

(De)briefing to the Belgian space actors

- (1) Status of Regulation “EU Space Programme”
- (2) Status of Regulation “Horizon Europe”
- (3) Debriefing of IMM-ESA 2018
- (4) Status of Preparation “Space19+”**

BELSPO info session – 9 November 2018

Content

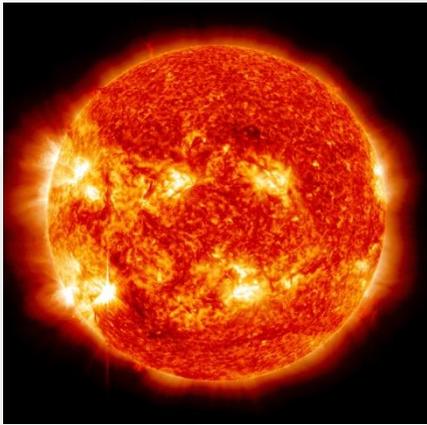
- ESA Programmes (4 pillars)
 - Science and Exploration
 - Safety and Security
 - Space Safety – Applications – Cybersecurity
 - Applications
 - Earth Observation – Telecom – Navigation
 - Enabling and Support
 - Space Transportation – Technology and scientific support – Operations
- Industrial Policy
- Bilateral Programmes
- National Programmes

ESA Programmes

Science and Exploration - The Science Programme

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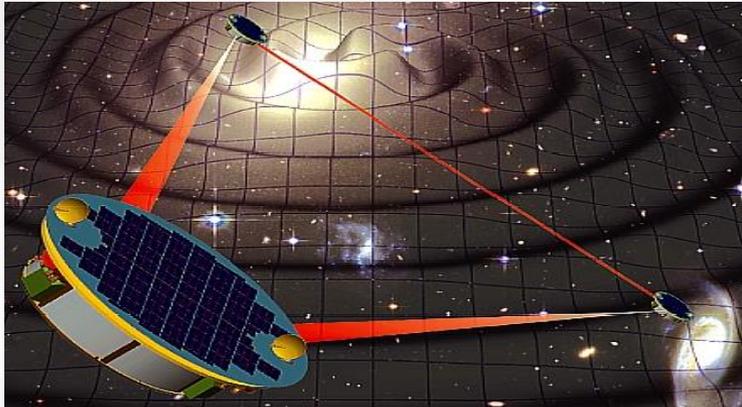
- Mandatory Programme
- Contributions according to relative GDP
- “Backbone” of ESA: provides long-term stability
 - Scientific excellence
 - Cutting-edge technologies and innovation
- Driven by the scientific community
 - Calls
 - Competition
 - Peer review
- Payloads are funded by national programmes
 - For BE: PRODEX
- Shows what Europe can do together in science and technology
- Provides a framework for additional national programmes



Solar System



Astrophysics



Fundamental physics

Planned activities for 2020-2025

- **Operations in orbit**

XMM, CLUSTER, INTEGRAL, MARS EXPRESS, GAIA, BEPI COLOMBO,
EXOMARS/TGO,
HST, SOHO, HINODE, MICROSCOPE, IRIS

- **Development**

CHEOPS, SOLAR ORBITER, EUCLID, JUICE, PLATO, ARIEL, ATHENA, LISA,
F1, M5 (ENVISION or SPICA or THESEUS),
EXOMARS 2020, PROBA-3,
JWST, SMILE, EINSTEIN PROBE, XRISM, (MMX)

- **Future calls**

S, M, L missions
New Missions of Opportunity

- **Basic activities**

Technology development
Science management support,
Programme contingency

Budget request

- Budget decision at CM 2016

Level of Resources (2017-2021), M€, mixed 2018 e.c. (based on estimated inflation)					
2017	2018	2019	2020	2021	TOTAL
500.0	510.0	507.4	499.4	492.5	2,509.3

- New proposal of ESA for Space19+: **increase of 20% from 2020 onwards**
- **New content** proposed in the Programme
 - Aligning the development of LISA and ATHENA by clever phasing of the developments and providing payload support to the Member States
 - Developing an additional M mission with NASA to Uranus and Neptune
 - Adding a recurrent F(ast) mission line to the Science Programme
 - Providing payload support to the Member States for all missions during phases A/B

ESA Programmes

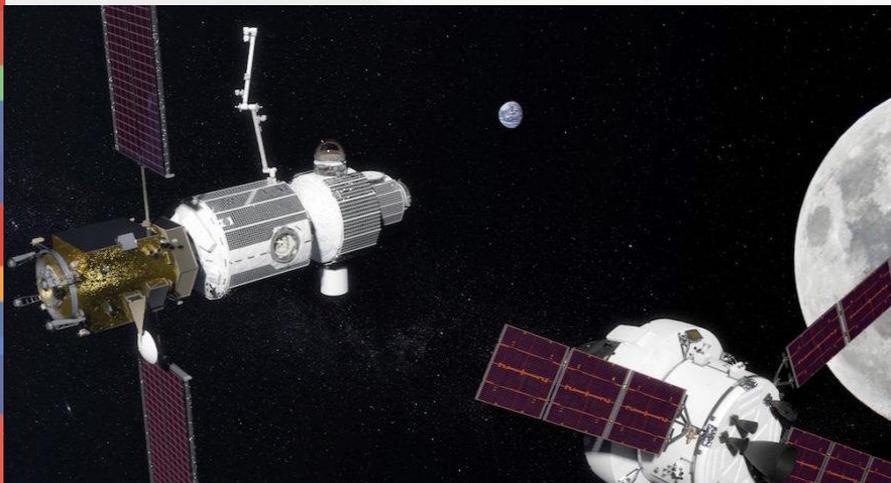
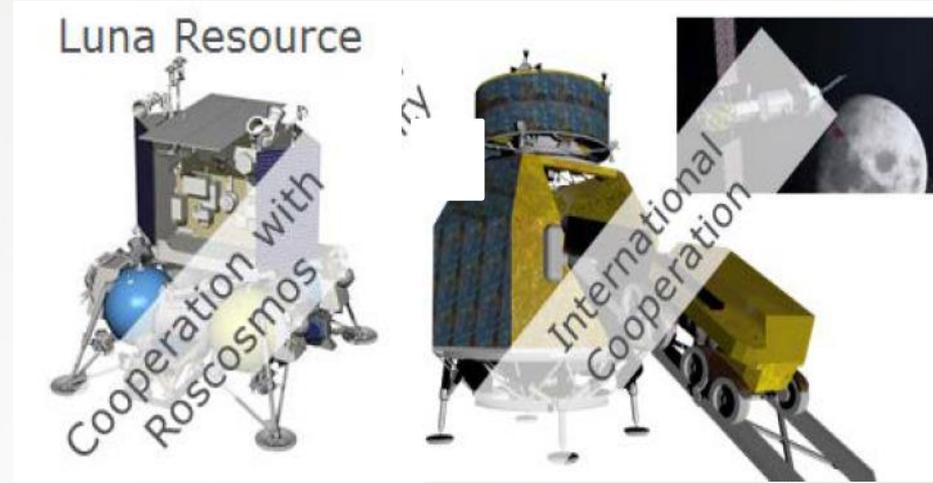
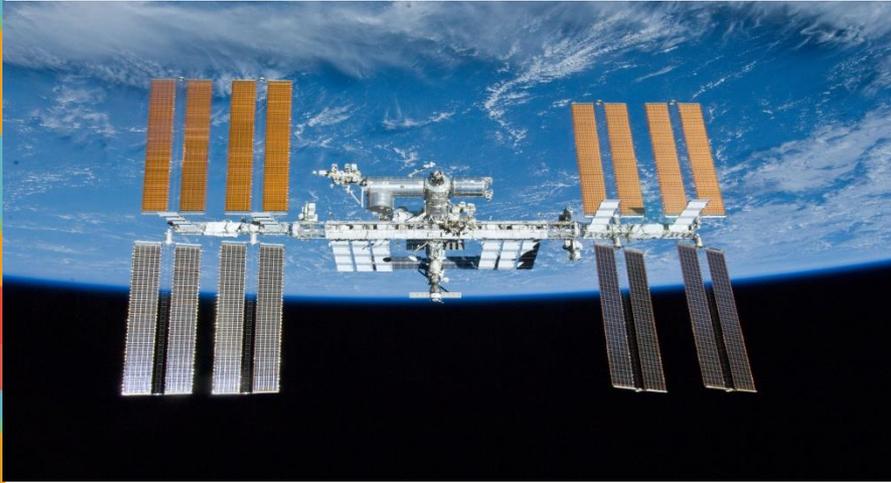
Science and Exploration - Exploration

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European Exploration Envelope Programme (E3P) – Period 2

- 4 main pillars
 - LEO exploitation
 - Early human mission beyond LEO
 - Human lunar surface exploration, initiated with robotic precursor mission
 - Mars Sample Return
- 2 optional technology demonstrators
 - In Situ Resource Utilisation
 - GNC/Rendez-vous/Docking
- 2 optional missions of opportunity
 - Commercial lunar mission
 - Cooperation with China
- Funding

Main pillars of E3P – Period 2



Pillar 1: LEO exploitation

- ISS exploitation currently approved till 2024
- US intends to extend ISS exploitation till 2030
- Post 2024 LEO exploitation options
 1. Status quo
 2. More commercialization of ISS
 3. ISS completely operated by industry
 4. End of ISS, with transition to Chinese space station and/or commercial space stations

Pillar 2: Early human mission beyond LEO (1)

- Orion European Service Module (ESM)
- Obligational barter elements towards NASA
 - ESM #1: remaining ISS obligations till 2020
 - ESM #2: part of ISS obligations 2021-2024
 - ESM #3 & #4: in discussion

Pillar 2: Early human mission beyond LEO (2)

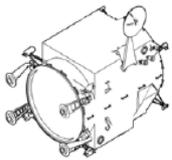
- Deep Space Gateway (DSG) = Lunar Orbital Platform-Gateway (LOP-G) = “The Gateway”
- Cooperation between ESA and NASA in discussion
- Potential European elements
 - International Partner Habitat (I-Hab) with JAXA
 - European System Providing Refueling Infrastructure and Telecommunications (ESPRIT)

Pillar 2: Early human mission beyond LEO (3)

• Gateway Elements/Modules

ADVANCED SEP

Power and Propulsion Element: 2022
Power, in-space transportation, and initial lunar communications

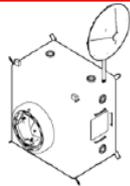


- One or more competitively award to industry
- Launching 2022 on commercial launch vehicle.
- Acquisition time: 3 years

EARLY OPERATIONAL CAPABILITY

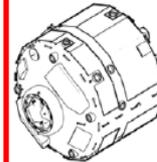
Launch package: ESPRIT and U.S. utilization module: 2023

