European Commission

Copernicus
today and tomorrow

Webinar “Scaling up the Sentinels in Europe”

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European Commission

Space

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Copernicus
Europe's eyes on Earth

COPERNICUS ARCHITECTU

Copernicus

FULL, FREE AND OPEN DATA

Sentinels

6 services use Earth Observation data to deliver…

…added-value products

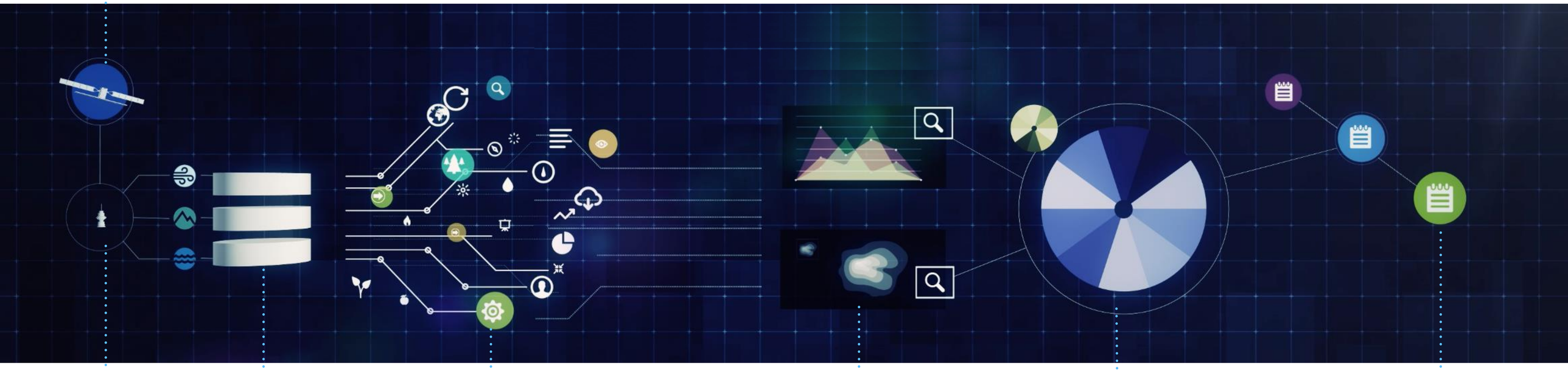
Contributing missions

In Situ

COPERNICUS COMPONENTS

OM GLOBAL EARTH OBSERVATION DATA TO LOCAL INFORMATION AND PRODUCTS

SENTINELS & CONTRIBUTING MISSIONS



IN SITU SENSORS DATA SERVICES INFORMATION TAILORED PROCESSES PRODUCTS

REACHING AN OPERATIONAL PROGRAMME

FROM 2000 T0 2013

ESA - Space Segment (ESA + EU Budget)
EU - Development of Applications
EU contribution mainly rough R&D Budget (FP6, 7, ….) - Annual Calls, several EU partners

AS FROM 2014

ESA - Space Segment (ESA + EU Budget)
EU Operational budget (4,3B€ 2014-2020)
Delegation Agreements, tenders, service specifications

R&D

R&D & Innovation

Preparatory actions

Horizon 2020 RD&I support for Copernicus
-Continuity in transfer (particularly in 2014)
-Downstream applications & uptake
-Service evolution R&D based on op. service feedback (especially post 2015)

