THE EUROPEAN SPACE AGENCY

UNITED SPACE IN EUROPE

February 2018

ESA facts and figures

- Over 50 years of experience
- 22 Member States
- Eight sites/facilities in Europe, about 2300 staff
- 5.6 billion Euro budget (2018)
- Over 80 satellites designed, tested and operated in flight

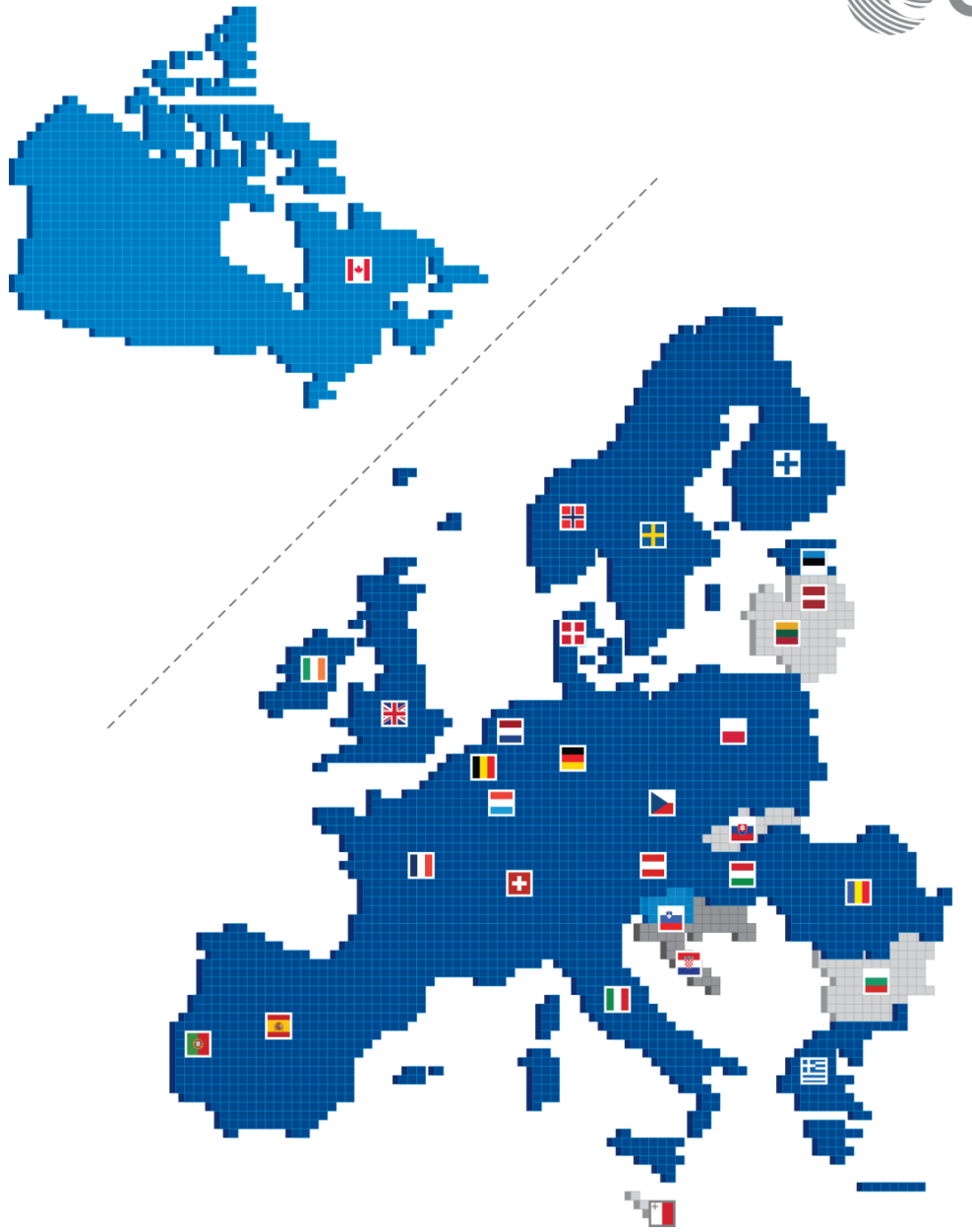
Member States

ESA has 22 Member States: 20 states of the EU (AT, BE, CZ, DE, DK, EE, ES, FI, FR, IT, GR, HU, IE, LU, NL, PT, PL, RO, SE, UK) plus Norway and Switzerland.

Six other EU states have Cooperation Agreements with ESA: Bulgaria, Cyprus, Latvia, Lithuania, Malta and Slovakia and Croatia.

Slovenia is an Associate Member.

Canada takes part in some programmes under a long-standing Cooperation Agreement.



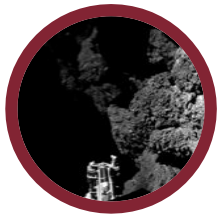
Activities

ESA is one of the few space agencies

in the world to combine responsibility in

nearly all areas of space activity.

* Space science is a Mandatory programme, all Member States contribute to it according to GNP. All other programmes are Optional, funded ‘a la carte’ by Participating States.


space science


human spaceflight


exploration


earth observation


space transportation

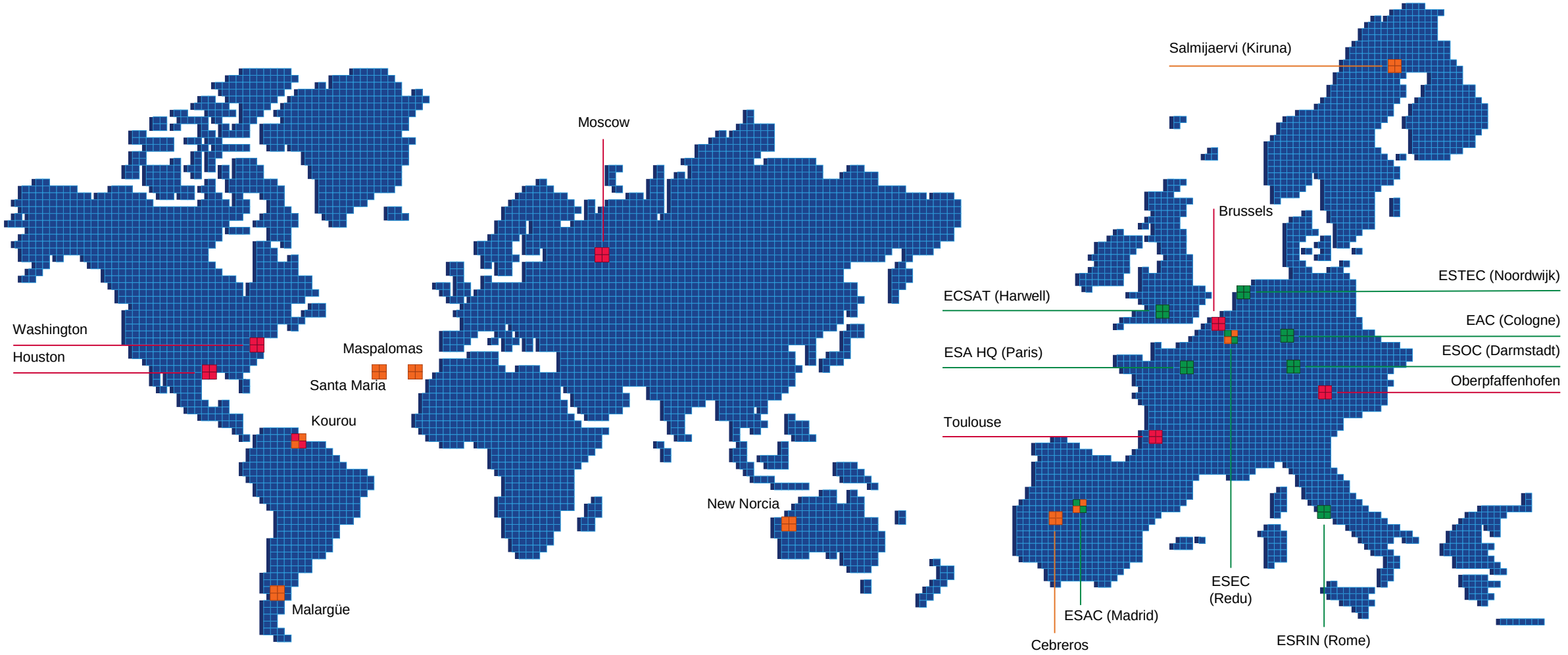

navigation


operations


technology

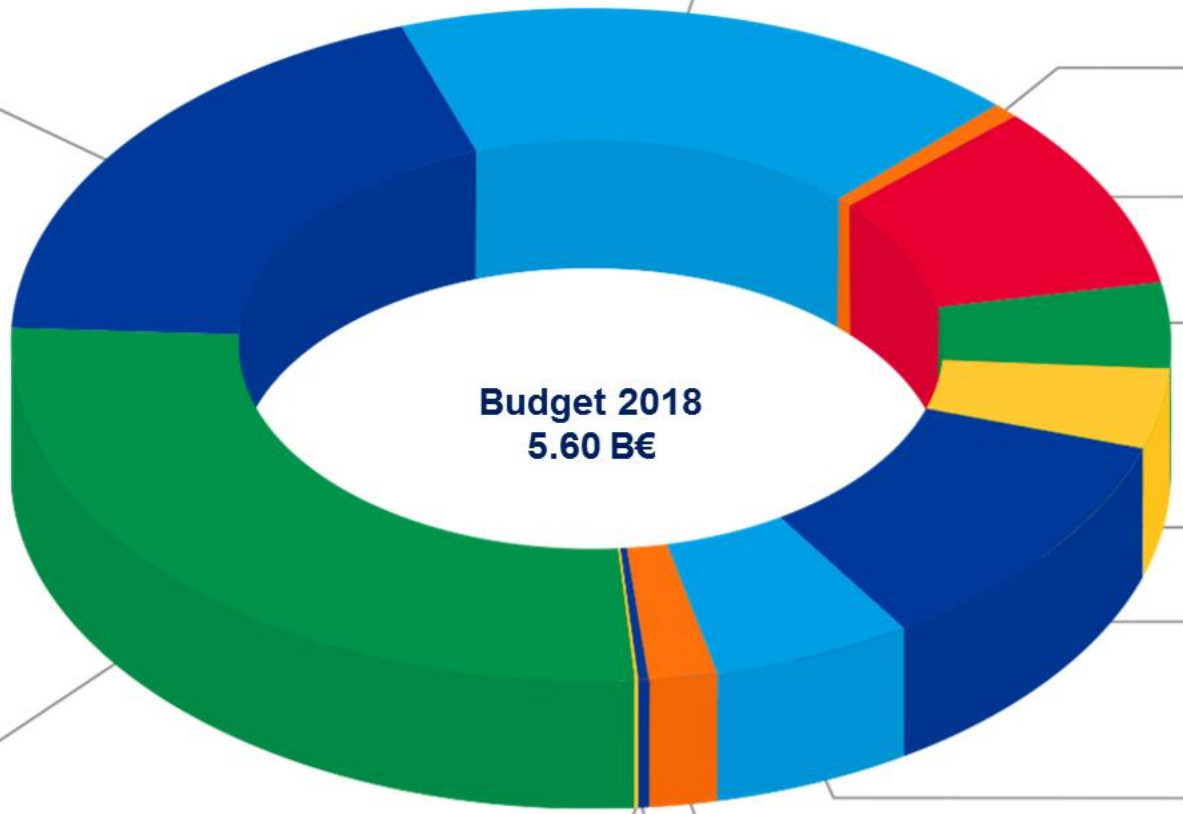

telecommunications

ESA’s locations



- ESA sites
- Offices
- ESA Ground Station
- ESA Ground Station + Offices
- ESA sites + ESA Ground Station