ESPRIT provides PPE refueling, science airlock and additional lunar communications. The U.S. Utilization Element provides initial habitation volume and logistics for up to 15 days



ESPRIT:

- Provided by ESA
- Launching NET 2023 on SLS
- Acquisition time: 3-4 years



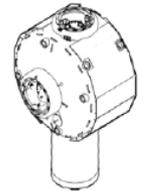
U.S. Utilization Module:

- Provided by NASA
- Launching NET 2023 on SLS
- Acquisition time: 3-4 years

EVA CAPABILITY

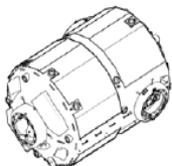
Airlock:
EVAs and additional docking

- Acquisition approach deferred until 2020
- Ongoing studies with NASA and ROSCOSMOS
- Acquisition time: 3-6 years



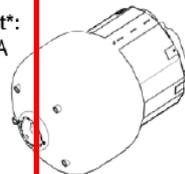
ENHANCED HABITATION

International partner and U.S. habitat modules: 2024 and 2025
Two habitats provide increased volume for crew operations and science



International Partner Habitat*:

- Provided by ESA with JAXA contributions
- Launching NET 2024 on SLS
- Acquisition time: 5 years



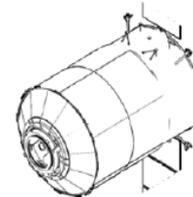
U.S. Habitat*:

- U.S. provided by competitive award to industry
- Launching NET 2025 on SLS
- Acquisition time: 5-6 years

*Habitat functional allocations are currently under review

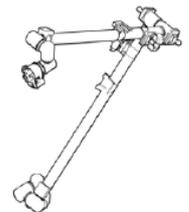
ENHANCED SCIENCE & OPERATIONS

Launch package: Provides logistics and utilization payloads, external robotic capabilities



Logistics:

- U.S. and international partner provided
- Earliest delivery 2024
- Acquisition time: 3-4 years



Robotic Arm:

- CSA provided
- Earliest delivery on first logistics flight (2024)

Pillar 3: Robotic lunar exploration

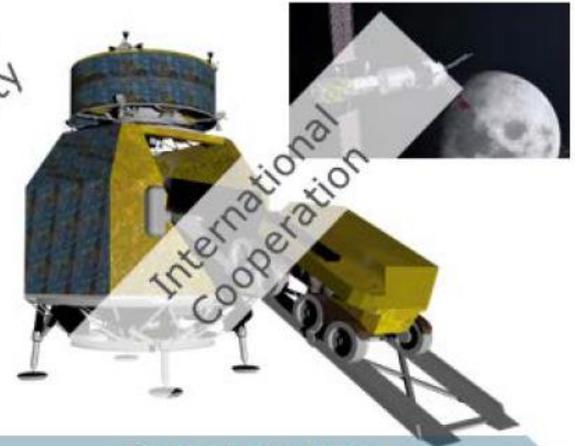
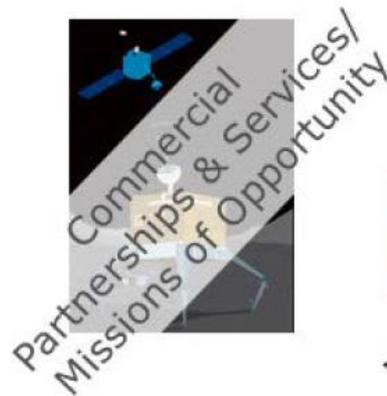
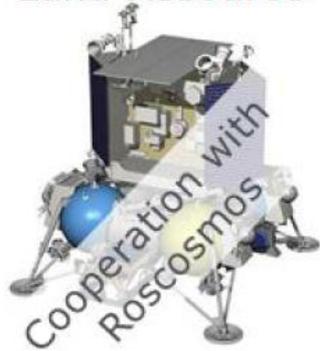
Implementing the ESA Science and Research Plan, through a sequence of missions with gradually increasing complexity and science and research opportunities

Luna Resource

Lunar Pathfinder

Robotic Surface Missions

HERACLES



Resource Prospecting
Precision Landing

Lunar CubeSats
Com/ Nav Service

Surface Payloads
Delivery Service

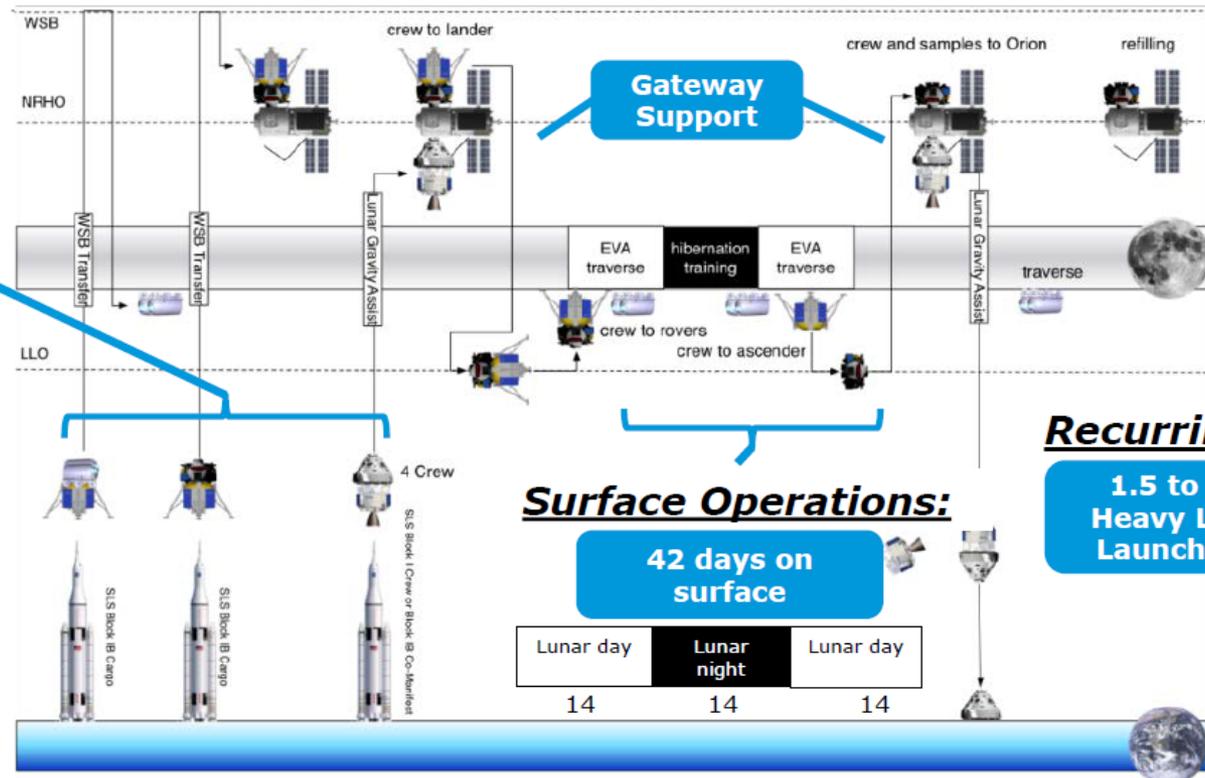
Sample Return
Ascent/ Extended Mobility

Pillar 3: Human lunar surface exploration

First Mission:

**3 Heavy Lift Launches
3 Lunar Elements**

1. Two Pressurized Rovers (2 crew each)
2. Lunar Lander (4 crew)
3. Crew Vehicle (4 crew)



Recurring Missions:

**1.5 to 2
Heavy Lift
Launches**



Pillar 4: Mars Sample Return (1)

- Taking account of ExoMars lessons learned
 - Build on European heritage in Science Programme and ExoMars
 - Selected novel technologies
 - Avoid highest risk elements

Pillar 4: Mars Sample Return (2)

- Possible European contributions

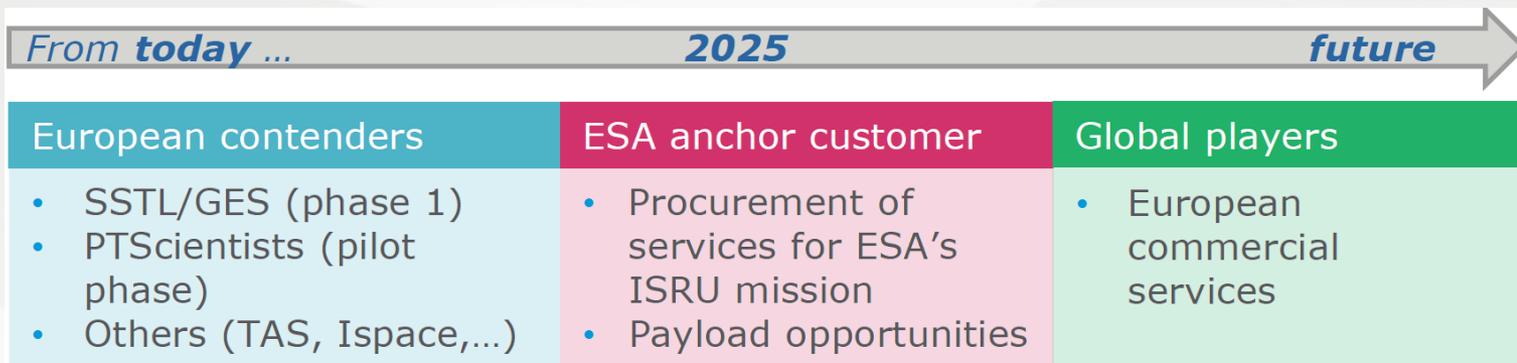
Estimate	Element	Risk for ESA	Heritage
Orbiter (900ME)	System design & integration	Low-Medium	ExoMars/BepiC/JUICE etc.
	Rendezvous & capture	Medium-High	ATV
	Propulsion	Medium	ExoMars/BepiC/JUICE etc.
	Comms	Low	ExoMars/BepiC/JUICE etc.
	Operations	Low	ExoMars/BepiC/JUICE etc.
	Launch	Low	Assumes Ariane 6 proven by 2026
Orbiter sample system (250ME)	Capture Mechanisms	High	None
	Sealing System	Very High	None
	Earth Return Capsule	Very High	ARD but not velocity/heat flux
Fetch Rover (440M€)	Rover Vehicle	Medium	ExoMars if auto nav implemented
	Sample transfer robotics	Medium-High	ExoMars/Insight
	Rover surface operations	Medium	ExoMars
Total: 1590 M€			

Optional technology demonstrators

- In Situ Resource Utilisation
 - Goal: create potable water and/or oxygen on the moon by 2025 with a budget < 250 M€
- GNC/Rendez-vous/Docking
 - Goal: demonstrate in flight GNC/rendez-vous/docking technology for exploration missions, in orbit assembly, debris removal...
 - Build on existing technology from ATV

