SHALOM: SPACEBORNE HYPERSPECTRAL APPLICATIVE LAND AND OCEAN MISSION: A JOINT PROJECT OF ASI-ISA AN UPDTAE FOR 2014

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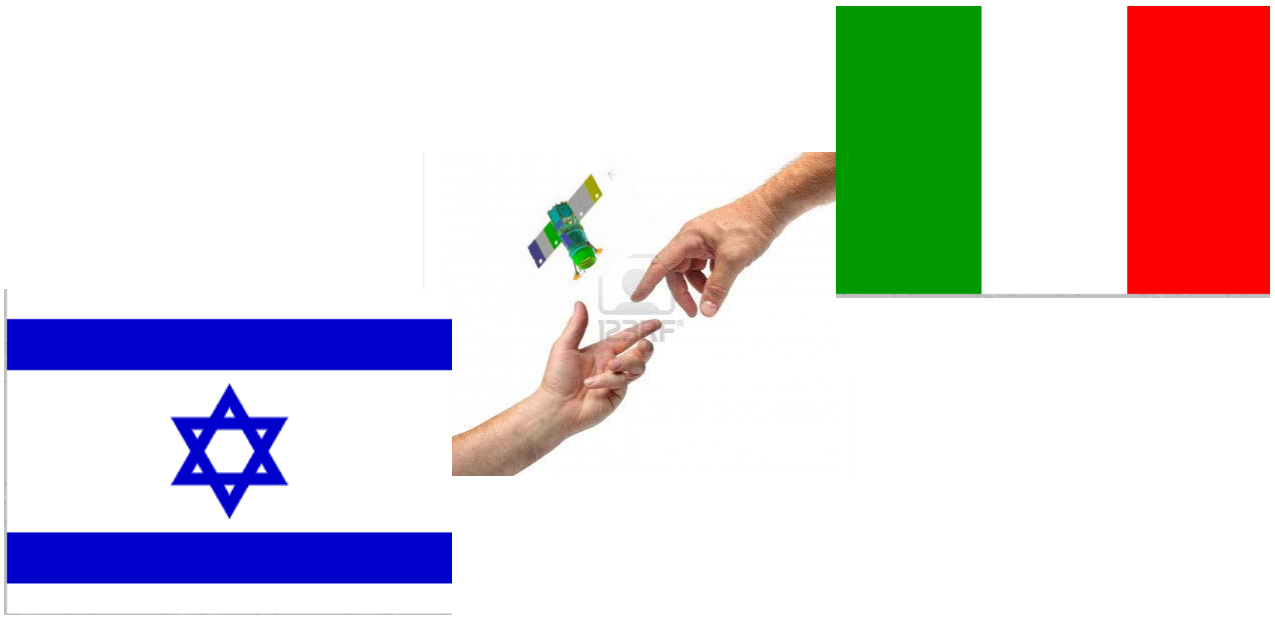
THE REMOTE SENSING LABORATORIES

ASI – ISA joint collaboration agreement

The Agenzia Spaziale Italiana (ASI) and Israeli Space Agency (ISA) signed on 16 June 2009 a Cooperation Agreement in the area of Earth Observation .



International Collaboration between Italy and Israel Space Agencies

ASI ISA

Highlight - SHALOM

Supported by Ministry of Science Technology and Space (Israel) and Ministry of of Education, Universities and Research (Italy)

Industry involvement

Italian side:

- Selex Galileo
- ThalesAlenia
- Telesprazio

Israeli side:

- Israel Aerospace Industry
- Elbit System (ElOP)

The Mission Scope

SHALOM is an HSR Earth observation mission driven by operational and commercial needs that will provide high spatial , spectral and temporal resolutions of the Earth from space.

The Concept of SHALOM

The **Mission Data Users** are the primary beneficiaries of the Mission.

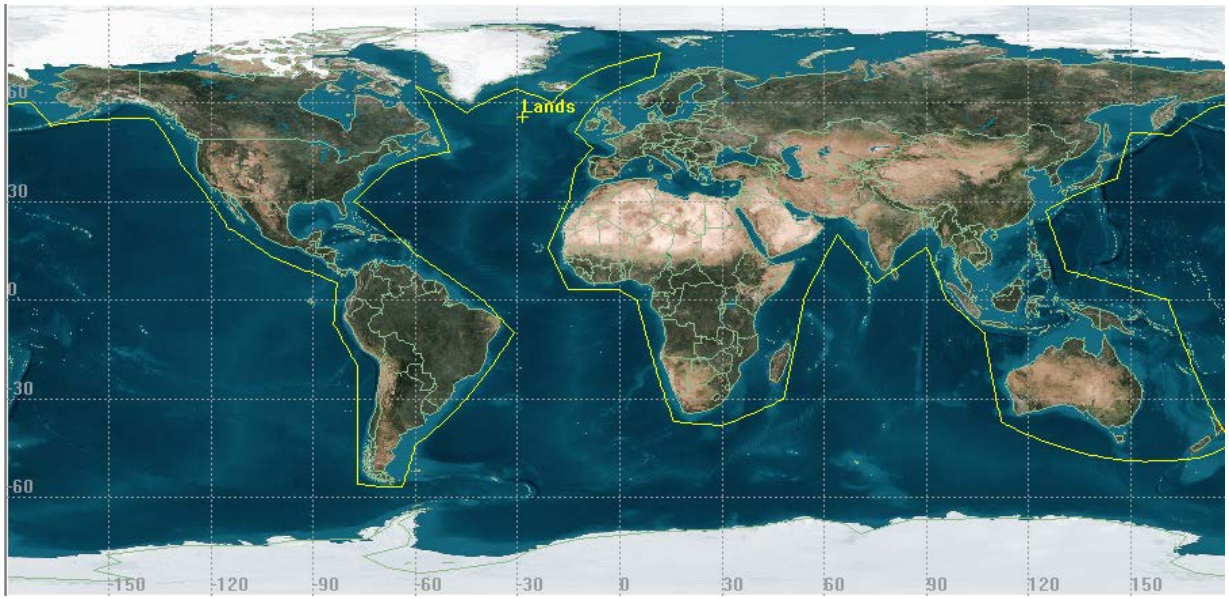
- Only **civilian operational** users and **scientific entities** are currently foreseen to exploit the system according to their needs.

