The Coming ESA Programmes

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European Space Agency

Outline

- Outcome of 2008 ESA Ministerial Council
- Planned ESA Missions
  - Earth Observation
  - Science
  - Robotics
  - Launchers
  - Human Space
  - Telecommunication
  - Navigation
  - Security
- Technology
- Conclusions

Summary of ESA Ministerial Council-08

- Significant emphasis on applications: Meteorology, Global Monitoring for Environment and Security (GMES), Telecommunications, Satellite Navigation and Integrated Applications
- Strengthening of mandatory Space Science programme and basic technical activities: Increase by 3.5 % annual budget
- Mars Exploration: Exomars programmatic consolidation before final decision
- Upgrade of existing launcher (A5) and completion of the development of a new launcher (VEGA)
- Preparatory activities for Robotic and Human Transportation and Exploration preparing for decision in 2011
- Start of Space Situational Situational Awareness
- Strengthening of General Support Technology Programme (GSTP)

CM-08

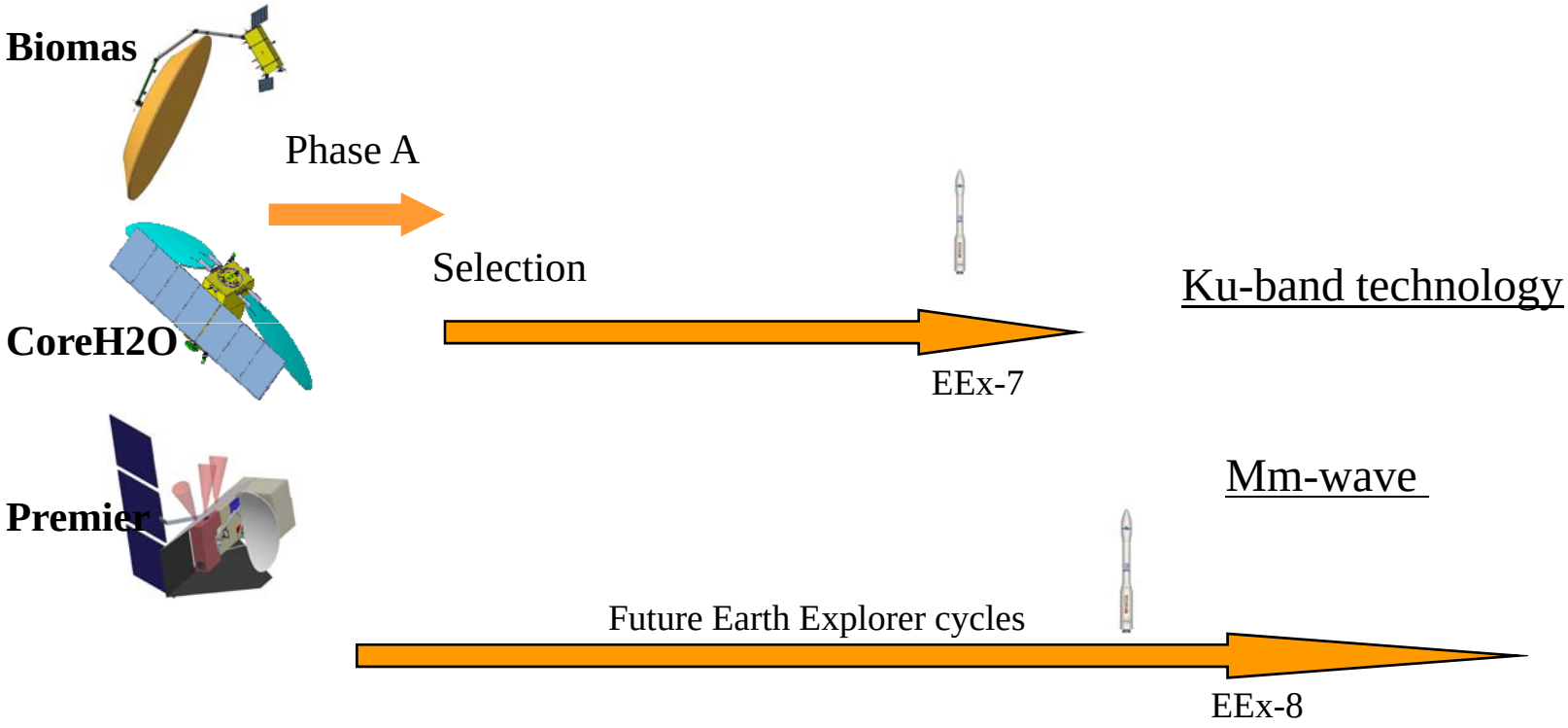
- Earth Observation: (plus some additional subscription to EOEP and GMES SE)
  - Approval MTG (942.89 M€)
  - Segment 2 of GMES (797.56 M€)
  - Essential Climate Variables (74.55 M€)
- Space Science:
  - Increase by 3.5 %
- Robotics Exploration:
  - Additional contributions to Exomars, current level 850.3 M€
  - Start Mars Robotic Exploration Preparation, 23.35 M€
- Launchers (plus some additional subscription to Vega development and to Soyuz at CSG)
  - ARTA, 497.3 M€
  - Post ECA 356.97 M€
  - VERTA 98.5 M€
  - FLPP, 170 M€ (including IXV)
- Human Space Flight
  - Exploitation, 1370.6 M€
  - ELIPS, 284.83 M€
  - ETHE, including early activities 61.22

CM-08

- Telecommunications:
  - ARTES 1, 34, 5; 533 M€,
  - ARTES 7, EDRS, 154.2 M€
  - ARTES 8, large platform, 34.7 M€
  - ARTES 10, IRIS, air traffic management, 34.09 M€
  - ARTES 11, SGEO, 11.7 M€
  - ARTES 20, Integrated Applications, 52.93 M€
  - To be allocated, 198.26 M€
- Navigation
  - European GNSS Evolution Programme, 53.08 M€
- Space Situation Awareness
  - Core, 20.2 M€
  - Space Weather, 11.38 M€
  - Radar, 8.15 M€
  - Pilot Data Centres, 10.09 M€
- GSTP
  - Period 5 and some period 4, 360.7 M€
- PRODEX, 87 M€