Optional missions of opportunity (1)

- Commercial lunar mission
 - Goal: create first European beyond LEO exploration service business where a commercial entity provides communication, navigation, operations and transport to the moon



Optional missions of opportunity (2)

- Cooperation with China

- Goal

- ESA positioning itself as a strategic partner of China
 - Supporting the integration of China in the global exploration framework

- Manner

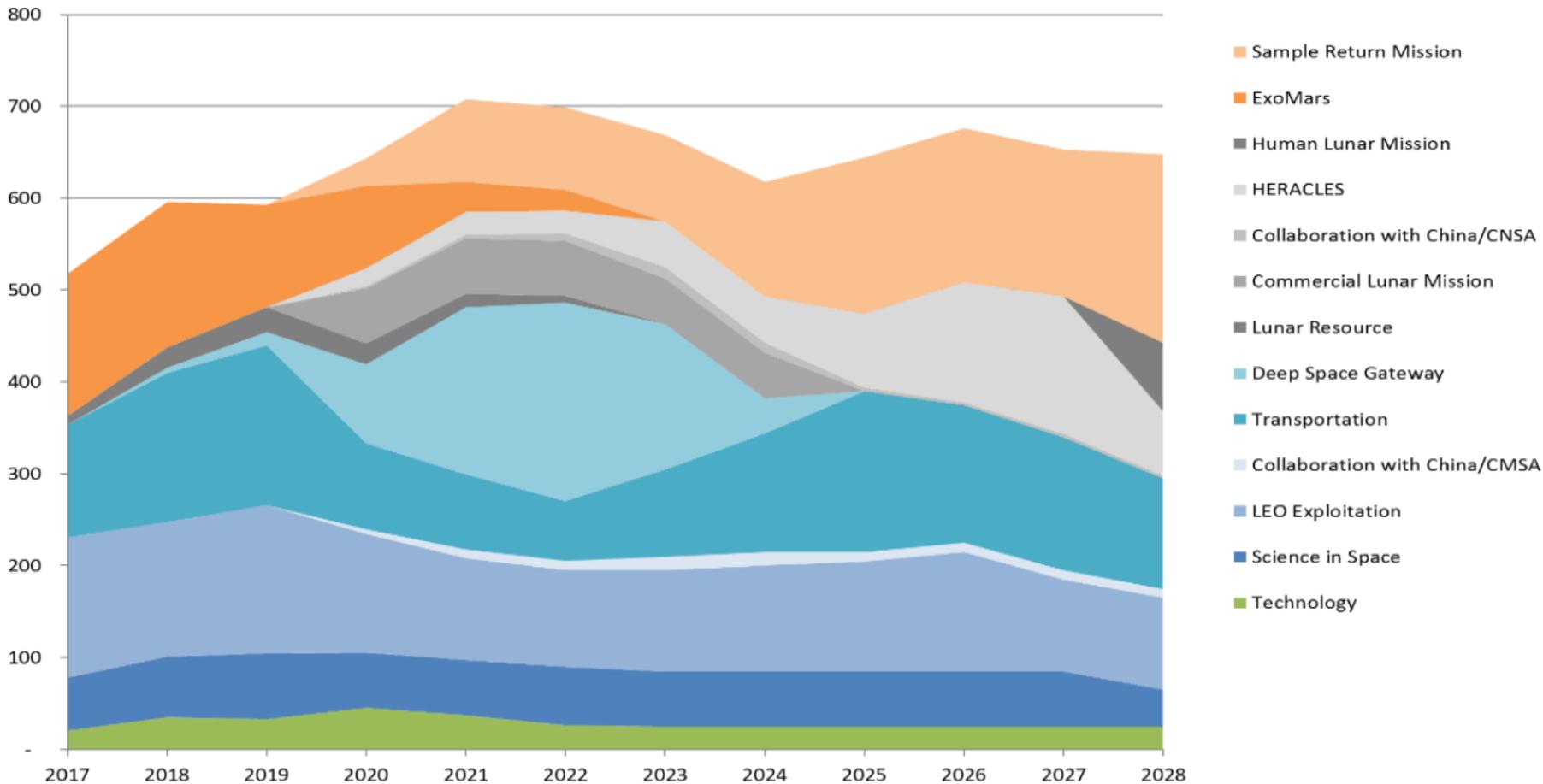
- Deliver services/elements to the Chinese Space Station (CSS) in exchange for ESA astronaut flights on the CSS

- Touchy

- ITAR
 - Reaction of current ESA partners?

Funding

- Bottom-up model with **all** possible elements included



ESA Programmes

Safety and Security - Space Safety

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- Rationale of the Space Safety Programme

Ensuring the sustainable development of space activities requires a global effort and includes the protection of our planet, humanity and assets in space and on Earth from dangers originating in space.

- Regroups and extends the content of the existing SSA Programme within a broader context

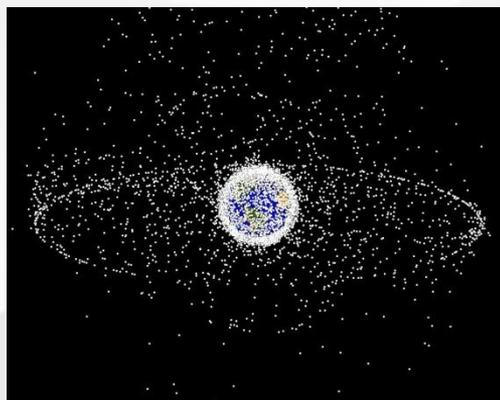
Space Weather (SWE)



Planetary Defence (NEO)



Space Debris (SST) and Cleanspace



Space Weather (SWE)

development of new applications

development of instrumentation and deployment on host mission

services: development and pre-operations

+

Cornerstone 1: SWE observation system: L5 + L1

- SWE L5 Mission
- Coordinated approach with US (US: L1, ESA: L5)
- Phase A/B1 signed Feb. 2018
- Decision at CM19 on phases C/D/E1 continuation

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launch 2024

Planetary Defence (NEO)

Cornerstone 2: the HERA impact mitigation mission to asteroid Didymos
Phase B1 signed in 2018; phases B2/C/D proposed for Cmin 2019;
launch 2024



deployment of 1-3 Fly-Eye telescopes
(detection and orbit determination)
sensor development
operational services



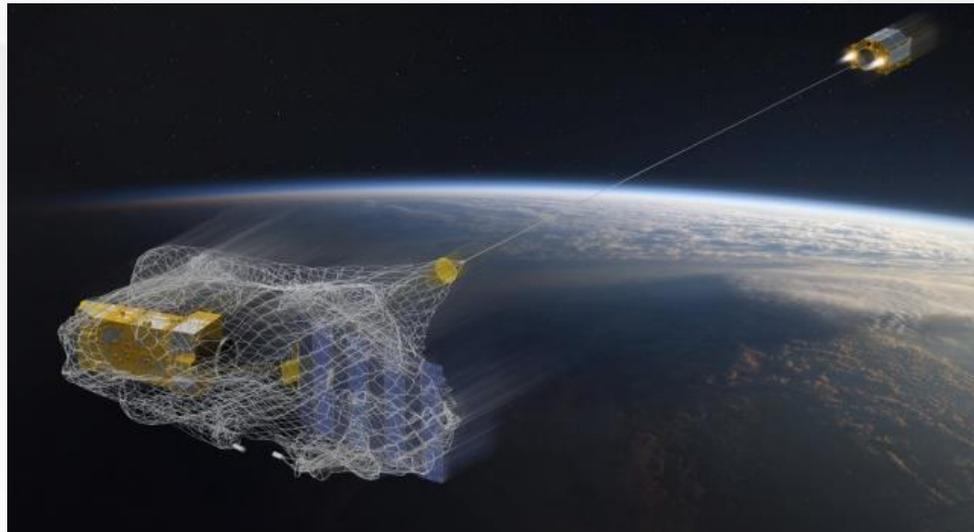
Space Debris (SST)

sensor technology + data processing development

Cornerstone 3: a Satellite Collision Avoidance Automation System
(technology development and demo mission)

Cleanspace

Cornerstone 4: e.Deorbit: a debris removal mission (in-orbit servicing)
technology activities ongoing in GSTP; phases B2/C/D proposed for CMin
2019; launch 2024



Budget

- Proposed total budget 2020-2027: 1500 M€ (~180 M€/y)
 - Baseline activities in the 3 segments: 450 M€
 - SWE LGR mission: 450 M€
 - NEO HERA mission: 250 M€
 - Clean Space debris removal mission: 350 M€ ESA cost
(PPP 77% / 23%)

ESA Programmes

Applications – Earth Observation

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EO Programmes at Space19+

- Future-EO (formerly known as EOEP)
- Copernicus 2.0 (Copernicus Space Component)
- Earth Watch
 - ALTIUS
 - PROBA-V
 - Incubed
 - International development aid
- Safety & Security EO

Future-EO (1)

Comparison EOEP and Future EO



	EOEP	Future EO-1
Envelope approach	Yes	Yes
Period duration	5 years	3 years: 2020 - 2023
Funding	Yearly cruising level 300 – 350 M€	Increased funding, amount TBC
Content	Block 1, 2, 3, 4	<p>Same +</p> <ul style="list-style-type: none"> • NewSpace features, Small (demo) Mission / Mission of Opportunity, HAPS • Climate Adaptation & Mitigation and SDGs • EO AFRICA
Approach @ Research missions	Earth Explorers partly or fully funded in period	Earth Explorers fully funded until Phase E1



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Future-EO (2)

Future EO - 1



Foundations and Concepts

- Earth Explorer-10: mission candidates preparation until selection
- Earth Explorer-11: initiation of preparatory activities
- 'Mission of opportunity': early activities
- Early Innovative Mission Concepts: follow-up
- Smallsat Challenge
- Copernicus: future architecture and S&T activities on evolution
- Next Generation Meteo: initiation of activities
- Continuation of techno/IPD activities
- Non-orbiting platforms / High Altitude Pseudo-Satellites (HAPS)
- In-orbit EO technology demonstrators: Preparation/pre-development



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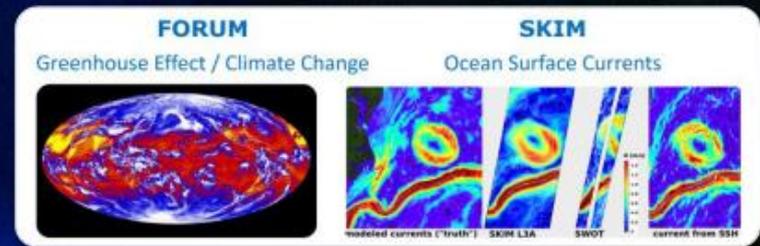
Future-EO (3)

Future EO - 1



Research Missions

- Completion Earth Explorer 9
- Smallsat demonstrator
- Mission of Opportunity (e.g. NGGM)
- Aeolus FO early phase



Ground Segments

- Mission management SMOS, CryoSat, Swarm, Aeolus, EarthCARE
- Geophysical (L2) products for 9 Explorers
- Development & operations of generic PDGS
- Data access for Africa



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Future-EO (4)

Future EO - 1

Earth Science for Society

- Fostering scientific excellence (incl. ESA-EC/RTD Initiative)
- Innovating EO Applications
- Stimulating European downstream EO industry
- Developing platforms with AI
- Bring EO solutions to SDGs and climate adaptation & mitigation
- Consolidating the Regional Initiatives (focus user needs)



Platforms & AI



Earth System Science



Regional Initiatives



SDGs Indicators



Adaptation & Mitigation



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Copernicus (1)

Operational EO



Copernicus 2.0

Objective Covers the ESA MS co-funding to the EU Copernicus programme for the space component, as outlined in (evolving) Long-Term Scenario.