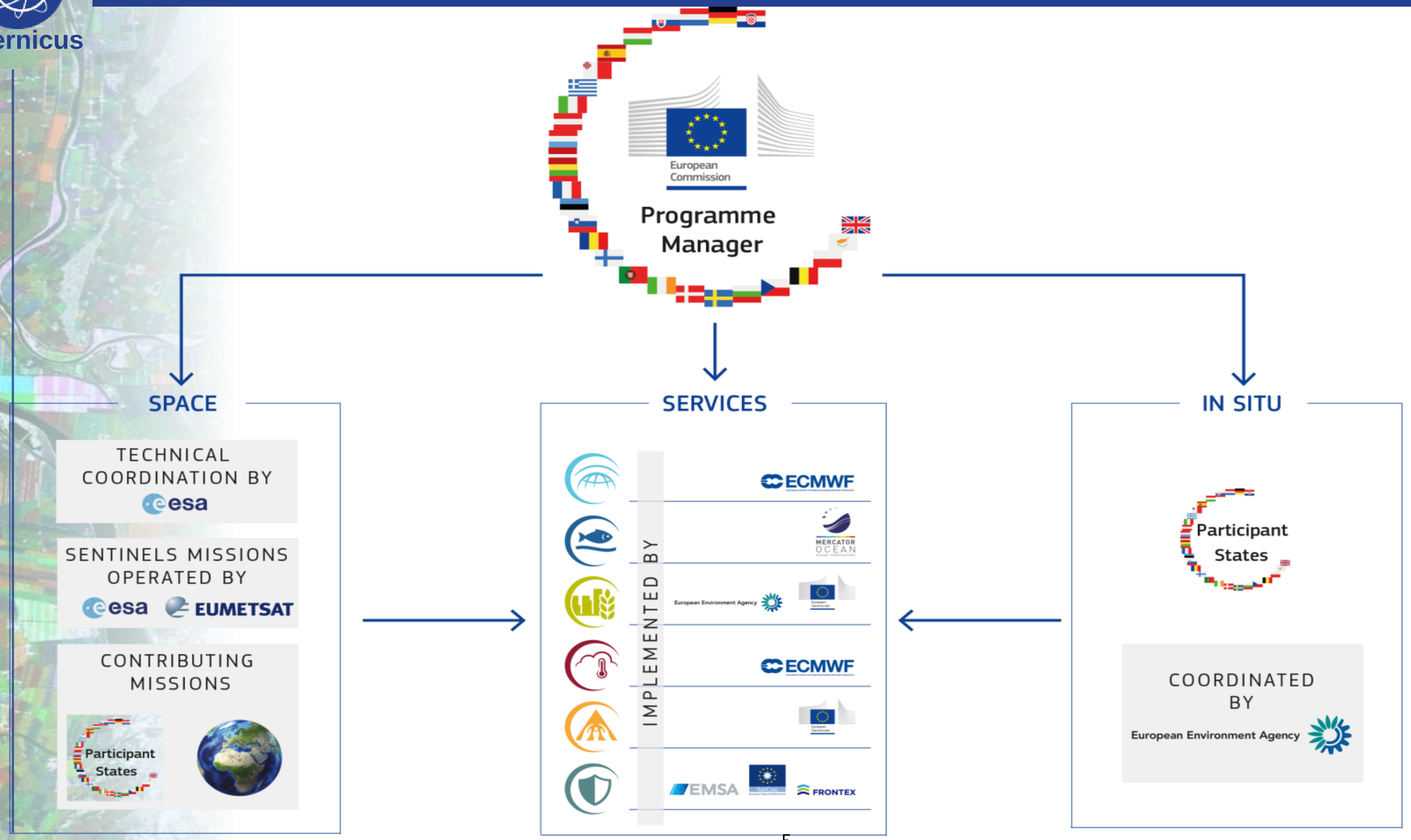
EU operational programme

*ESA and EU budgets are still subject to negotiations with MS

5.4B€ (tbc) by EU (next MFF
2.4B€ (tbc) ESA CSC-4 prog

2000 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024

COPERNICUS GOVERNANCE



THE SENTINELS

Sentinel Mission and Status		Key Features
 **SENTINEL-1:** 4-40m resolution, 3 day revisit at equator	*2 Sats in orbit*	Polar-orbiting, all-weather, day-and-night radar imaging
 **SENTINEL-2:** 10-60m resolution, 5 days revisit time	*2 Sats in Orbit*	Polar-orbiting, multispectral optical, high-res imaging
 **SENTINEL-3:** 300-1200m resolution, <2 days revisit	*2 Sats in Orbit*	Optical and altimeter mission monitoring sea and land parameters
 **SENTINEL-4:** 8km resolution, 60 min revisit time	*1st Launch in 2023*	Payload for atmosphere chemistry monitoring on MTG-S
 **SENTINEL-5p:** 7-68km resolution, 1 day revisit	*1 Sat in Orbit*	Mission to reduce data gaps between Envisat, and S-5
 **SENTINEL-5:** 7.5-50km resolution, 1 day revisit	*1st Launch in 2023*	Payload for atmosphere chemistry monitoring on MetOp 2ndGen
 **SENTINEL-6:** 10 day revisit time	*1st Launch in 2020*	Radar altimeter to measure sea-surface height globally

COPERNICUS SIX SERVICES

COPERNICUS SERVICES APPLICATIONS

- AGRICULTURE
- NATURAL DISASTERS
- SECURITY
- RENEWABLE ENERGIES
- AIR QUALITY
- FORESTRY
- URBAN MONITORING
- OIL & GAS
- MARITIME EXPLOITATION AND RESERVATION

7 Sentinel satellites in operations

All Sentinel missions remain operational during the lockdown and post-lockdown periods, with on-site activities gradually resuming in ESA establishments and within industry and institutions involved in Sentinel operations

All Sentinel missions are operated in full operations capacity

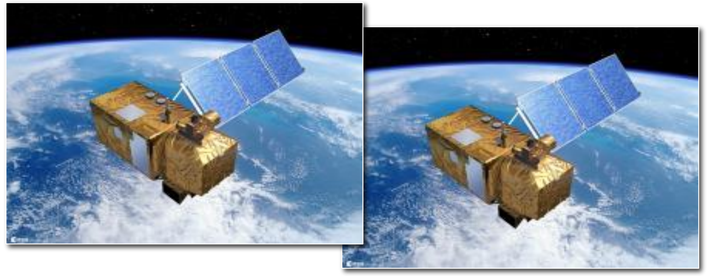
- *Reliable provision of Sentinel data to Copernicus users*
- *Sentinels operated via pre-defined observation plans (Sentinel-1 and -2)*

➔ **Sentinel-1A and Sentinel-1B** → **nominal operations**

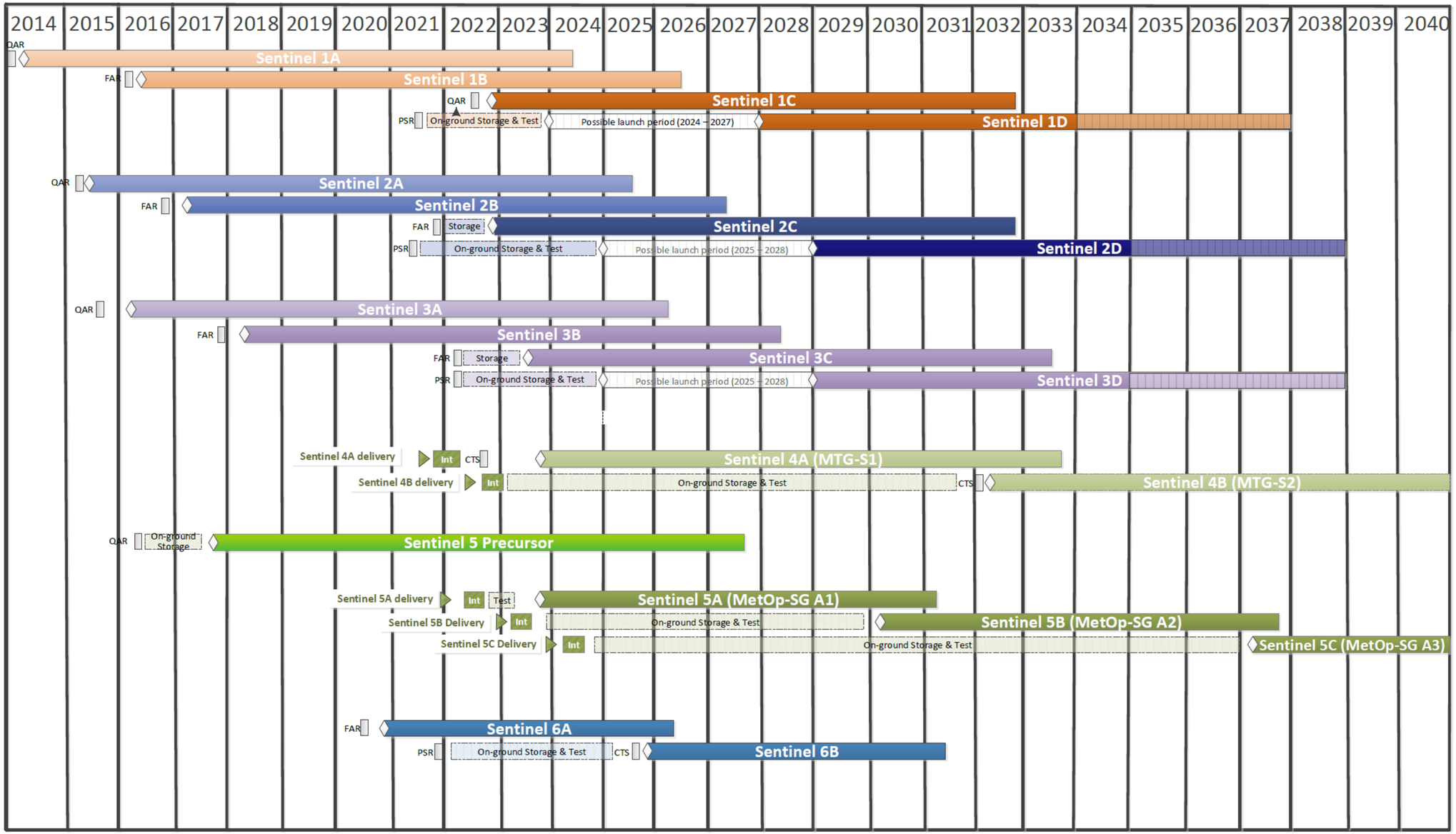
➔ **Sentinel-2A and Sentinel-2B** → **nominal operations**