ESA budget for 2018: by domain



Navigation*
14.0%, 782.6 M€

Space Transportation*
19.8%, 1,110.7 M€

B€: Billion Euro

M€: Million Euro

***includes programmes implemented for other institutional partners**

Earth Observation*
26.0%, 1,455.8 M€

European Cooperating States Agreements
0.1%, 6.9 M€

Prodex
1.2%, 65.4 M€

Scientific Programme
9.2%, 518.2 M€

Basic Activities
4.2%, 237.2 M€

Associated with General Budget
3.9%, 218.4 M€

Human Spaceflight, Micro. And Expl.
13.1%, 731.9 M€

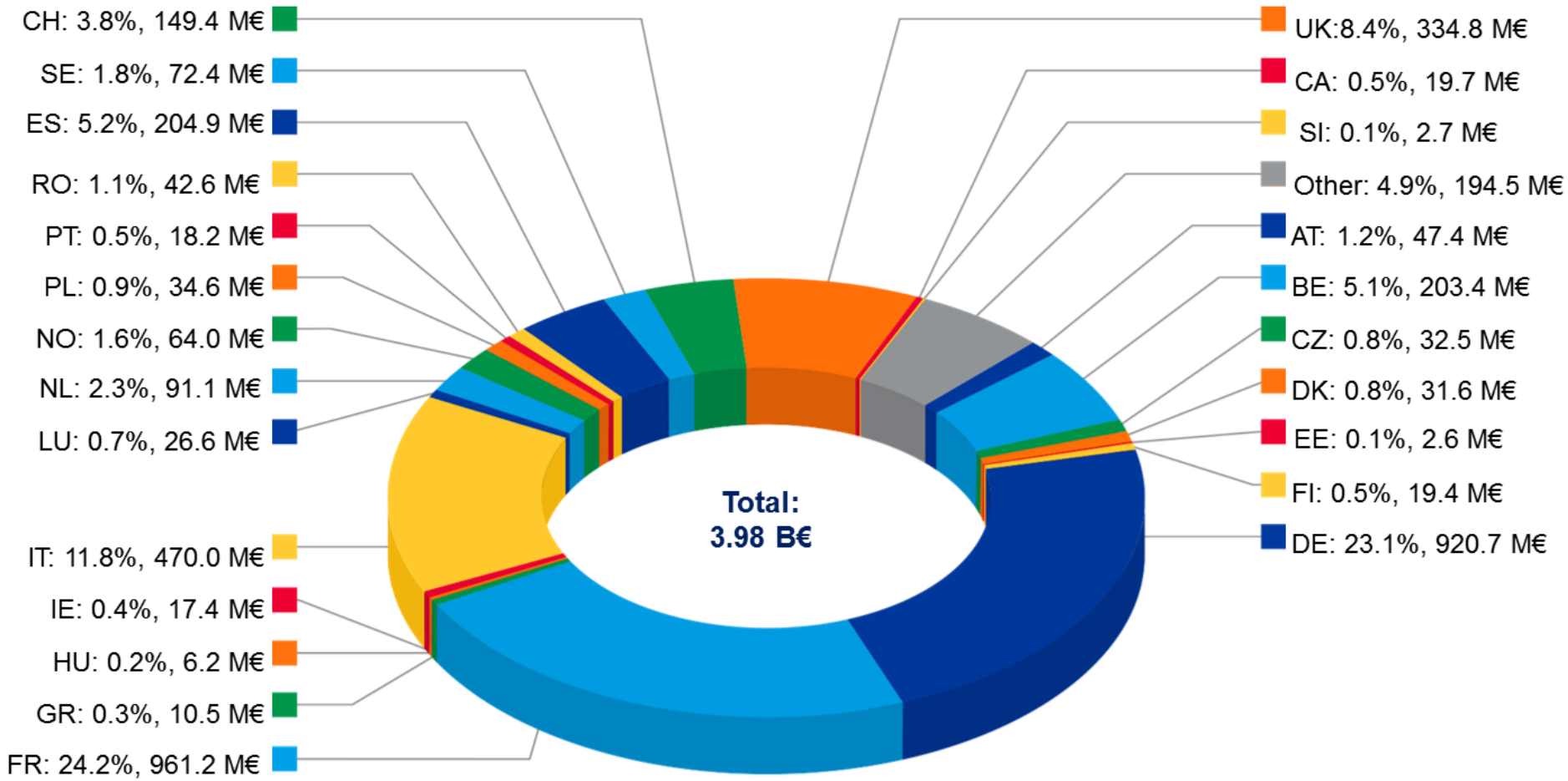
Telecom & Integrated Applications*
4.9%, 275.0 M€

Technology Support*
3.2%, 177.9 M€

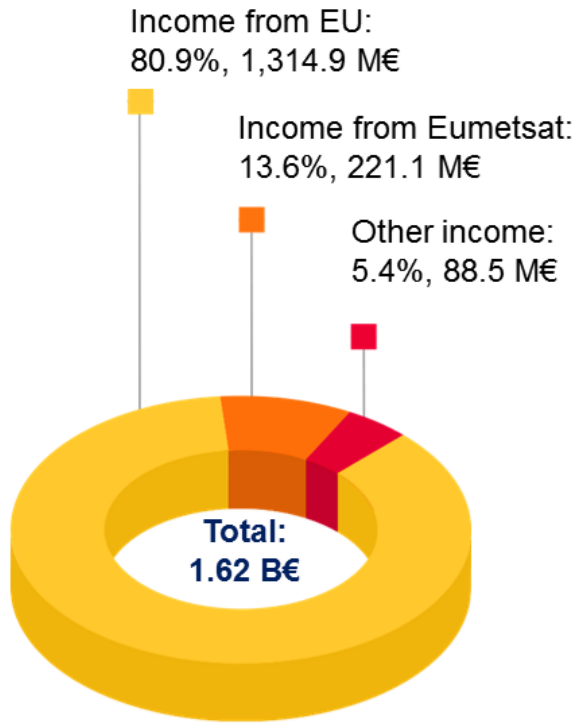
Space Situational Awareness
0.4%, 22.9 M€

ESA budget for 2018: 5.6 B€

ESA Activities and Programmes



Programmes implemented for other institutional partners



B€: Billion Euro M€: Million Euro

ESA and the European space sector

- The European space industry sustains around 35 000 jobs;
- Europe is successful in the commercial arena, with a market share of telecom and launch services higher than the fraction of Europe’s public spending worldwide;
- European scientific communities are world-class and attract international cooperation;
- Research and innovation centres are recognised worldwide;
- European space operators (Arianespace, Eumetsat, Eutelsat, SES Global, etc.) are the most successful in the world.

ESA’s industrial policy

About 85% of ESA’s budget is spent on contracts with European industry.

ESA’s industrial policy:

- Ensures that Member States get a fair return on their investment;
- Improves competitiveness of European industry;
- Maintains and develops space technology;
- Exploits the advantages of free competitive bidding, except where incompatible with objectives of the industrial policy.

Birth of commercial operators

ESA's 'catalyst' role

ESA is responsible for R&D of space projects. On completion of qualification, they are handed to outside entities for production and exploitation. Most of these entities emanated from ESA.

Meteorology: Eumetsat

Launch services: Arianespace

Telecoms: Eutelsat and Inmarsat

ESA Council

The Council is the governing body of ESA.

It provides the basic policy guidelines for ESA's activities. Each Member State is represented on the Council and has one vote.

Every two to three years, Council meets at ministerial level ('Ministerial Council') to take key decisions on new and continuing programmes and financial commitment.

The ESA Council at ministerial level also meets together with the EU Council to form the European 'Space Council'.

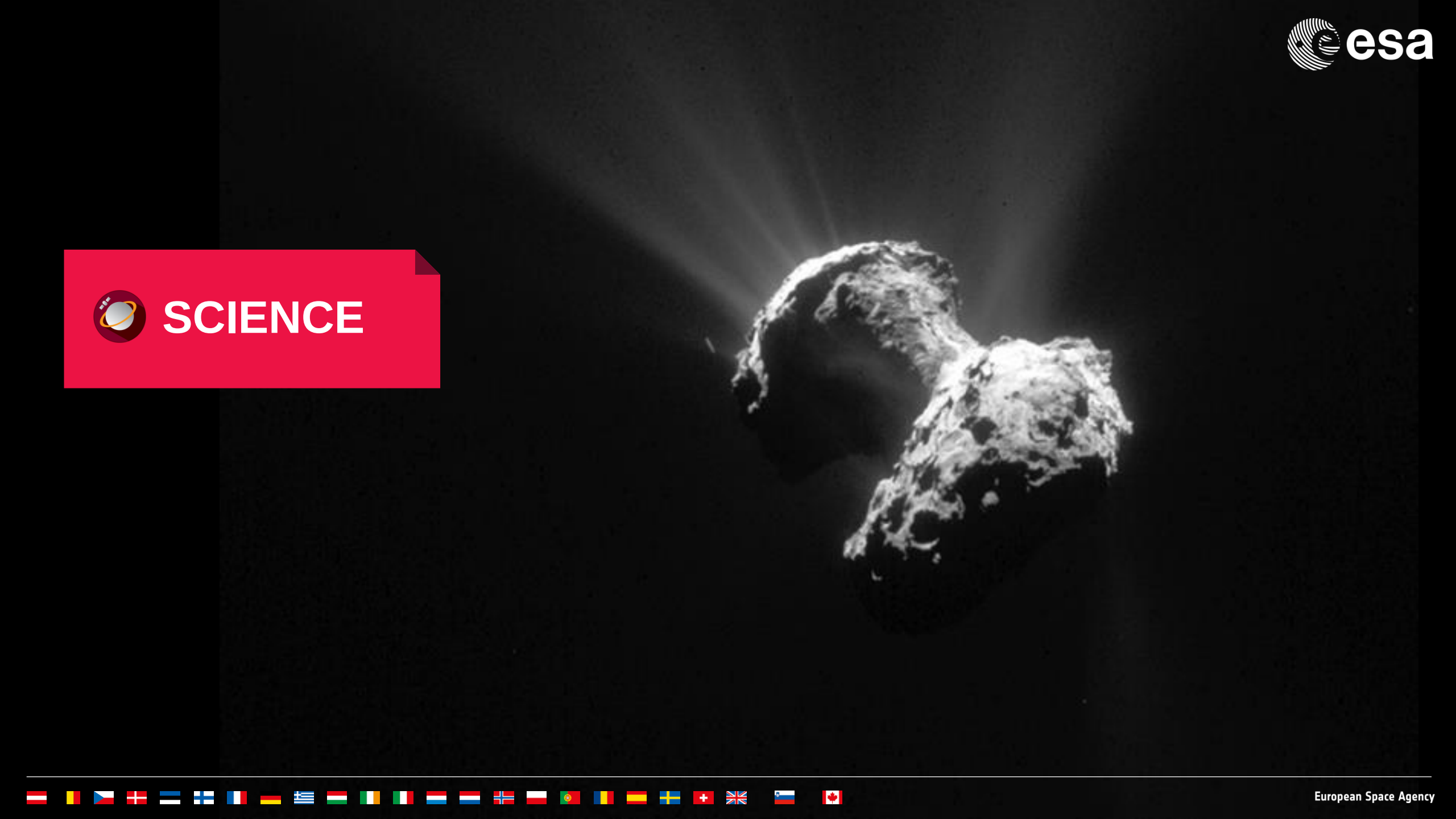
Ministerial Council 2016, Lucerne

Ministers declared support for the ESA Director General's vision for Europe in space and the role and development of ESA:
now the Space 4.0i era can start with ESA committing to inform, innovate, interact
and inspire. The next Council at ministerial level is scheduled for the end of 2019 in Spain.