Planned ESA Missions

Enable future missions: EO, Earth Explorers



Prepare missions: EO, Operational Meteorology

Geostationary

MSG

MSG-3

MSG-4

Approved CM-08
942. 89 M€

MTG-I (x4)

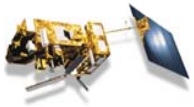
MTG

MTG-S (x2)

Polar

EPS - Met***Op***

Met***Op***-B



MetOp-C

Not in CM-08 agenda

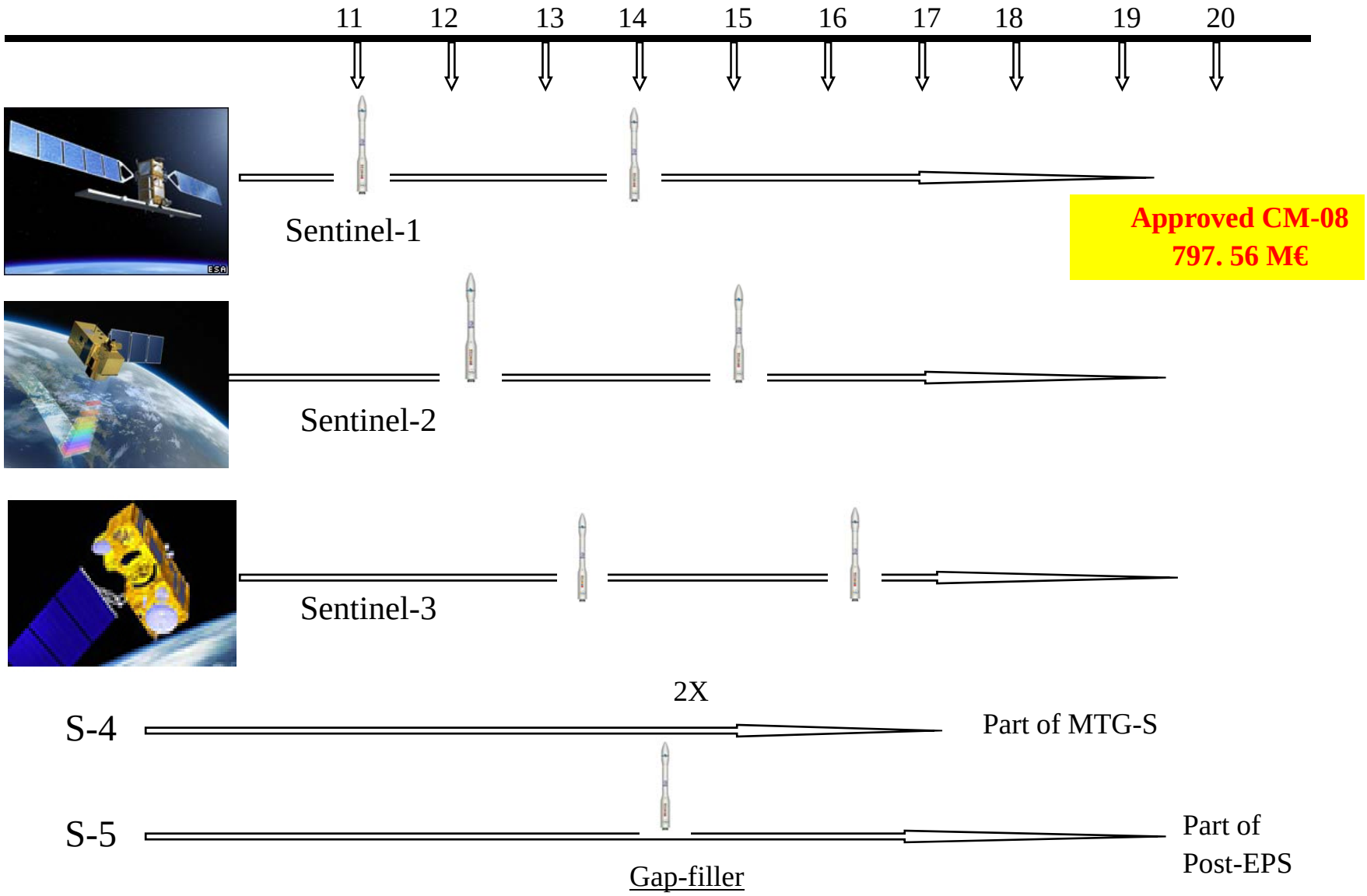
Post-EPS, six reference missions:

- Sounding: IR and microwave
- Wind profiling
- Ocean imaging
- Ocean topography
- Cloud, precipitation and land imaging
- Atmospheric chemistry

Being defined

Some may be parallel, e.g SMOS FO, Aeolus FO

Prepare missions: EO, GMES



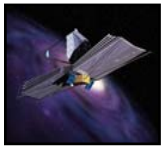
Prepare missions: Space Science

08 11 17 18

LPF

Gaia

BC



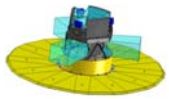
JWST

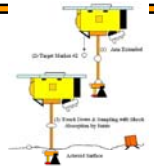
421 M€ / year

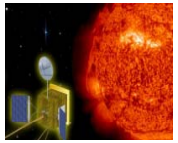
Herschel
Planck

Cosmic Vision 2015 - 2025

M1, M2 2017, 2018



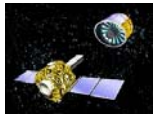




Cross-Scale, EUCLID, PLATO, Marco Polo, SPICA

SOLO

L1, 2020



Laplace, LISA, XEUS/IXO

Prepare missions: Aurora, Mars Robotic Exploration

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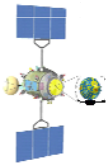
Exomars