- Establishing commercial RND segments in both countries to **commercialize** "thematic" data.

- Support the **scientific community** in both countries using HSR technology

Coverage Area

- Imagery area selection rules:
  - Sun zenith angle > 30°
  - Within ±70 ° latitude).
  - Imaging above all terrestrial areas and sea-shores,



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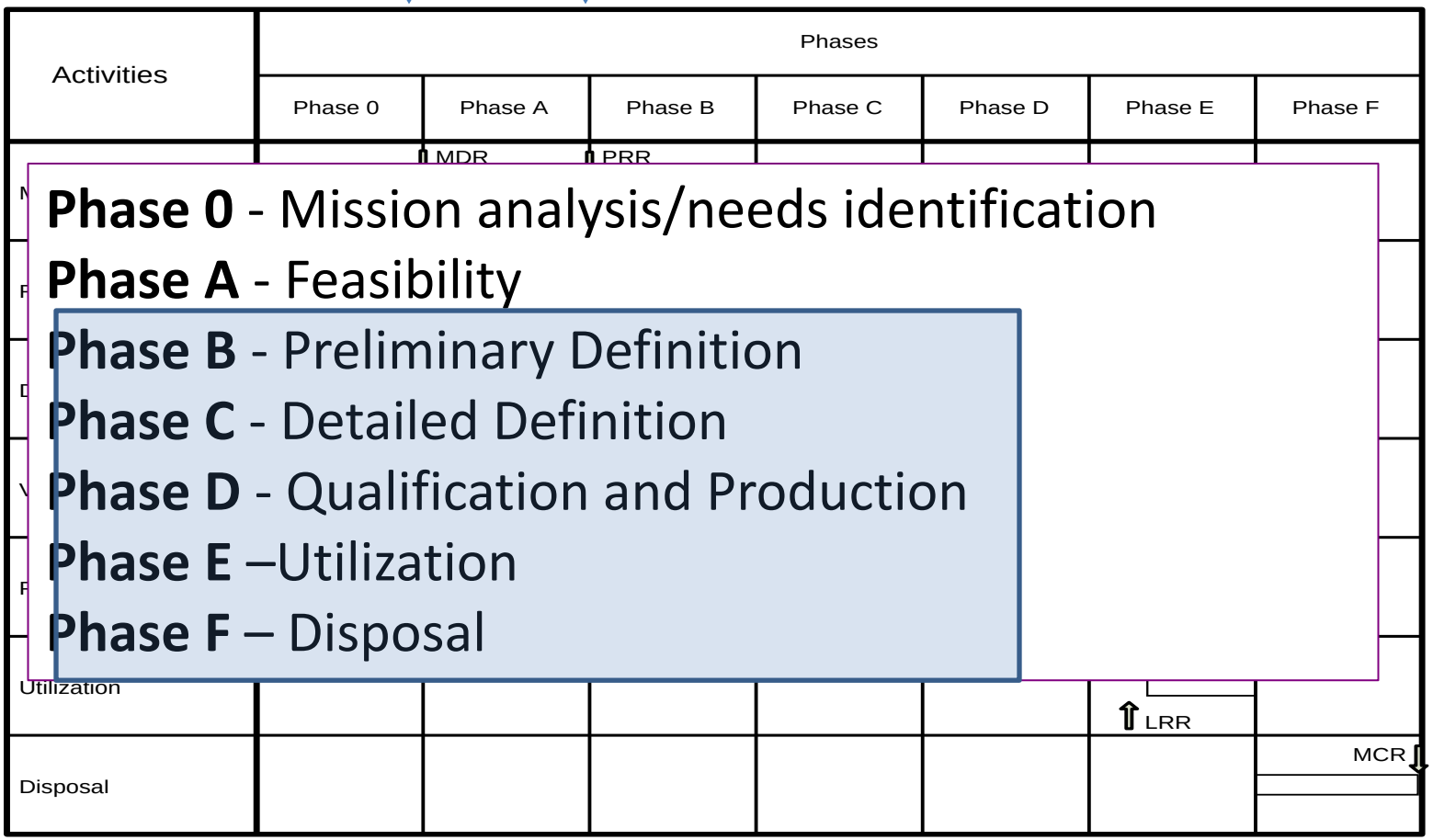
2019
Launch