➔ **Sentinel-3A and Sentinel-3B** → **nominal operations**

➔ **Sentinel-5P** → **nominal operations**



Indicative Copernicus Constellation Deployment Schedule



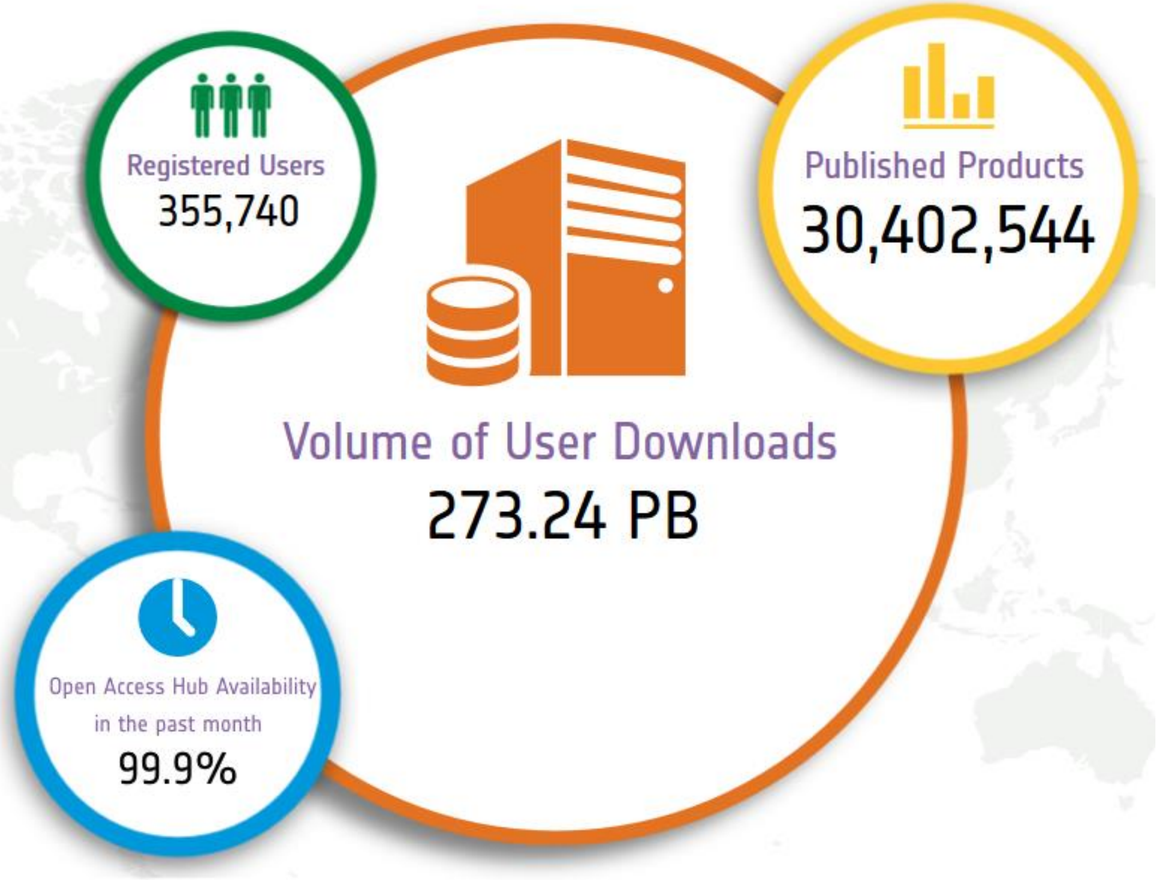
Legend:

- Qualification Acceptance Review (QAR)
- Flight Acceptance Review (FAR)
- PreStorage Review (PSR)
- Consent to Ship (CTS)
- On-ground Storage & Test — Satellite On-ground Storage & Test
- Satellite Test — Satellite Assembly, Integration & Test
- Int — Integration
- Tentative Launch Date

Date: 22 July 2020

Sentinels Data Access

Sentinels data access at ESA (4 different hubs)



The Sentinel data access availability remained excellent during the post-lockdown period with impressive numbers in terms of number of users, volume of user downloads and hubs availability

