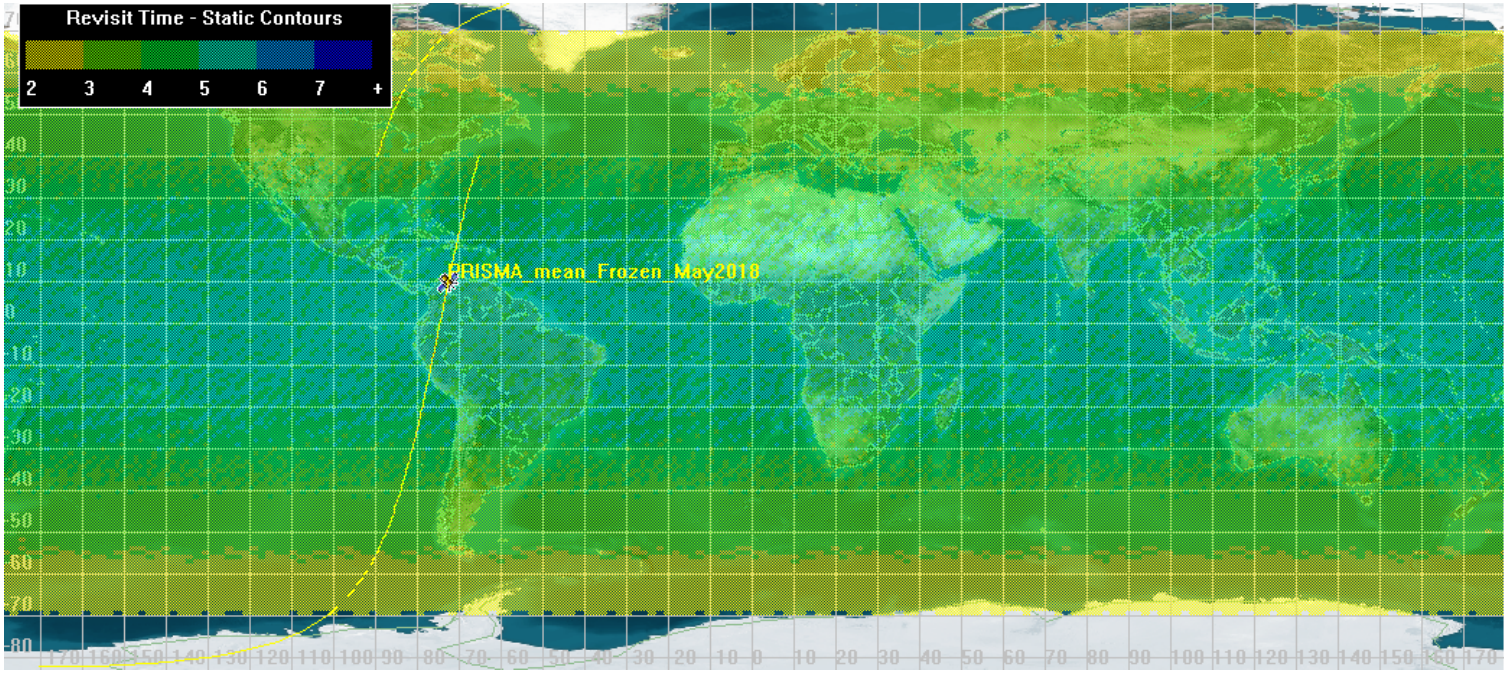
Target access opportunity (over the P-AoI):

- ❑ Number of orbits/day: 15/15
- ❑ One Earth pointing session per orbit
- ❑ Up to 29 min in earth pointing attitude
- ❑ Time devoted to Earth Observation is 240 min daily
- ❑ Up to 223 single images of 30kmx30km (about 500 Mbyte) per day
- ❑ Image acquisition period = duration of Day-light Earth Pointing Session (Nadir attitude) =39 minutes
- ❑ MOL is 240min daily for 5 years = 438.000 min
- ❑ Acquisition Frame= 30m x 30km (GSD x Swath) = 4,31msec
- ❑ Single Image (Minimum Image Length) = 30km x 30km =4,31 sec
- ❑ Uninterrupted acquisition up to 1800km
- ❑ On board lossless (compression factor 1.6); near lossless compression available



Revisit Time

PRISMA satellite shall be able to manoeuver in order to capture two images at a maximum distance of 1000 km in a single pass (from worst case left to right side looking and viceversa).



