ESA Strategic Perspectives on Space Security

SpaceTech Alumni Symposium

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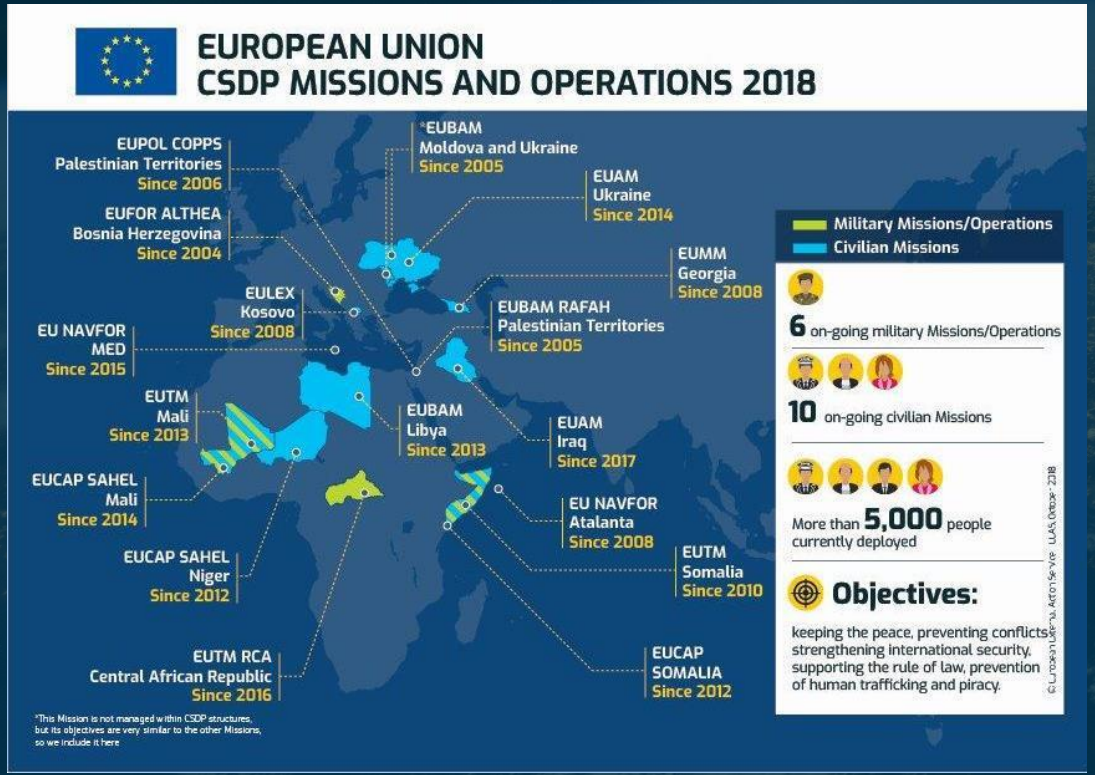
SPACE IS A *TOOL*

The European Union and ESA share a common aim: to strengthen Europe and benefit its citizens.

Closer ties and an increased cooperation between ESA and the EU will bring substantial benefits to Europe by:

- guaranteeing Europe's full and unrestricted access to services provided by space systems for its policies
- encouraging the increasing use of space to improve the lives of its citizens, and increasing political visibility of space and taking full benefit from its economic and societal dimension
- Space now is fully imbedded on our society, economy, way of life.

SPACE: INDISPENSABLE TO EUROPE'S STRATEGIC AUTONOMY



- ✓ Information gathering
- ✓ Strategic analysis
- ✓ Political decision-making
- ✓ Operational implementation

SPACE IN THE GLOBAL STRATEGY (JUNE 2016)

"In space, we will promote the autonomy and security of our space-based services… *European security hinges on better and shared assessments of internal and external threats and challenges. This requires investing in …* ***satellite communications, and autonomous access to space and permanent earth observation.***"

The Implementation Plan on Security and Defence as a follow-up to the Global Strategy defines the capability efforts to be made, such as: **cyber and maritime security, Intelligence, Surveillance and Reconnaissance (ISR), Remotely Piloted Aircraft Systems (RPAS), satellite communications including Governmental Satellite Communications (GOVSATCOM), and autonomous access to space and permanent Earth observation**.

Security in Europe

- Art. 42.2 TEU: NATO in charge of the EU's collective **security** (UK-sponsored)
- Art. 42.7 & 222 TEU: Mutual self-**defence** (but not achievable under CSDP)

- ✓ EUGS: **Protect** Europe
- ✓ NATO: **Defend** Europe
- ✓ EU-NATO **Aims**: share information, increase interoperability and coordinate actions.
- ✓ NATO relies on national space capabilities.

- 2019: NATO Space Policy; space declared an operational domain.
- October 2020, new NATO Space Centre at Allied Air Command in Ramstein, Germany.

MEMBER STATES AT THE HEART OF EUROPEAN SPACE

- France
- Germany
- Italy
- UK…

→ Individually

→ Collectively

- ESA
- EU
- Eumetsat

→ Bilaterally

STRATEGIC CHALLENGES OF REMIT TO ESA

GLOBAL CHALLENGES

1. Global pandemics and their economic impact
2. Climate change impacts on food security, energy, health care systems, etc.
3. Unilateralism vs. multilateralism / cooperation vs. nationalism
4. Internal and international displacements

EUROPEAN CHALLENGES

1. Post CV19 EU political governance
2. Space Regulation (EUSPA and new EU-led programmes) and their funding (MFF)
3. EDF and PESCO broadening EU competences but fragmenting space responsibilities

SECURITY CHALLENGES

1. Global expansion of strategic competitors and counter-space capabilities
2. Security in Europe: *status quo* of factionalism
3. Cyber resilience and information operations by competitors
4. Supply chain and strategic industrial autonomy

TECHNOLOGY CHALLENGES

1. Quantum information science & computing;
2. Development of the Cloud and Big Data;
3. Artificial Intelligence (incl. affordable designs used by competitors);
4. 5G & Internet of Things (IoT).