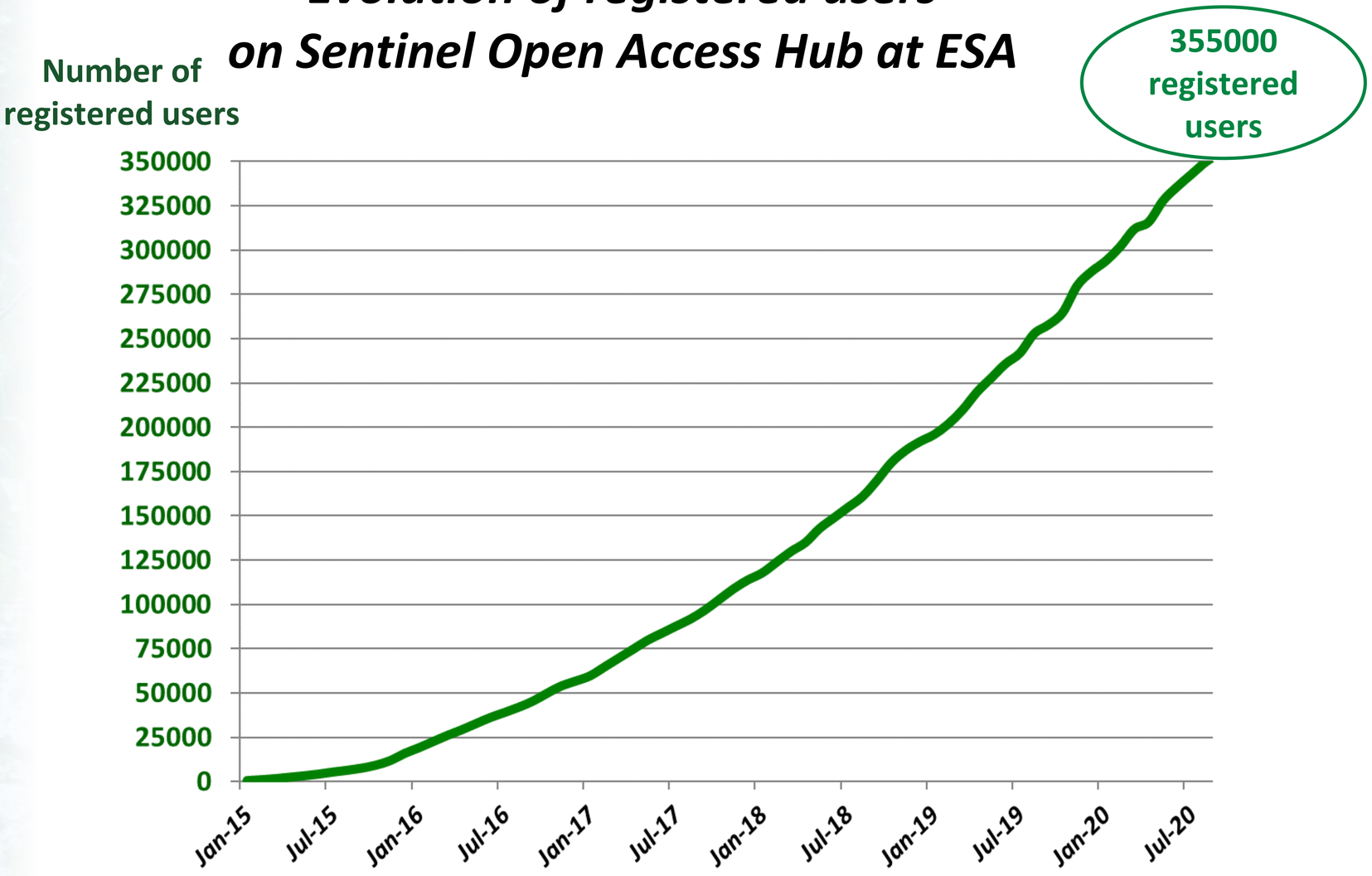
Sentinel data access 2019 report available at:
scihub.copernicus.eu/reportsandstats