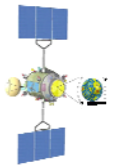
Enhanced at CM-08
Total 850.3 M€

Preparatory Studies

Exploration Technology Preparation



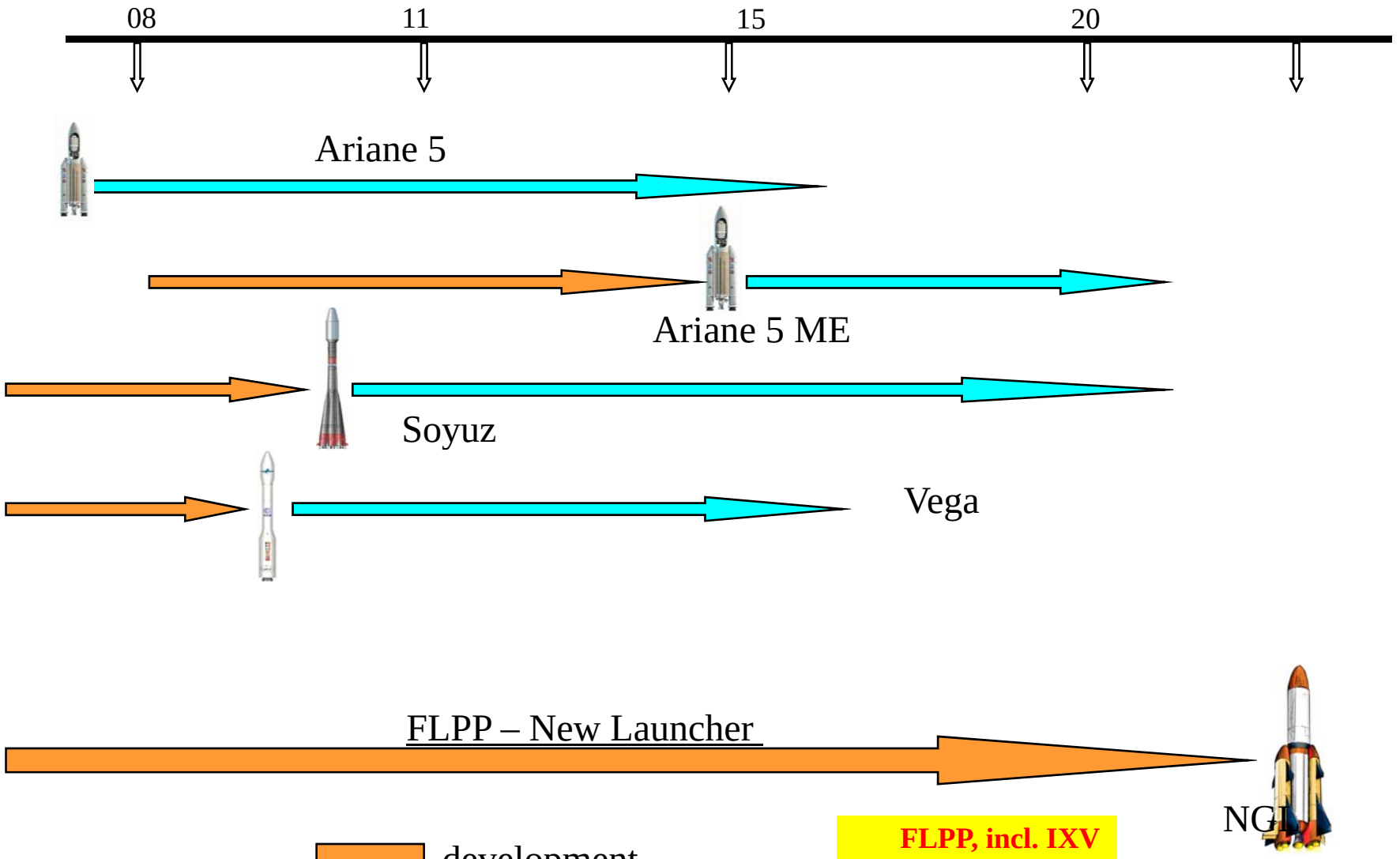
Intermediate missions



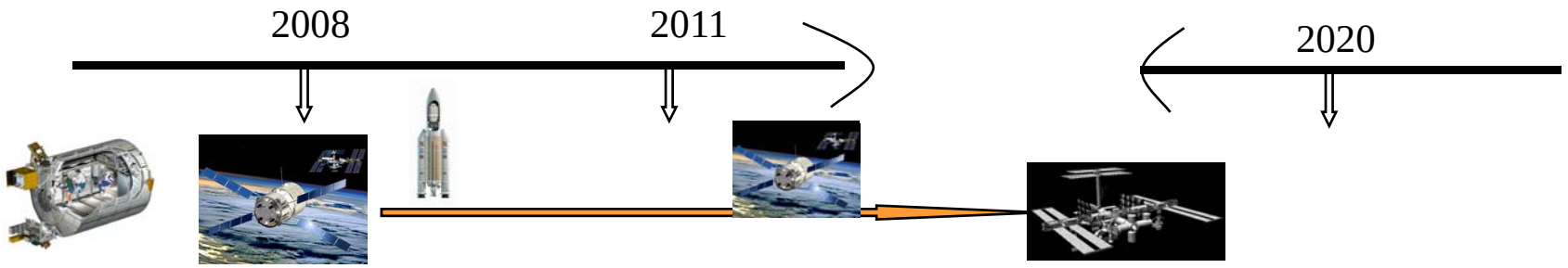
MSR

2009 -2012 at CM-08
Total 23.35 M€

Prepare missions: Launchers



Human Space Flight and Exploration



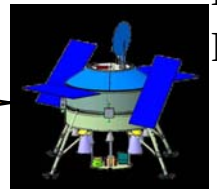
MoonNext studies

2010

Preparation

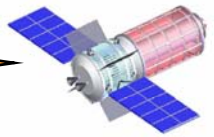
Lunar Payload Lander

Baseline B2CDE



European Payload lander

Enabling Capabilities Human Exploration



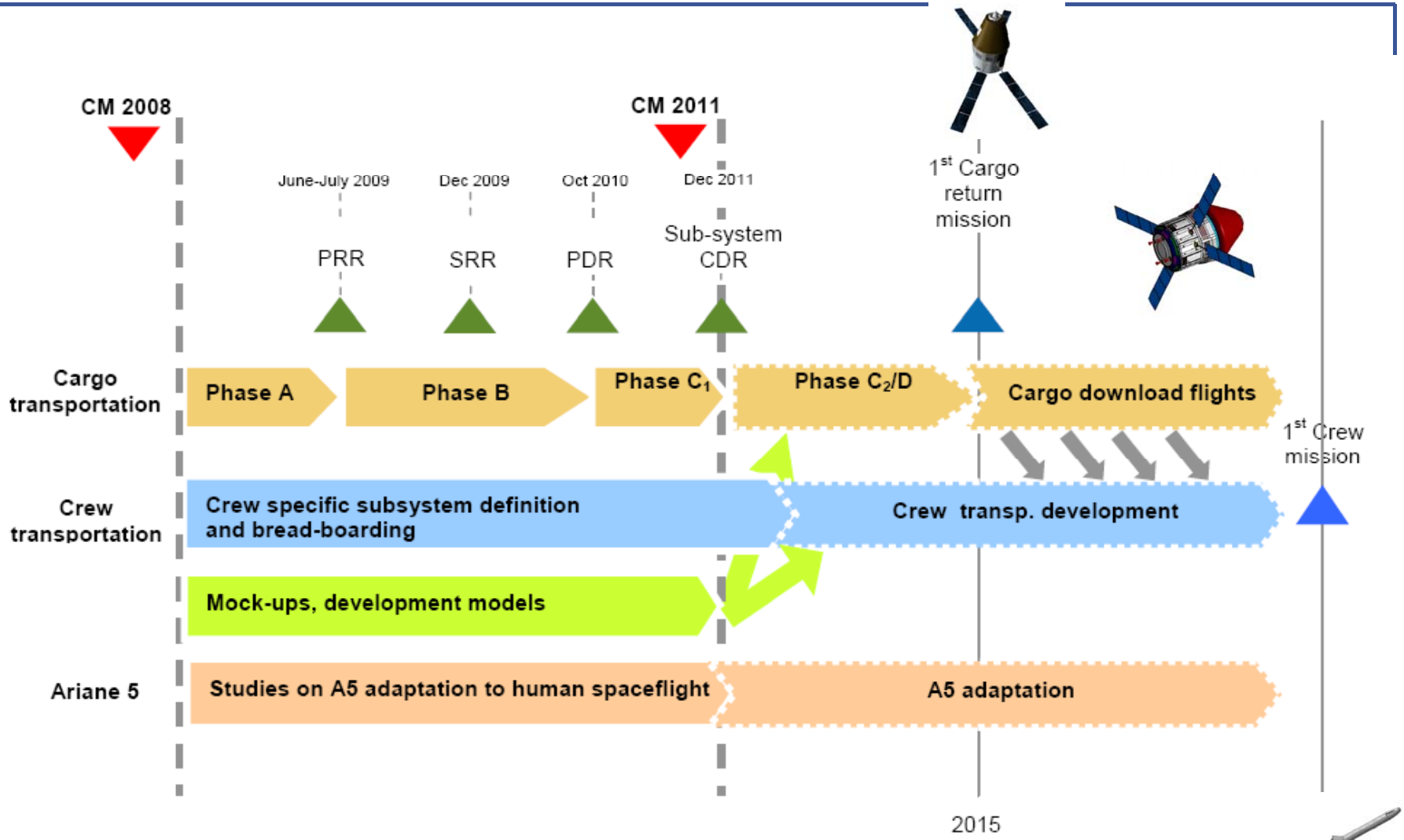
LEO infra

European Transportation & Human Exploration 61 M€

VRI Syn

European Space Agency
Agence spatiale européenne

Prepare missions: Human Transportation