AGENDA 2025

5 ESA Priorities for 2025

- Strengthen ESA–EU relations
- Boost green and digital commercialisation
- Develop space for safety and security
- Address critical programme challenges
- Complete the ESA transformation

- **Security** is either a necessity (e.g. cyber to protect critical infrastructure) or a service (data for decision-makers and operational security user communities)
- Security communities, including defence, continuously rely on civil infrastructure, including in space
- ESA is *de facto* a security player and provider (PRS, launchers, weather satellites, Sentinels, 4S etc)

- ✓ Security activities are a **Member State prerogative**, including in choosing to undertake future activities **collectively** through ESA
- ✓ ESA has the infrastructure and *savoir faire* to implement cooperative space and security programmes based on clear national or European **user requirements**
- ✓ Security is a key consideration in redefining the **ESA-EU** relationship

A POLITICAL PROCESS

- Member States are in the driving seat and have paved the way for cooperative security projects (Space19+)
- Security in Europe will require a political process to maximise the benefits of:
  - ✓ ESA programmes and EU programmes (incl. EDA)
  - ✓ new policy orientations (e.g. Strategic Autonomy and Compass)
  - ✓ instruments (e.g. EDF and PESCO)
  - ✓ governance structures (e.g. ESA, EUSPA, EDA, SatCen)
  - ✓ role of commercial operators and the competitiveness of industry

AGENDA 2025'S POLITICAL PROCESS PROPOSAL

- The specific case of space and security should be tackled through the **European Space Summit** proposed for 2022, as a contribution to the Conference on the Future of Europe.
- On 4-5 November 2021, an **ESA Security Conference (Space for Europe's Security Policies)** will explore European security needs, and the means required to fill identified gaps.
- This process will feed the **ESA Ministerial decisions of 2022**, in full complementarity with national priorities and programmes, as well as with EU initiatives

ESA & Security Missions

ESA AND SECURITY

"To provide for and promote, for exclusively peaceful purposes, cooperation among European states in **space research** and **technology** and their **space applications.**"

Article 2 of ESA Convention

- Interpretation of the ESA Convention in 2003: "peaceful purposes" interpreted in light of UN treaties as "non-aggressive".
- Dual-use synergies are possible; ESA not a « civil-only » agency.
- ESA to protect Member States' investments in space, its mission, its excellence and image

THE 20 NOVEMBER 2020 ESA-EU MINISTERIAL SPACE COUNCIL

*"RECOGNISES that, also for security-related activities, EU, ESA and their respective Member States have **parallel competences** in European space policy for determining European needs for technological independence and autonomy, without prejudice to national security."*

THE SPACE AND MAJOR DISASTERS CHARTER

disasterscharter.org

Providing satellite data to those affected by natural or man-made disasters through registered organisations, for use in monitoring and response activities

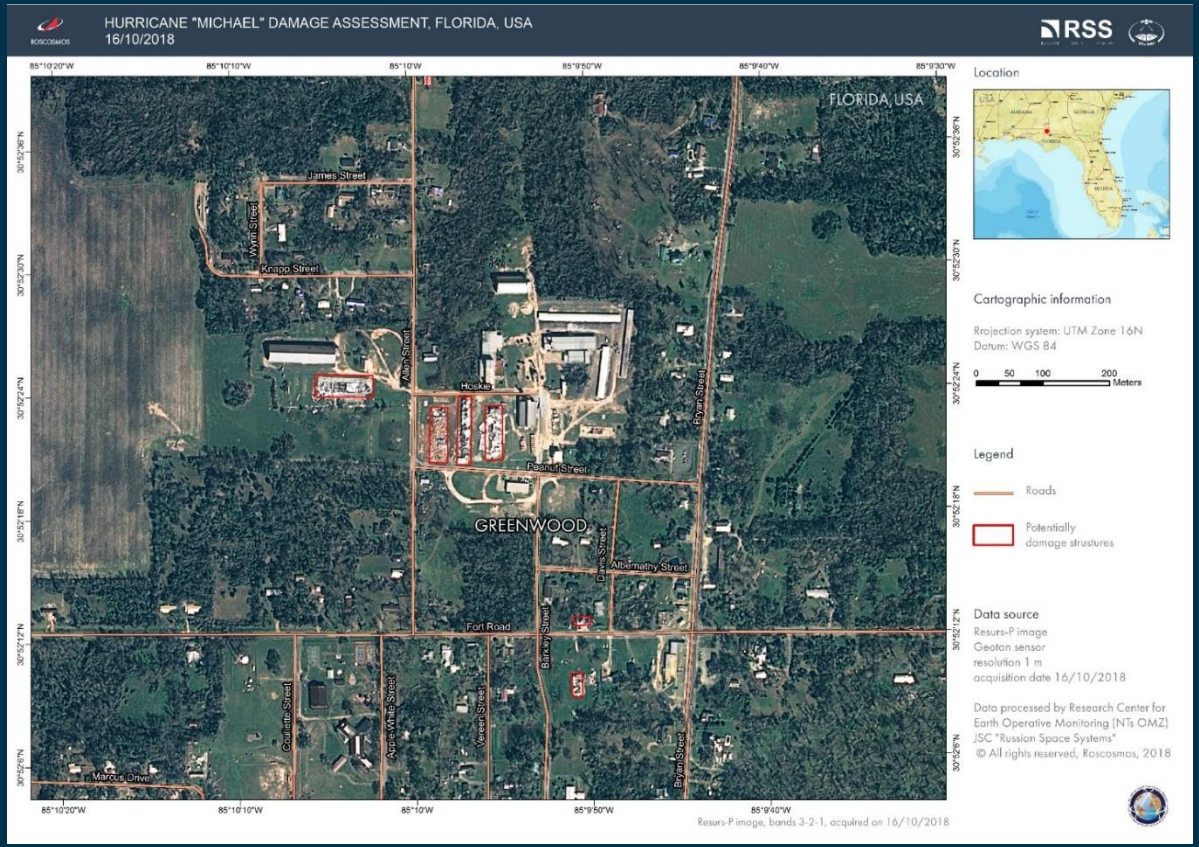
As of early July 2021:

- 715 Activations
- 126 Countries
- 17 Charter Members
- 61 Contributing Satellites

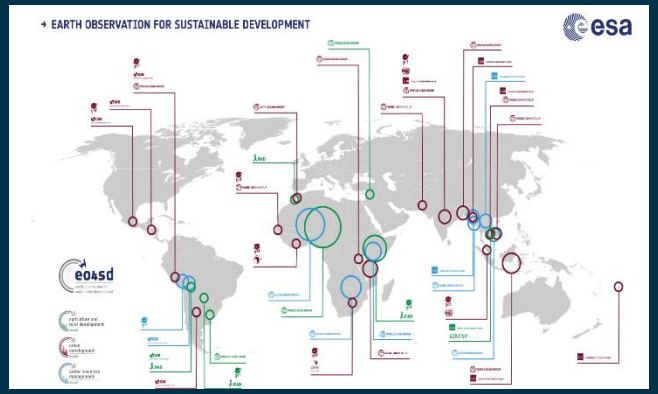
The International Charter Space and Major Disasters was initiated by the European Space Agency (ESA) and the Centre National d'Etudes Spatiales (CNES) following the UNISPACE III conference in 1999. The Canadian Space Agency (CSA) signed the Charter in 2000.