Four Resolutions were adopted:

- Towards Space 4.0 for a 'United Space in Europe';
- Level of Resources for the Agency's Mandatory Activities 2017–21;
- Guiana Space Centre, 2017–21;
- ESA Programmes.

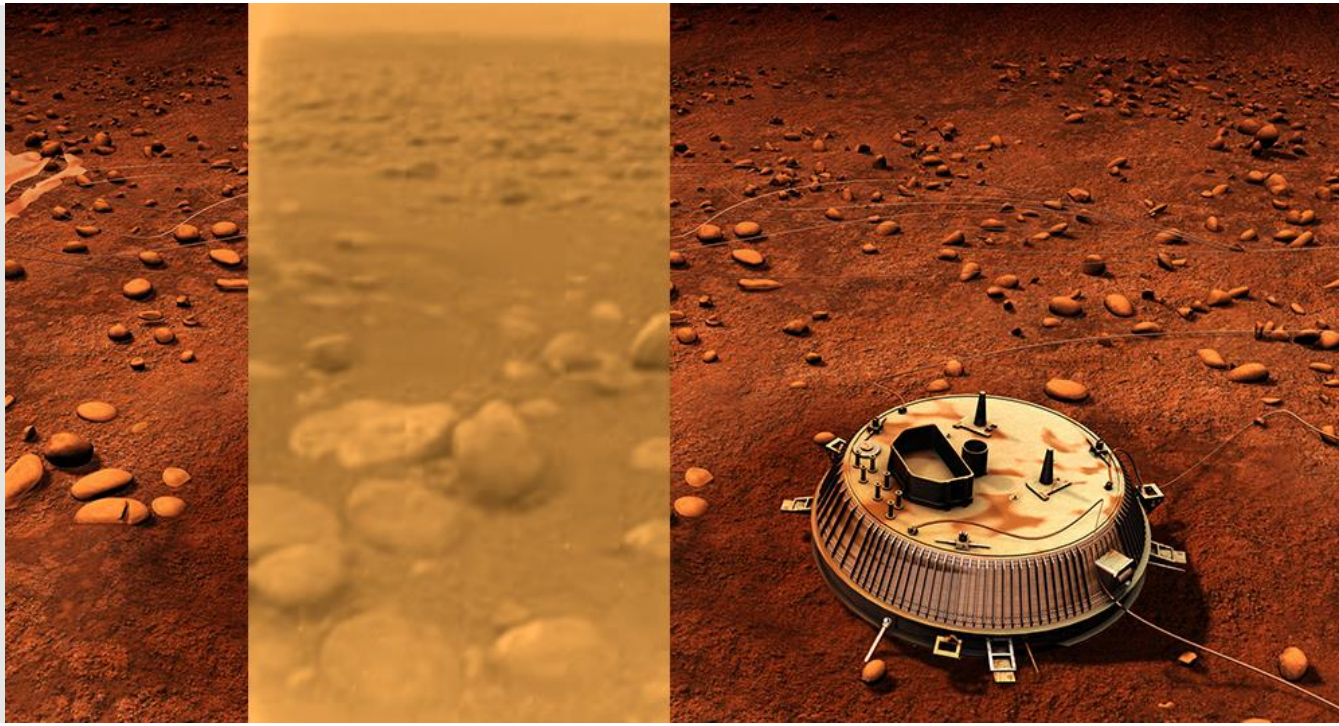
SCIENCE



Huygens

First landing on a world in the outer Solar System

On 14 January 2005, ESA's Huygens probe made the most distant landing ever, on Titan, the largest moon of Saturn (about 1427 million km from the Sun).



First rendezvous, orbit and soft-landing on a comet

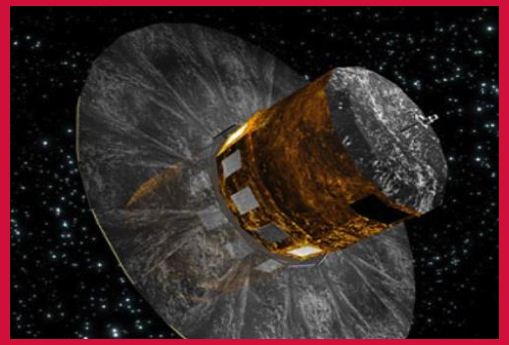
On 6 August 2014, ESA's Rosetta became the first spacecraft to rendezvous with a comet and, on 12 November, its Philae probe made the first soft-landing on a comet and returned data from the surface.

Today’s Science missions

- **Mars Express** (2003–) studying Mars, its moons and atmosphere from orbit
- **Gaia** (2013–) mapping a thousand million stars in our galaxy
- **LISA Pathfinder** (2015–) testing technologies to detect gravitational waves

Mars Express

Gaia

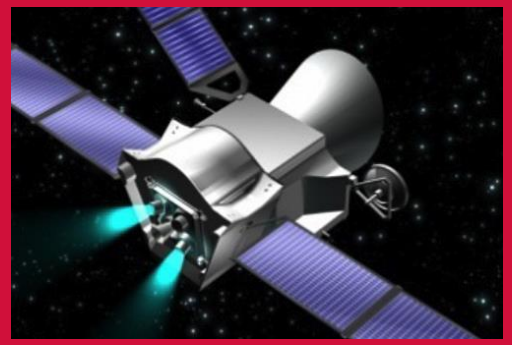


LISA Pathfinder

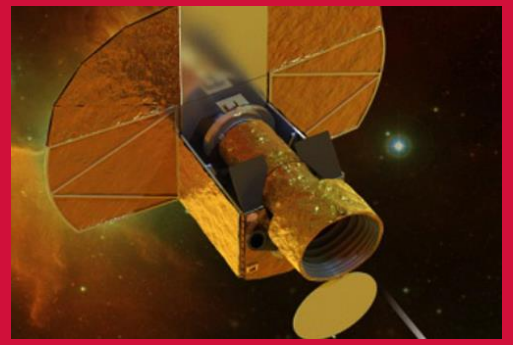
Upcoming missions (1)

- **BepiColombo** (2018) a satellite duo exploring Mercury (with JAXA)
- **Cheops** (2018) studying exoplanets around nearby bright stars
- **Solar Orbiter** (2018) studying the Sun from close range
- **James Webb Space Telescope** (2019) studying the very distant Universe (with NASA/CSA)

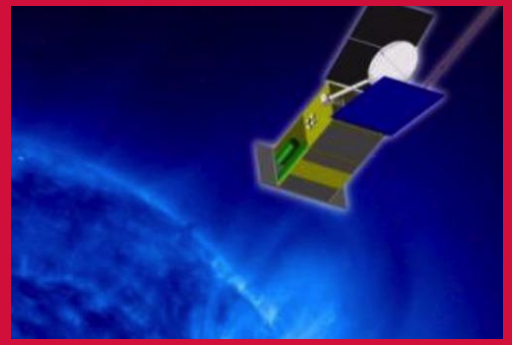
BepiColombo



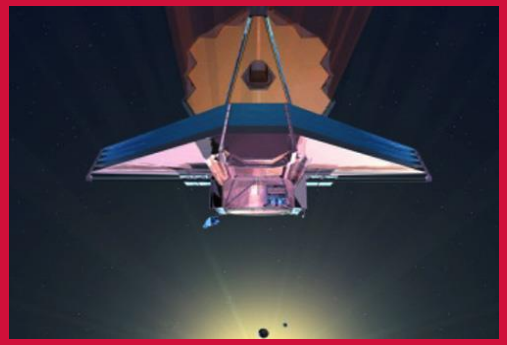
Cheops



Solar Orbiter



James Webb Space Telescope



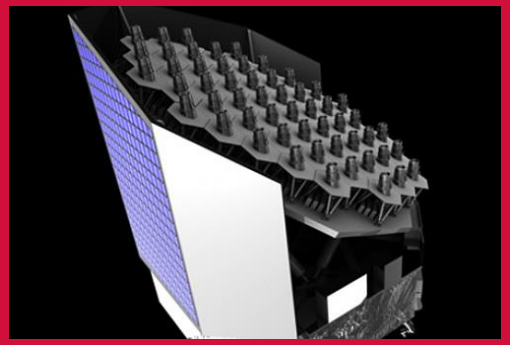
Upcoming missions (2)

- **Euclid** (2020) probing ‘dark matter’, ‘dark energy’ and the expanding Universe
- **JUICE** (2022) studying the ocean-bearing moons around Jupiter
- **Plato** (2024) searching for planets around nearby stars
- **Athena** (2028) space telescope for studying the energetic Universe
- **Gravitational wave observatory** (2034) studying ripples in spacetime caused by massive objects in the Universe

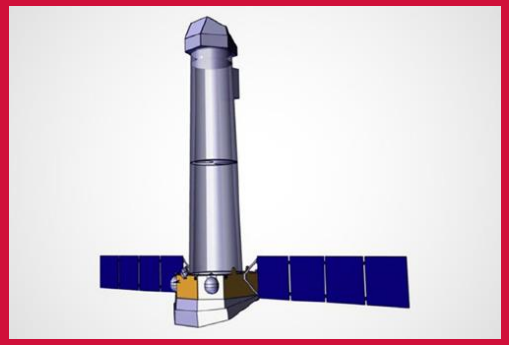
Euclid

JUICE

Plato



Athena



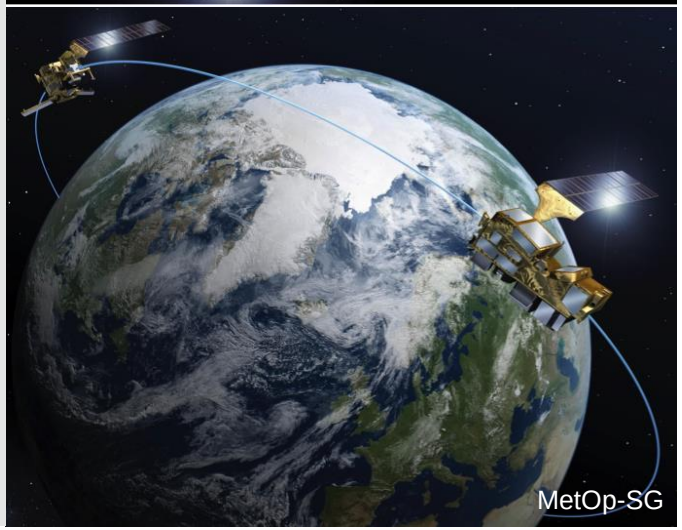

esa
EARTH
OBSERVATION
European Space Agency

Earth Explorers

These missions address critical and specific issues raised by the science community, while demonstrating the latest observing techniques.