European Transportation & Human Exploration 61 M€

Prepare missions: Telecommunications

08 11 18 19 20

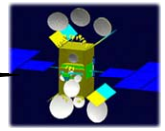
ARTES programme elements: concepts, technology, services, demos

	M€
TB allocated	198.26
ARTES 34	226.05
ARTES 5	80.3

Hylas

α bus → Evolution

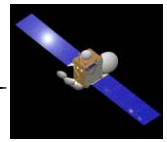
Alphasat



Large Platform
CM-08 34.07 M€

SGEO PF → Evolution

Redsat



Small GEO
CM-08
11.7 M€

Air Traffic Management
CM-08 34.09 M€

A (Alphasat TDP),B

EDRS

C (dedicated satellite)
CM-08
154.2 M€

New initiatives: IAP

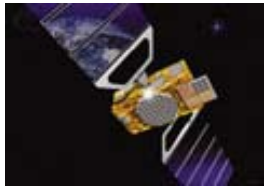
Prepare missions: Navigation

2005 2008 2011 2018

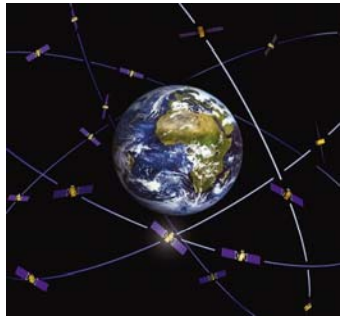
EGNOS and Galileo 1st generation development and operations