THE SPACE AND MAJOR DISASTERS CHARTER

THE SPACE AND MAJOR DISASTERS CHARTER



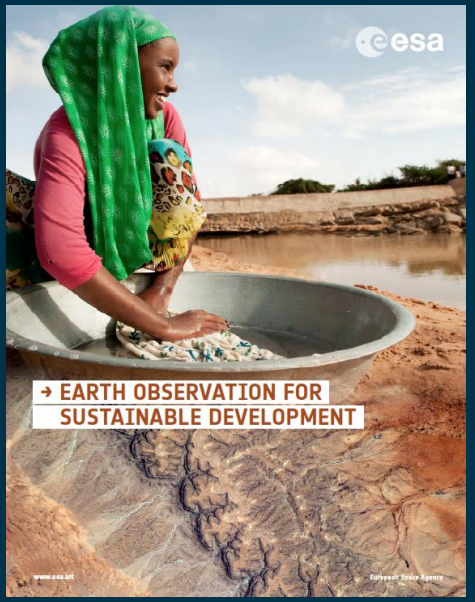
EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT



- Water Management
- Conflict, Fragility & Resilience
- Climate Resilience
- Agriculture and rural development
- Urban development, etc.

eo4sd
earth observation for sustainable development

***World Bank**, Dec 2015, COP-21 Paris*



***Asian Development Bank**, Nov 2016, ESRIN*

ESA AND THE UN SDGs

- ESA activities supporting sustainable development
- SDGs adopted on 25 September 2015 with the aim of ending poverty & hunger by 2030

Sustainable development concerns all of us and is a security issue.

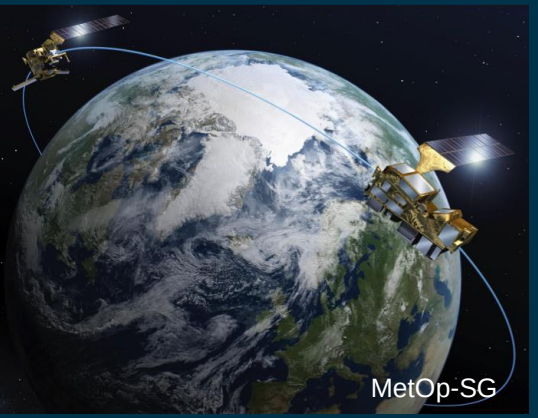
As an international organisation ESA has a responsibility to use its technology for the further development of humankind. ESA has already developed a wide range of programmes that will help achieve the Sustainable Development Goals for everyone on Earth.

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 (2017) studying global winds
- EarthCARE (2018) studying Earth's clouds, aerosols and radiation (ESA/JAXA)
- Biomass (2021) studying Earth's carbon cycle
- FLEX (2022) studying photosynthesis

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–): series of 4 geostationary satellites providing images of Earth.

Meteosat Third Generation (2021–): series of 6 geostationary satellites providing images and atmospheric sounding.

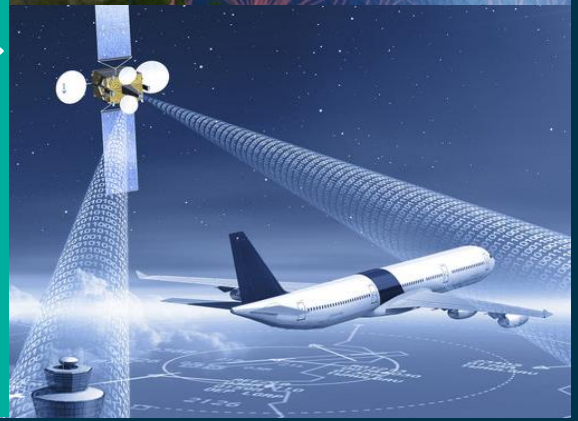
MetOp (2006–): series of 3 satellites providing operational meteorological observations from polar orbit.

MetOp Second Generation (2022–): series of 6 polar-orbiters, continuing and enhancing meteorological, oceanographic and climate monitoring observations from the first MetOp series.

SATCOM – NEW MARKETS

SAT-AIS

Iris

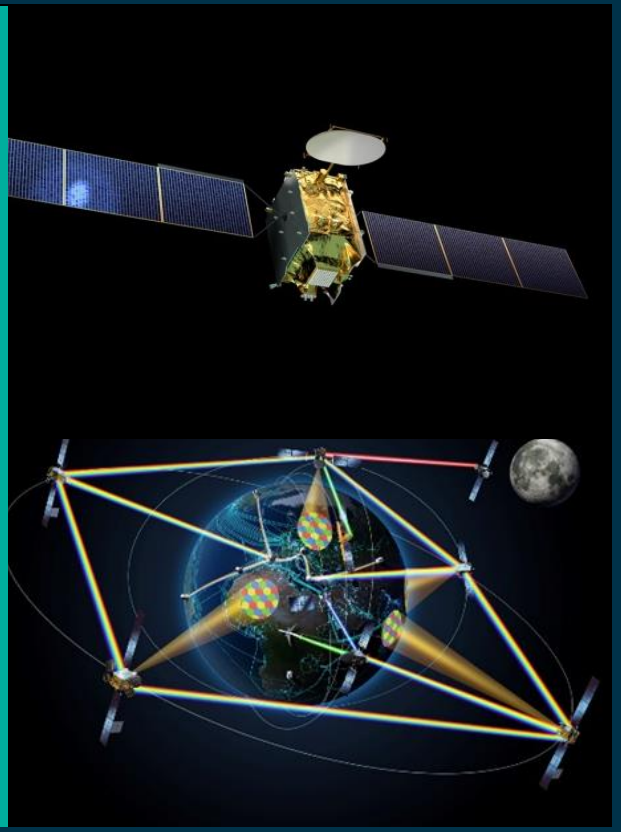


- **Iris** – Initial Operational Capability from 2018, leading to operational service by 2020
- **SAT-AIS** – first launch 2019
- **ESA's Govsatcom Precursor** – service demonstrations 2017–20
- **Pioneer** – starting 2017
- **Mercury** – satellite for 5G initiative

SATCOM INNOVATION AND TECHNOLOGY

Quantum ▷

EDRS ▷



- **EDRS** – first launch, 2016; second launch, 2019
- **Quantum** – 2019/20
- **ScyLight** – includes HydRON, a high throughput “fibre in the sky”
- **Novacom** – partnerships with primes/integrators for next-generation satcom systems
- **4S** – Space System for Safety and Security

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 EU and international partners.

