Human and Robotic exploration at ESA

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Fast pace in the international context

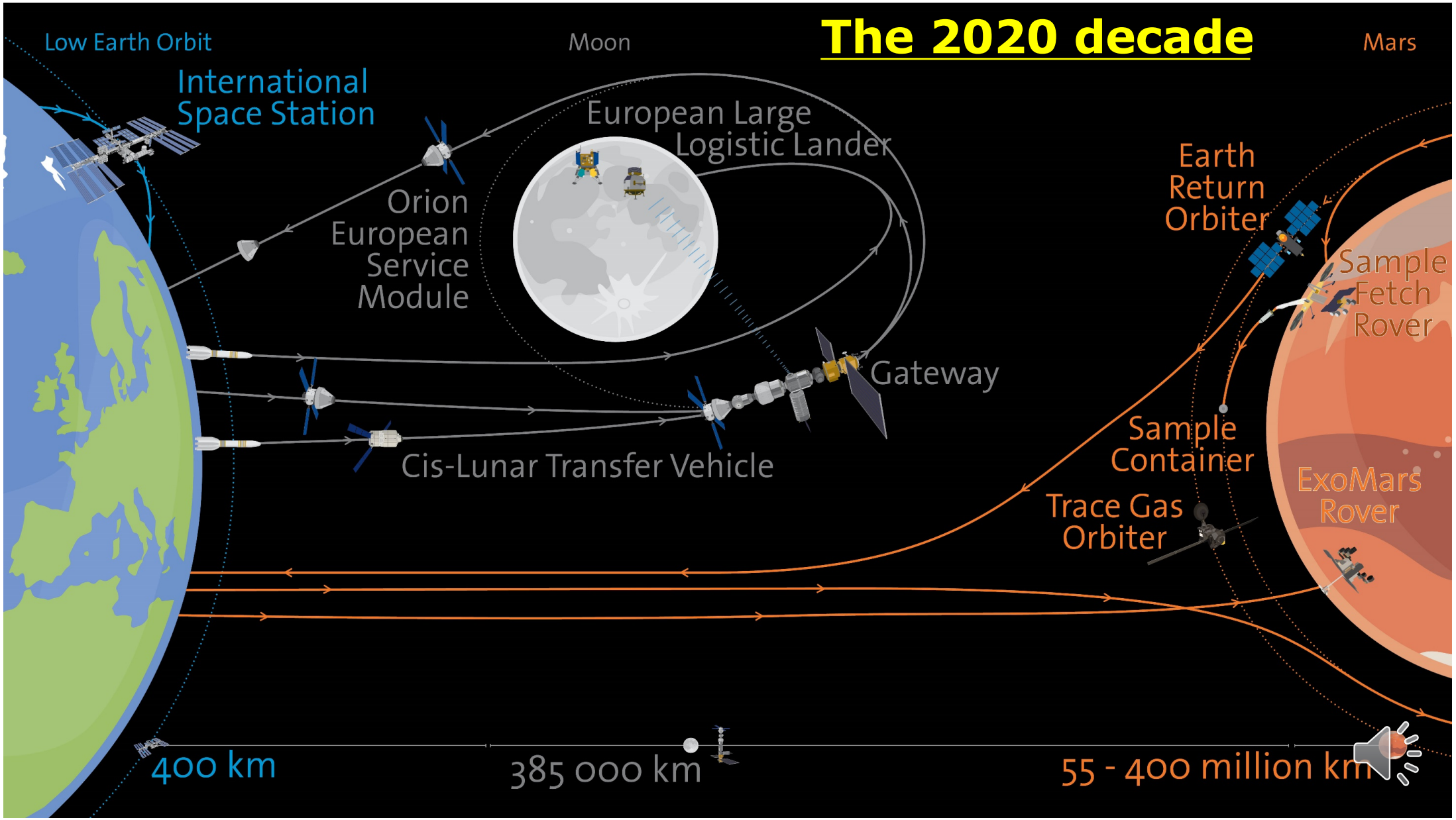

Regular US commercial flights to ISS

Disruptive access to LEO

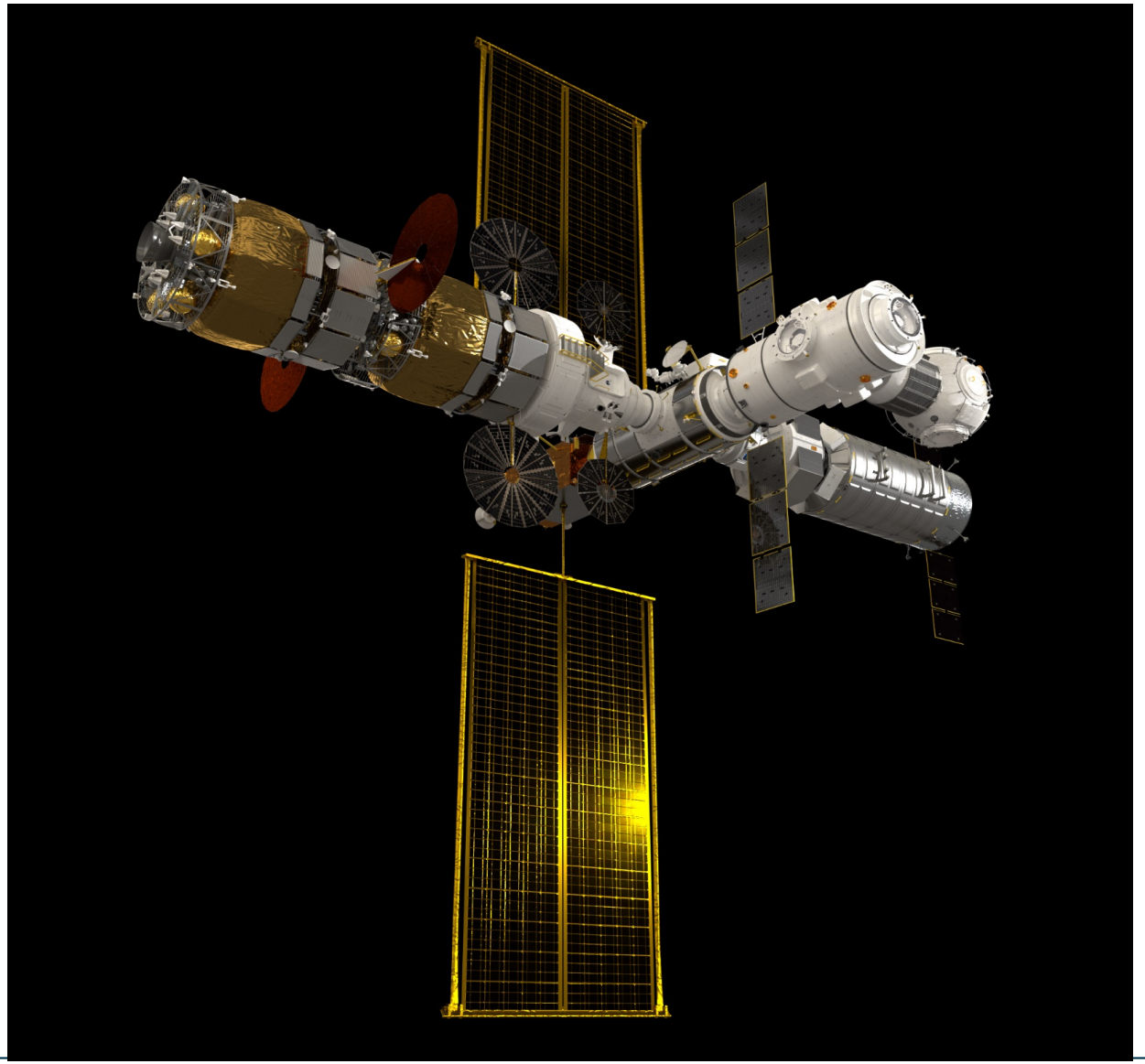

SLS/ESM-Orion maiden flight

Indian human space flight vehicle
non-crewed test flight

Chinese Space Station
in-orbit assembly


The 2020 decade
Low Earth Orbit
Moon
Mars
International Space Station
European Large Logistic Lander
Orion European Service Module
Earth Return Orbiter
Sample Fetch Rover
Gateway
Cis-Lunar Transfer Vehicle
Sample Container
Trace Gas Orbiter
ExoMars Rover
400 km
385 000 km
55 - 400 million km