Statistics at beginning September 2020

Sentinels Data Access

Copernicus

Evolution of registered users on Sentinel Open Access Hub at ESA

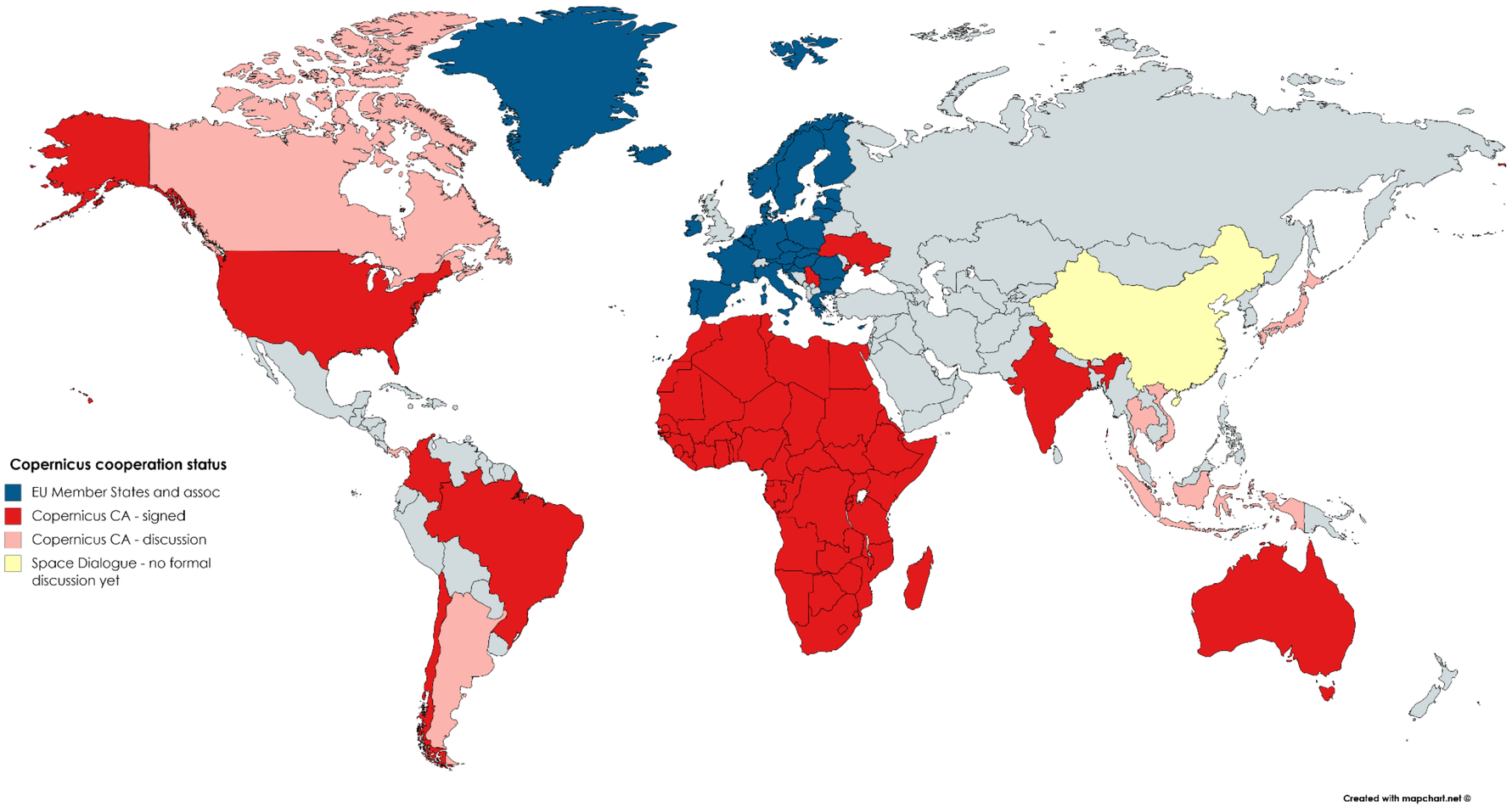


Statistics at beginning September 2020

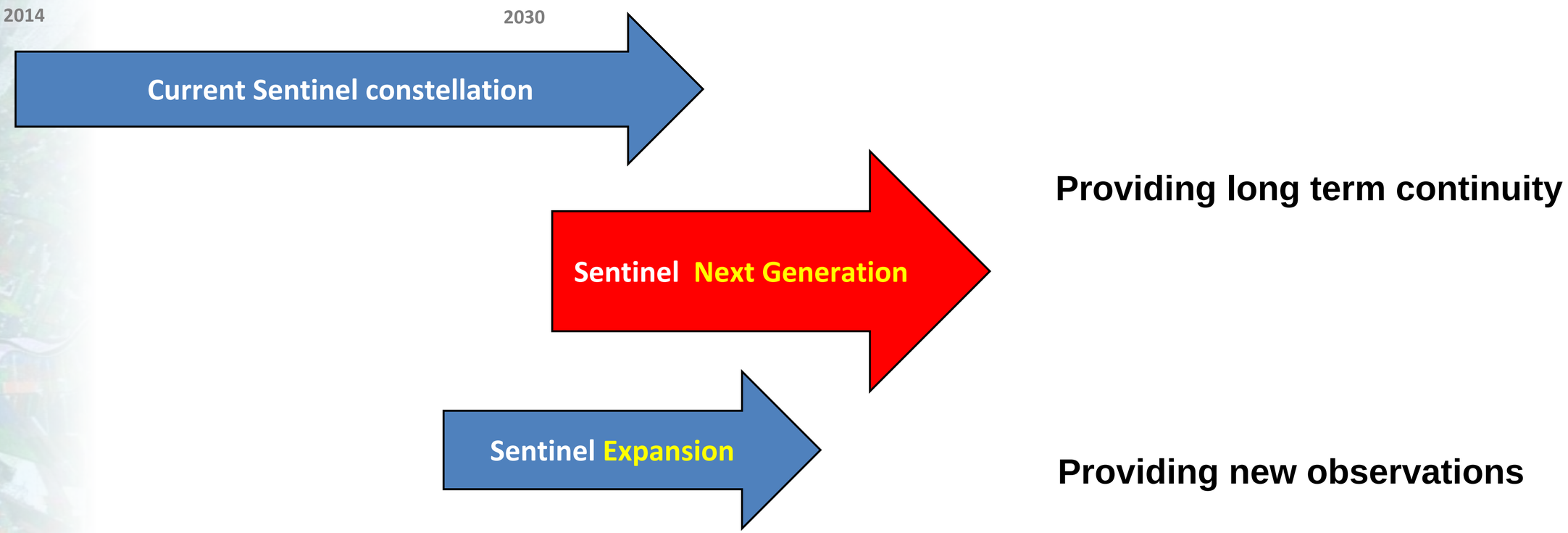
sentinel-1a
sentinel-1b
sentinel-2a
sentinel-2b
sentinel-3a
sentinel-3b
sentinel-5p

Copernicus international cooperation

Status Sept 2020



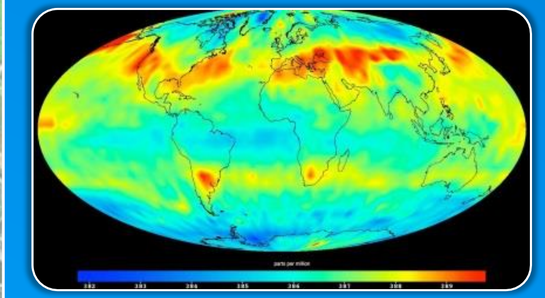
Evolution of the Copernicus Space Component beyond 2030



- Top priority is to ensure the enhanced continuity of current observations
- New observations to match the emerging user needs: climate change, the arctic and sustainable development; land use and agriculture; security/defense
- Adaption to new realities: new space, European resilience and strategic autonomy on key systems, geopolitical realities

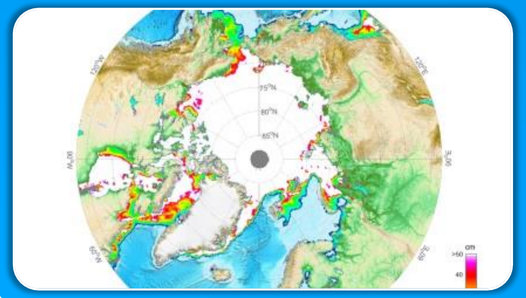
Identified user needs for new Copernicus observations

6 priority challenges have been identified …

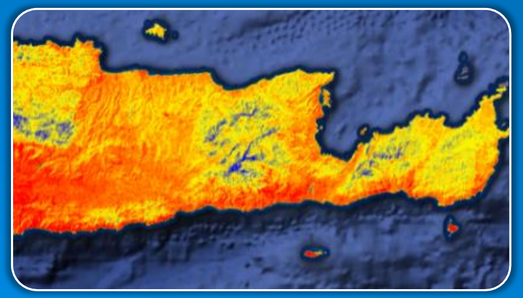


Causes Climate Change

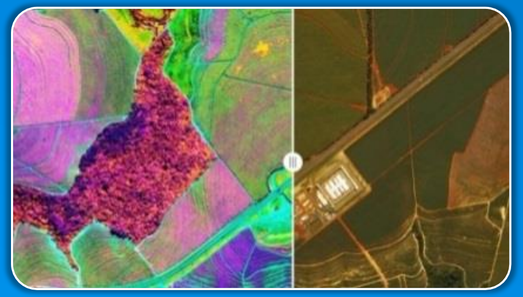
Effects Climate Change



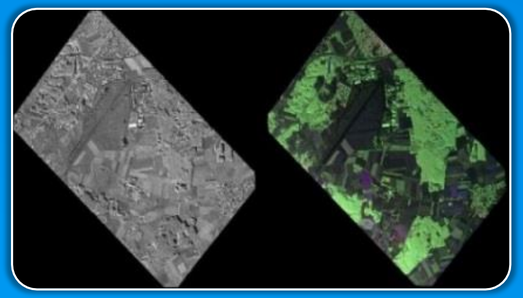
Sea Ice & Hydrology



Agriculture & Urban Mgmt.