Giove-A

Giove-B



IOV



FOC

Operations

GNSS evolution programme

CM-08
53.08 M€

GNSS 2nd generation

Prepare missions: Security and SSA

Accommodate in ESA systems requirements security communities

New Security initiatives, common and complementary assets

Towards European capabilities

Technology

In-orbit demonstration

Phase I: Core, space weather, radar, pilot data centres

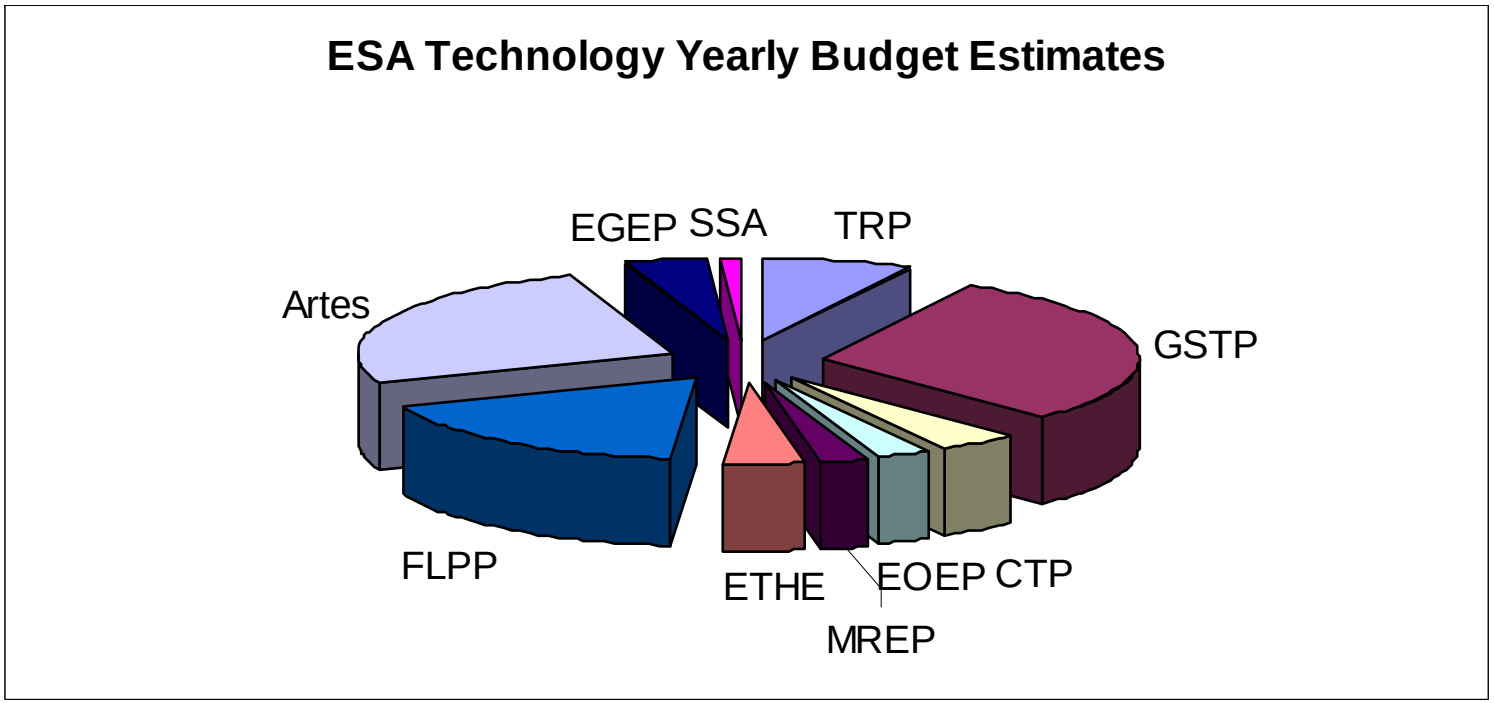
Phase II: common and complementary assets

European capabilities

CM-08 49.82

Technology

Technology at CM-08



Total ~ 240 M€ / year

Yearly budgets, total subscription / number of years

FLPP includes IXV

EGEP, SSA,

ETHE assumption on technology fraction plus early activities

ARTES 3, 4, 5

CTP, EOEP as in 2008

Example of Technology Evolution: Robotics

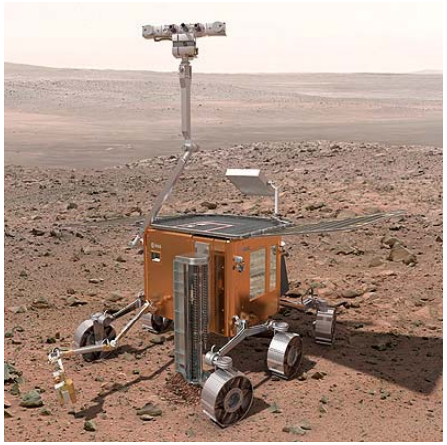
ERA: European Robotic Arm

(waiting for launch)

Today :

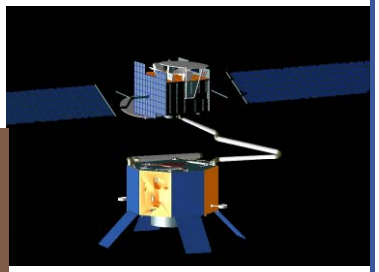
EXOMARS

(Launch Date 2016)



Mid-term

In-Orbit Servicing(> 2020)



MSR

(> 2020)

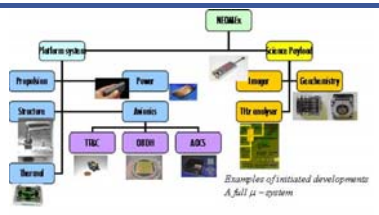
Planetary Aerobots

Future

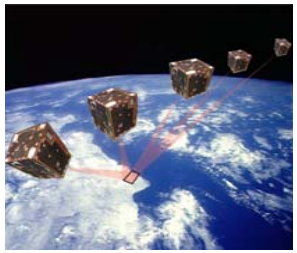
Key technologies

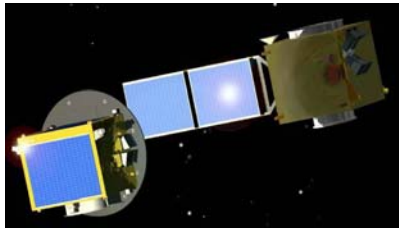
- Micro-systems, miniaturization, MNT
- Autonomy, intelligence and locomotion
- Sensors and actuators
- Power, comms

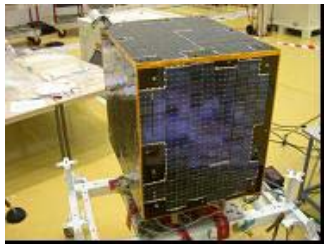
In-Orbit Demonstration objectives

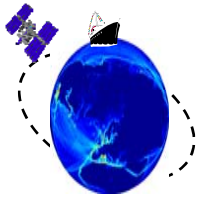


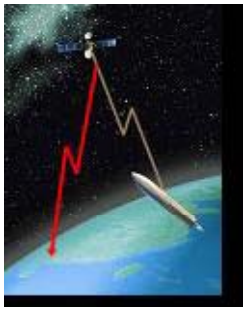
- In-orbit demonstration, as part of TRL ladder and of overall technology roadmap in LTP, is required for:
  - ➢ new technology, specially disruptive and technology, via spin-in, in particular if flight heritage required
  - ➢ research,
  - ➢monitoring techniques,
  - ➢ operation techniques (FF, RV, planetary entry, communications),
  - ➢ environment (space / spacecraft) characterization,
  - ➢ development + AIV (including relations with industry) and
  - ➢ satellite operation techniques,
  - ➢ training of experts
- IOD will lead to innovation in technology, processes and knowledge

