(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

<table>
<thead>
<tr>
<th>Year</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>TOTAL</th>
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<tbody>
<tr>
<td></td>
<td>500.0</td>
<td>510.0</td>
<td>507.4</td>
<td>499.4</td>
<td>492.5</td>
<td>2,509.3</td>
</tr>
</tbody>
</table>

• 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)

- 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 awarded 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

*Habitation 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

Cooperation with Roscosmos
Commercial Partnership
Commercial Partnerships & Services/ Missions of Opportunity
International Cooperation

- 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)

**Gateway Support**

**Recurring Missions:**

- 1.5 to 2 Heavy Lift Launches

**Surface Operations:**

- 42 days on surface

- Lunar day
- Lunar night

**Timeline:**

- 14
- 14
- 14
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

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

development of new applications
development of instrumentation and deployment on host mission services: development and pre-operations

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

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

<table>
<thead>
<tr>
<th></th>
<th>EOEP</th>
<th>Future EO-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envelope approach</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Period duration</td>
<td>5 years</td>
<td>3 years: 2020 - 2023</td>
</tr>
<tr>
<td>Funding</td>
<td>Yearly cruising level 300 – 350 M€</td>
<td>Increased funding, amount TBC</td>
</tr>
<tr>
<td>Content</td>
<td>Block 1, 2, 3, 4</td>
<td>Same +</td>
</tr>
<tr>
<td>Approach @ Research missions</td>
<td>Earth Explorers partly or fully funded in period</td>
<td>NewSpace features, Small (demo) Mission / Mission of Opportunity, HAPS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Climate Adaptation &amp; Mitigation and SDGs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EO AFRICA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Earth Explorers fully funded until Phase E1</td>
</tr>
</tbody>
</table>
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
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
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)
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.
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)
Monitor effects of Climate Change (Arctic/Polar ice volume)
Sea Ice Conc. & SST (Arctic situational awareness)

Agriculture & Water Productivity
Food Security, Soil & Minerals, Forestry, Biodiversity
Soil Moisture, Vegetation & Ground Motion
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
Earth Watch - ALTIUS

Altius PhE
Operational ozone concentration monitoring

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

Period
2020-2025
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:
  o TMA
  o TIR
  o Hyperspectral

Feasibility is under investigation
Scenario’s are under discussion with ESA
Earth Watch - InCubed

InCubed+

Ambitious continuation of InCubed

Objective
Secured continuation of InCubed until 2023, with larger scale ambitions and top-innovative deliverables

Format
Revision of current InCubed Earth Watch Element, with updated Implementing Rules (e.g. procurement)

Deliverables
Pre-commercial products, up to full-fledged demonstrators, with integration of fast growing technologies. Focus on upstream and/or end-to-end solutions
Earth Watch -
International Development Aid

<table>
<thead>
<tr>
<th>Int. Development Aid</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bring operational EO solutions to ODA activities</td>
<td>Develop operational EO solutions to support International Development Aid activities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Format</th>
<th>Deliverables</th>
</tr>
</thead>
</table>
| New Earth Watch element, ODA compatible and aligned with IFI funding | - 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 |
### 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
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

• 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
• **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:**

- **Tools in CC box:** AT, CG, Scylight
CC in ARTES 4.0:
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

- All info updated available on
  https://artes.esa.int/artes-scylight-secure-and-laser-communication-technology
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

<table>
<thead>
<tr>
<th>PPP Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classic</td>
<td>Operator is ESA partner and proposes innovative projects &amp; industrial core team - Business case for commercial exploitation</td>
</tr>
<tr>
<td>Ecosystem</td>
<td>(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</td>
</tr>
<tr>
<td>Prime</td>
<td>Satellite/System integrator is ESA partner and proposes innovative product line with/without supply chain &amp; with/without validation mission - Business case based on product sales</td>
</tr>
<tr>
<td>Cutting Edge</td>
<td>ESA proposes partnership with Operators/Users for testing and validation of immature technology from technical or market standpoint - Long term business case</td>
</tr>
<tr>
<td>Service</td>
<td>Partner is an Operator with an industrial team for introduction/piloting of new services without new space segment - Business case for commercial exploitation</td>
</tr>
</tbody>
</table>

... 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 cryptoGrApHic mission,
  a European QKD Network Precursor

- **LDRA**
  = Large Deployable Reflector Antenna,
  enabling 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 cybersecurity 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

---

**Develop Downstream Technical Capability**
- Prepare Strategic Markets to Apply Space Assets
- Develop Downstream Services for Institutions

---

**Develop Downstream Services for Commercial Markets**
- Support Companies in the Market
- Outreach and Recruitment

---

**Activity Allocation**

---

**CC & PPP**

---

**ESA Upstream Activity**

- Science and Exploration
- Safety and Security
- Applications
- Enabling and Support (transp., tech., & ops)

---

**ESA Specialist Downstream Activity**

---

**ESA Market-Facing Downstream Activity**
ARTES 4.0 PROGRAMME

Letter of Allocation

CC

BA*

PPP Projects

Transversal Themes

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:

- Mission/service flexibility
- Cost reduction through reusability
- Enhance service to Transport in/from space
- European response to light satellite demand
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 are 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

(*) Orbital flexibility (Direct GEO/MEO, Multiple orbits...) using kick-stage
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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Reusability for cost reduction: in-flight demo

Preparation 2016-20

National & EU
- REFEX (DLR)
- Callisto (CNES)

ESA
- Recovery test (PLD-ES)
- DTV and DTV+ flight tests (INCAS-RO)
- Prometheus hot fire test (2021)

full scale flight test: 2023

Application to next generation of launchers

Objective:
Scale 1 Protolight recovery with Prometheus as precursor

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ESA | 03/05/2018 | Slide 13
LOx-Methane Propulsion > consolidation

Ariane 62/64

- LEE
- FLPP System Studies
- ETID ID#1
- ETID-H/M
- PROMETHEE (CNES)
- CH4 (FLPP)
- PROMETHEUS
- Microlauncher
- Vega E US Engine
- MIRA
- VEGA C

Ariane 6 improvements (performance; lower cost; mission extension; ...)
Ariane 6 Next (low-cost; new launch services; ...)

Next Gen US Engine ETID-M

Next Gen Hi-Thrust engine Reusability Protoflight

Extended Reusability LCH4 ISRU In-orbit propulsion

VEGA C improvements
VEGA E Prep.
VEGA Evolution (low-cost; new launch services; ...)

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European Space Agency
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.
Technology Themes

Sustainability / Cleanspace

Cyber-security

Digital Design to Produce

Advanced Manufacturing
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
Drivers

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
ESA Programmes

Enabling and Support – PRODEX

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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/](http://belair.vgt.vito.be/)

- Web site and newsletters (job offers!)  

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