SPACE FOR SAFETY & SECURITY FROM SPACE19+ ONWARDS

IN SPACE

Space traffic management

Debris removal & mitigation

Space weather monitoring

Space logistics

Planetary defence

Cyber security

- Bigger pillar + new flagships
- Close interaction process with MS
- Need to provide holistic end-to-end approaches
- Market dimension of S&S

FROM SPACE

New tools & applications

Smallsats and HAPS

Secure communication

Rapid response EO

CM22 Preparation – Josef Aschbacher

Heads of Delegation meeting

30 April 2021

ESA & CYBER RESILIENCE

CYBER THREATS ARE NOW AN EVERYDAY FACT

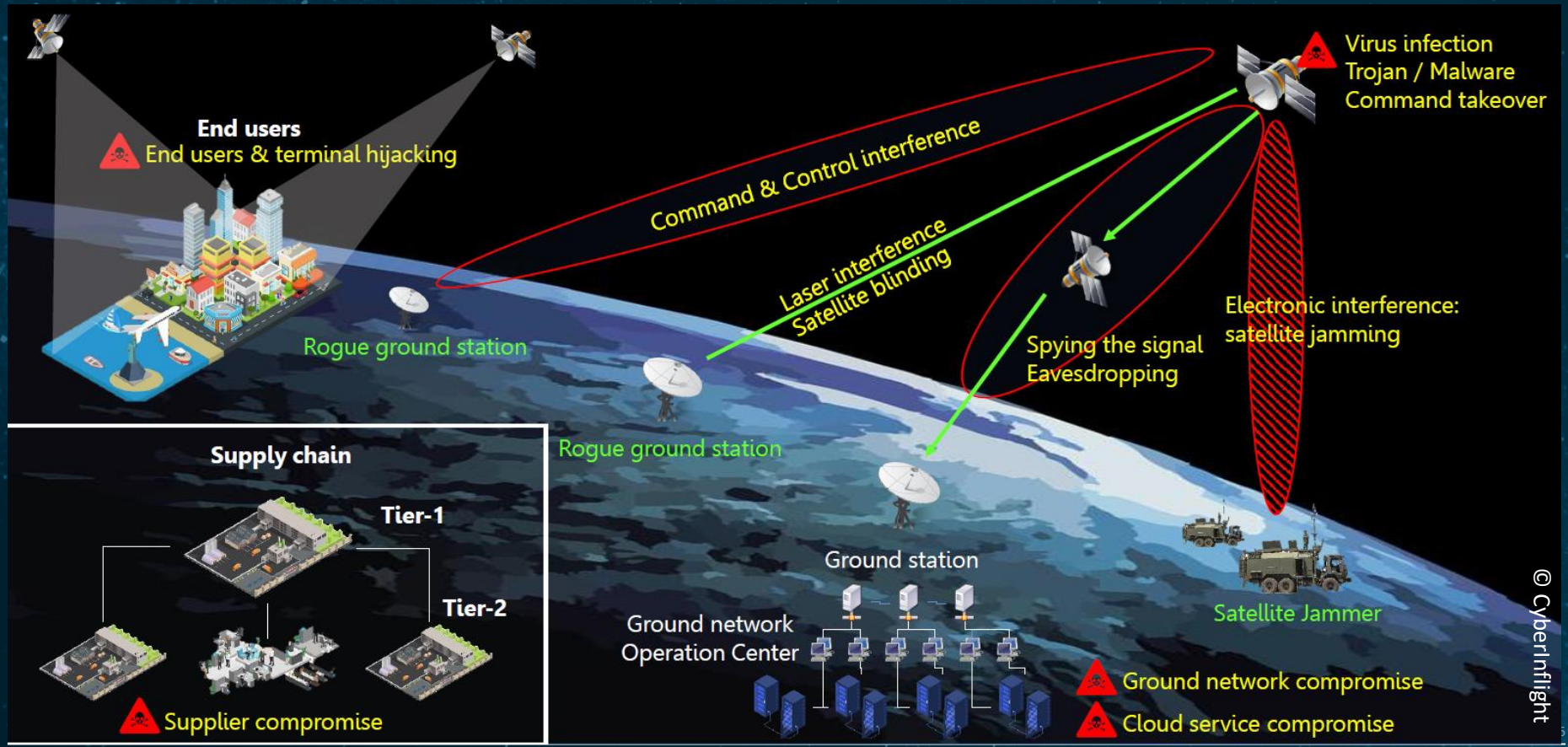
- Threats (cyber and hybrid) to governmental or commercial assets are now well documented (e.g. Russia's Luch/Olymp)

- ESA has a responsibility to protect its Member States' investments in space

- ESA needs to react to these threats and an increasingly holistic, coherent, visible approach needed in:

1. Policy and regulatory;
2. Awareness and training;
3. Research and development;
4. Capacity building for operational cyber security.

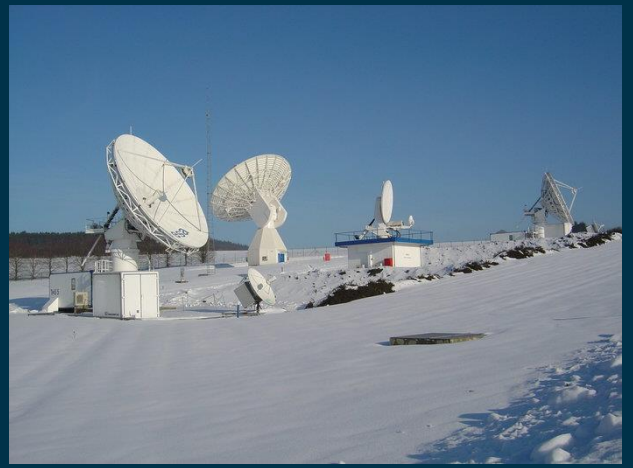
THREATS TO THE SPACE ECOSYSTEM



ESA'S CYBER RANGE IN ESEC (REDU, BE)