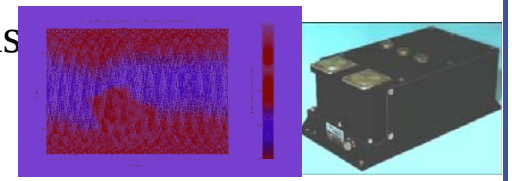












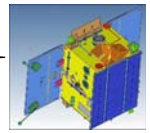
IOD, Ongoing

2008 2011 2016

Operations

PROBA-1 (GSTP-2)

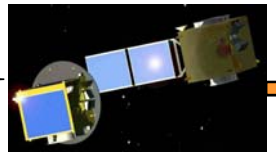
Development



Operations

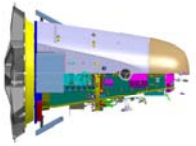
PROBA-2 (GSTP-3)

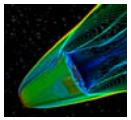
Development



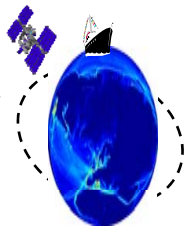
Operations

PROBA-3 (GSTP-4)





Expert (GSTP 3,4)

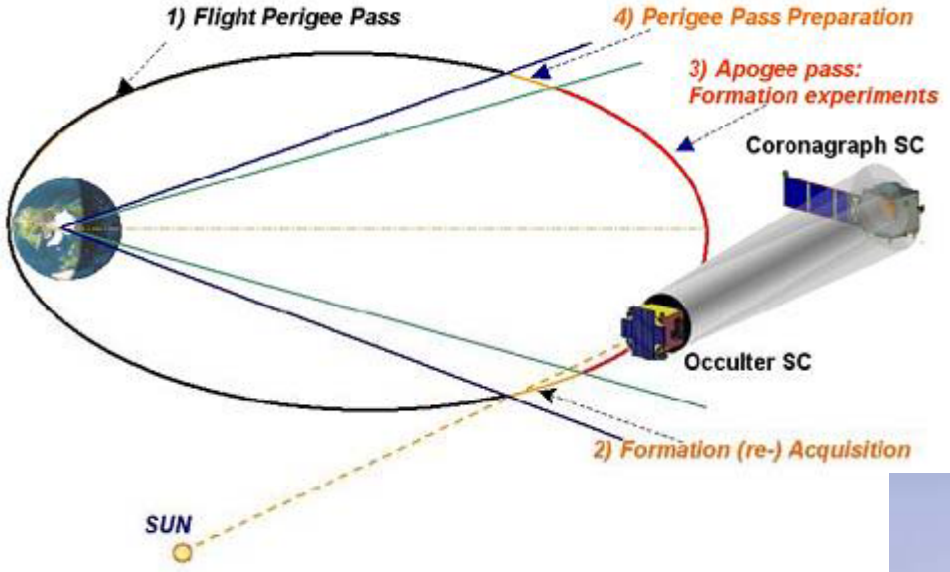


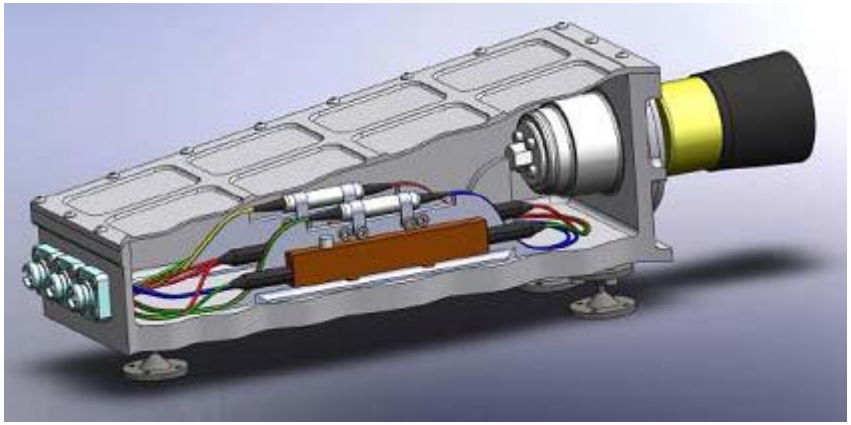
AIS on ISS (GSTP-4,5)