- GOCE (2009–13) studying Earth’s gravity field
- SMOS (2009–) studying Earth’s water cycle
- CryoSat-2 (2010–) studying Earth’s ice cover
- Swarm (2013–) three satellites studying Earth’s magnetic field
- ADM-Aeolus (2018) studying global winds
- EarthCARE (2019) studying Earth’s clouds, aerosols and radiation (ESA/JAXA)
- Biomass (2021) studying Earth’s carbon cycle
- FLEX (2022) studying photosynthesis
- Earth Explorers 9 & 10 to be selected

Meteorological missions



Developed in cooperation with ESA's partner, Eumetsat, as Europe's contribution to the World Meteorological Organization's space-based Global Observing System:

Meteosat Second Generation (2002, 2005, 2012, 2015–) series of four satellites providing images of Earth from geostationary orbit.

Meteosat Third Generation (2021–) series of six geostationary satellites providing images (four satellites) and atmospheric sounding (two satellites).

MetOp (2006, 2012, 2018) – series of three satellites providing operational meteorological observations from polar orbit.

MetOp Second Generation (2021–) two series of polar-orbiters, three satellites in each series, continuing and enhancing meteorological, oceanographic and climate monitoring observations from the first MetOp series.

Global monitoring for a safer world

Copernicus: an Earth observation programme for global monitoring for environment and security.

Led by the European Commission in partnership with ESA and the European Environment Agency, and responding to Europe's need for geo-spatial information services, it will provide autonomous and independent access to information for policy-makers, particularly for environment and security issues. ESA is implementing the space component: developing the Sentinel satellite series, its ground segment and coordinating data access.

ESA has started a Climate Change Initiative, for storage, production and assessment of essential climate data.

Copernicus space component: the Sentinels

- Sentinel-1 – land and ocean services. Sentinel-1A launched in 2014/Sentinel-1B in 2016.
- Sentinel-2 – land monitoring. Sentinel-2A launched in 2015/Sentinel-2B launched in 2017.
- Sentinel-3 – ocean forecasting, environmental and climate monitoring. Sentinel-3A launched in 2016. Sentinel-3B (2018).
- Sentinel-4 – atmospheric monitoring payload (2019)
- Sentinel-5 – atmospheric monitoring payload (2021)
- Sentinel-5 Precursor – atmospheric monitoring launched in 2017.
- Sentinel-6 – oceanography and climate studies (2020)


TECHNOLOGY

Space technology

The development of technology, along with access to space, is one of the enabling activities of ESA. ESA's technical heart is ESTEC (NL).

- Supporting competitiveness of European industry.
- Transferring technology from space to non-space applications ('spin-off'), and bringing innovations from outside the space sector to use in design of new space systems ('spin-in').
- Fostering innovation and enhancing European technological independence and the availability of European resources for critical technologies.
- Creating Space Incubators across Europe.

MISSION OPERATIONS

Mission operations

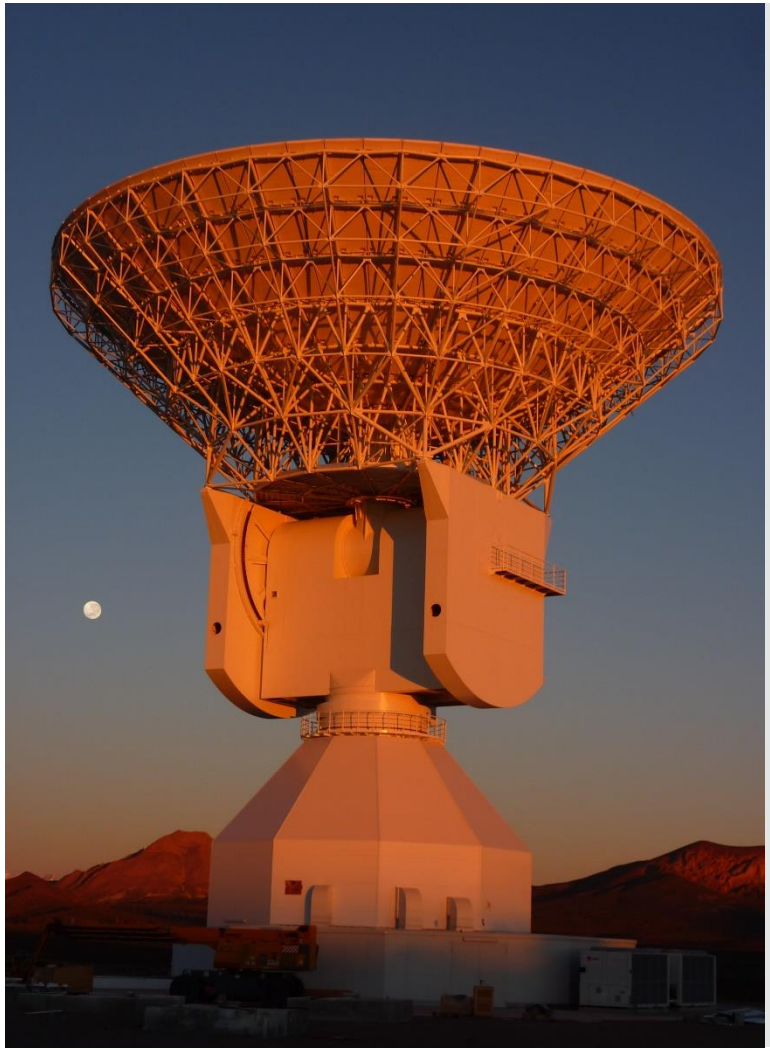
ESOC, the European Space Operations Centre, is ESA's centre for mission operations and ground systems engineering, where we:

- Study and develop mission concepts and technologies;
- Specify required ground facilities and functionality;
- Simulate mission scenarios and train multi-disciplinary mission teams;
- Perform end-to-end mission readiness testing;
- Plan and execute spacecraft and ground facilities operations during all mission phases.

Ground segment engineering

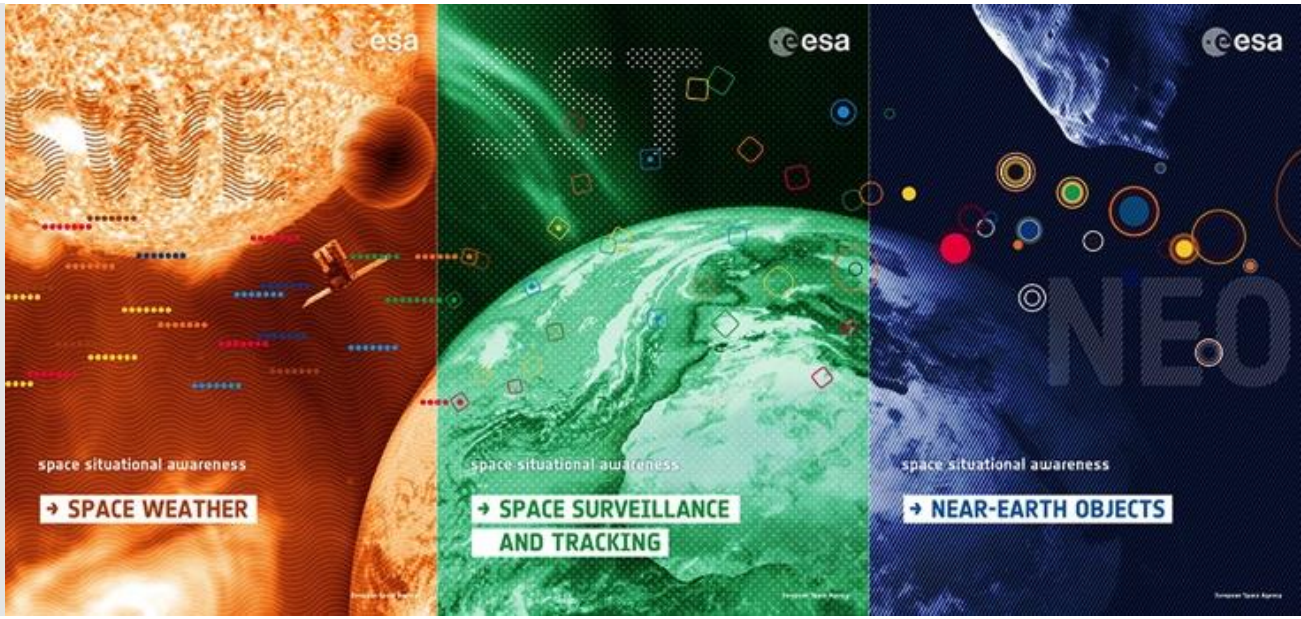
ESOC’s ground systems engineering teams:

- Develop multi-mission infrastructure for mission control systems, ground stations, high-fidelity simulators, operational communication and computer systems and tailor them for specific missions;
- Perform studies, mission analysis, flight dynamics, high-precision navigation, space-debris monitoring and avoidance and CleanSpace studies;
- Develop new technologies and standards to support future missions.