Lunar Gateway



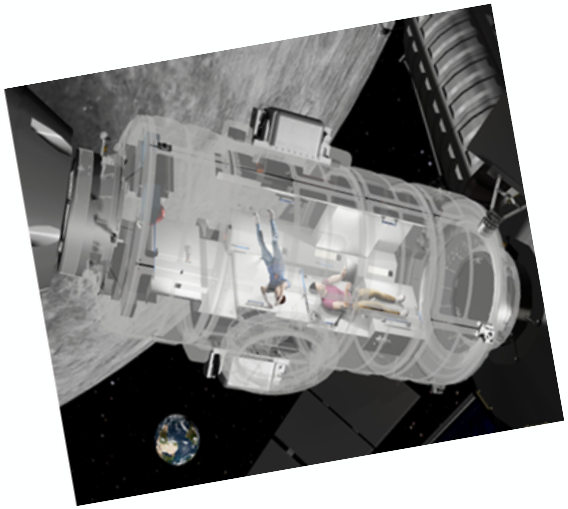
International Habitat (I-HAB)

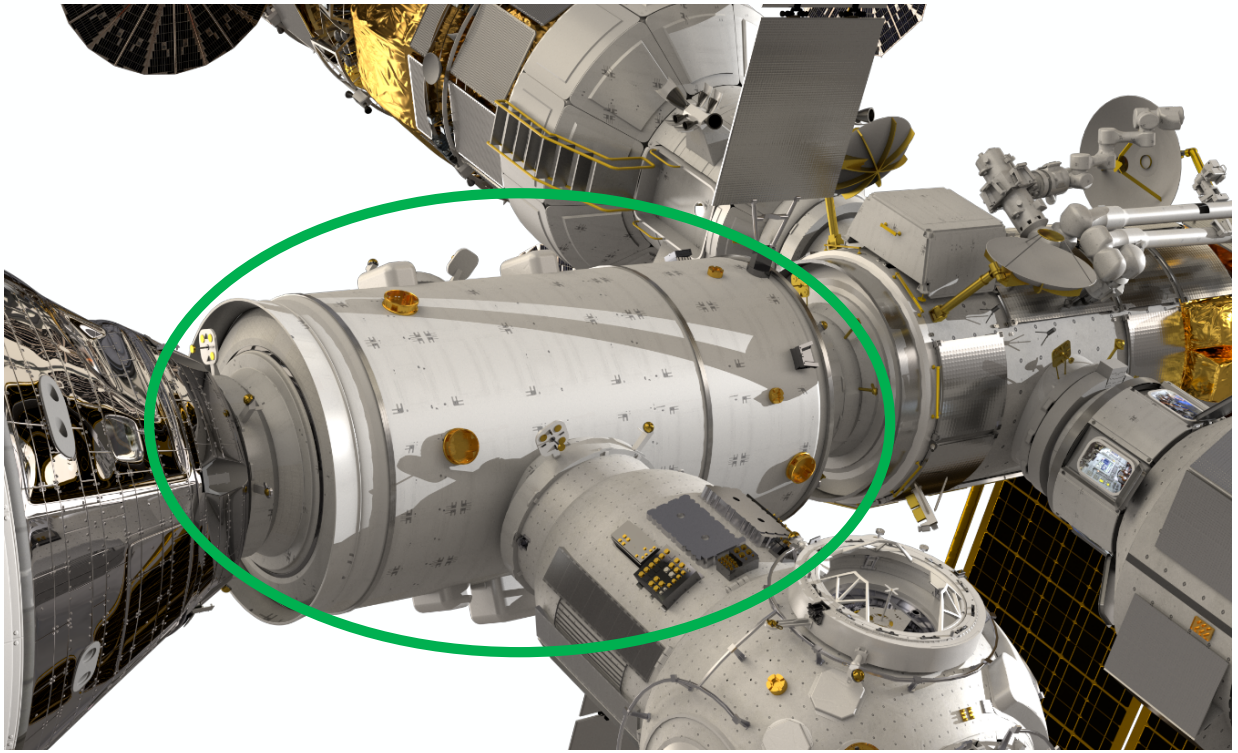
Function: Gateway habitable module with life support systems and docking ports for visiting vehicles

Launch: 2026

Status: Phase B2

Prime: Thales Alenia Space (IT)