- Deliverables (Selection)**
- Development of prototype missions for new Sentinels in response to EU policy priorities.
 - Development of prototype missions for the continuation of observations of the current Sentinel-1-6 series.
 - Development of Ground Segment for future Sentinels.



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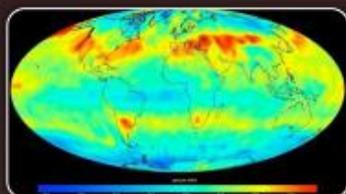
Copernicus (2)

Operational EO: Copernicus 2.0

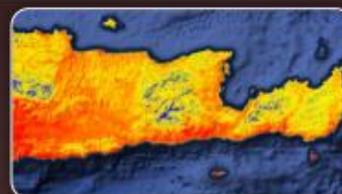


Addressing current and future user and policy needs

6 High Priority Candidate Missions & Next Generation Sentinels 1, 2 and 3



Monitor causes of Climate Change (CO₂ emissions)



Agriculture & Water Productivity



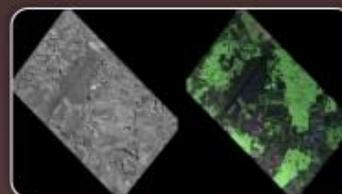
Monitor effects of Climate Change (Arctic/Polar ice volume)



Food Security, Soil & Minerals, Forestry, Biodiversity



Sea Ice Conc. & SST (Arctic situational awareness)



Soil Moisture, Vegetation & Ground Motion



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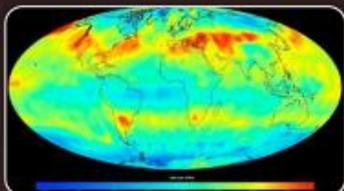
Copernicus (3)

Operational EO: Copernicus 2.0

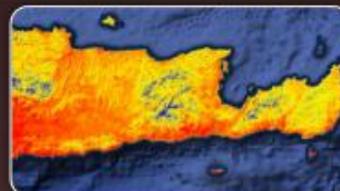


Addressing current and future user and policy needs

6 High Priority Candidate Missions & Next Generation Sentinels 1, 2 and 3



Anthropogenic CO₂
Imaging Spectrometer



High Resolution
Surface Temp.



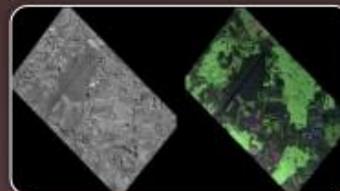
Polar Ice & Snow
Topography



Hyperspectral Imaging



Passive Microwave
Imaging



L-band
SAR



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Earth Watch - ALTIUS

Altius PhE

Operational ozone concentration monitoring



Period
2020-2025

Objective

Operational monitoring of ozone concentration columns by limb sounding, as from 2022

Format

Extension of the existing Earth Watch element / to be merged with the current Altius development element

Deliverables

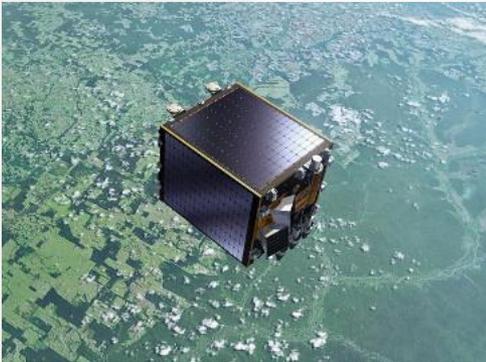
- Launch service, LEOP, commissioning
- Up to 3 years operations and L2 products



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Earth Watch - PROBA-V

Objective Extension and succession of the PROBA-V mission



Format Extension of the existing Earth Watch element

Deliverables

- Extension of the operations of PROBA-V beyond 2019.
- Succession / Expansion of PROBA-V mission with 12U-cubesats:
 - TMA
 - TIR
 - Hyperspectral

Feasibility is under investigation
Scenario's are under discussion with ESA

Earth Watch - InCubed

<p>InCubed+</p> <p>Ambitious continuation of InCubed</p>  <p>Period 2020-2023</p>	<p>Objective</p>	<p>Secured continuation of InCubed until 2023, with larger scale ambitions and top-innovative deliverables</p>
<p>Format</p>	<p>Revision of current InCubed Earth Watch Element, with updated Implementing Rules (e.g. procurement)</p>	
<p>Deliverables</p>	<p>Pre-commercial products, up to full-fledged demonstrators, with integration of fast growing technologies. Focus on upstream and/or end-to-end solutions</p>	



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Earth Watch - International Development Aid

Int. Development Aid

Bring operational EO
solutions to ODA activities



Period
2020-2025

Objective

Develop operational EO solutions to support International Development Aid activities

Format

New Earth Watch element, ODA compatible and aligned with IFI funding

Deliverables

- Space-derived environmental info production & delivery to Bank / Aid Agency / Countries
- Set-up of regional Clusters / Centres of Excellence in strategic locations in the developing world
- Comprehensive Capacity-Building programme



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Safety and Security EO

Safety and Security EO



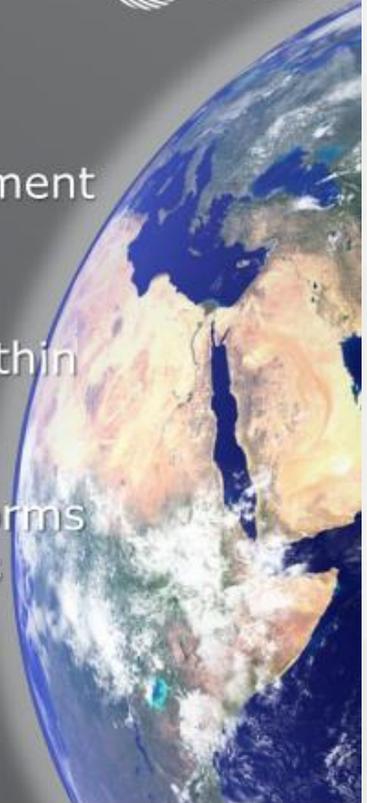
Scope Build up security element using Civilian EO (focus on 'blue' security forces)

Objective Strengthen European security and law enforcement capabilities and increase safety of human lives

- Elements**
- Dialogue with civilian security users
 - Prototype Services embedding civilian EO within mainstream intelligence and investigation/analysis practices
 - Security-relevant G/S and exploitation platforms
 - Develop technology & system demonstrators

Partners Europol, Interpol, UNODC, EDA, EMSA, SatCen

Framework 2020-2025, as a cross-Directorates initiative



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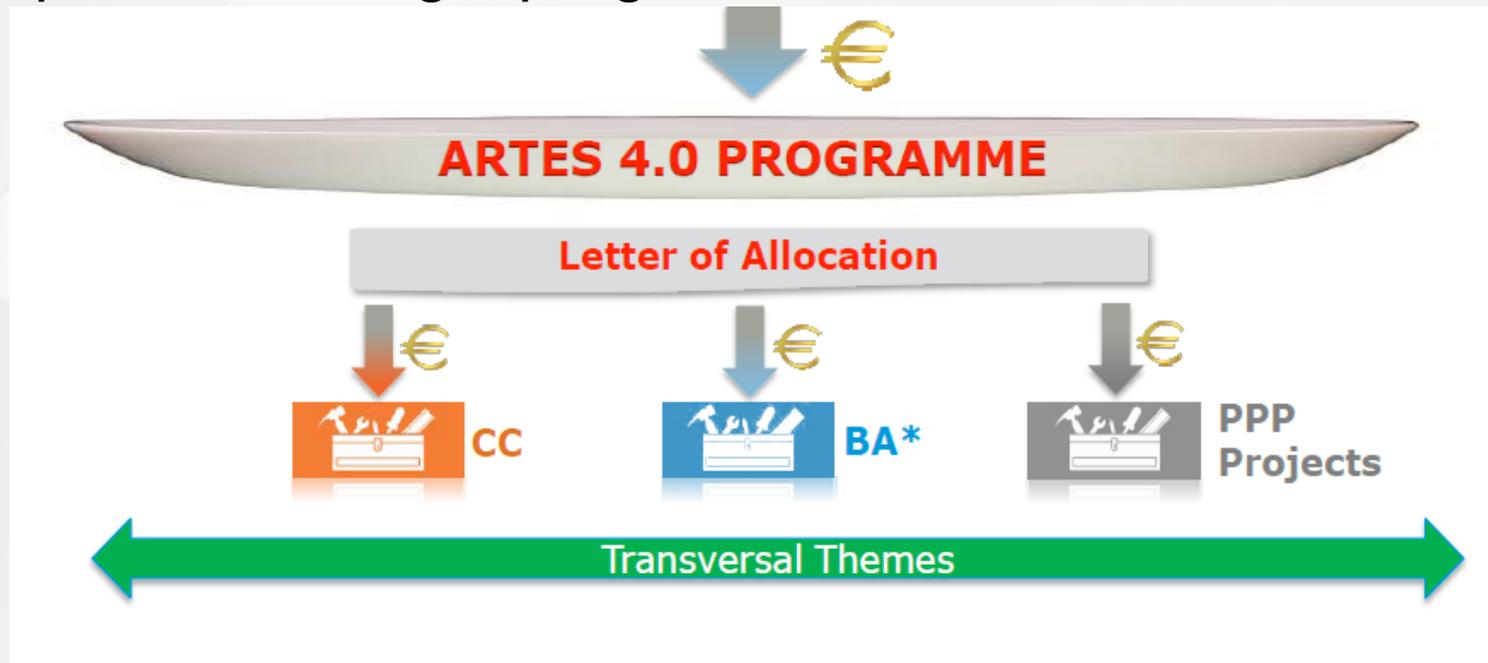
ESA Programmes