Revisit Time on primary AoI (days) 29 days Repetition Cycle	
	off-Nadir angle ±20.7°
Maximum	6
Average	4.8
Minimum	3

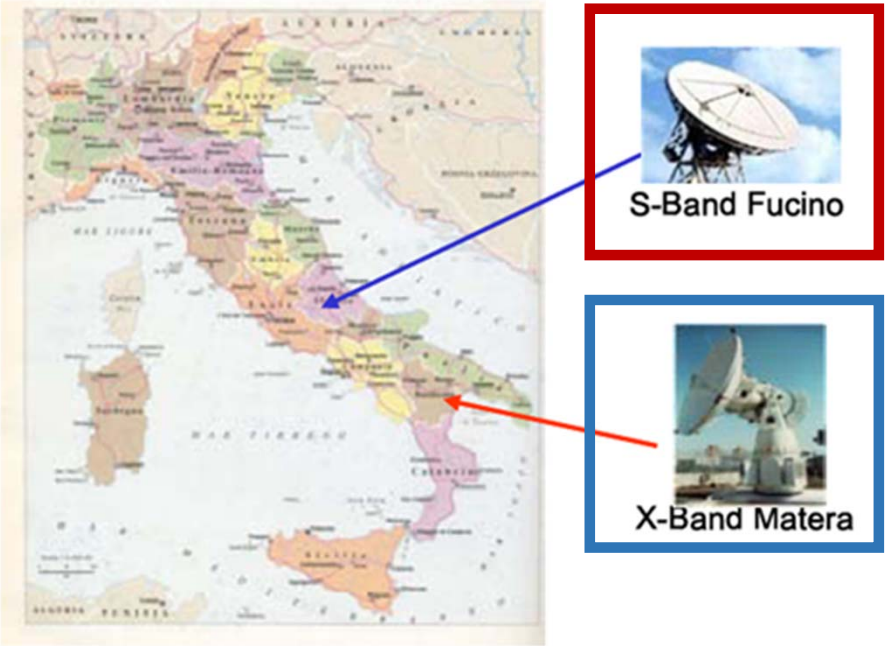
Average Revisit Time on Area of Interest

Ground Segment

G/S main basic functions:

- ❑ User Services Management
- ❑ Mission Programming
- ❑ Satellite Control & Monitoring
- ❑ Mission Exploitation in terms of data acquisition, archiving and processing

MCC - Mission Control Center
SCC - Satellite Control Center
IDHS - Image Data Handling Segment



Standard Products

Level 0 (Hyperspectral / PAN) - formatted data product with appended metadata, including ancillary data and file formatting information (Archived data).

Level 1 (Hyperspectral / PAN) - radiometrically corrected and calibrated radiance data in physical units. This product provides:

- Top-of-Atmosphere Spectral Radiance
- Cloud mask
- Sun-glint Mask
- Calibration and characterization data used
- Classification Mask

Level 2b Geolocated at Ground Spectral Radiance Product (Hyperspectral / PAN)

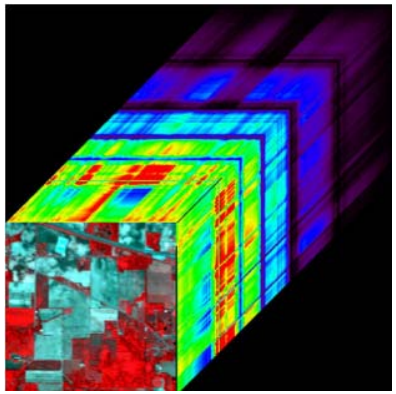
Level 2c Geolocated At-surface Reflectance Product (Hyperspectral / PAN). This product includes:

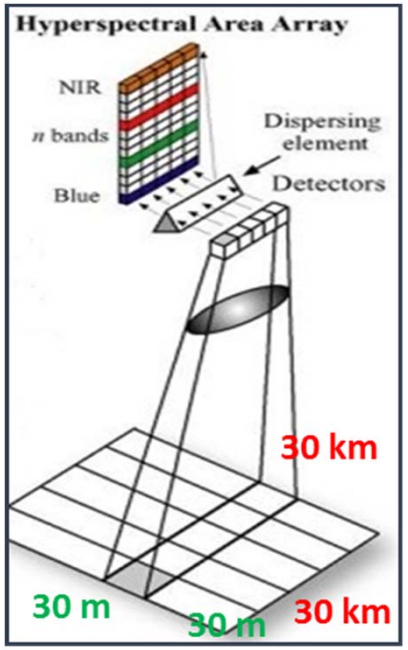
- Aerosol Characterization Product (VNIR)
- Water Vapour Map Product (Hyperspectral)
- Cloud Characterization

Level 2d Geocoded version of the level 2c products (Hyperspectral / PAN)

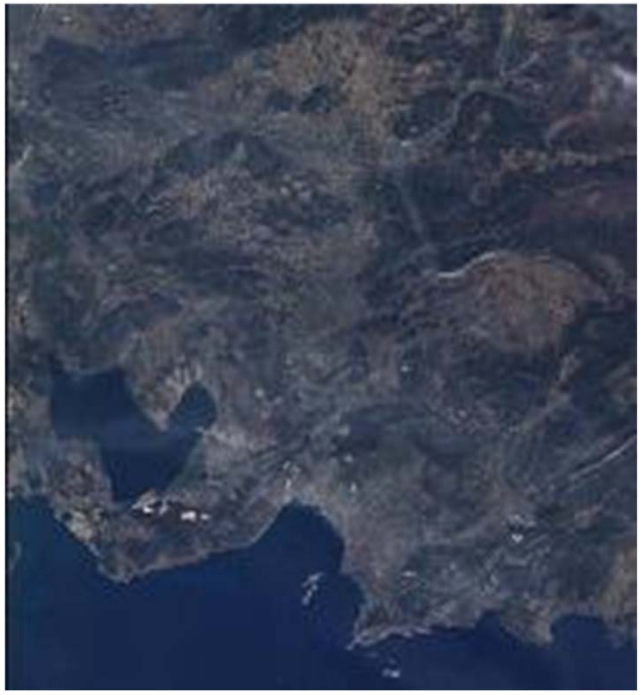
Products Main characteristics

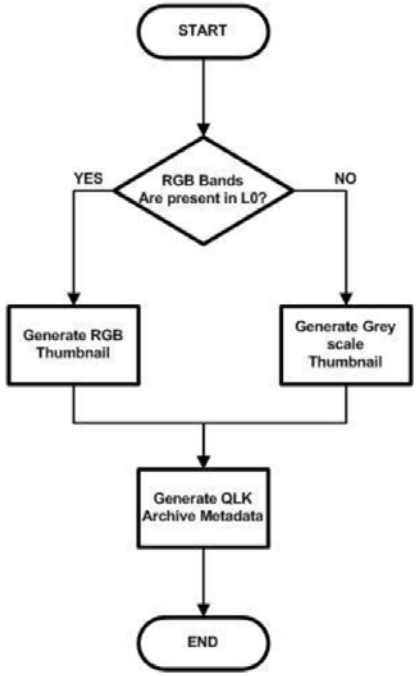
- Nominal EO dimensions:
  - HYP 1000 x 1000 x 239 (max) samples
  - PAN 6000 x 6000 samples (temporally coregistered)
  - Swath width: 30 Km @ Nadir
  - Single Frame: 30Km x 30Km
  - Spectral range: 0.4-2.5 µm (Hyp) / 0.4-0.7 µm (PAN);
  - Continuous coverage of spectral range with spectral bands 10 nm
  - GSD:
    - 30 m (HYP @ Nadir)
    - 5 m (PAN @ Nadir)