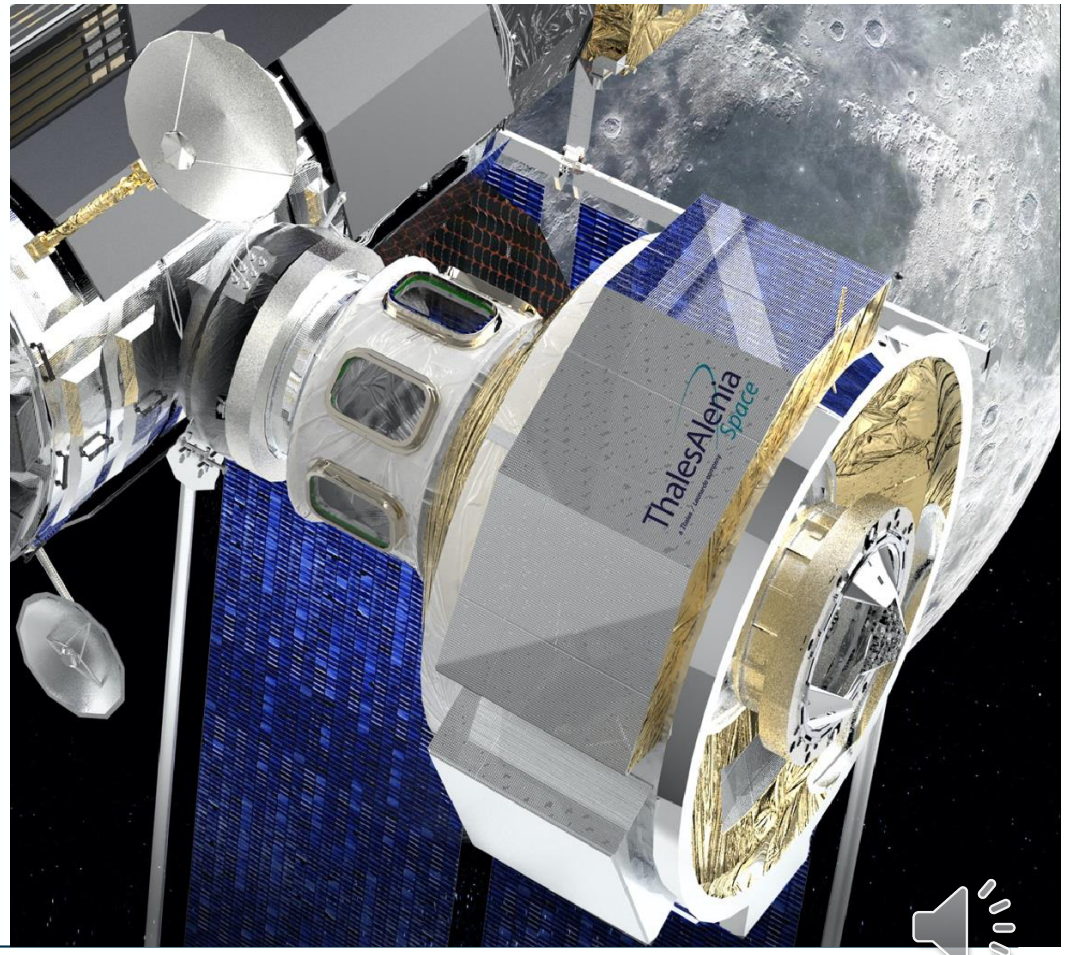
European System Providing Refuelling, Infrastructure, and Telecommunications (ESPRIT)

Function: Gateway communications and refuelling module providing viewing capability

Launch: 2027

Status: Phase B2

Prime: Thales Alenia Space (FR)