Space Situational Awareness

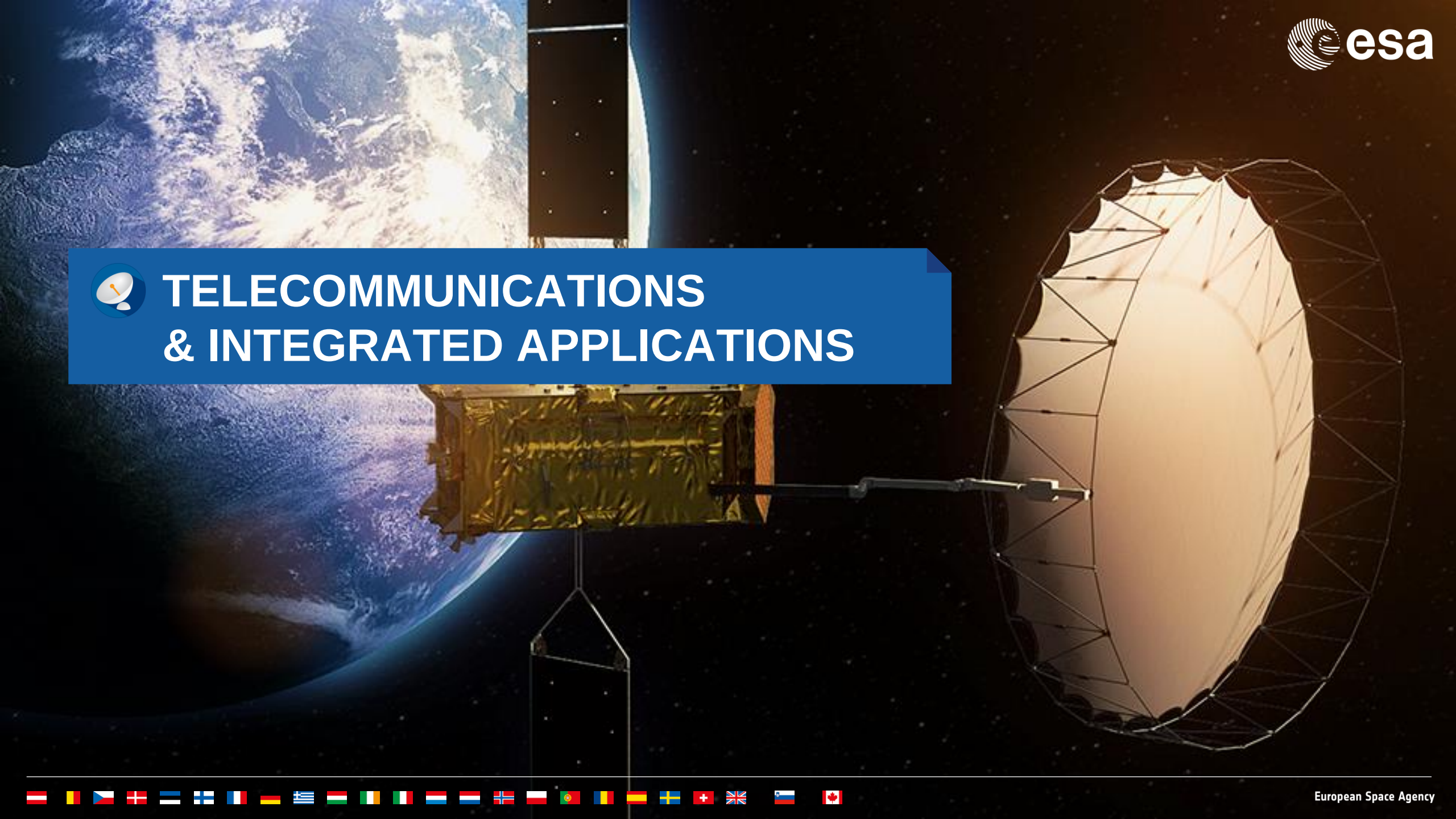
ESOC is home to the Space Situational Awareness Programme (SSA) an initiative aiming to provide European autonomy in civil systems and services needed to protect satellites and Earth.



Entering its third development period, it will consolidate European facilities and services for:

- Monitoring, cataloguing and tracking space debris;
- Monitoring space weather, and preparing for a future Lagrange mission;
- Identifying and tracking near Earth objects.

Supported by 19 Member States, SSA is coordinated with the institutions of the European Union and international partners.



TELECOMMUNICATIONS & INTEGRATED APPLICATIONS

Ensuring competitive and innovative industry

ESA's Advanced Research in Telecommunications Systems (ARTES) programme stimulates innovation and promotes the development of products, services and applications in partnership with industry.

- Helping European industry to stay at the leading edge of the highly competitive global market for satellite communications and applications;
- Supporting R&D and pioneering technical, commercial and operational approaches to bring new systems and solutions close to the point of market readiness;
- Building partnerships capable of creating wealth, jobs and new services for the citizens of Europe;
- Improving our daily lives across almost every market sector, from health to transport and from civil protection to energy and environmental services.

ARTES satellite platforms

- SmallGEO – for the 3-tonne market, with OHB (first launch on Hispasat's H36W-1, 2017)
- Spacebus Neo and Eurostar Neo – for the 3- to 6-tonne market, with Thales Alenia Space/Airbus D&S (first launches in 2019)
- Electra – first fully electric propulsion OHB satellite, with SES (2021)

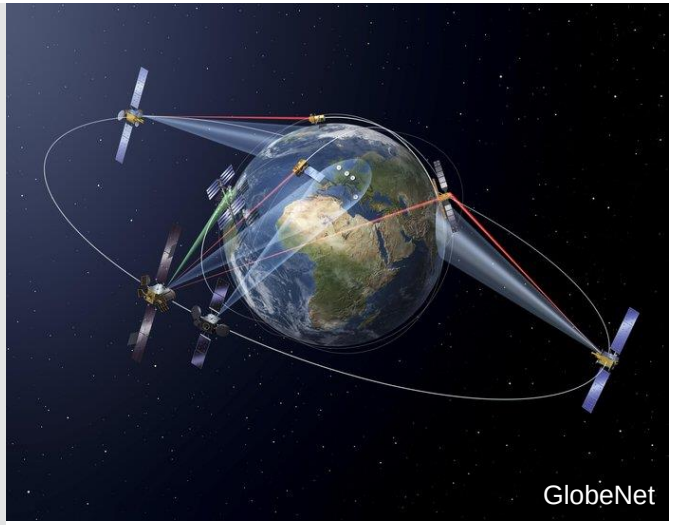
SmallGEO

Spacebus Neo

Eurostar Neo

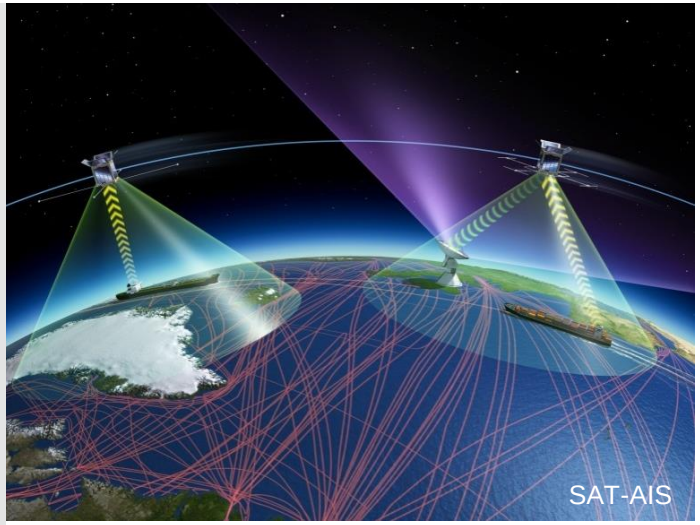
Electra

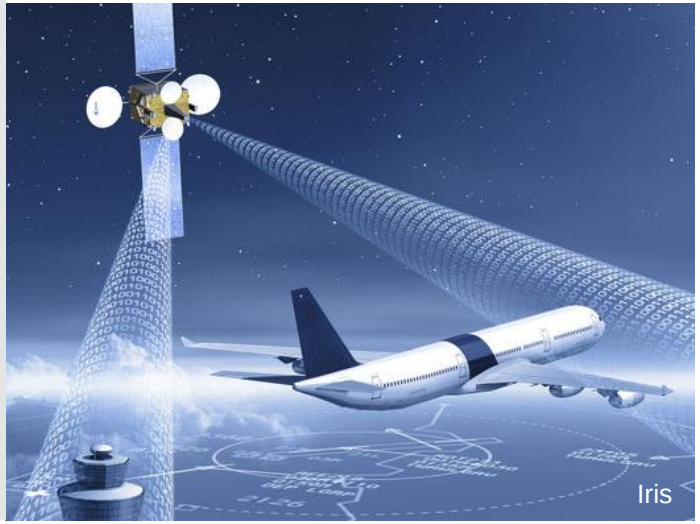
ARTES innovation and new technology



- EDRS – the European Data Relay System, or ‘SpaceDataHighway’, that with its GlobeNet extension will make data gathered anywhere on Earth available in quasi-real time, with Airbus D&S (first launch, 2016; second launch, 2018)
- ScyLight – optical communications capable of exchanging unprecedented amounts of data between satellites, aircraft and the ground (starting 2017)
- Quantum – in-orbit reprogrammable ‘chameleon’ satellite, with Eutelsat/Airbus D&S (2018)
- ICE – next-generation mobile satellite services, with Inmarsat (starting 2017)

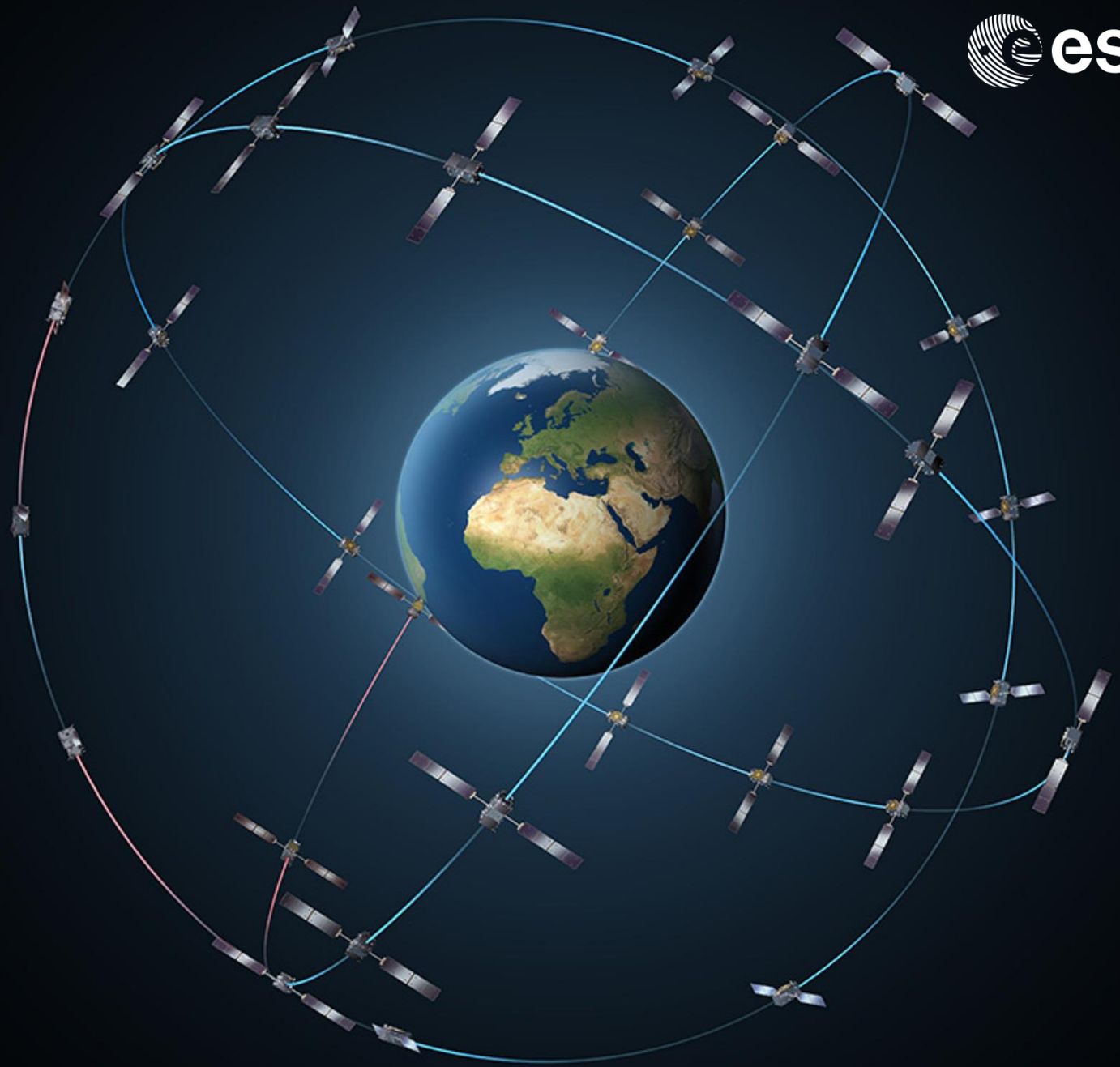
ARTES for new markets





- SAT-AIS – microsatellites will track seafaring vessels anywhere on Earth, with the European Maritime Safety Agency (first launch, 2017)
- Iris – a new satellite-based data communication system as part of the Single European Skies Air Traffic Management Research project, with Inmarsat (precursor service, 2018–28)
- ESA's Govsatcom Precursor – secure and resilient European government communications, in coordination with the EC and EDA (service demonstration, 2017–20)
- Pioneer – helping new technologies and services obtain fast, low-cost in-orbit demonstration (starting 2017)