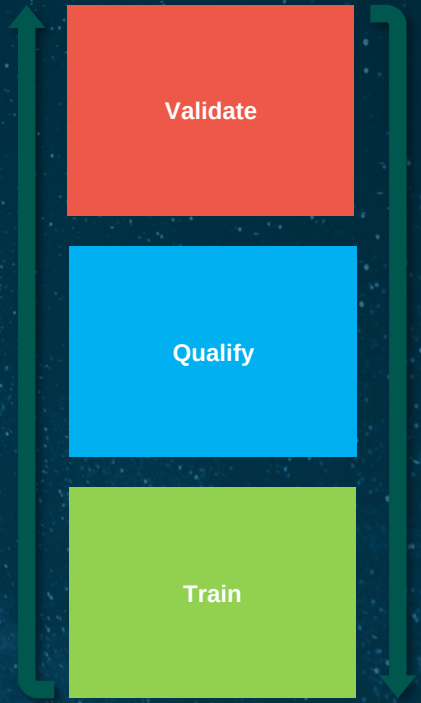
Goals

1. Develop a cyber-security training and simulation environment;
2. Provide training courses that develop knowledge in cyber awareness, incident detection and investigation, response planning and forensics to counter
3. Develop a Long Term Perspective Outlook and financial model concerning the potential for ongoing use of the established Cyber Range.



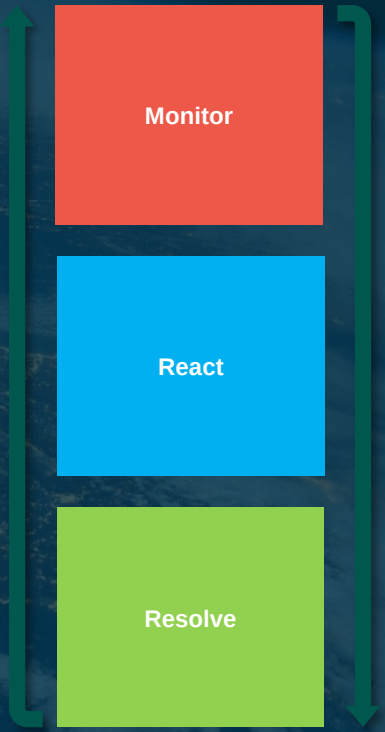
SECURITY CYBER CENTRE OF EXCELLENCE

Security Cyber Centre of Excellence (SCCoE), an innovative tool, providing a unique capability in Europe. It will perform validation and testing of space systems through a synthetic environment, including the validation of security operating procedures and critical components, against up to date complex cyber threat scenarios. It will also represent the focal point for a Security Information Sharing capability, training and centralisation of forensic services/expertise as well as developing a distributed risk analysis process capability;



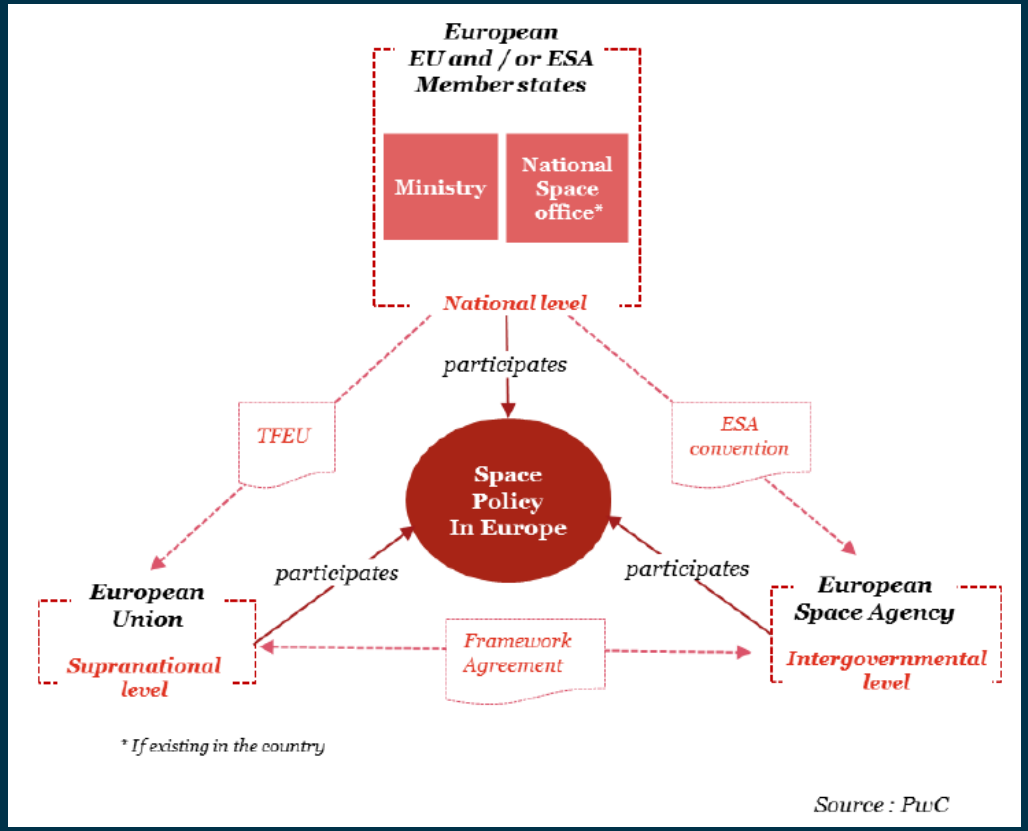
ESA CYBER OPERATIONS CENTRE

Cyber Security Operations Centre (C-SOC), complementing the capabilities of our state-of-the-art Computer and Communications Emergency Response Team (CERT), the C-SOC will provide an ESA-wide cyber monitoring and management capability. The Cyber Security Operations Centre (C-SOC) will monitor and track relevant information and events with the objective of maintaining the overall Agency security posture. The C-SOC will detect security incidents and support the readiness of the organisation's defensive capabilities. The C-SOC will be the ESA Super SOC coordinating all Cyber functionalities in ESA and representing an essential tool not only for ESA, but for all Member States and Third Parties.



ESA & THE EU

THE ESA-EU PARTNERSHIP



THE NEW ESA-EU FRAMEWORK OF COOPERATION

- 2004 ESA-EU Framework Agreement; ESA-EU Security Agreement
- COM(2018) 447 final: Regulation of the European Parliament and of the Council **establishing the space programme of the Union and the European Union Agency for the Space Programme** and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013, (EU) No 377/2014 and Decision 541/2014/EU
- To be finalised by Parliament once MFF is voted;
- The GSA becomes the EU Space Programme Agency.
- EU programmes funding 2021-27:
  - Galileo & EGNOS: €9 billion
  - Copernicus: €5.4 billion
  - GOVSATCOM and Space Situational Awareness: €0,44 billion
  - Total Space: €14.88 billion ; EDF: €8 billion
- FFPA to govern relations through new MFF: Signed on 22/06/2021
- Space Summit in 2022: For new ESA-EU Flagships (secure connectivity?)