Applications – Telecom

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ARTES Programme (Telecom)

Proposal of a single programme with 1! Financial envelope



and allocation to 3 boxes:

CC= Core Competitiveness

BA = Business Applications

PPP = Public Private Partnerships

Improved features in ARTES 4.0



ARTES 4.0 PROGRAMME

- For all new subscriptions at Space19+ and onwards
- Faster kick off of new activities & more flexibility
- Guaranteed Industrial Return of 1 extended
- Increase efforts to improve ESA Efficiency to maximize industrial support activities

Allocations within ARTES 4.0



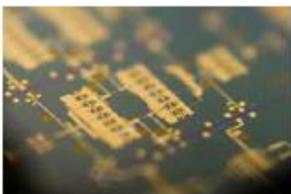
- **At Space19+:** a global allocation to the ARTES 4.0 envelope is possible or some amounts may already be attributed to the boxes (BA, CC, PPP) or given PPP project.
- **After Space19+, within a programmatic period:**
 - Allocation via letter by a JCB delegate from ARTES 4.0 subscriptions not yet allocated to the 3 boxes (BA, CC, PPP)
 - Letters to re-distribute allocations are managed at JCB level
 - At the end of each period: unallocated subscription under ARTES 4.0 Programme is automatically re-distributed to the next period



CC in ARTES 4.0

- **Projected growth** of 10% p.a. of committed Industrial Activities
=> MS financial support must follow
- **Technology pillars for CC:**

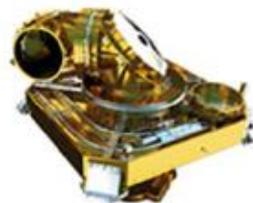
mm wavelength Communication



Digital Processing



Optical Communication



Smart Antenna



Smart Manufacturing



- **Tools in CC box:** AT, CG, Scylight



CC in ARTES 4.0:

NEW!

AT mission demonstrators

- **“5G Node”** in the Sky: technology demonstration of high-speed, low-latency, fully terrestrial integrated solution
- **AI Autonomous Satellite:** self-learning operations in space to reduce/avoid ground control, and automatic health check with debris avoidance
- **Cognitive Satellite:** demonstration of SDR using advanced ultra deep submicron technology in space
- **Ultra Gbps Satellite System:** using mm wave communication, Gbps modem and advanced air interface

+ Ideas from Industry and MS



CC in ARTES 4.0: Scylight



- ESA initiated activities (workplan)
+
- Industry initiated activities (always open call for proposal):
 - TESAT: NGLCT (Next Generation GEO Laser Communication Terminal)
 - SES TECHCOM: QUARTZ (Quantum Cryptography Telecommunication System)
 - CPA (Coarse Point Assembly 70mm)
 - Airborne Terminals
 - Photonics Optima IOD

NEW!

running and requiring demo
forecasted

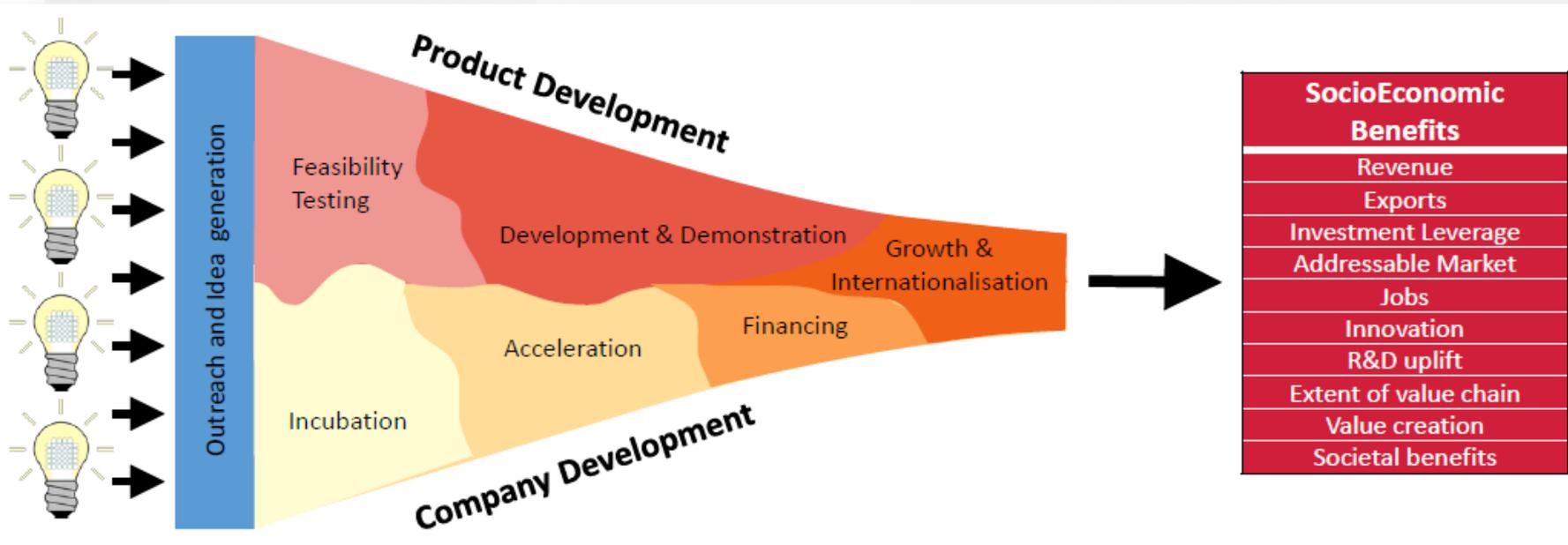
- All info updated available on

<https://artes.esa.int/artes-scylight-secure-and-laser-communication-technology>





BA in ARTES 4.0



BA 4.0 will bring together under one single umbrella at ESA:

- Awareness and Outreach
- Company development = current BIC and TT extended
- Product development = current IAP extended



BA in ARTES 4.0: Company development

- **BIC:** Business Incubation Center establish confidence and define a path towards market success.
- **TT:** ESA Technology Transfer.

NEW!

• **Access to Private Finance**

NEW!

• **Access to European and Global markets**



BA in ARTES 4.0: Product development

- **Feasibility activities:** to establish confidence and define a path towards market success.
- **Demonstration projects:** to develop and test business solutions with users and commercial customers.
- **Grant-like process:** to simplify and speed up the industry experience.

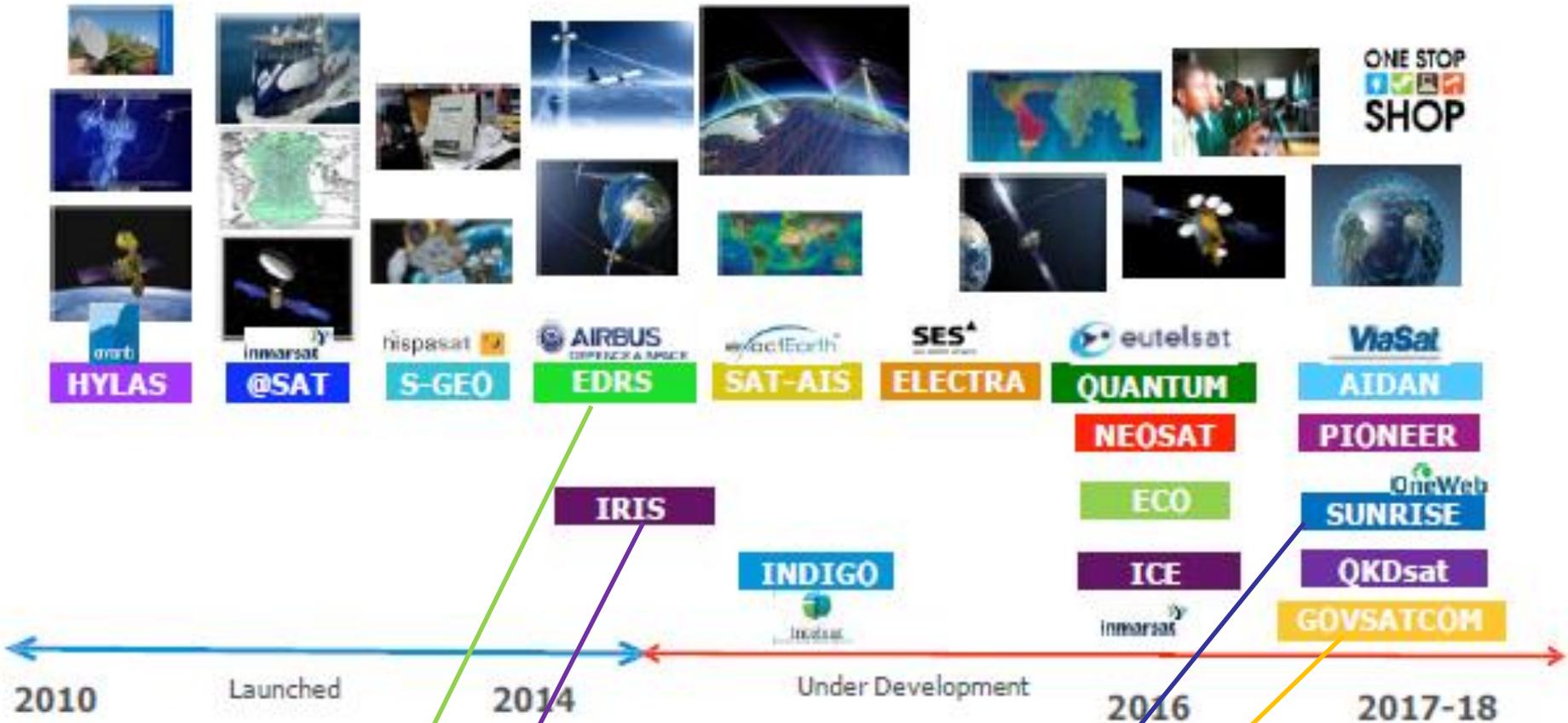


PPPs in ARTES 4.0: Subscribing

- **At Space19+:**
 - Mature PPPs included in the ARTES 4.0 Programme Proposal
 - Subscriptions to ARTES 4.0 may already be allocated to a specific project at Space19+, or allocated later on
- **After Space19+:**
 - Project proposal issued to JCB (programmatic, cost, schedule details)
 - Interested MS may agree on such Proposal and allocate funds to a new PPP
 - Following sufficient allocations the new PPP can start and progress will be reported at each JCB
 - On a yearly basis the Industrial return and cost status for each individual PPP will be reported to JCB