NAVIGATION



Galileo: ‘made in Europe’

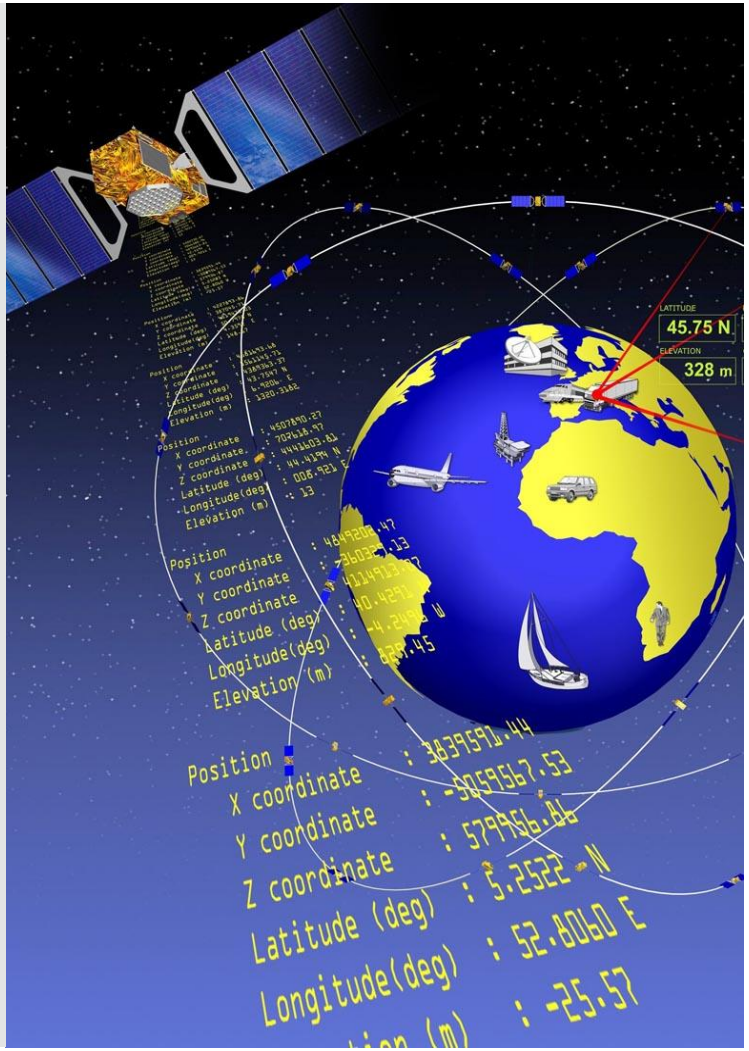
Putting Europe at the forefront of this strategically and economically important sector, Galileo
will provide a highly accurate, guaranteed global positioning service under civilian control.

Full Operational Capability – 22 satellites now in orbit. Deployment of remaining ground/space infrastructure ongoing (full system – 24 satellites, plus orbital spares to prevent interruption in service).

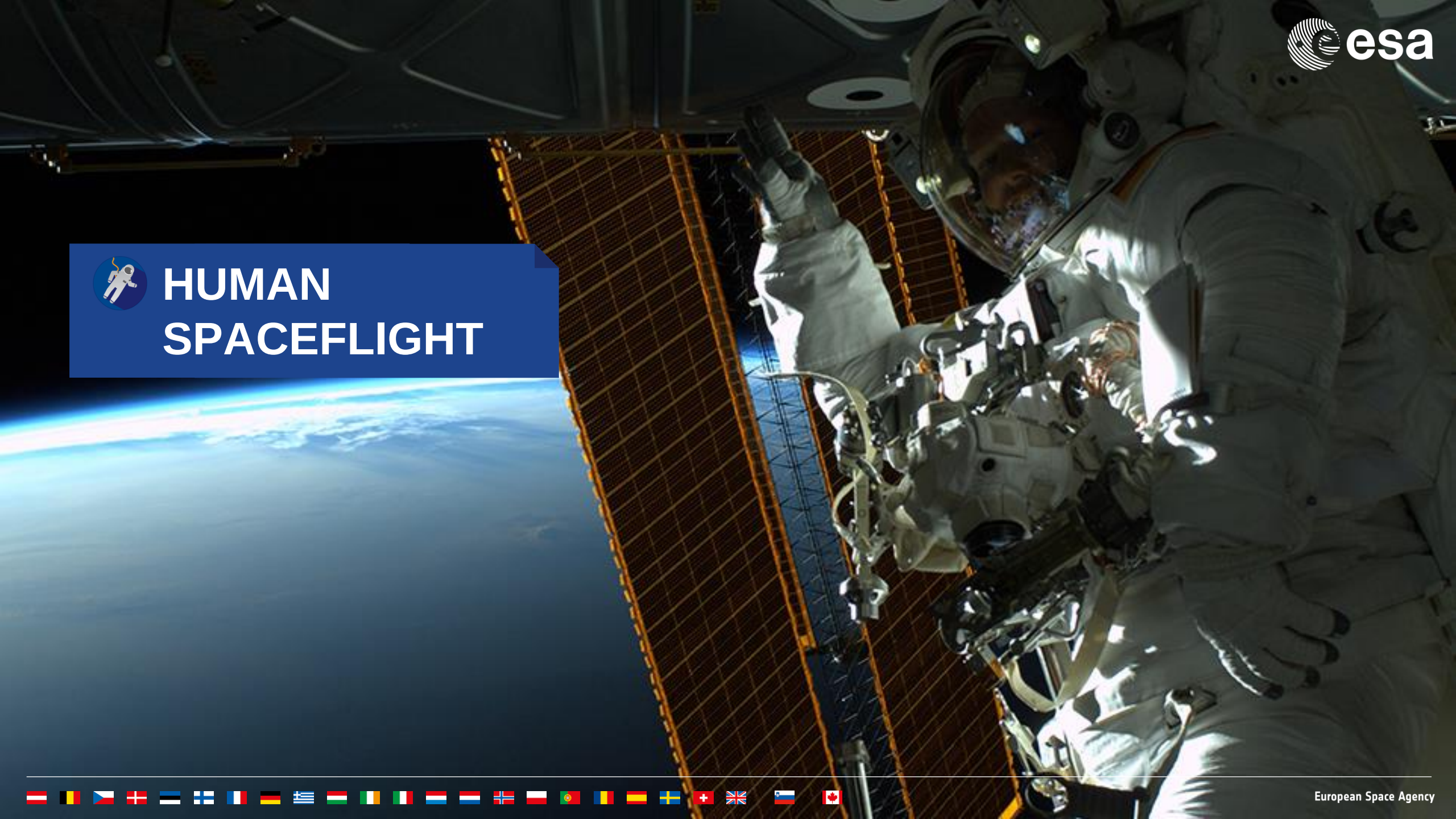
ESA is the system architect for Galileo, managing its design, development, procurement, deployment and validation on behalf of the EU. ESA will maintain this role, providing technical support to the European GNSS Agency, designated by the EC to run the system and provide Galileo services.

Dec 2016 – start of Galileo Initial Services, the first step towards full operational capability.

EGNOS, Galileo applications and NAVISP



- Since 2010, EGNOS has been improving accuracy and augmenting GPS, offering safety-critical applications for aviation users.
- Galileo is expected to spawn a wide range of applications, based on positioning and timing for transport by road, rail, air and sea, infrastructure and public works management, agricultural and livestock management and tracking, e-banking and e-commerce.
- It will be a key asset for public services, such as rescue operations and crisis management.
- With the new ESA Navigation Innovation and Support Programme (NAVISP), research will focus on integration of space and terrestrial navigation and new ways to improve GNSS.



HUMAN SPACEFLIGHT

European Exploration Envelope (E3P)

In response to the Resolution on Europe's Space Exploration Strategy adopted in Luxembourg in December 2014, exploration activities are being consolidated in a single European Exploration Envelope Programme (E3P) integrating the three ESA exploration destinations 'as part of a single exploration process'. Its main activities will cover:

- International Space Station – Operations until 2024
- ExoMars – Trace Gas Orbiter and 2020 rover mission
- Luna-Resource Lander – Contributions to Russian-led Luna-Resource Lander, Luna 27 (2021)
- European Service Module – First Orion flight (June 2020) and second flight model (TBC)
- Future Human Exploration
- SciSpacE – Science in Space Environment
- ExPeRT – Exploration Preparation, Research and Technology

International Space Station (ISS)

The ISS unites USA, Russia, Japan, Canada and Europe in one of the largest partnerships in the history of science. Crews of up to six astronauts conduct research into life and physical sciences and applications, and prepare for future human exploration missions.

Europe's two key contributions are the Columbus laboratory and the Automated Transfer Vehicle (ATV). Columbus provides a substantial part of the ISS's research capability, specialising in fluid physics, materials science and life sciences. Europe has also provided almost 50% of the pressurised part of the ISS, including Cupola, Node-2 and Node-3.

European Service Module

The European Service Module (ESM) is ESA's contribution to NASA's Orion spacecraft that will send astronauts to the Moon and beyond. The spacecraft comprises the ESM and the US Crew Module.

The ESM resembles ESA's Automated Transfer Vehicle, from which it evolved. Between 2009 and 2014, five Automated Transfer Vehicles delivered supplies to the International Space Station and helped to keep the outpost in orbit.