Food Security, Soil & Minerals



Soil, Vegetation & Ground Motion

High Priority Cancidate Missions (Sentinel expansion missions)

Proposed Mission	Primary Observation Requirements to be addressed	
CO2	Monitoring of anthropogenic CO2 emissions at country/regional and megacities scale (priority mission, responding to the Paris Climate Agreement)	CO2M
Changes in the Arctic: Passive Microwave Radiometer	Sub-daily monitoring of Sea Ice concentration in the Arctic @ minimum 15KM^2 resolution in support of ship navigation	CIMR
Thermal Infrared	Crop-water use in support of agricultural production, Food security, water management and water abstraction policies	LSTM
Polar Ice and Snow topography mission	Land ice elevation and sea-ice thickness and snow loading in support of climate change applications	CRISTAL
L-Band SAR Mission	Measurements of forest cover, Ground movement and deformation	ROSE-L
Hyperspectral measurements	Sustainable use of natural resources, i.e. in Agriculture (nutrients, water, soil properties), exploration of raw materials and mine environment management	CHIME

Potential Sentinel Expansion and Next Generation Missions

Microwave Imaging Family:

- Copernicus Imaging Microwave Radiometry (Sentinel-CIMR)
- Radar Observing System for Europe L-band SAR (Sentinel-ROSE-L)
- Sentinel-1 Next Generation (C-band SAR mission)

Optical Imaging Family:

- Sentinel-2 Next Generation
- Sentinel-3 Next Generation - optical
- Land Surface Temperature (Sentinel-LSTM)
- Copernicus Hyper-spectral Imaging (Sentinel-CHIME)

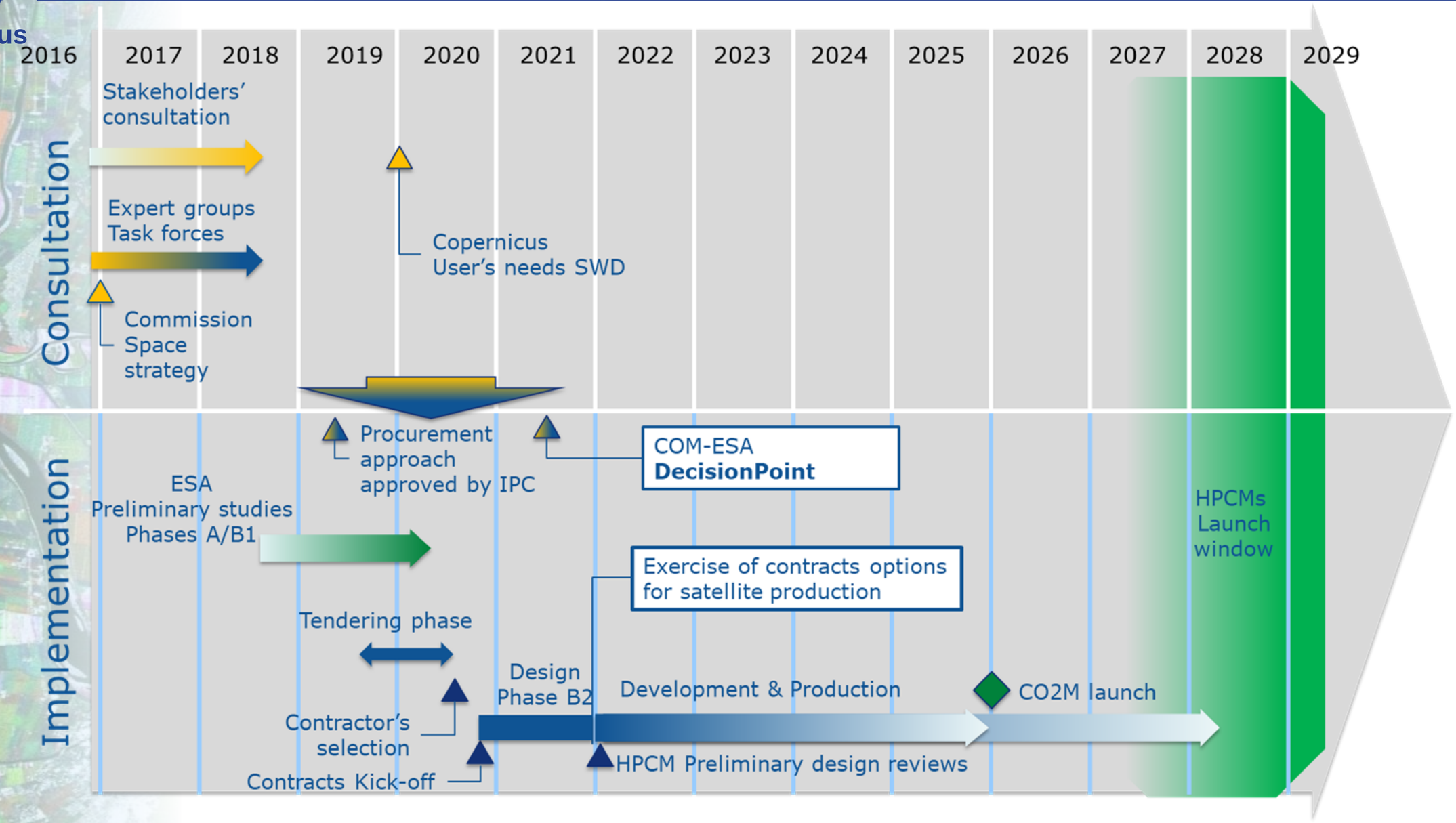
Topographic Measurement Family:

- Sentinel-3 Next Generation - topographic mission;
- Copernicus polaR Ice and Snow Topographic ALtimeter (Sentinel-CRISTAL)
- Sentinel-6 Next Generation

Spectroscopic Atmosphere Measurement Family:

- Copernicus Anthropogenic CO2 Monitoring (Sentinel-CO2M) mission.