2012 2013 2014 015 2016 2017 2018



Phase 0 - Mission analysis/needs identification

Phase A - Feasibility

Phase B - Preliminary Definition

Phase C - Detailed Definition

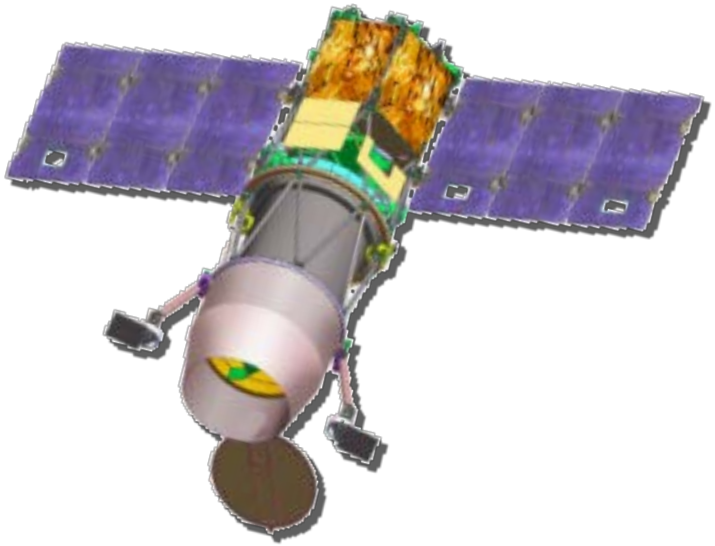
Phase D - Qualification and Production

Phase E –Utilization

Phase F – Disposal

SHALOM - Spaceborne Hyperspectral Applicative Land and Ocean Mission

- System characteristics:
  - Spatial resolution
    - **Pan - 2.5 m @ 600 Km Orbit height**
    - **Hyperspectral - 10 meters @ 600 Km Orbit height**
  - Spectral bands - 241 bands @ 0.4µm – 2.5µm
  - Spectral resolution ~ 10nm
  - Swath – 10km
  - **Daily area coverage - 200,000Km^2**
  - **Revisit time – 2 days**



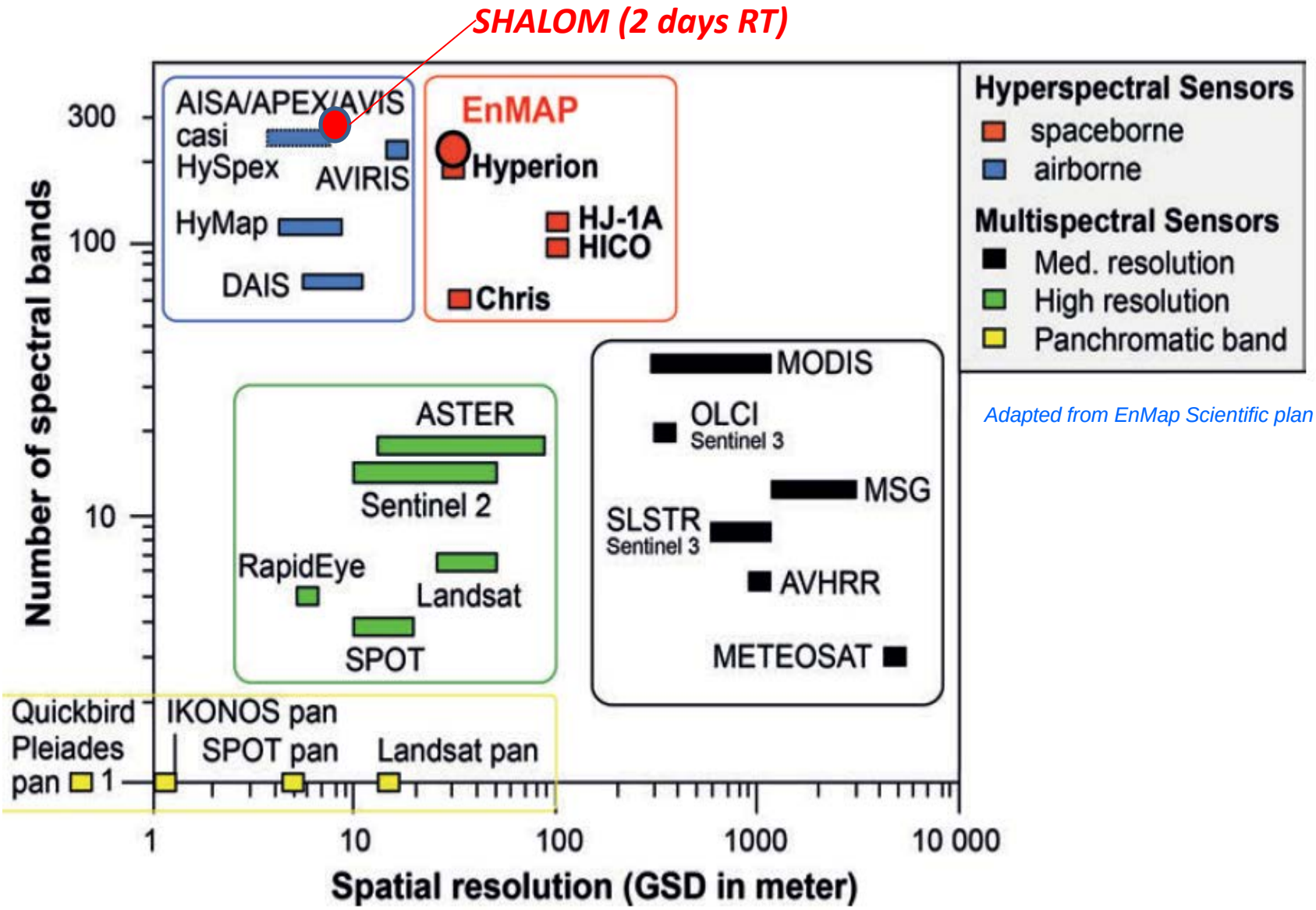
PARAMETER	THRESHOLD
Orbit type	Low Earth Orbit Sun-Synchronous Frozen
Orbit geometry	Altitude 500…900 km Local Time at equator 10.0 … 11.30
Along Track Image length	200 Km
Maximum solar zenith angle for imaging	65 deg (Arctic)
Maximum Roll angle off nadir at the satellite from the center of the swath	±30 deg
Acceptable cloud coverage with quick look	30%