The first mission for the complete Orion spacecraft will be an unmanned flight to the Moon and back (first launch, June 2020)

Recent and future flights

Paolo Nespoli
(IT)

Alexander Gerst
(DE)

Luca Parmitano
(IT)

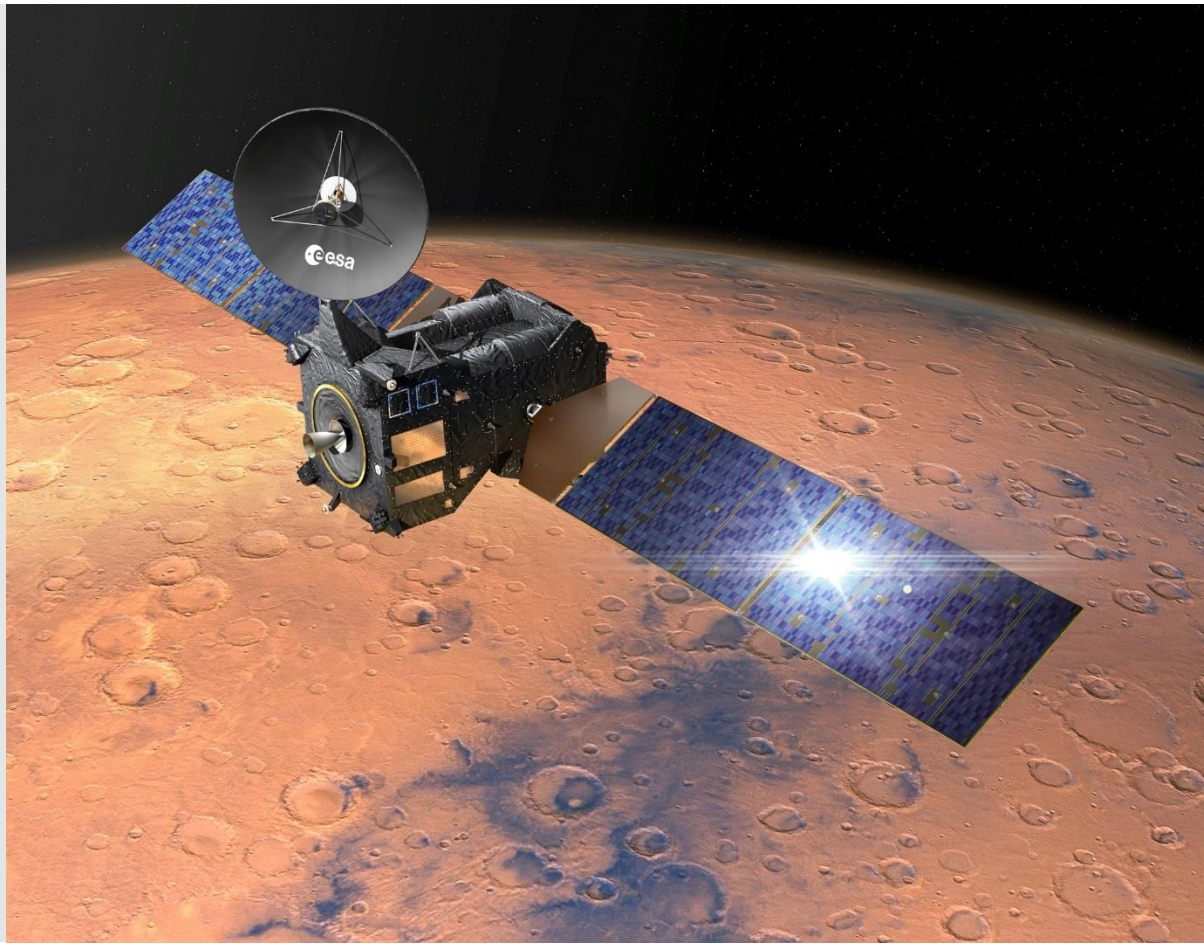
Paolo Nespoli – Expedition 52/53, Soyuz MS-05, May 2017

Alexander Gerst – Expedition 56/57, Soyuz MS-09, May 2018

Luca Parmitano – May 2019

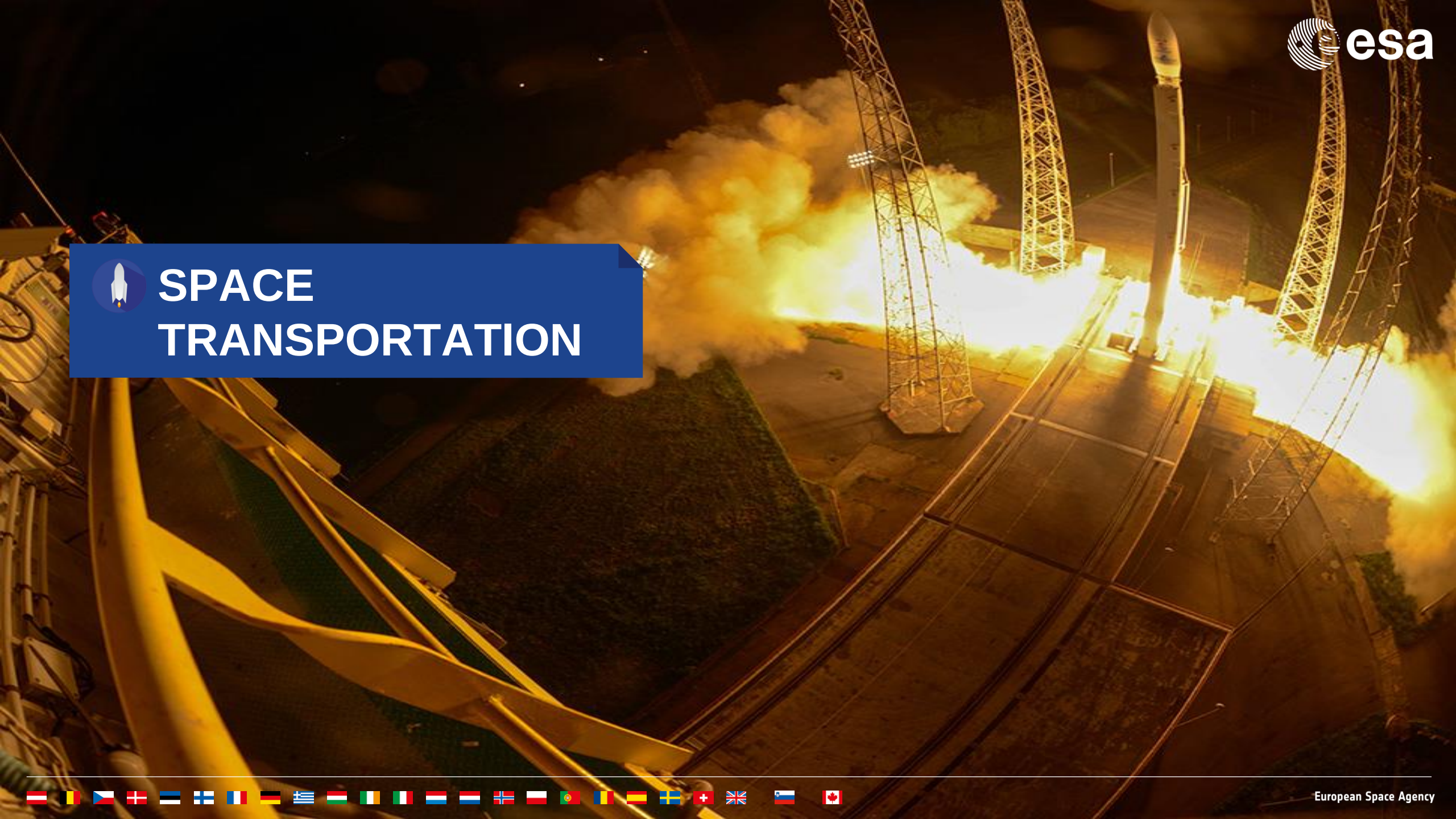
Robotic exploration

In cooperation with Roscosmos (Russia), two ExoMars missions (2016 and 2020) will investigate the martian environment, particularly astro-biological issues, and develop and demonstrate new technologies for planetary exploration with the long-term view of a future Mars sample return mission.



ExoMars

The ESA-provided Trace Gas Orbiter is now in orbit around Mars (2016). ESA's ExoMars rover will be launched in 2020. Roscosmos will be responsible for the 2020 descent module and surface platform, and provides Proton launchers for both missions. Both partners will supply scientific instruments and will cooperate closely in the scientific exploitation of the missions. The Entry, Descent & Landing Demonstrator Module was deployed on 19 October 2016, but made a 'hard landing' on Mars after returning a large volume of useful data.



SPACE TRANSPORTATION

The European launcher family

The Ariane and Vega launchers developed by ESA guarantee European autonomous access to space.
Their development and successful exploitation is an example of how space challenges European industry and provides precious expertise.

Ariane is one of the most successful launcher series in the world. Complemented since 2011 by Vega and Soyuz, they are all launched from Europe’s Spaceport in French Guiana.

Launchers and technologies of the future: Ariane 6 and Vega C

European Ministers agreed at the Ministerial Council 2014 to develop Ariane 6 and Vega C. These launchers will provide guaranteed access to space for Europe at a competitive price without requiring public sector support for commercial exploitation.

- Ariane 6 – modular three-stage launcher with two configurations, using two (A62) or four boosters (A64);
- Vega C – evolution of Vega with increased performance and same launch service cost;
- Common solid rocket motor for Ariane 6 boosters and Vega C first stage;
- New governance for Ariane 6 development and exploitation allocating increased roles and responsibilities to industry;
- Vega C and Ariane 6 first flights – 2019 and 2020.

Launchers and technologies of the future

Space Rider

- An affordable, reusable, end-to-end integrated transport system offering Europe independent access to and from low Earth orbit.
- European opportunities for in-orbit validation of technologies.
- First launch on Vega C in 2020.

Future Launchers Preparatory Programme (FLPP) New Economic Opportunities (NEO)…

1. Develop competitive technologies for future launchers that will:

- include low development and production costs, and lower risks;
- shorten the launcher development phase to less than 5 years.