Roadmap for Copernicus Evolution

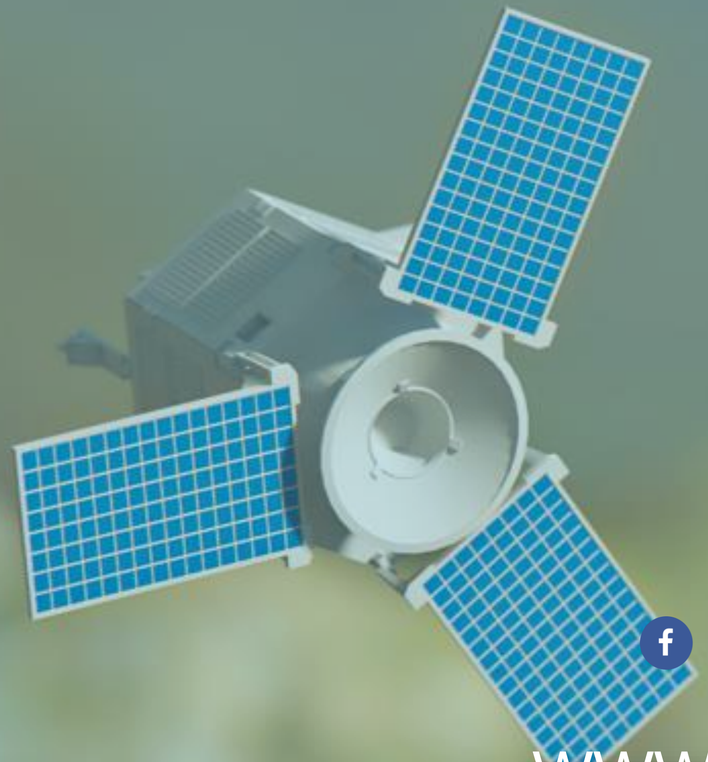


Commission-ESA Joint Decision Point, late 2021

- **Identified ambition > 8 BEUR for 2021-2028; vs available EU+ESA budgets (current est. ≥ 6 BEUR)**

- **Programmatic Decision Point to adjust the ambition (Sentinel expansion and NG missions) to:**
  - **available funding (incl. further potential sources);**
  - **programmatic priorities;**
  - **technical parameters (outcome of satellite design studies).**

- **Output of Decision Point:**
  - **a detailed system architecture for the Copernicus Space Component, including the description of the future Sentinel missions to be implemented (space and ground segment);**
  - **an indicative target schedule for their deployment;**
  - **operational modalities for the system.**



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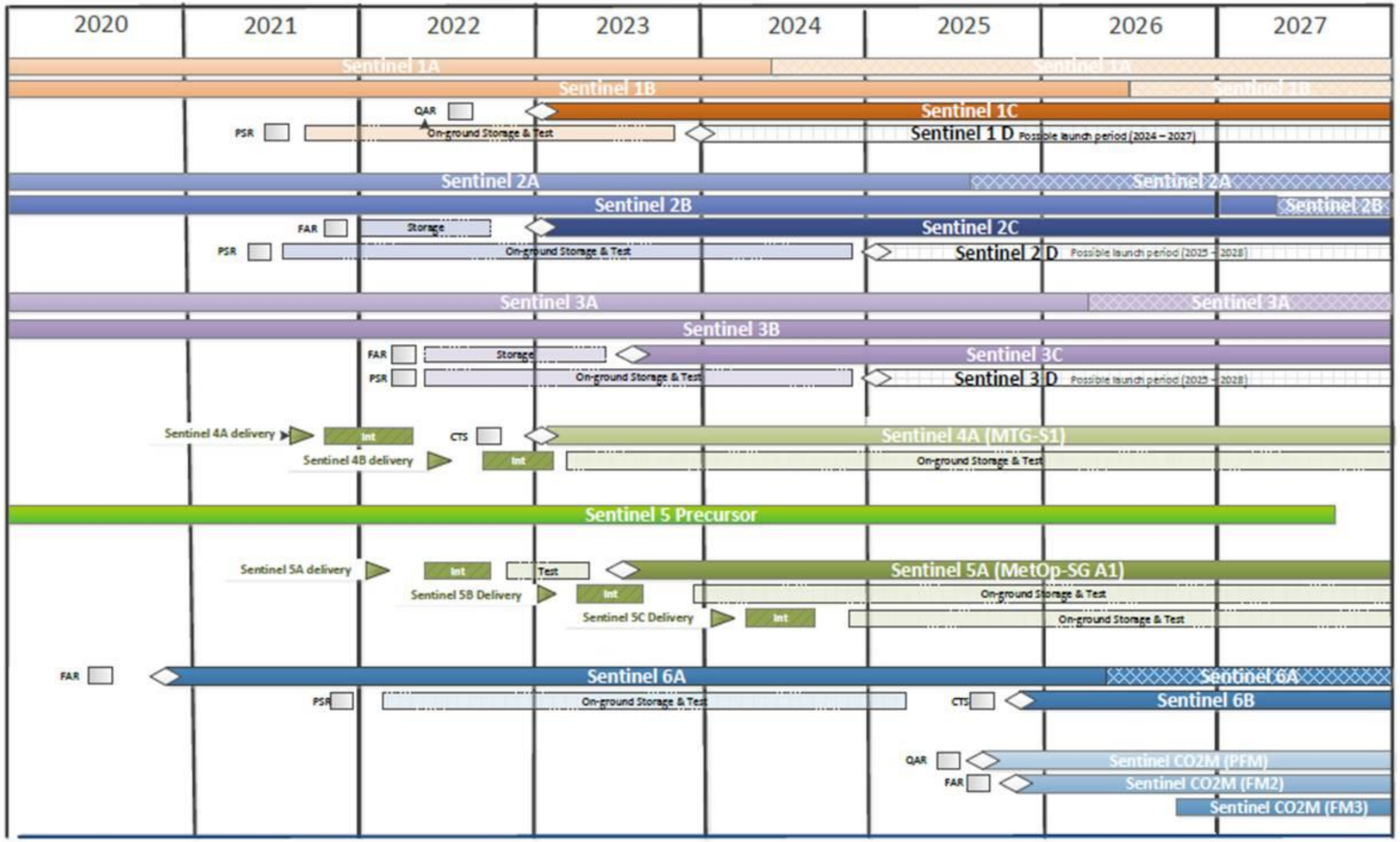
Europe's eyes on Earth

Indicative Sentinel Deployment Schedule (2020-2027)



Note : CO2M timeline is presented in this Sentinel Deployment Schedule, as being part of the Long Term Scenario Sentinels (amongst other HPCMs and NG missions) that will come into operations within the next MFF 2021-2027 period. The respective QAR, FAR and possible on-ground storage timeline will be consolidated with the programmatic decision point .