Swath width

	10 Km
Ground Sampling Distance (GSD)	
VNIR, SWIR	10m
PAN	2.5 m
Spectral coverage Hyperspectral	
VNIR	400-1010 nm
SWIR	920-2500 nm
Spectral band PAN	400 –700 nm
Spectral resolution (FWHM)	
VNIR	10 nm
SWIR	10 nm
Spectral sampling interval	
VNIR	10 nm
SWIR	10 nm
SNR (VNIR)	
@ approx. 650nm	≥600:1
between 400nm and 1000nm.	≥200:1
SNR (SWIR)	
@ approx. 1550nm	≥400:1
between 1000nm and 1750nm.	≥200:1
@ approx. 2100nm	≥200:1
between 1950nm and 2350nm.	≥100:1
SNR (PAN)	≥240:1

241 bands

SHALON vs. other HSR Sensors



Adapted from EnMap Scientific plan doc.

Mission Objectives

- Provide high-resolution (spectral, spatial, temporal) data of geo-chemical geo-physical and geo-biological variables

- Provide thematic digital maps of the above parameters such as: environmental quality, crisis monitoring, search for mineral and natural resources, monitoring water bodies, assisting precision agriculture activity etc..

- Enable quantitative measurement of currently immeasurable (space) parameters that are required by a wide range of end users

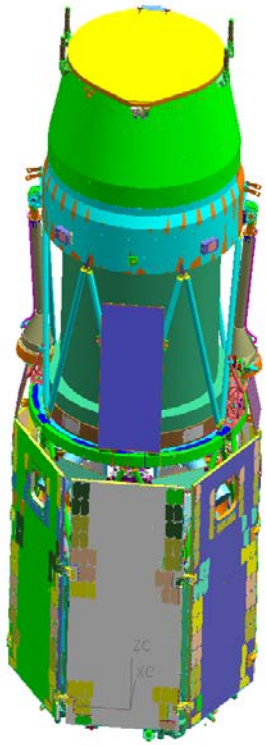
- Provide high quality calibrated data as input for generating thematic maps and models for monitoring those parameters

Major Scope and Activities:

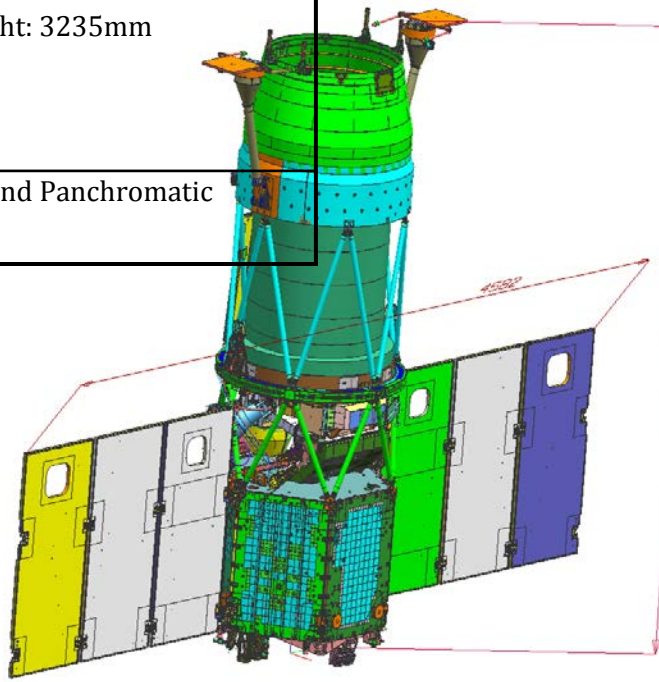
TO:

- **Define users' needs and work on market development**
- **Acquire HSR Images**
- **Generate products (all levels)**
- **Disseminate of (available) thematic products**
- **Provide a taylor made suit for potential end user**
- **Exploit the huge amount of HSR algorithms available in the literature and implement them for the benefit of the end user**

SHALOM S/C BUS is based on OPTSAT 3000



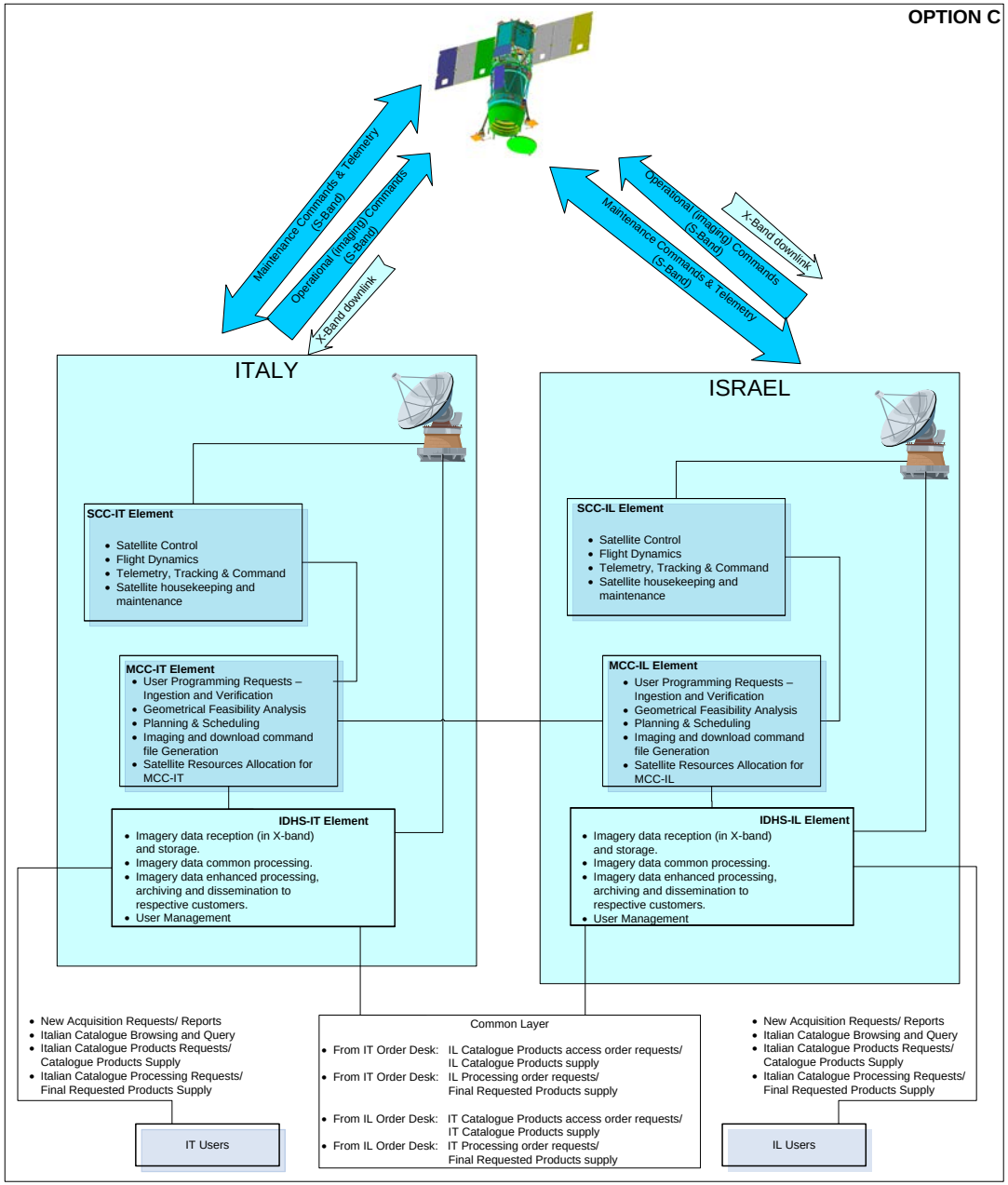
	Manufactured by	MBT SPACE/ IAI
	Launch date	2019?
	Launch Mass	385 Kg
	Satellite Dimensions: Stowed	Diameter: 1208 mm Height: 3235mm
	Payload	Hyper Spectral and Panchromatic Imager