AT4 Alberto Tobias; 29/10/2008

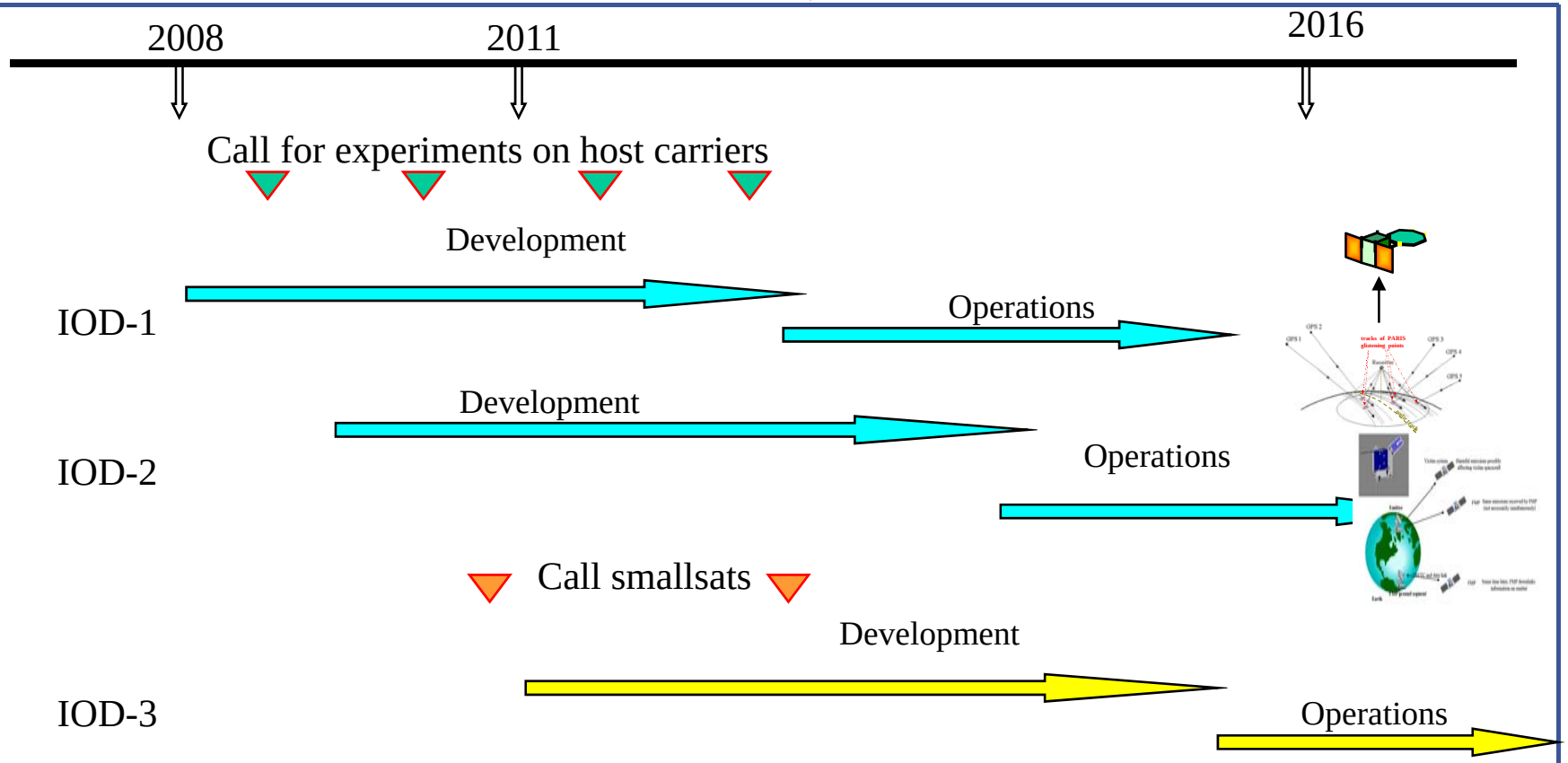
PROBA-3

- PROBA-3 demonstrator of formation flying techniques: acquisition, re-acquisition, fly-around, coarse and fine FF, safety
- Technologies, products and algorithms: sensors and actuators
- Tools and practices: simulators, verification benches, concurrent engineering,





IOD, plans

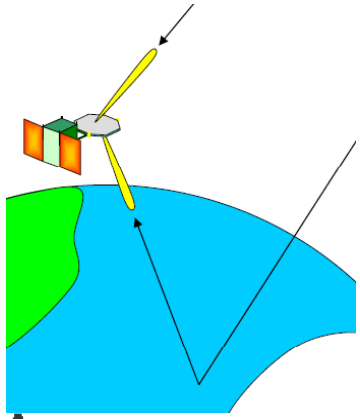


Plan

- first IODs are proposed according to degree of preparation, previous technology investments, and perceived interest /need and timeliness,

IOD concepts: reflectometry

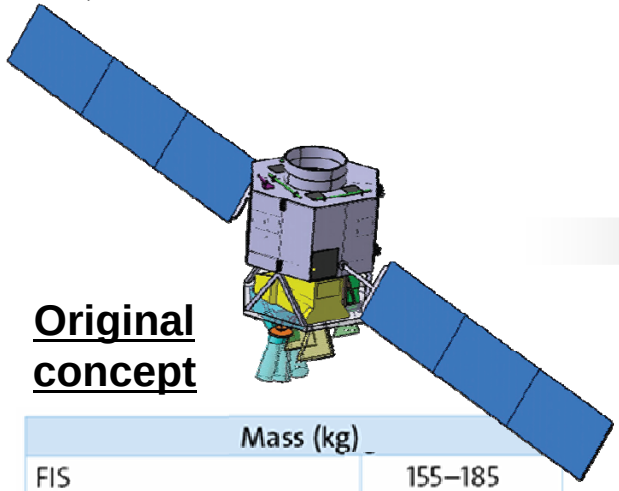
- Primary Objective: Ocean Mesoscale Altimetry Demonstration Mission
- Additional Objectives: Ice topography, ice mapping, soil moisture
- Payload: PARIS Altimeter (based on GNSS-R)
- Frequency: GPS L5, L1, Galileo E5 (switchable)
- Beams: 4 specular beams for ocean topography
- Field of view: 30° about nadir = 950km swath
- Antennas: Up-looking - 31 element, RHCP
  Down-looking - N=31 elements, LHCP
- Receivers: 1-1.5 dB noise figure (without antenna),
  2x31x2 channels
- Signal Processor: FPGA-based, L5 safety of life, L1, E5
- Altimetric precision: 17cm (100km 5cm mesoscale requirement)
- By-products: TEC over ocean, wave height, mean squared slope, wind over ocean, ocean currents