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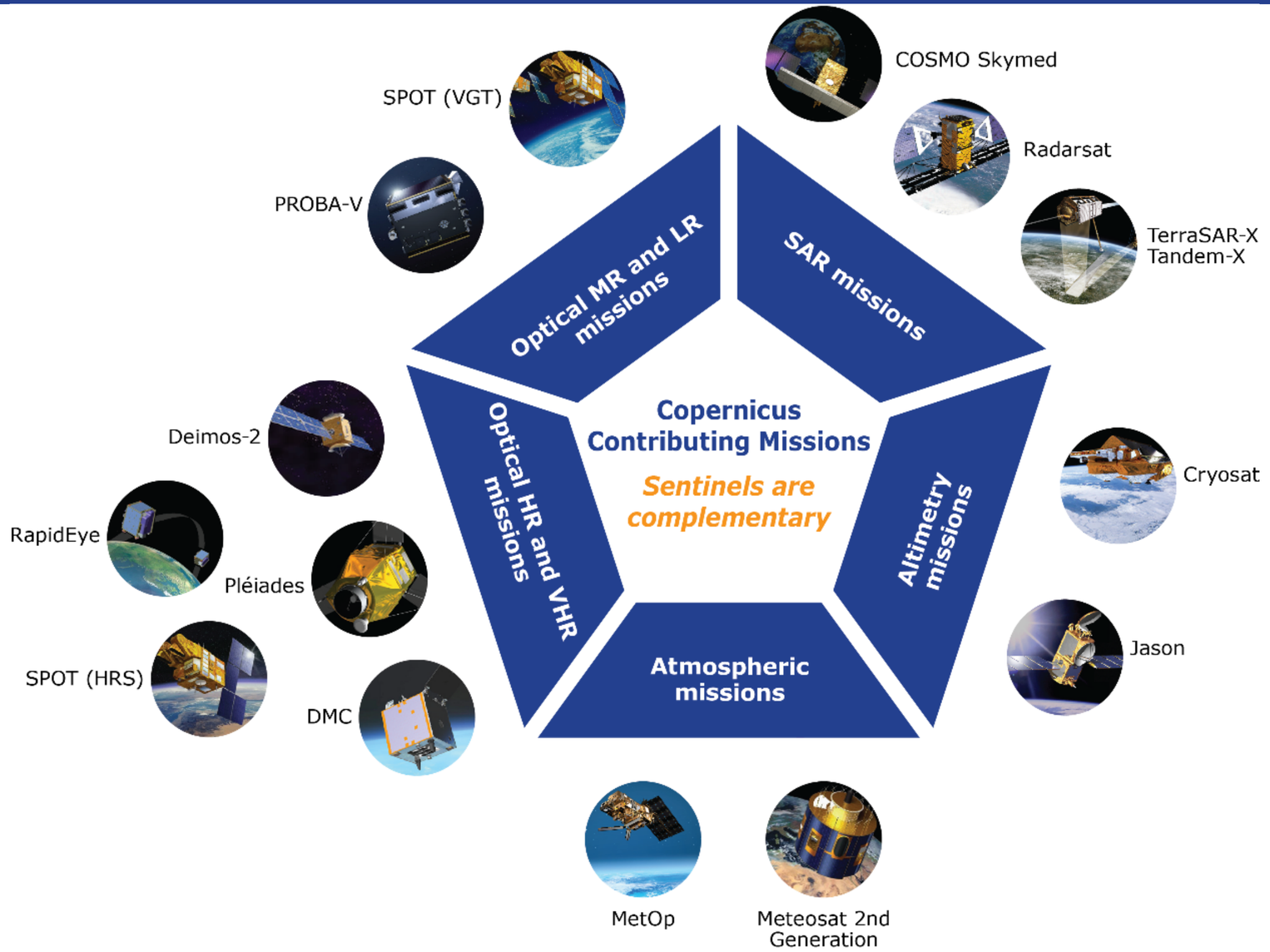
- Satellite Test — Satellite Assembly, Integration & Test
- Int — Integration
- Tentative Launch Date
- Potential Extended Operations

Date: 3 July 2020

COPERNICUS SPACE COMPONENT: THE CONTRIBUTING MISSIONS



COPERNICUS SERVICES AND IN-SITU COMPONENTS IMPLEMENTING BODIES

Copernicus

European Environment Agency	Land Monitoring Service (pan-EU & local) and In-situ Coordination
EC DG JRC	Land Monitoring Service (global)
MERCATOR OCEAN	Marine Environment Monitoring Service
ECMWF EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECAST	Atmosphere Monitoring Service
	Climate Monitoring Service
EC DG ECHO and DG JRC	Emergency Management Service
FRONTEX EUROPEAN BORDER AND COAST GUARD AGENCY	Security Service (Border surveillance)
EMSA European Maritime Safety Agency	Security Service (Maritime Surveillance)
	Security Service (Support to External Action)

#vdLcommission

Political Priorities for the next European Commission 2019-2024

1. A European Green Deal
2. An economy that works for people
3. A Europe fit for the digital age
4. Protecting our European way of life
5. A stronger Europe in the world
6. A new push for European democracy

Contribution to Commission Priorities

- Green deal: earth observations help to understand the health of our planet (land, oceans, atmosphere), to observe the consequences of extreme events (hurricanes, floods, earthquakes,…), to observe how the Climate is changing, to contribute to the generation of SDG indicators, to assess if environmental legislation is respected (e.g. Environmental Compliance Assurance) and the effects it produces, …

- Links with digital: data generated by Copernicus are indeed already digital products. Nevertheless a further integration with digital tools has to be fostered, in particular Artificial Intelligence (for image analysis and archiving), Quantum technologies (for encryption of signals), cloud solutions (for storage and distribution of data) and High Performance Computing (for generating models and simulations of our planet based on Earth observation e.g. the “Twin Earth” concept.

Contribution to Commission Priorities

- Economic impact: the generation of Copernicus data (big data) fosters the creation of innovative businesses and new jobs. Nevertheless effort has to be dedicated to prepare new generation of professionals to use it.

- Links with Security and Defence: Copernicus provides already security dimension by generating information on Border surveillance, Maritime security and support to EU external action. In addition, synergies with Defence needs and capacities should be explored for the future, bearing in mind the civil nature of the Copernicus programme.

- The role of Europe in the world: Copernicus has put Europe at the forefront in the Space Earth Observation sector in the world. Copernicus has become a world reference. We should use this recognized role to strengthen cooperation with other space leading countries and to reinforce the support activities of Europe in developing or less-developed countries.