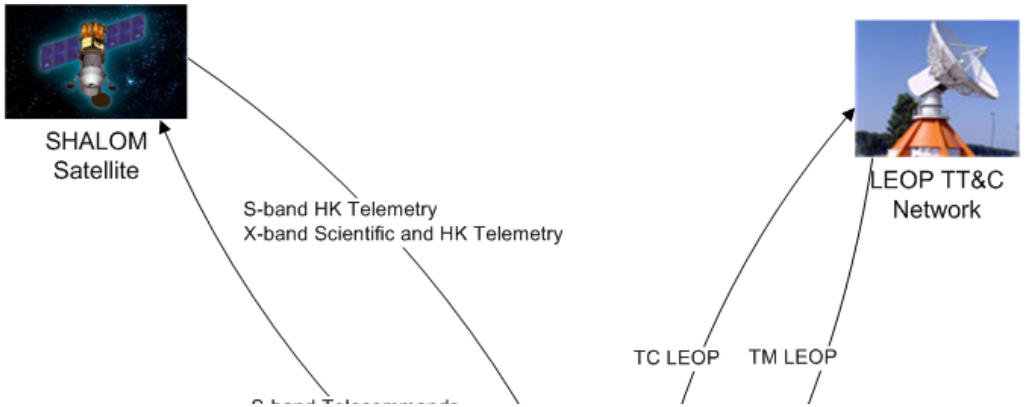


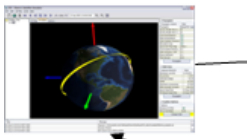
A Mission operations and Satellite control facility

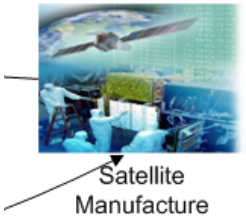
Will be shared by the countries to meet the following:

- Ground Stations for data reception
- Facilities for data processing and archiving
- Sales and purchase order management system
- Means for distribution of data to potential users


OPTION C
Maintenance Commands & Telemetry (S-Band)
Operational (imaging) Commands (S-Band)
X-Band downlink
Operational (imaging) Commands (S-Band)
X-Band downlink
Maintenance Commands & Telemetry (S-Band)
ITALY
ISRAEL
SCC-IT Element
Satellite Control
Flight Dynamics
Telemetry, Tracking & Command
Satellite housekeeping and maintenance
SCC-IL Element
Satellite Control
Flight Dynamics
Telemetry, Tracking & Command
Satellite housekeeping and maintenance
MCC-IT Element
User Programming Requests – Ingestion and Verification
Geometrical Feasibility Analysis
Planning & Scheduling
Imaging and download command file Generation
Satellite Resources Allocation for MCC-IT
MCC-IL Element
User Programming Requests – Ingestion and Verification
Geometrical Feasibility Analysis
Planning & Scheduling
Imaging and download command file Generation
Satellite Resources Allocation for MCC-IL
IDHS-IT Element
Imagery data reception (in X-band) and storage.
Imagery data common processing.
Imagery data enhanced processing, archiving and dissemination to respective customers.
User Management
IDHS-IL Element
Imagery data reception (in X-band) and storage.
Imagery data common processing.
Imagery data enhanced processing, archiving and dissemination to respective customers.
User Management
New Acquisition Requests/ Reports
Italian Catalogue Browsing and Query
Italian Catalogue Products Requests/ Catalogue Products Supply
Italian Catalogue Processing Requests/ Final Requested Products Supply
IT Users
Common Layer
From IT Order Desk: IL Catalogue Products access order requests/ IL Catalogue Products supply
From IT Order Desk: IL Processing order requests/ Final Requested Products supply
From IL Order Desk: IT Catalogue Products access order requests/ IT Catalogue Products supply
From IL Order Desk: IT Processing order requests/ Final Requested Products supply
New Acquisition Requests/ Reports
Italian Catalogue Browsing and Query
Italian Catalogue Products Requests/ Catalogue Products Supply
Italian Catalogue Processing Requests/ Final Requested Products Supply
IL Users

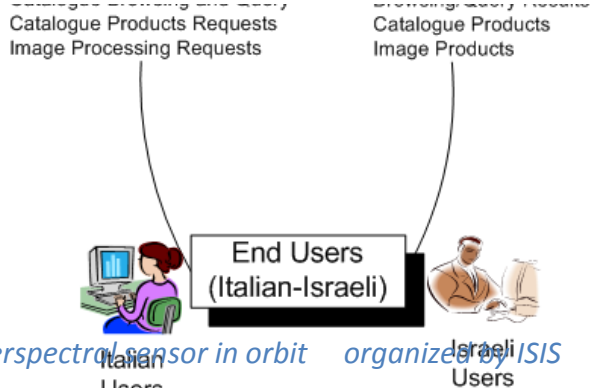






The ground segment will include :

- A Mission Control Centre (MCC)
- A Satellite Control Centre (SCC)
- An Image Data Handling and Processing (IDHS)
- A ground communication network (GSNet)
- A Commercial discriminating Centre (CDC)