PPPs in ARTES 4.0: Running PPPs



New developments and funding request at Space19+



PPP in ARTES 4.0:

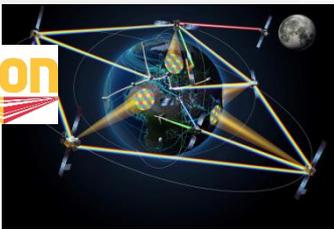
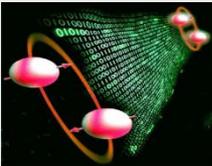
Enlarged portfolio of PPP types

PPP Type	Definition
Classic	Operator is ESA partner and proposes innovative projects & industrial core team - Business case for commercial exploitation
Ecosystem	(NewSpace) Operator is ESA partner and comes with high-level definition of cooperation and intended innovation. Loosely correlated activities in different areas - Business case for commercial exploitation
Prime	Satellite/System integrator is ESA partner and proposes innovative product line with/without supply chain & with/without validation mission - Business case based on product sales
Cutting Edge	ESA proposes partnership with Operators/Users for testing and validation of immature technology from technical or market standpoint - Long term business case
Service	Partner is an Operator with an industrial team for introduction/piloting of new services without new space segment - Business case for commercial exploitation

... with TBD co-funding levels

PPPs in ARTES 4.0: Potential new proposals



-   **High thRoughputOptical Network**
= fiber in the sky
-  **Novacom**
= Partnerships with Integrators for next gen Satcom systems
-  **SAGA**
= Security And cryptoGrAphicmission,
a European QKD Network Precursor
-  **LDRA** = Large Deployable Reflector Antenna,
unabling a European techno

Transversal themes in ARTES 4.0



- **Covering a wide multi-disciplinary inter-related R&D actions**
- Providing coherent support with less contractual rigidity from ESA.
- Already identified themes:

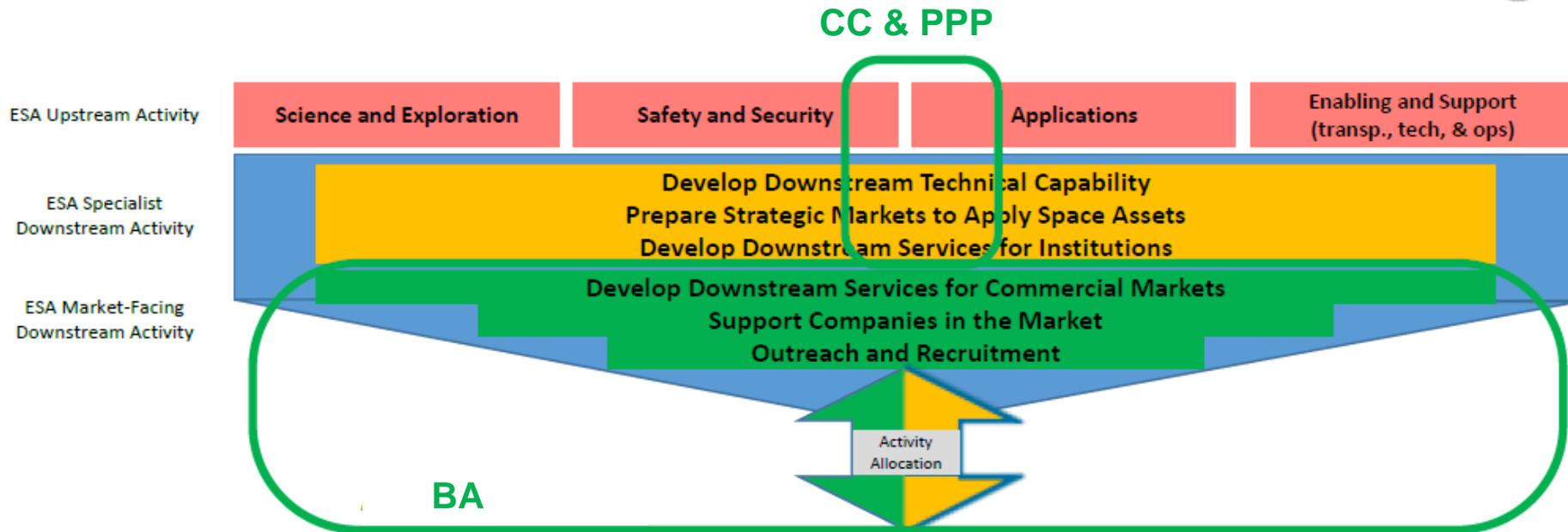


➤ **5G**: new generation of communications is key to support the Digital Transformation with integration of satellite with terrestrial telecom networks



➤ **4S (Secure Satcom for Safety and Security)**: driven by the need to adopt high levels of cyber-security and respond to cyber-warfare

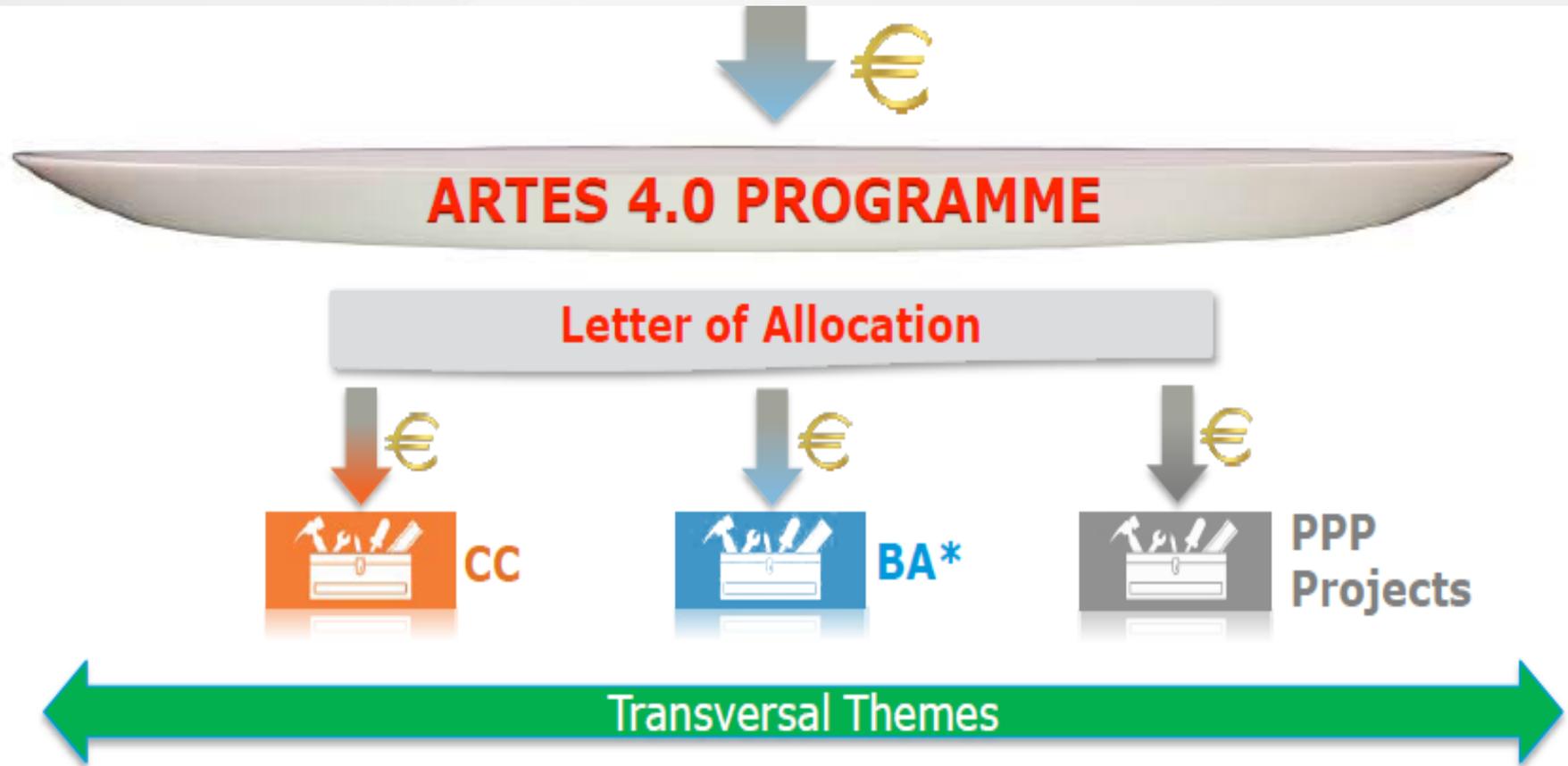
ARTES 4.0 in ESA's Pilar vision



Downstream Gateway to the Customer

Common internal services for all ESA programme areas:
European & International Market Outreach,
Key Account Management,
Handling of new proposals, Procurement support

ARTES Programme (Telecom)



ESA Programmes

Applications – Navigation

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- Securing R&D activities in Navigation to be seen as precursor for the next generation of European GNSS

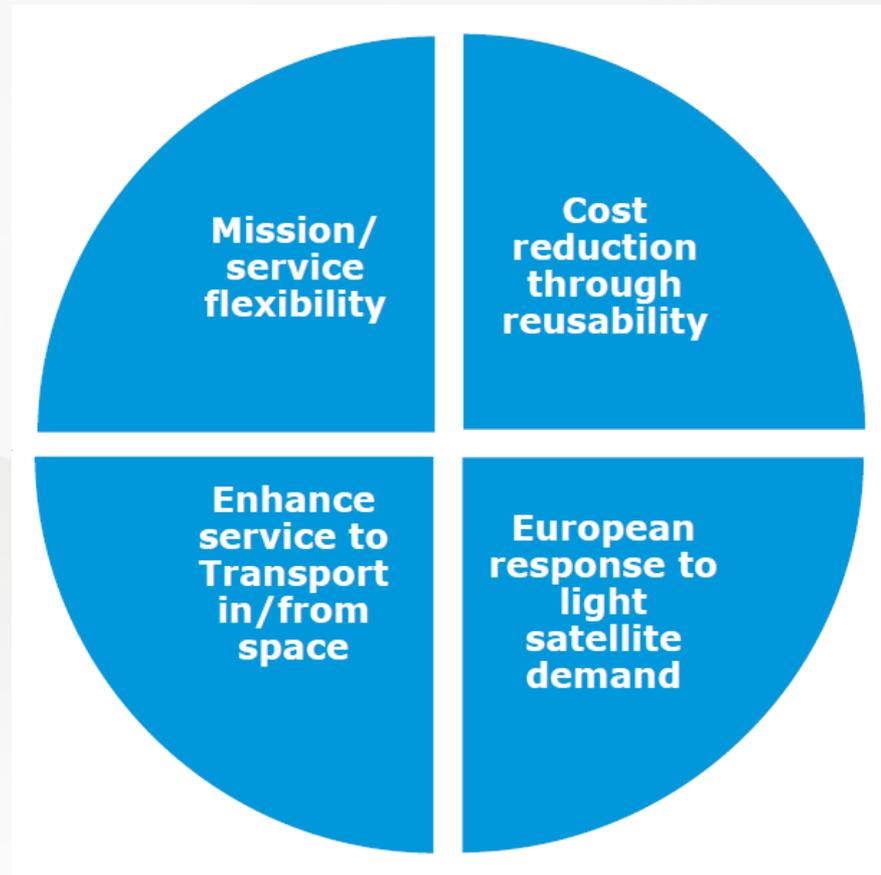
ESA Programmes

Enabling and Support – Space Transportation

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Development and Technology Programmes