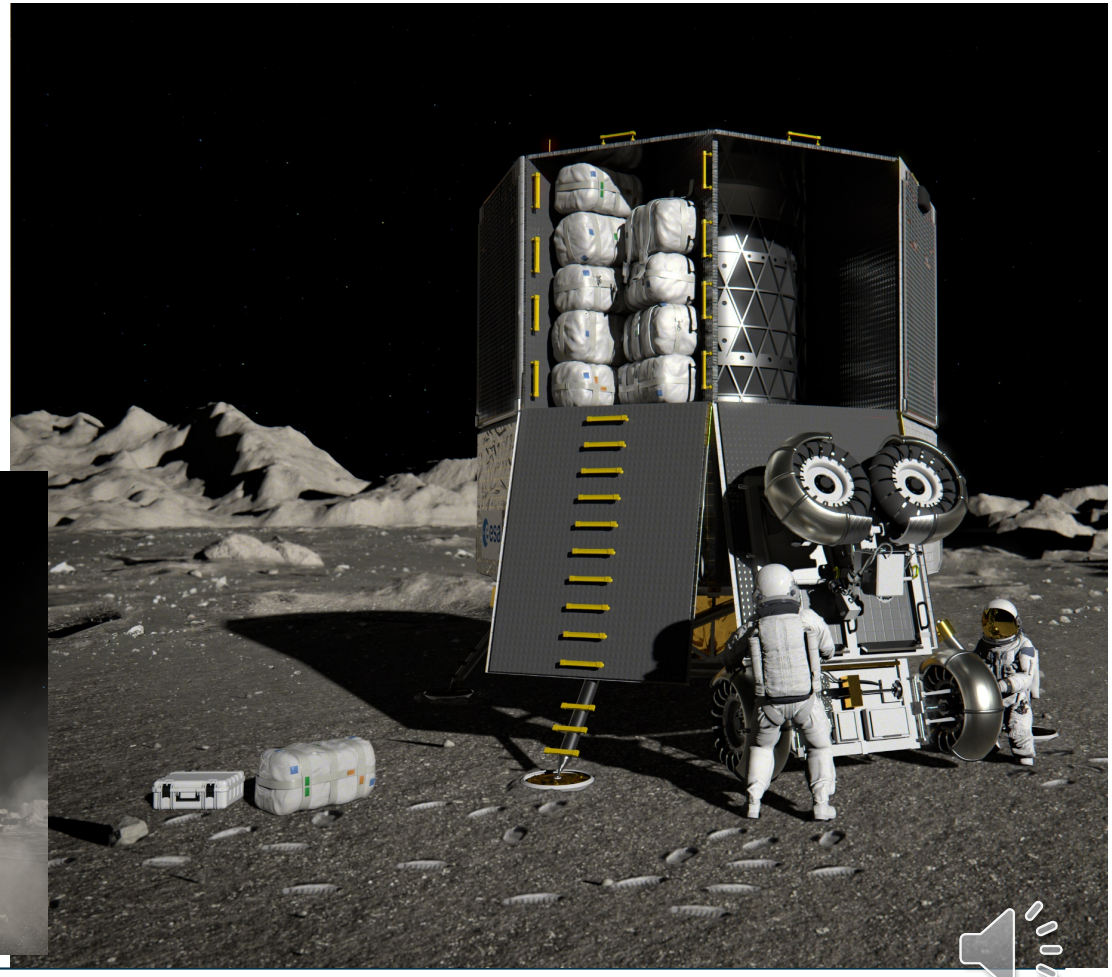
EL3: European Large Logistics Lander

Function: Deliver scientific instruments and cargo in a human environment (Artemis)

Launch: TBD (Ariane 64)

Status: Phase A/B1

Primes: Airbus DS (DE); Thales Alenia Space (IT)



Cis-Lunar Transfer Vehicle (CLTV)

Function: Ferry cargo and logistics (e.g. fuel) to the Gateway, but also in LEO post-ISS scenarios

Launch: TBD (Ariane 64)