Quick Look Product





QL is not a self-standing product to be requested/downloaded by the PRISMA user, but is associated to each archived product to support the user in data selection

Products Validation

- A systematic validation process is foreseen both during the commissioning phase (Performance Assessment) and during the operational phase (Performance Monitoring).
- The Validation involves the assessment of the accuracy of data and products, over the relevant spatial and temporal domains.
- The overall approach for validation is based on an extensive use of ground-based datasets.
- The PRISMA Calibration/Validation (Cal/Val) Plan is under definition.
- A PRISMA Calibration and Validation Working Group will provide support for the definition of the mission calibration and validation strategies. This group will monitor and control the high mission performances and data exploitation.
- PRISMA Science Community will be involved in CAL/VAL activities.

HSIS

Hyper Spectral Image Simulator (HSIS) is included in the PRISMA system, as part of the IDHS G/S Element.

- ingests as input either synthetic or real surface reflectance/radiance images, compatible with PRISMA sensor characteristics. Input radiance and/or reflectance data can be generated starting from synthetic images or from other satellite or airborne hyperspectral radiance images;
- produces simulated PRISMA-like imagery in the spectral range of interest ([0.4-2.5] µm) integrating into a single tool all the relevant knowledge about the instrument, the radiation source, the atmosphere, and the observed scene.
- Used for the Validation of the production chain before its integration in the Processing Subsystem, thanks to its capability of simulating all the relevant knowledge about the instrument, the orbit, the radiation source, the atmosphere and the observed scene.