ESA – EU Cooperation with a Security Dimension

Galileo: December 2016 – start of Galileo Initial Services

Galileo will provide a highly accurate, guaranteed global positioning service **under civilian control**. The **Public Regulated Service**, an encrypted navigation service, will be available for authorised governmental users.

Search And Rescue (SAR) Service: Galileo is the first GNSS constellation offering global SAR capability. The service will be available at sea, in the mountains, across the desert and in the air. It helps operators respond to a distress signal faster and more efficiently.

Full Operational Capability – 26 satellites now in orbit.

ESA is the system architect for Galileo, managing its design, development, procurement, deployment and validation on behalf of the EU. The GSA is designated by the European Commission to run the system and provide Galileo services.

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.

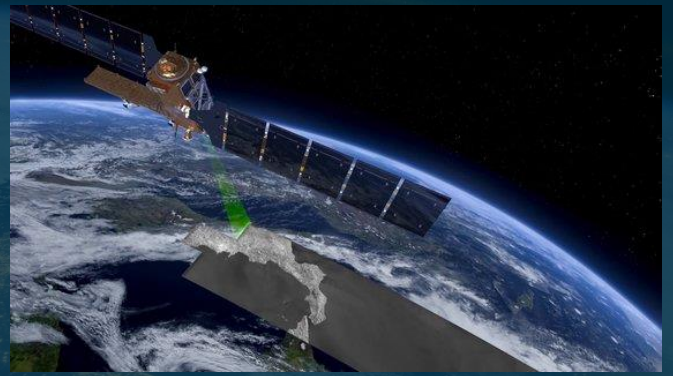
SENTINELS: THE COPERNICUS SPACE COMPONENT

- 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 (2017).
- Sentinel-3 – ocean forecasting, environmental and climate monitoring. Sentinel-3A launched in 2016. Sentinel-3B (2017).
- Sentinel-4 – atmospheric monitoring payload (2019)
- Sentinel-5 – atmospheric monitoring payload (2021)
- Sentinel-5 Precursor – atmospheric monitoring (2017)
- Sentinel-6 – oceanography and climate studies (2020)

COPERNICUS SECURITY SERVICES

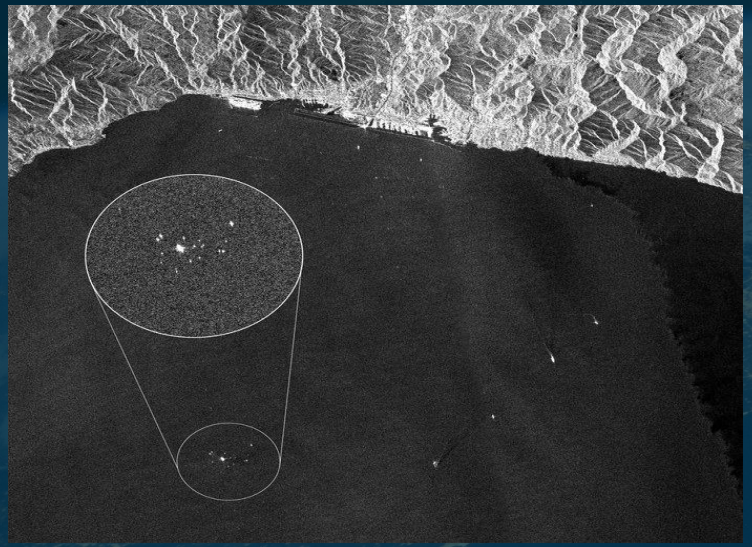
The Copernicus service for Security applications aims to support European Union policies by providing information in response to Europe's security challenges. It improves crisis prevention, preparedness and response in three key areas:

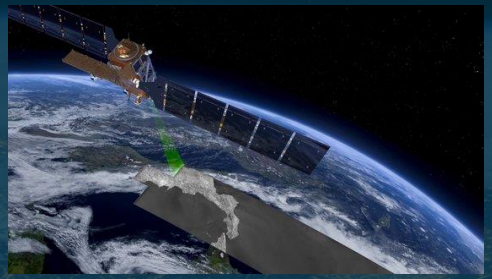
- Border surveillance;
- Maritime surveillance;
- Support to EU External Action.



MARSUR example: The objective of the EU is to support Europe's maritime security objectives (e.g. safety of navigation, support to fisheries control, combatting marine pollution, and law enforcement).

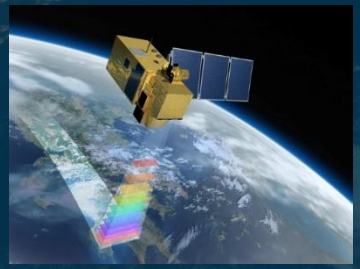
COPERNICUS AND MARITIME SECURITY





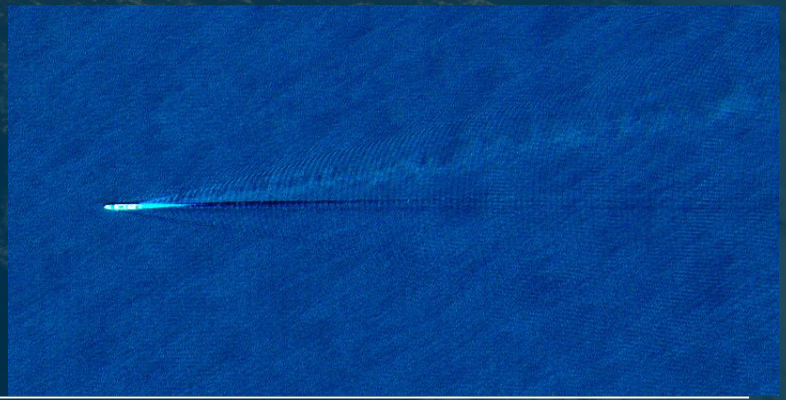
Sentinel 1

- SAR
- 5 m resolution



Sentinel 2

- Optical
- 10 m resolution



ESA - EDA COOPERATION

ESA-EDA COOPERATION

- **Administrative Arrangement: 2011**
- **ESA and EDA can cooperate in any area of joint interest**
- **Secondment scheme**
- **Effective cooperation in technology, satcoms, RPAS, Cyber, CBRN**

Areas of cooperation

Policy Cooperation

- Observer in C-Min and Space Council
- Coordination towards EC (and thus SWP/MS) and European Parliament (SEDE)
- DG-Level Bilaterals
- Space Dialogue (EEAS, EC, GSA, ESA)
- Public Relations, etc.