Status: Phase A/B1

Primes: TBD soon

Based on ATV technologies

Courtesy ADS

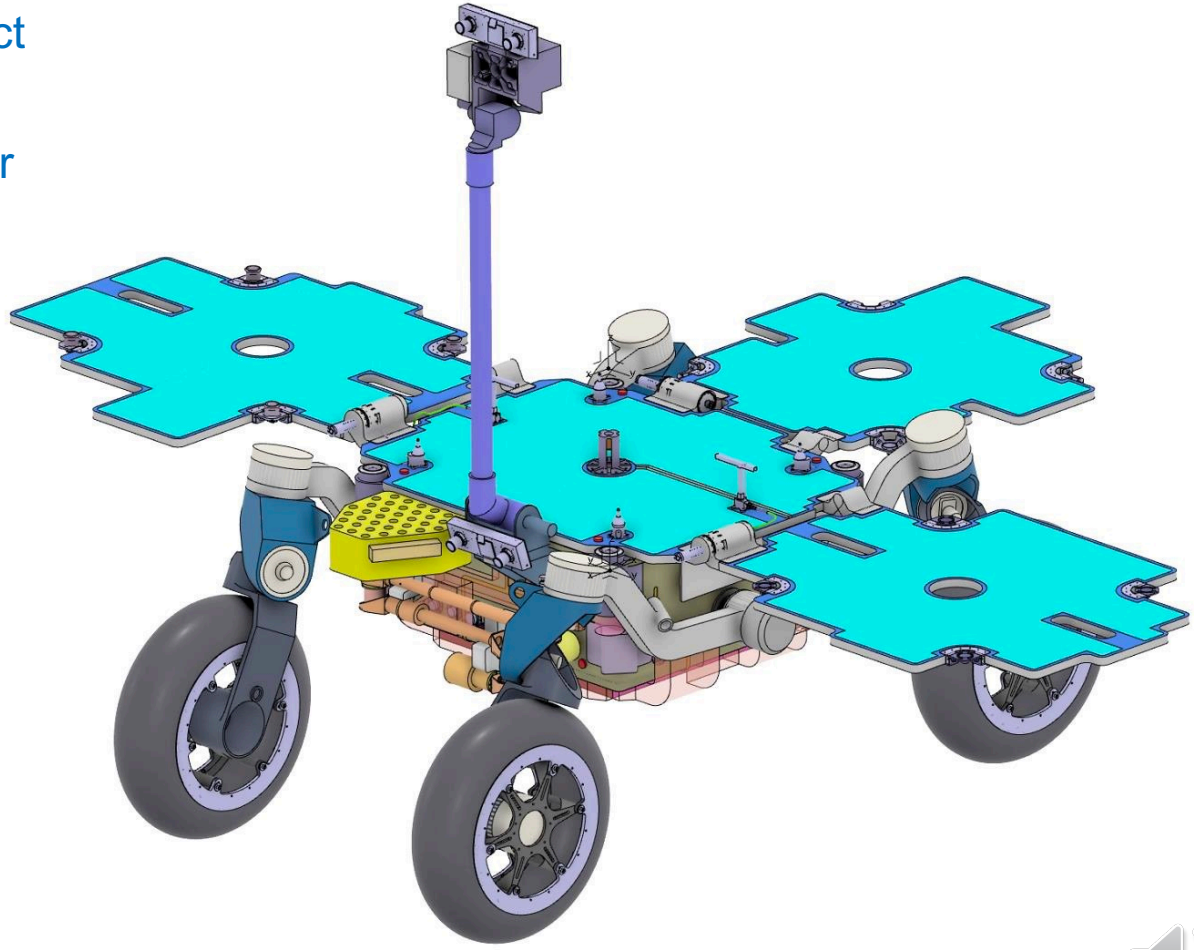
Sample Fetch Rover

Function: Autonomous navigation to detect and pick up sample tubes collected by the NASA Perseverance rover to deliver tem on the NASA ascent launcher

Launch: 2026

Status: Phase B2

Prime: Airbus DS (UK)



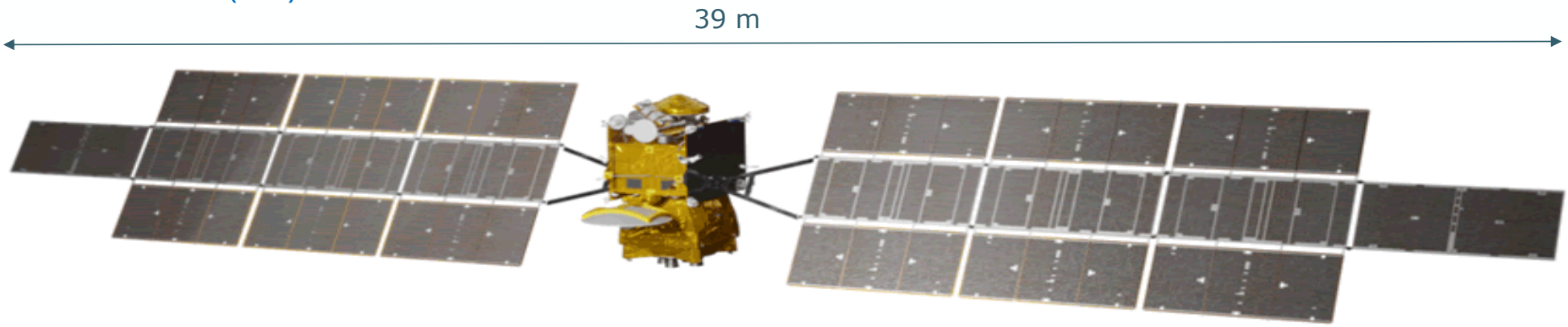
Earth Return Orbiter (ERO)