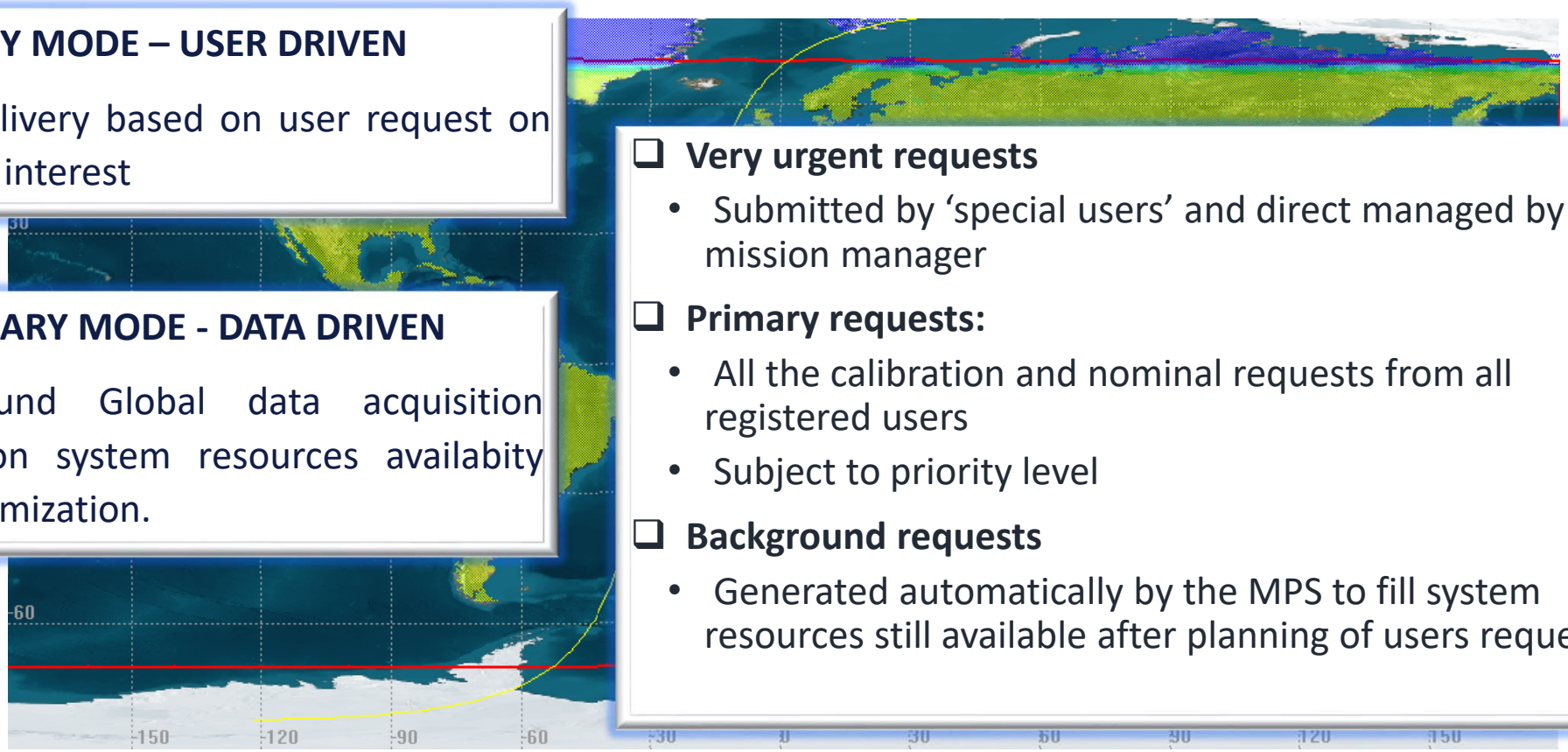
Mission Highlight

PRIMARY MODE – USER DRIVEN

Data Delivery based on user request on areas of interest

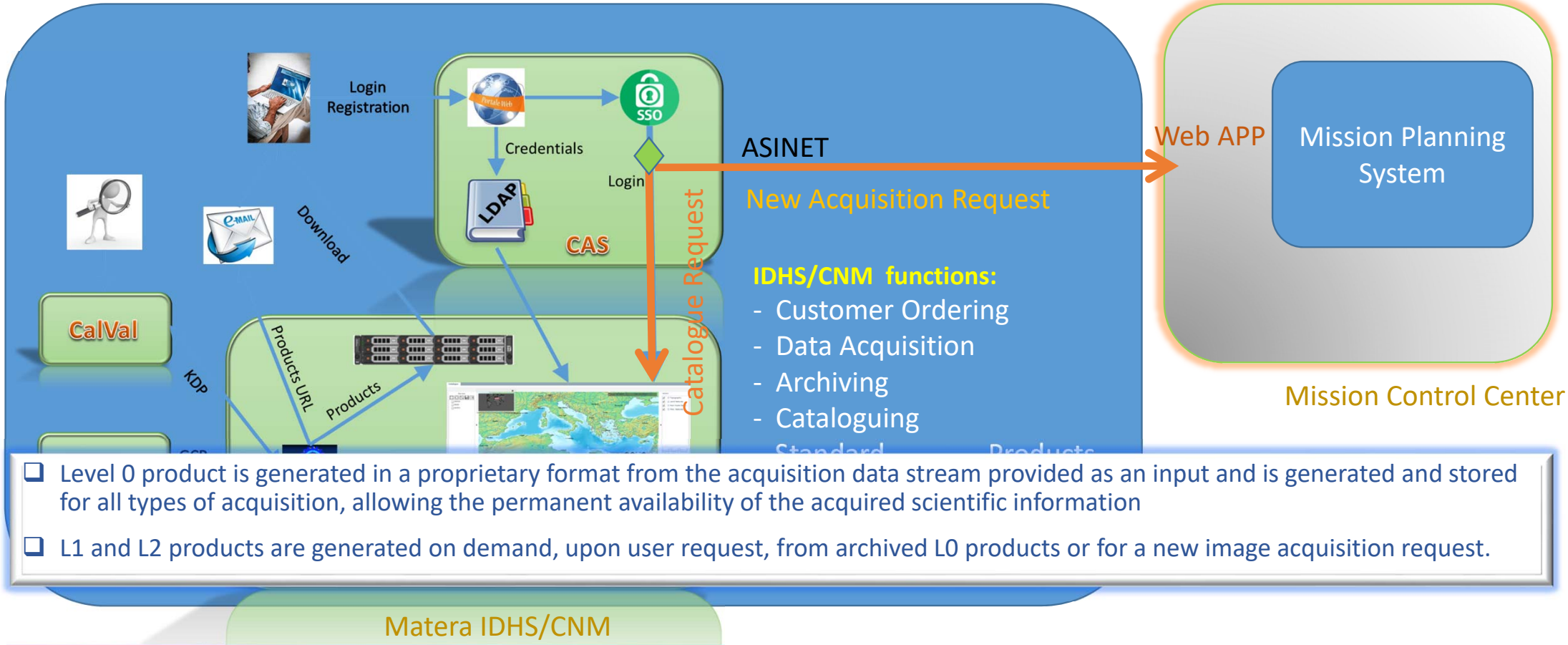
SECONDARY MODE - DATA DRIVEN

Background Global data acquisition based on system resources availabity and optimization.



- **Very urgent requests**
  - Submitted by 'special users' and direct managed by the mission manager
- **Primary requests:**
  - All the calibration and nominal requests from all registered users
  - Subject to priority level
- **Background requests**
  - Generated automatically by the MPS to fill system resources still available after planning of users requests

Mission Data Access



- Level 0 product is generated in a proprietary format from the acquisition data stream provided as an input and is generated and stored for all types of acquisition, allowing the permanent availability of the acquired scientific information
- L1 and L2 products are generated on demand, upon user request, from archived L0 products or for a new image acquisition request.

Mission Access

Users can select some image acquisition parameters

- SZA
- off nadir angle
- Validity time window (within one repeating cycle; 29 days)
- Maximum cloud coverage
- Image geographic coordinates
  - Spot: image center coordinates
  - Strip: coordinates of a point of the strip and the strip length before and after that point

Data Policy

High level DATA POLICY (ASI-MoD)

for all the National Public EO Civil & Dual Missions

CSG guidelines for Data Access

PRISMA guidelines for Data Access

(To be Approved)

PRISMA – Applications