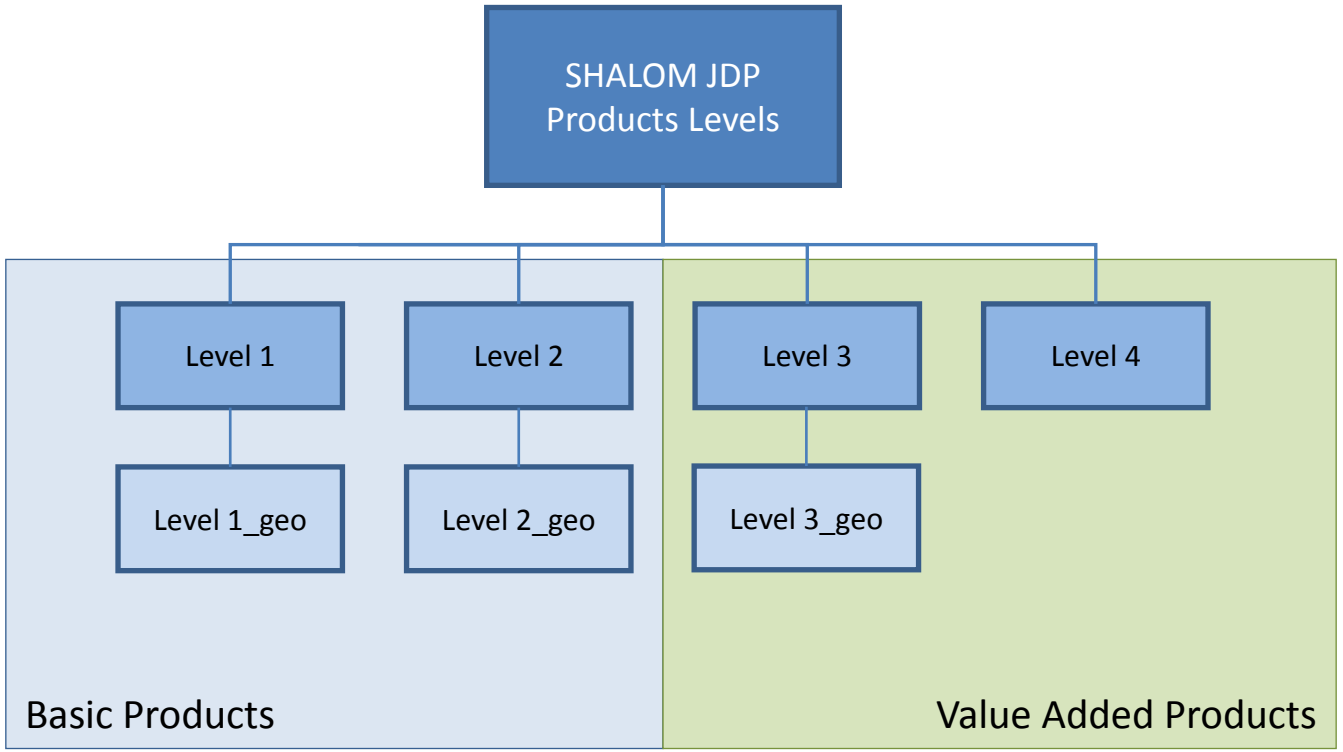
A Market Survey Analysis

shows that:

- **HSR products will be demanded by many end-users**
- **Good products will be required and customers are willing to pay**
- **Many applications are not yet available and the “application per suit” concept is promising**
- **The HSR market has a promising potential**

Product Name
Crop, Rangeland and Invasive Species Map
Burnt Area Map
Vegetation Status Indicators
Vegetation Damage and Stress Indicators
Fire Fuel Map
Mineral Map
Coastal Bathymetry Map
Urban And industrial Functional Area Map
Lithological Map
Lava Flow Parameters
Soil Surface Pollutants Map
Volcanic Gas And Aerosol Emission Map
Forest Species Map
Forest Biomass Map
Ice Cover Map
Soil Characterization Map
Land Cover Map
Land Cover Change Detection Map
Snow Cover Map
Forest Nitrogen and Chlorophyll Map
Wetlands Classification Map
Marine And Aquatic Quality And Productivity Indicators
Lava and ash distribution map
Snow And Ice Cover Characterization