Function: Rendezvous and capture of the sample holding canister launched into martian orbit and bring them back to Earth; acting also as communications relay for the campaign

Launch: 2026 (Ariane 64)

Status: Phase B2

Prime: Airbus DS (FR)



The quest

- Space exploration, more than any other space activity, needs a coherent long term perspective and perseverance in implementation

- Humans on Mars as the horizon goal (2040's) requires preparatory robotic precursors, intermediate steps at the Moon (2030's) and using LEO as an exploration laboratory (ISS in 2020’s and post-ISS)

- Each destination shall not be abandoned in order to move to the next one – we want to create sustainable activities

→ **Sustainable economic and social value for Europe**

Beyond the quest

- A bold vision, comprehensive narrative and tangible outcomes for society are needed to convince decision-makers at all levels

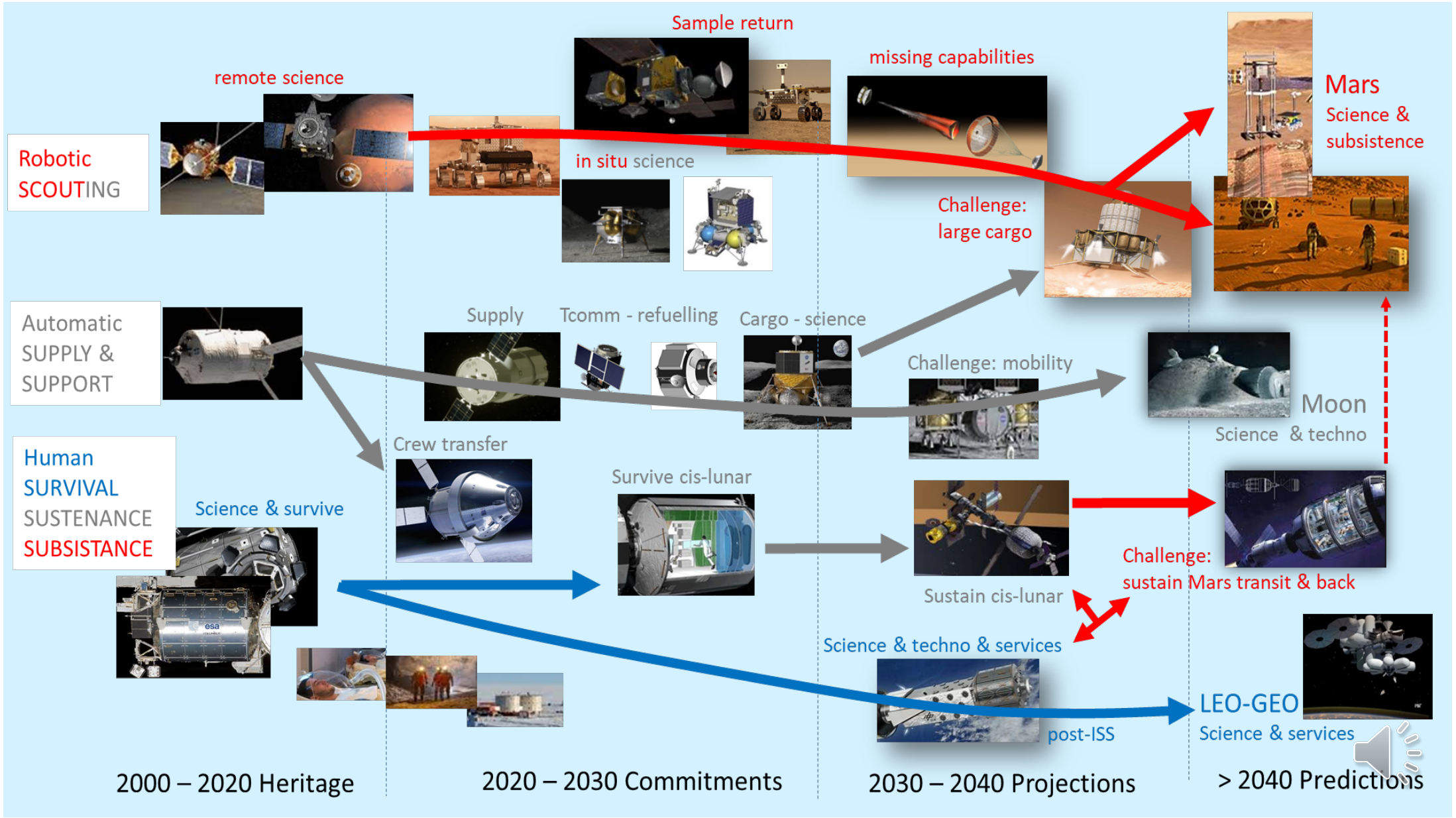
- **In times of economic turmoil and major environmental challenges the message needs to be:**