The combined hyperspectral and panchromatic products give the capability of recognition of the geometric characteristics of a scene and may provide detailed information about the chemical composition of materials and objects on the Earth surface, giving enormous impacts to remote sensing applications.

The main benefits are expected in the field of:

- **Forest analysis** (e.g., forest disturbance, forest fires, forest classification, biomass analysis),
- **Precision agriculture** (e.g., crop mapping, crop rotation, crop stress analysis, fertilization)
- **Inland and Coastal waters** (e.g., Water quality ,chlorophyll monitoring, alga bloom)
- **Climate change & Environmental research** (e.g., desertification, deforestation, vegetation stress, environmental degradation and hazards)
- **Raw material exploration and mining**
- **Soil degradation and soil properties**
- **…**

PRISMA – National Mission

Original contribution to Remote Sensing applications & Significant role in the upcoming international scenario

- PRISMA an Opportunity for R&D initiatives
  - Data Processing and Data Exploitation
  - New Products (Data Fusion)
  - Pre-operational downstream services
  - Exploitation Platforms
- National contribution for EU/International EO programs
  - Technology for SHALOM, Copernicus
  - Sinergy with non ASI mission (FLEX)

PRISMA Data Exploitation Strategy

- Data Exploitation Plan and Activities in the perspective of future hyperspectral missions (SHALOM, FLEX, Hyperspectral Copernicus Mission)
- Science and User Community will be involved
  - PAGE (PRISMA Advisory Group for Exploitation)
  - R&D activities for innovative data exploitation algorithms and pre-operational products
  - CAL/VAL activities
  - Workshops
  - ….

Grazie

For more information:

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PRISMA web-site

http://www.prisma-i.it/