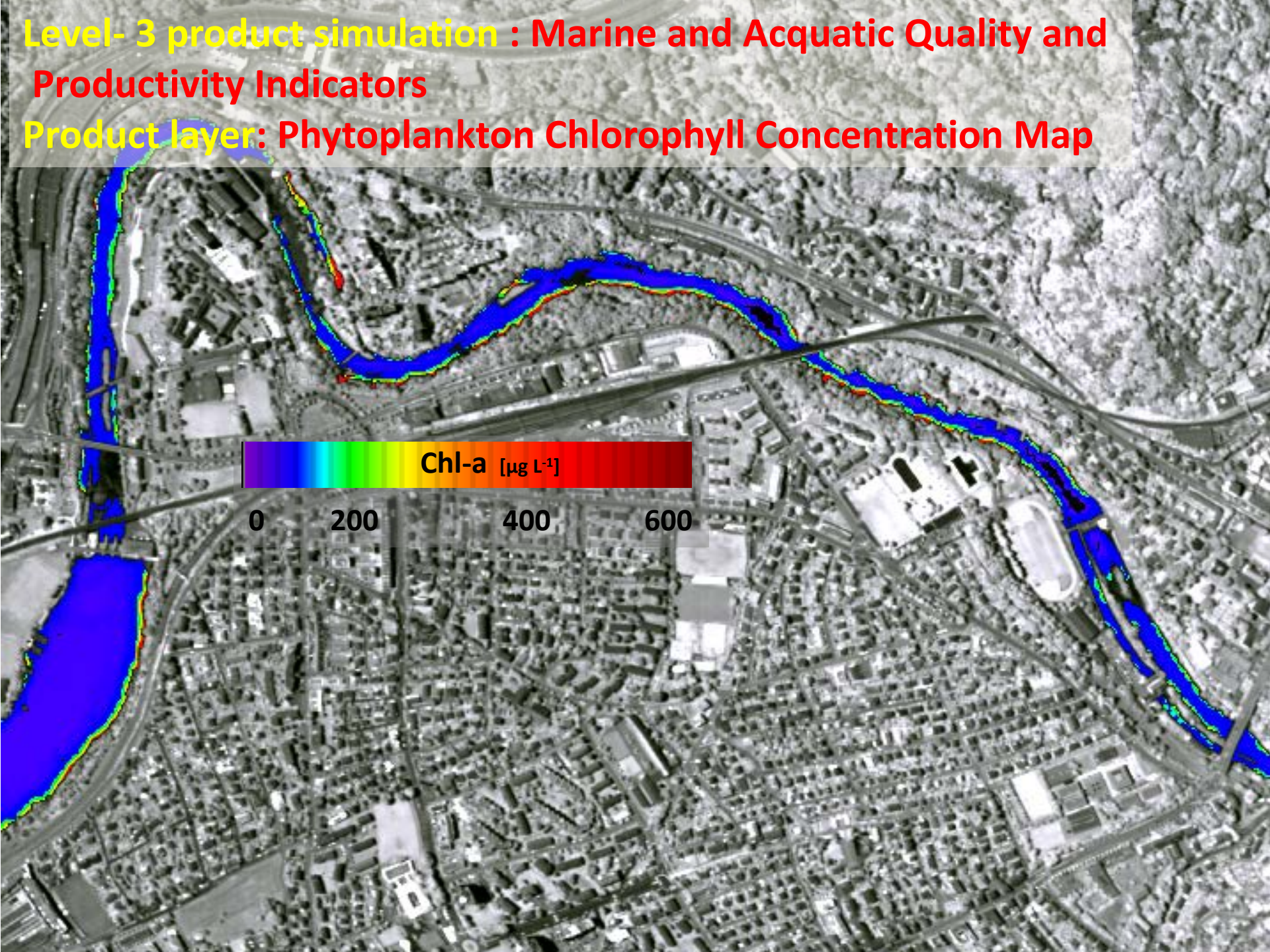
1.Main Possible applications/products:
1.MARKETING PLAN


SHALOM JDP
Products Levels
Level 1
Level 2
Level 3
Level 4
Level 1_geo
Level 2_geo
Level 3_geo
Basic Products
Value Added Products

Product Level	Product Type	Bands	Description
Level 1	At sensor radiance	VNIR/SWIR	At-sensor radiance: absolute radiometric correction applied, coregistration (spatial and spectral) performed. lat and lon data of each pixel provided.
		PAN	Visual data after applied non-uniformity correction, 'contrast stretch' and cloud corrections. Lat and lon data of each pixel provided.
	Cloud mask		Clear/cloudy pixels
Level 1_geo	Geocoded at-sensor radiance	VNIR/SWIR	Geocoded Level 1 product
		PAN	
Level 2	Surface reflectance	VNIR/SWIR	Surface reflectance, geographic pixel location (lat, lon) provided.
		PAN	
Level 2_geo	Geocoded Surface Reflectance	VNIR/SWIR	Geocoded Level 2 products
		PAN	
Level 3	Geophysical / geochemical / biophysical / biochemical parameters		Surface cover map of geophysica, geochemical, biophysical, biochemical parameters, derived from level 1 and level 2 products.
Level 3_geo			Geocoded Level 3 products
Level 4	Geocoded Info		Info derived from post-processing of Level 3_geo products, e.g. trend computation for selected geophysical, geochemical, biophysical, biochemical parameters

Level- 3 product simulation : Marine and Acquatic Quality and Productivity Indicators

Product layer: Phytoplankton Chlorophyll Concentration Map



Raw Data policy

- The ground segment allows storing all level 0 products, together with their relevant calibration data applied.
- All products having level higher than 0 can be forever generated at any time.
- The ancillary data shall be archived for the same period as level 0.
- The data archived shall be maintained without degradation for at least of 10 years after commissioning.

Summary and Conclusions

- SHALOM in an ambitious HSR mission carrying out by a joint agreement between ASI & ISA
- The data quality and characteristics (spatial , spatial and temporal resolutions) will meet new standards
- A commercial needs for HSR products shows a promising potential
- A commercial operational concept is the driving force behind the SHALOM mission
- The scientific community will have an open door for the SHALOM mission and data
- Phase B is waiting for funding agreement between the two governments.

Makhtesh Ramon Israel, as a supper site for HRS vicarious calibration

SELEX GALILEO
A Finmeccanica Company

Elbit Systems

IAI
ISRAEL AEROSPACE INDUSTRIES

TELESPAZIO
A Finmeccanica / Thales Company

ThalesAlenia Space