2. Invest in a more diversified launcher development portfolio focusing on:

- key technologies and new manufacturing processes;
- integrated demonstration before transfer into orbit;
- validating ultra-low cost engine demonstrator (Prometheus).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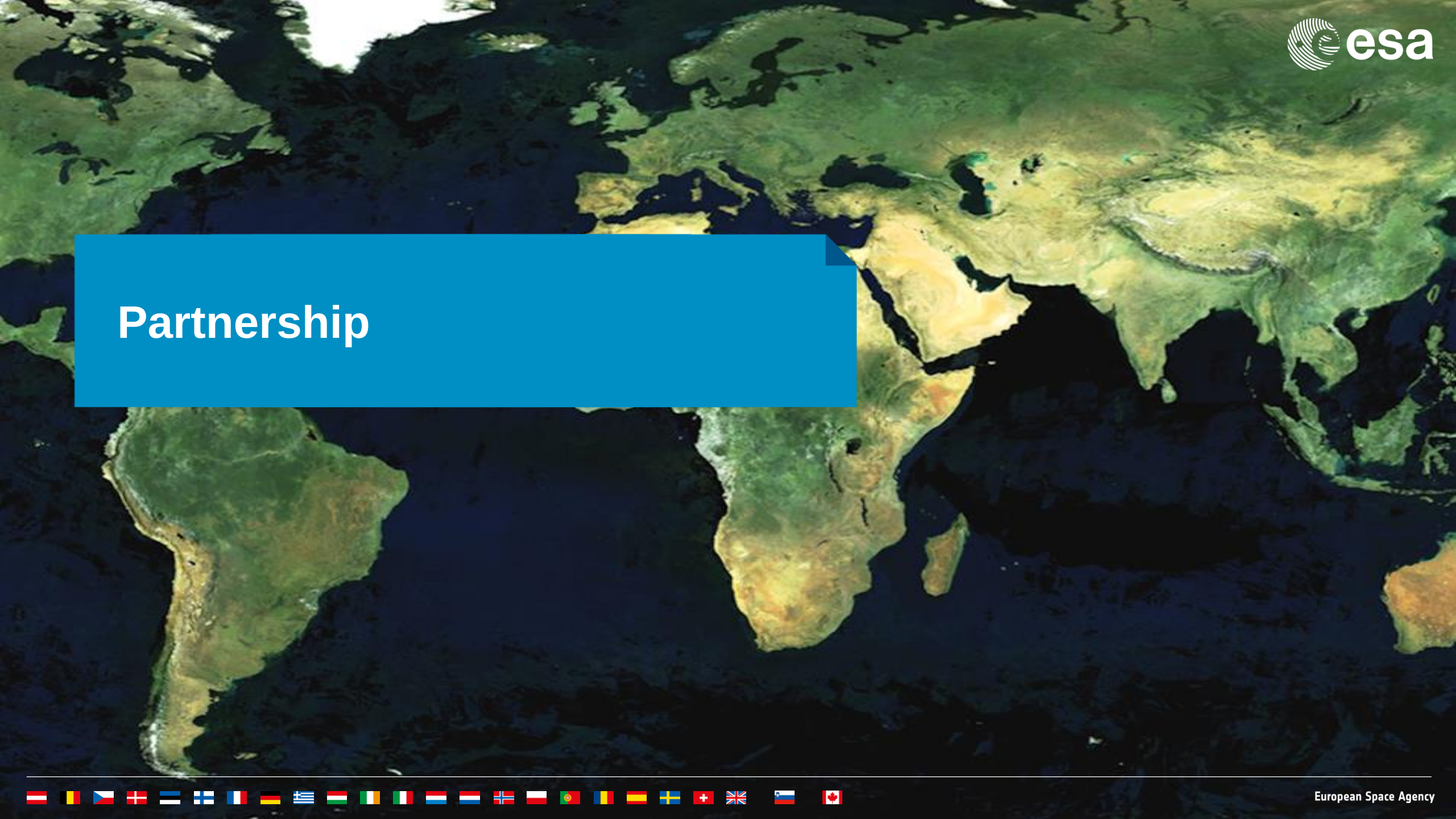
ESA AND
THE EUROPEAN UNION
European Space Agency

United space in Europe

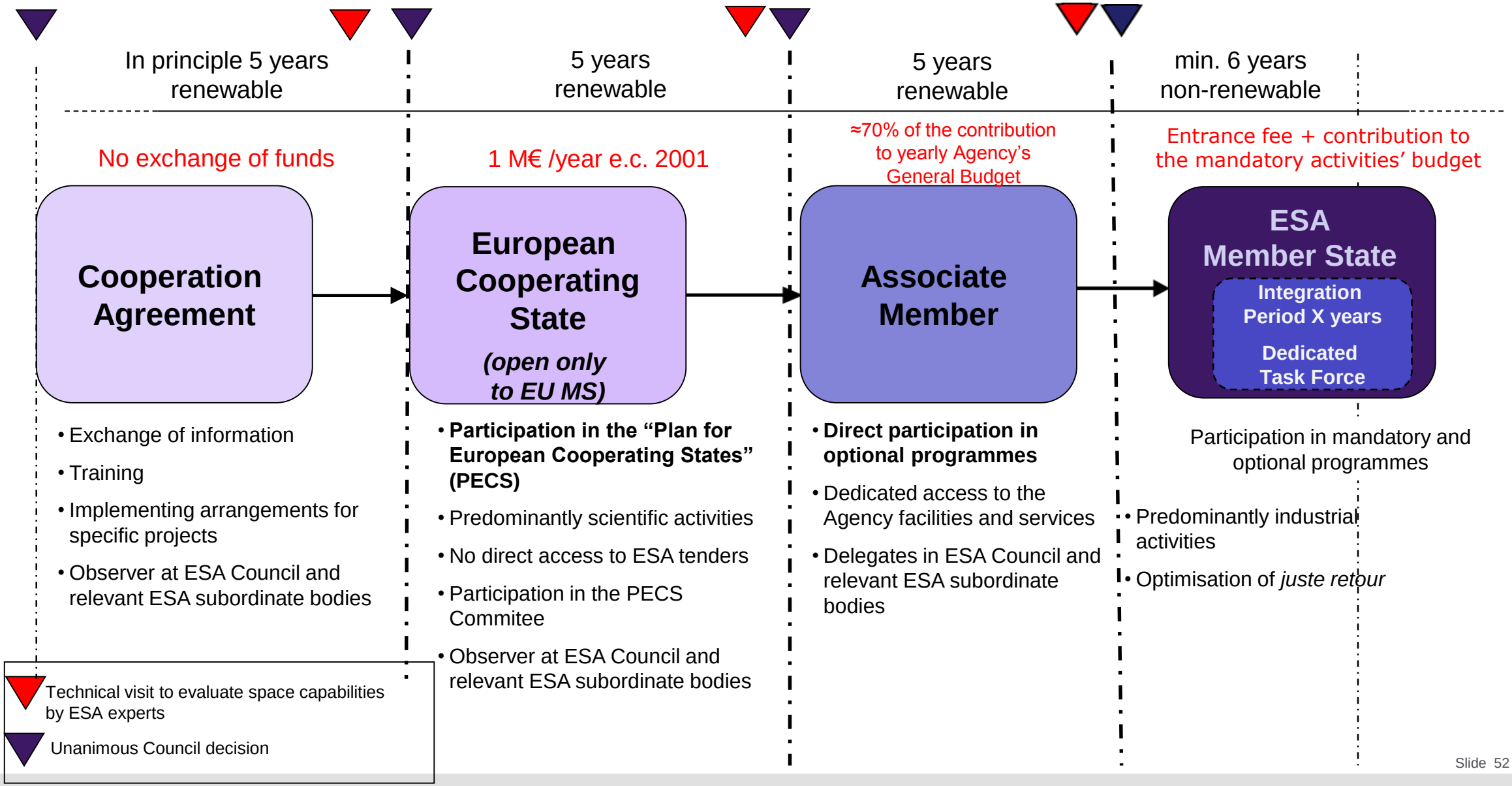
As confirmed in the ‘Joint Statement on Shared Vision and Goals for the Future of European Space’, signed by the ESA Director General and the European Commission in October 2016, ESA and the EU share three core goals for the future:

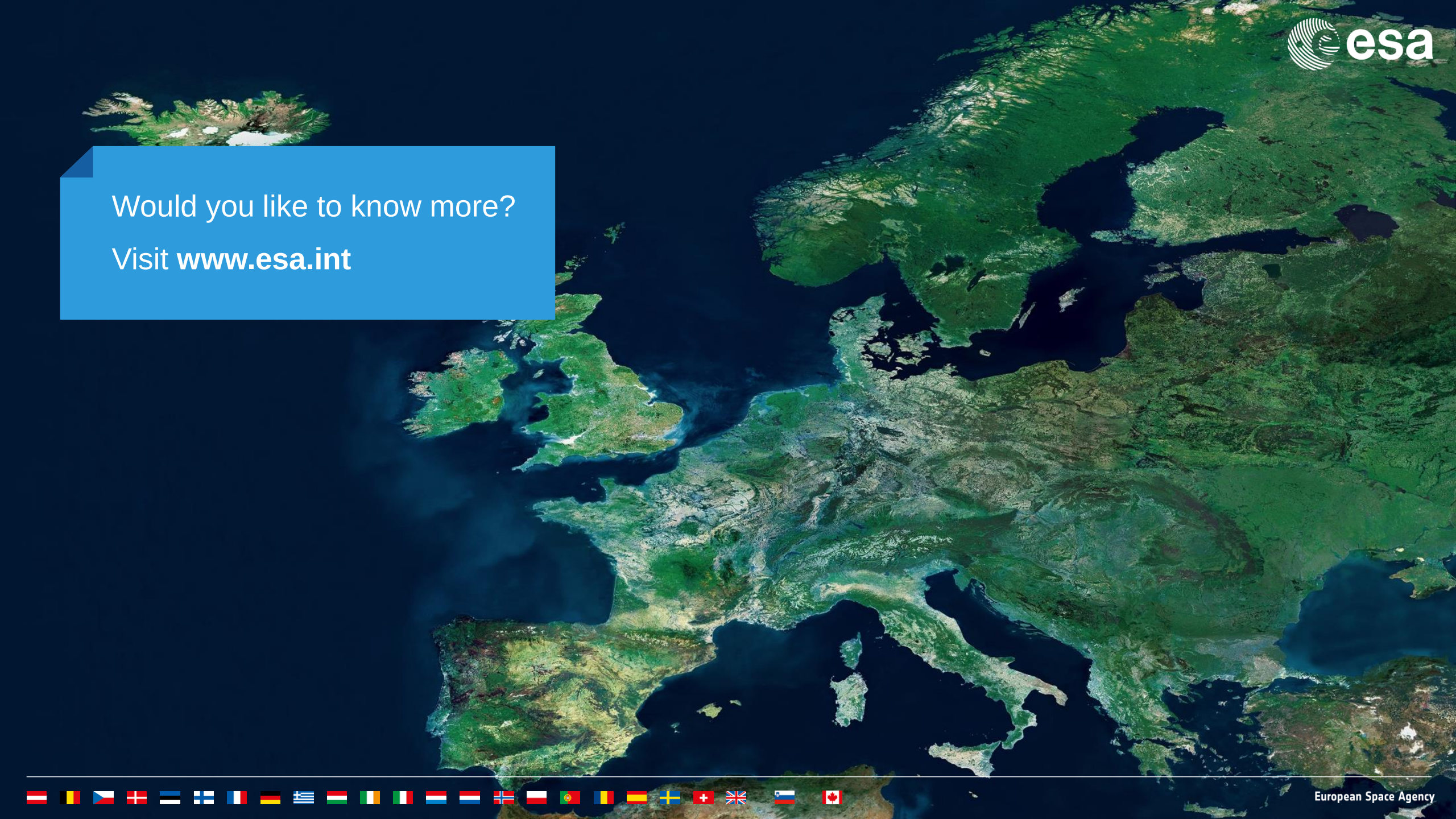
- To maximise the integration of space into European society and economy;
- To foster a globally competitive European space sector;
- To ensure European autonomy in accessing and using space in a safe and secure environment.



Partnership

From Cooperation Agreement to Accession Agreement for European Union Member States not ESA Member States

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