NOT DISCUSSED YET, but the focus areas are defined:



Current status of discussion

- Importance of the completion and initial exploitation of Ariane-6 and Vega C
- Cost reduction as key driver for upcoming programme proposals, including on re-usability
- Basic support to 4 focus areas as proposed by ESA, considering affordability
- Micro-launchers and spaceports: ESA as an enabler and expert, not as a developer, nor a guaranteed user

Light weight "Black" Upper Stage (Ariane case)



Preparation 2013-23

Development decision: 2022

Operational: 2025

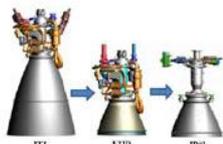
Composite tank & structure



Mass -35%
Cost -20%



Vinci Evolution



Mass -40%
Cost -50%



Scale 1 Cryostage Demo 2023



Drivers^(*):

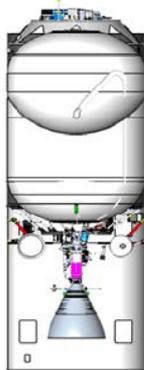
- Reduced RC
- Increased P/L
- In orbit reusability potential



Objective:
>20% performance



Versatility & cost reduction (Vega case)

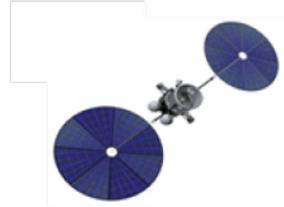
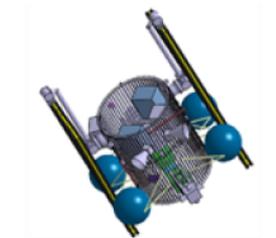
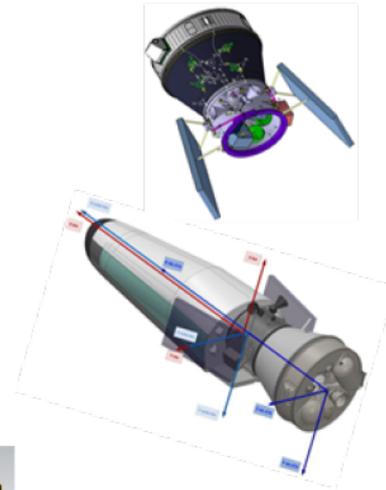


10 T-CLASS LIQUID OXYGEN AND METHANE ENGINE

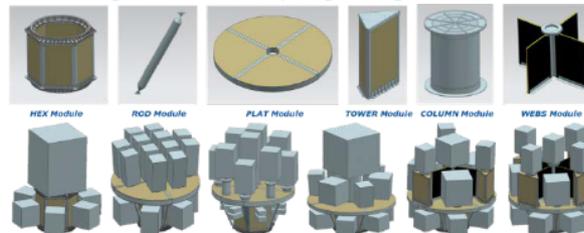
LOW COST GREEN AND FLEXIBLE UPPER STAGE
VENUS ELECTRIC MODULE

ADAPTABLE CONFIGURATIONS USING BUILDING BLOCKS

INCREASED OPPORTUNITIES FOR SMALL SPACECRAFT MISSIONS AND IN ORBIT SERVICES



Modular design elements for multiple flight configurations



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ESA | 03/05/2018 | Slide 12



European Space Agency

Reusability for cost reduction: in-flight demo



Preparation 2016-20

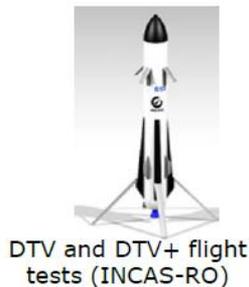
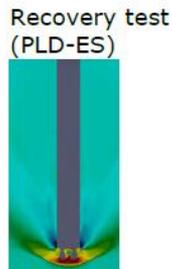
full scale flight test: 2023

National & EU



Prometheus hot fire test (2021)

ESA



Application to next generation of launchers

Objective:
Scale 1 Protflight recovery with Prometheus as precursor

ESA UNCLASSIFIED - For Official Use

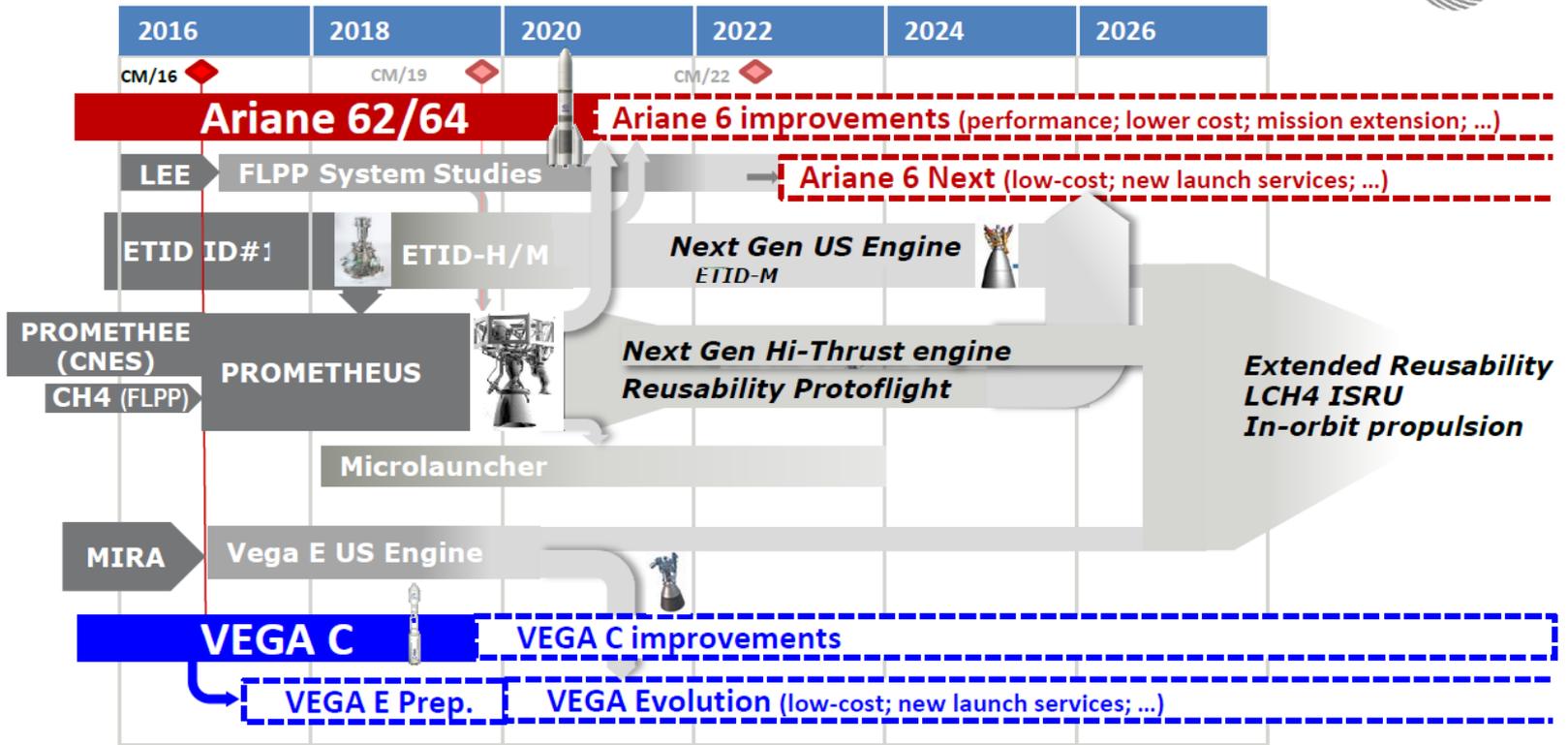
ESA | 03/05/2018 | Slide 13



European Space Agency



LOx-Methane Propulsion > consolidation



Exploitation Programmes (1)

- **Continuation of existing programmes**
 - LEAP Ariane 5 Supplementary 2020 to completion
 - Proposed amount by ESA: 450 M€ e.c. 2017
 - LEAP Vega Classical & MCO 2020-2021
 - Proposed amount to be defined
 - Ariane 6 and P120C Transition Programme
 - Step 1: 68,3M€ e.c. 2017 (subscribed at June 2018 Council)
Belgium has not subscribed
 - Step 2: proposed amount to be defined
 - Steps 1 + 2 cannot exceed 200 M€ e.c.2014
 - LEAP Ariane 5 Classical and MCO 2017 to completion (additional subscriptions needed)
 - Proposed amount at CM-16: 514 M€ e.c. 2016
 - Subscription at CM-16: 65,9%
 - Proposed amount for Belgium: 32,9 M€ e.c. 2016
 - Amount already subscribed by Belgium: 10,23 M€ e.c. 2016

Exploitation Programmes (2)

- **New “potential” programme (not discussed yet)**

- Ariane 6 and Vega C exploitation accompaniment programme

The subscription for the activities to be performed from 2020 to the end of the first 6 years of exploitation are planned in three waves: Space19+ and next CMs.