Ongoing Cooperation

- Critical Space Technologies
- GOVSATCOM
- **Cyber Ranges**
- **Cyber Defence R&T Study (2 phases)**
- CBRNe (AUDROS)
- Earth Observation - METEOR
- Unmanned systems (RPAS, UMS)
- GNC (ATENA)

Future & Potential Cooperation

- **Cyber Resilience (Joint Task Force)**
- Positioning, Navigation and Timing (PNT)
- Space and the Arctic
- New R&D demonstrations
- CBRNe Demonstration
- Next-Generation Secure Satellite Communication

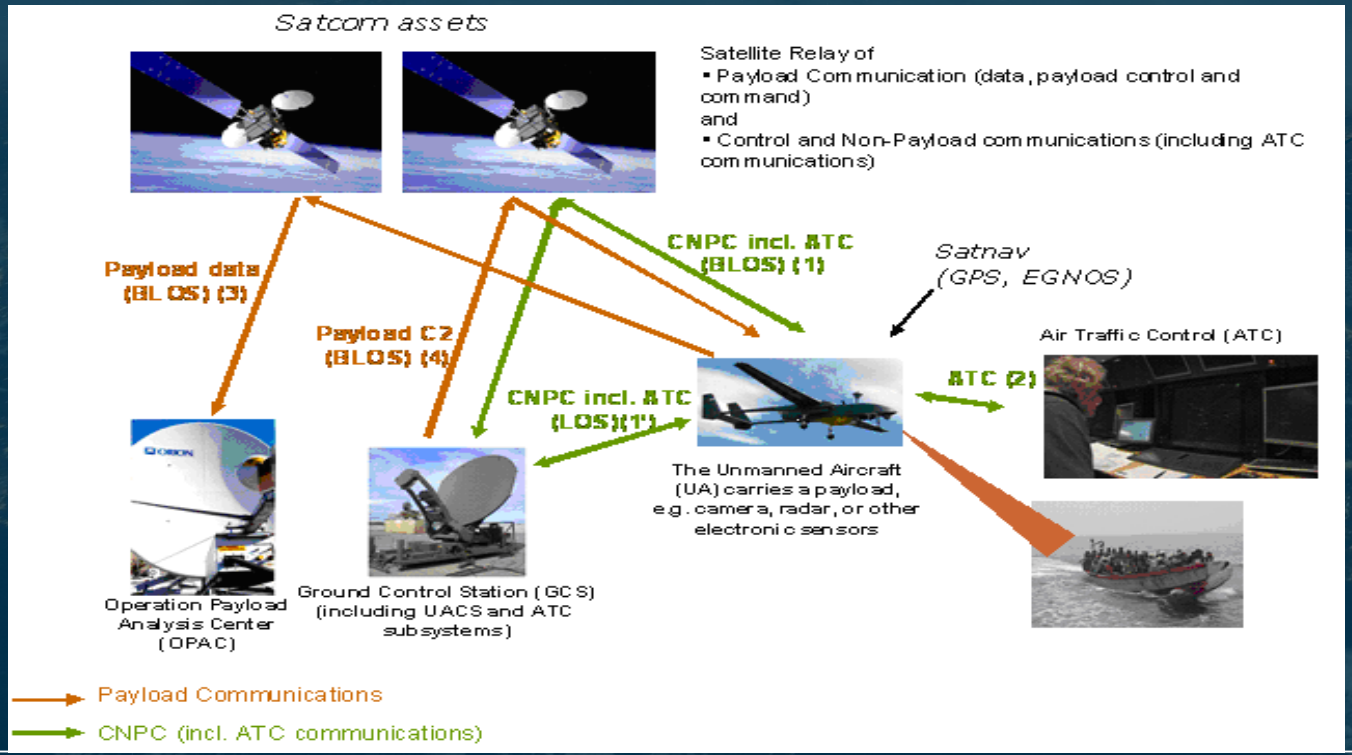
SECURE SATCOMS

- 2017 **Implementing Arrangement** on cooperation for Governmental Satellite Communications (GOVSATCOM)
  - (ESA GOVSATCOM Precursor & EDA GOVSATCOM Pooling and Sharing demonstration)
  - ESA GOVSATCOM Precursor: implementation of engineering, development and assembly, integration and test (“AIT”) activities as well as verification, validation and demonstration activities with respect to each of the Precursor’s projects.
  - EDA: focus on operational aspects and security regulations.

- 2021: **Memorandum of Intent** on Next Generation Secure Satellite Communications
  - Broadens GOVSACTOM IA to identify systems architectures that can respond to a wide set of user requirements in the field of secure communications.
  - EDA to take part in ESA’s exploratory systems study to provide expertise, information, data and a channel to its user communities.
  - Thereafter, ESA and EDA will explore further coordinated steps towards the evolution and preparation of next-generation secure satcom systems.
  - Activity coordinated with DG-DEFIS

RPAS & SPACE: THE DESIRE PROJECT

- **Space is a key enabler for RPAS integration in non-segregated airspace**
- **Pre-requisite for extensive adoption of RPAS-based applications**



UNMANNED MARITIME SYSTEMS

- December 2017 Implementing Arrangement
- Maritime applications require intensive efforts and high operational costs while seldom providing sufficient coverage and resolution to ensure comprehensive and timely data availability : UMS can overcome these limitations by providing timely and persistent data from the surface and beneath.

Relevance of space

- **PNT** to determine and control location, speed and course of the unmanned vehicles;
- **Data relay** e.g. remote control of the vessels (e.g. obstacles detection and avoidance);
- Reliable and **secure satcom** links play a key role to support and ensure crucial functions such as continuous tracking/monitoring of the vessels, route information update, remote control of the vessels, particularly for UMS operations in larger areas;
- **Earth observation** satellite applications ensure safety of operations at sea; remote sensing data integrated with data collected through UMS operations can support a plethora of maritime services, including maritime environmental surveillance.

NEW INITIATIVES: AUDROS & ATENA

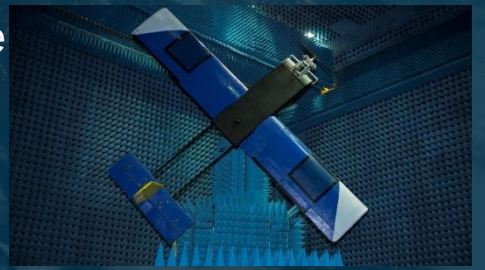
December 2019 Implementing Arrangements

AUDROS (CBRNe)

- harnessing drones for the monitoring of disaster-stricken regions or toxic spill sites; follow-up to a 2016 CBRNe cooperation
- Demonstration project highlighting the benefits of using autonomous and/or UAVs to detect toxic material and carry out rapid response to disasters.