  → ***more understandable***

  → ***more relevant***

  → ***more known***

  → ***more citizen involvement***


Robotic SCOUTING
remote science
Sample return
in situ science
missing capabilities
Challenge: large cargo
Mars
Science & subsistence
Automatic SUPPLY & SUPPORT
Supply
Tcomm - refuelling
Cargo - science
Challenge: mobility
Moon
Science & techno
Human SURVIVAL SUSTENANCE SUBSISTANCE
Crew transfer
Survive cis-lunar
Science & survive
Challenge: sustain Mars transit & back
Sustain cis-lunar
Science & techno & services
LEO-GEO
Science & services
post-ISS
2000 – 2020 Heritage
2020 – 2030 Commitments
2030 – 2040 Projections
> 2040 Predictions

Venturing into deep space sustainably

- The space sector alone is not able to make break troughs in many areas of interest for future deep space presence, especially for human exploration

- Policy decision to focus on areas of societal impact :
  - → *Not just a posteriori spin off justification: objective-driven science and R&D*
  - → *Supporting daily life challenges to improve space applications*
  - → *Outcome-driven procurement as opposed to pre-defined work-orders*
  - → *Reaching out to sectors that have real impact on daily life issues*
  - → Challenge-based innovation will give a boost to exploration outreach activities

Example of successful challenge-type activity

2003 — Develop and test a grey water recycling system for use in an extreme operational environment

2005 — Grey water recycling system operational use in the Antarctic Concordia station since 2006, with successive improvements

2020 — Spin-off to large scale use in public buildings

MELiSSA grey water recycling system in the Antarctic Concordia station and now applied for hotels

Examples of challenges in your field of expertise

→ ***Being more innovative for the ISS utilisation by:***

- Dividing by 4 the waste mass produced
- Dividing by 2 the food upload without compromising nutrition quality
- Dividing by 5 the number of clothing upload without compromising hygiene & safety
- Multiplying by 100 the biomedical analytics capabilities
- …

→ ***Reducing the foot print of deep space exploration***

- Transitioning from surviving, to sustaining to subsisting
- e.g. waste as resource, bio-printing…

Post-Covid increased awareness

More conscious of risk and prevention

→ reducing foot print of future presence on the Moon and Mars

More knowledgeable about biological hazards

→ planetary protection, extraterrestrial search for life and life forms detection

More considered about public health – physical and mental

→ survival in harsh environments – remote medical and life support

More keen to engage locally

→ new foods and closed loop life support systems in space environments

More mindful about the environment

→ promoting circular economy with limited resources ; planetary space resources utilisation

More cognisant about interdependencies

→ European space autonomy balanced with need for cooperation

Another look at the Earth from the space lens

From LEO: Earth = visible environmental changes

→ *Home is close*

[limits of techno validation incentive]

From the Moon: Earth = a spacecraft with 7 Bn inhabitants

→ *Deep space outpost survival*

[low incentive - few weeks at Gateway or Moon surface]

From Mars: Earth = tiny blue dot

→ *Sustain life during the solo journey*

→ *Subsist on the surface with local resources*

[techno improvements +++]

Moving out of our Low Earth Orbit cradle