Mandatory Programme

- **Draft CSG Resolution 2020-2025 (not discussed yet)**

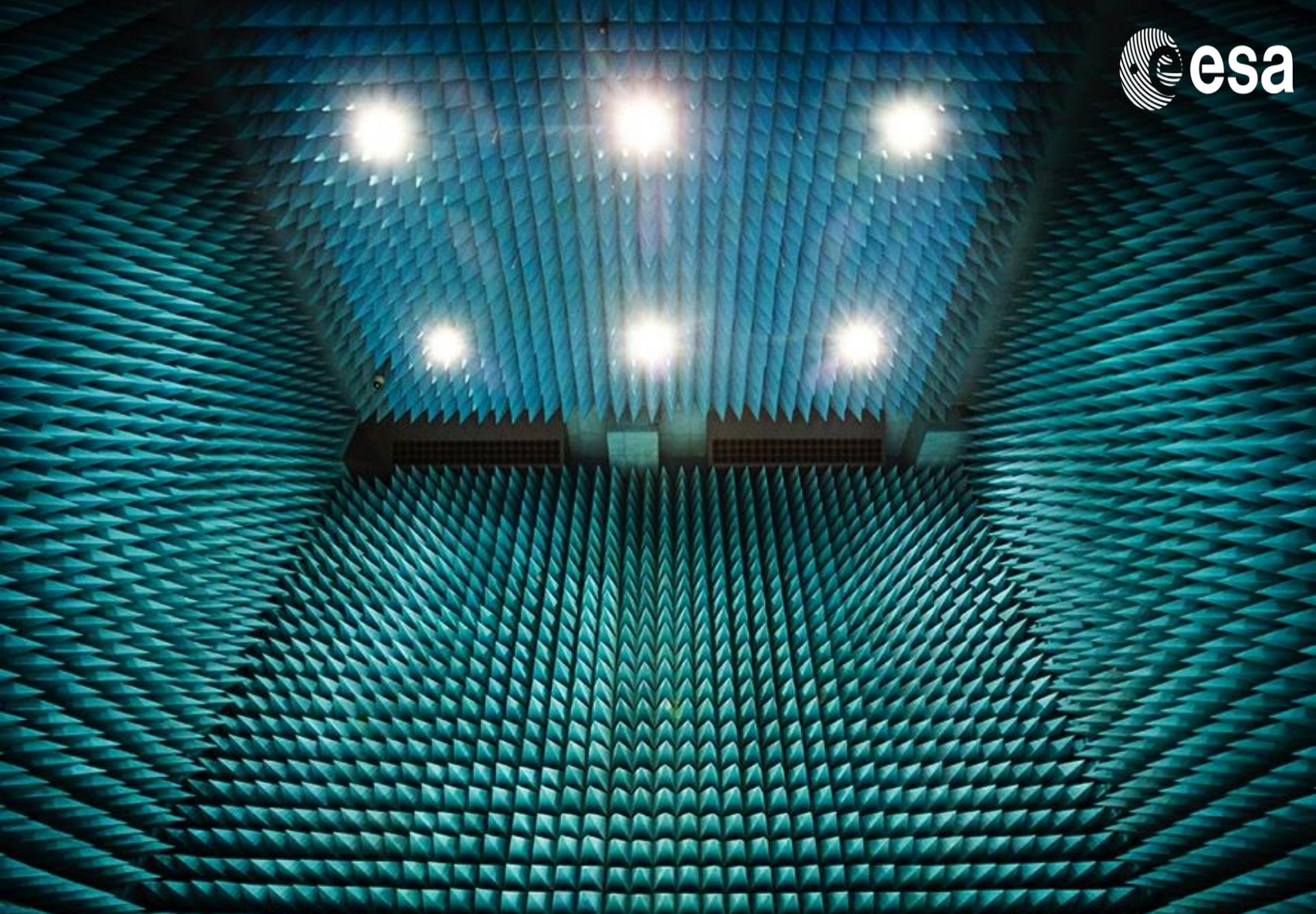
Roadmap towards Space19+

- **Nov. 18 - PB-LAU**
 - Report on exploitation status A-5 and revised Exploitation model A-6
 - Updated ESA STS financial overview
 - Consultation on key priorities in Development/Exploitation/Future
- **Feb. 19 - PB-LAU**
 - Enabling Resolutions Ariane-6 and Vega-C exploitation accompaniment programme
- **May 19 - PB-LAU**
 - First draft Programme Proposals and Declarations

ESA Programmes

Enabling and Support – Technology and Engineering

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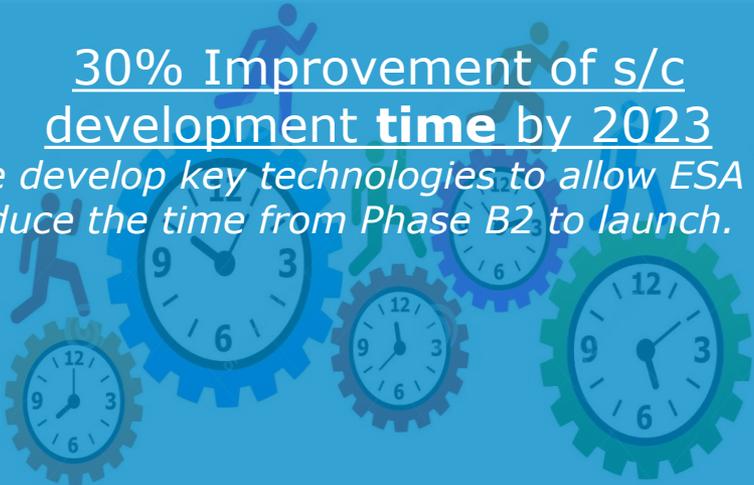


Technology and Engineering Targets



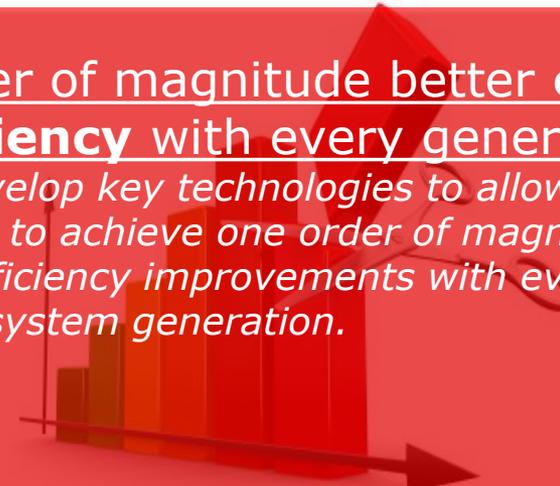
30% Improvement of s/c development **time** by 2023

We develop key technologies to allow ESA to reduce the time from Phase B2 to launch.



Order of magnitude better **cost efficiency** with every generation

We develop key technologies to allow Europe to achieve one order of magnitude cost efficiency improvements with every space system generation.



30% **faster** development & adoption of **innovative** technology

We develop processes, methods and technologies to allow Europe to take full benefit from the early introduction of new technologies into space systems.

Inverting Europ. contributions to **space debris** by 2030

We develop the technologies that allow us to leave the space environment to the next generation in a better state than we have inherited it.

Example of Effectiveness and Efficiency

Common Technical Infrastructure

- Unique common European technical infrastructure
- Support to conception and implementation of missions and industrial competitiveness

Standardisation

- For industry's competitiveness and support to export

Harmonisation

- Coordination of R&D activities among all actors
- Harmonised Technology Roadmaps



Mature, diverse, **industrial base**
Growth driven by **downstream**
Emergence of new **commercial**
opportunities
Full-scale **integration** of space into
modern economies



Digitalisation and 'Industry 4.0'
Big Data & Artificial Intelligence
Cybersecurity
Quantum Technologies
In-Space Servicing, Assembly &
Manufacturing

Urgency:

digital transformation

of the European space sector

Technology and Engineering @ Space19+

Re-establish funding level for Basic Activities

- Effective preparation of future initiatives via the Discovery, Preparation and Technology Development Elements
- Investment in Common Technical Assets
- Prepare for digital transformation

Continuation of GSTP

- Develop (ESA initiated), Make (Industry driven), Fly (flight opportunities)
- Small Missions and cubesats: techno opportunities (Model Based Systems Engineering, AI for on board autonomy, etc.)

Space Safety

- Support to Technology, HERA and ADR missions



Efficiency and Investment



Technology Strategy **implementable** and Technology Targets **achievable**
via

Continuing further internal efficiency increase

20% increase for Level of Resources for technology

20%

ESA Programmes

Enabling and Support – PRODEX

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Industrial Policy

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Five priority areas for Industrial Policy Evolution (1) – as proposed to June IPC

1. Consolidate a comprehensive industrial policy strategy responding to the evolved context, in close coordination with stakeholders, defining the objectives, priorities and tools of industrial policy at ESA, as well as the associated regulatory processes and indicators to measure its effectiveness
2. Introduce in the industrial policy at ESA to better respond to the diversity of actors an additional flexibility of activities at ESA, addressing the various time constraints of the ESA missions and proposing new solutions
3. Make ESA a more agile and responsive organisation, able to support innovation and to foster new partnerships and cooperation models, especially in the "NewSpace" context and with respect to commercial initiatives

Five priority areas for Industrial Policy Evolution (2) – as proposed to June IPC

4. With a view to better benefitting from the innovative potential of SME's from all MS, strengthen ESA's SME Policy and Initiative, by focusing on the financial viability of SME's, supporting the integration of SME's in the supply chain, elaborating activities customised to SME's and proposing a mentorship scheme;
5. Promote a closer cooperation between ESA and industry, to ensure that ESA responds optimally to the needs of European space industry for improving its competitiveness.

BELSPO current position

- We remain very much attached to the geo-return principle
- Cautious with respect to the Basic Activities and related decisions
- Open to a discussion on a hybrid return system (between fair return and guaranteed return), but with many open questions
- Requesting the simplification and harmonization of the ESA processes

Next steps

- October 25 IMM-ESA: endorsement of the Resolution which mandates the DG to work on ESA evolution including industrial policy
- November IPC: second discussion of draft proposals
- February 2019: IPC endorsement of proposals
- CWG for Space19+: proposals included in draft Resolution(s)
- Space19+: Resolution(s) endorsed

- On-going industry consultations (also at HLF): Eurospace, LSI's, SME associations
- On-going MS consultations

Bilateral Programmes

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Bilateral agreements

- Existing
 - France
 - Argentina
 - Russia
 - South Africa
 - Vietnam
 - China
- In preparation
 - UAE
 - Mexico

National Programmes

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BELGIUM: A LONG HISTORY IN REMOTE SENSING PROGRAMMES

- 33 years of continuous funding
- STEREO III Support to the Exploitation and Research in Earth Observation
- Belgian programme with limited participation of international teams
- Duration: 2014-2021
- Budget: ± 28 M€
- More than 50 projects financed
- Innovative and thematic research conducted by scientific institutions

SUPPORT TO THE RESEARCH COMMUNITY

- Systematic in-situ and RS data collection for cal/val and joint research <http://belair.vgt.vito.be/>
- Web site and newsletters (job offers!)
<https://eo.belspo.be/en>

SUPPORT TO THE INDUSTRIAL COMMUNITY

- Collaborations (knowledge transfer) between research institutions, public administrations and private companies
- Private companies cannot obtain funding by the STEREO III programme but are the beneficiaries of the results of the research

Space19+

- STEREO IV
- Duration: 2021-2028
- Budget: to be determined
- More focus on the use of free & open data and of Belgian infrastructures & sensors (Terrascope...)
- Continue to support technology transfer from research to companies