IOD concepts: Fluorescence

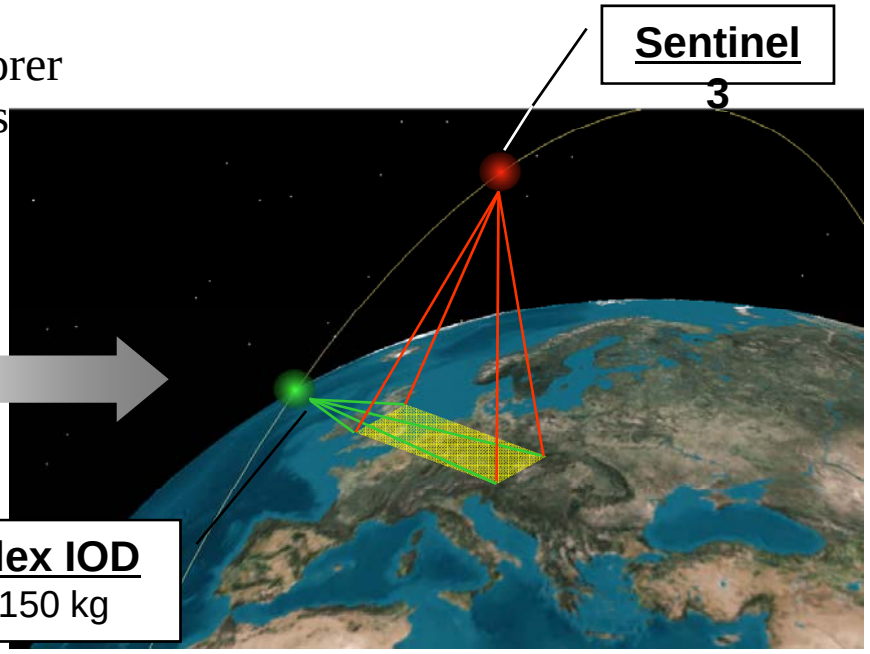
Concept being discussed between with Earth Observation programme

Derived from FLEX candidate Earth Explorer mission, a 1 ton satellite with 4 instruments



Original concept

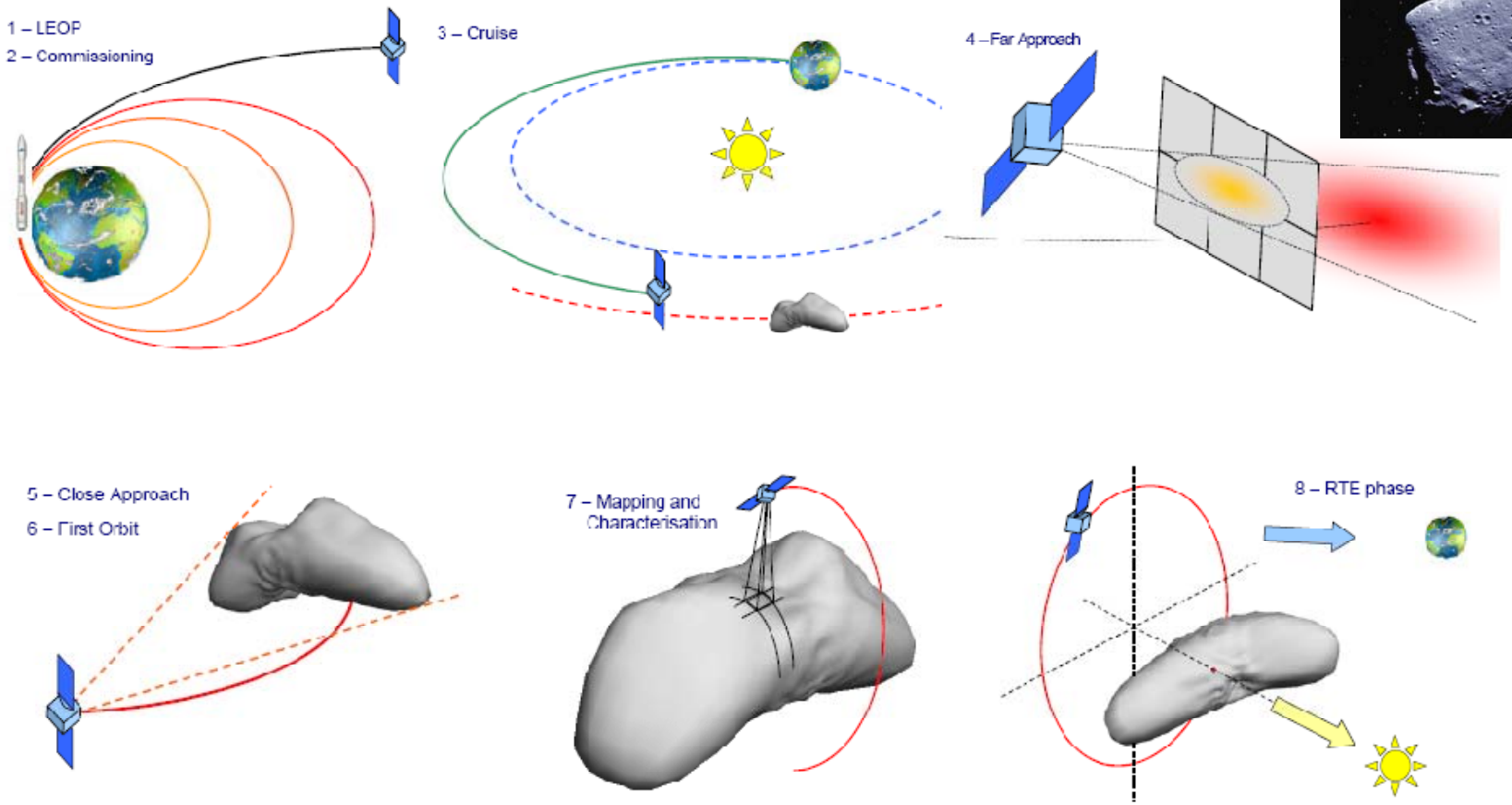
Mass (kg)	
FIS	155–185
TIR, VNIR, SWIR and ONI	140–160
Platform	600–760
Satellite (dry mass)	920–1100
Propellant	50–60
Satellite (launch mass)	1000–1200



- The IOD will have to be compatible with a small satellite, 150 kg
- Demonstrate the exploitation from space of the weak fluorescence signal, as well as technologies for very high spectral resolution
- Formation flying with Sentinel 3 so as to obtain the data of the missing instruments of original FLEX

VRI Symposium

IOD concepts: PROBA IP - 1



A NEO explorer demonstrating autonomy, μ– systems, manoeuvering

Conclusions

- ESA Member States continue to entrust ESA with the task of moving forward the European space frontier
- The number of projects and the overall resources have been increased for the coming years
- Emphasis is on applications for the well being and prosperity of European citizens
- Many challenges lay ahead that can only be achieved with a strong technology preparation
- European space industry excellence has been demonstrated many times and will continue to be critical for European competitiveness and independence
- Space developments will continue to be fuelled by dreams.. Before they turn into reality