ATENA (Guidance, Navigation and Control)

- Development of new AI-based capabilities in the field of GNC with the capability of flying safely over unknown territory, such as an asteroid, to achieve enhanced navigation performance vs vision-based.
- Advanced, autonomous GNC isto become an indispensable element of ambitious future space missions such as rendezvousing with asteroids & comets or the removal of space debris from orbit.



CD4SPACE

- Based on Critical Technologies for Non-Dependence (ESA, COM, EDA) rationale
- Implementing Arrangement: 02 December 2016
- 2 workshops with Member States supported the process in June 2017 and January 2019.
- The study is executed in 2 phases:
  - ✓ Phase 1 (12 months – 100 k€) for the identification of cyber threats on space missions and associated mitigation measures; 2 workshops with Member States supported the process in June 2017 and January 2019.
  - ✓ Phase 2 (12 months – 300 k€) for the development of the recommended solutions
  - ✓ Member States briefed between the 2 phases.

Objectives of the study

- Phase 1: Identification of vulnerabilities of inherent electronic components, signal and data processing, software and hardware elements along with communication links and protocols
- Phase 2 (ongoing): Cyber Threat Intelligence (CTI); webinar CTI exploitation demo on 30/09/2021

CYBER RANGES FEDERATION

- On 28 June 2018, six EDA Member States (Austria, Belgium, Estonia, Finland, Germany and Latvia) signed a Memorandum of Understanding on the pooling and sharing of their respective cyber ranges capabilities.
- EDA and ESA on 29 November 2017 exchanged letters on a cooperation on cyber ranges and training in order to explore the objectives and framework for sustained cooperation, namely through this MoU.
- ESA undertaking to have the MoU approved by the June 2019 ESA Council, which would establish the legal link with the 8 EDA participating MS to cooperate on cyber ranges.

- Technical demonstration with the ESEC cyber range organised for November 2019
- ESA Party to the MOU since 10/12/2020

ESA - EUSC COOPERATION

EU SATELLITE CENTRE

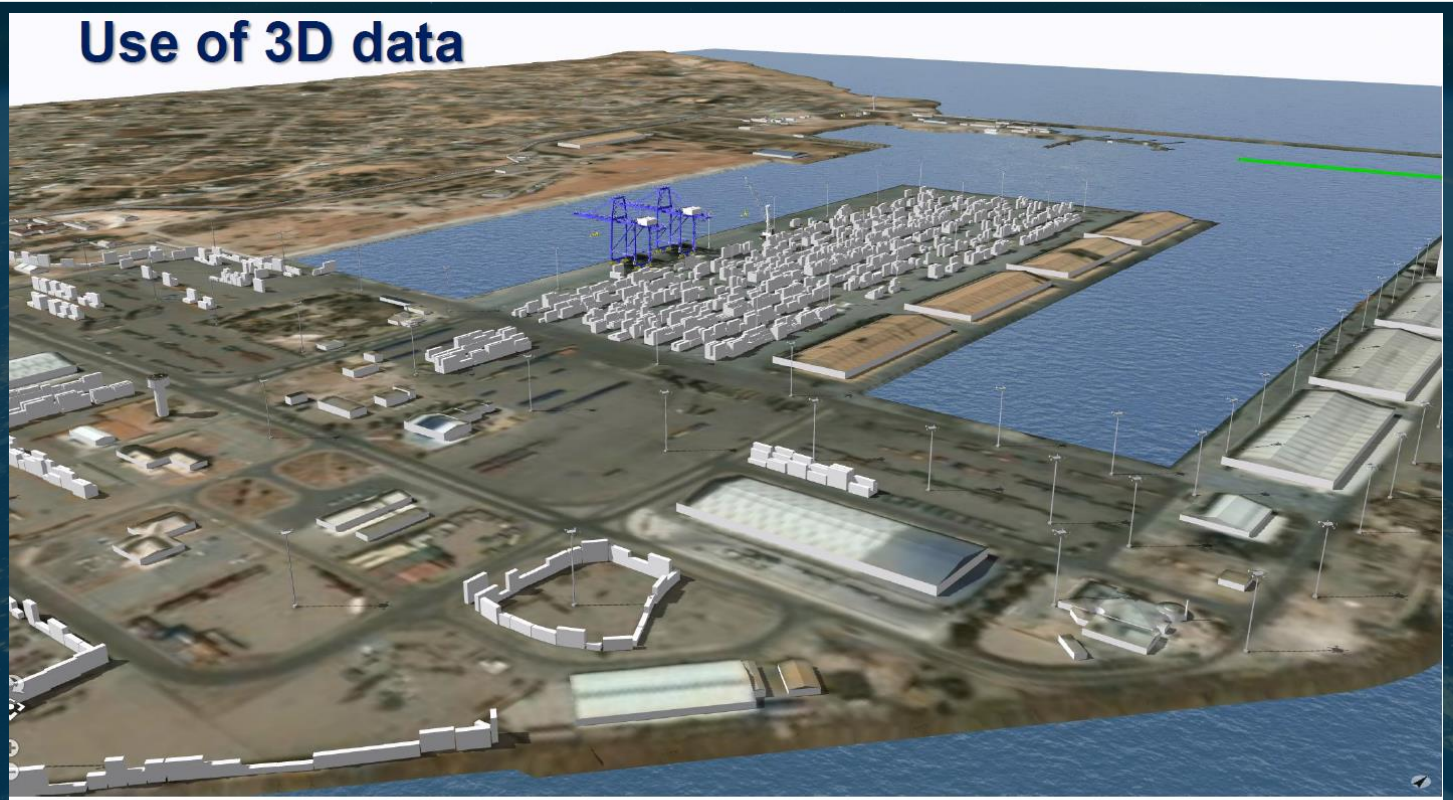
To support the **decision making and actions of the Union** by providing products and services resulting from the **exploitation of relevant space assets** and collateral data, including satellite and aerial imagery, and **related services**

- **ESA-EUSC Administrative Arrangement signed on 23 January 2018.**
- **EDA-EUSC exchange of letters outlining cooperation avenues.**

SYRIA, AR RAQQAH BATTLE DAMAGE ASSESSMENT

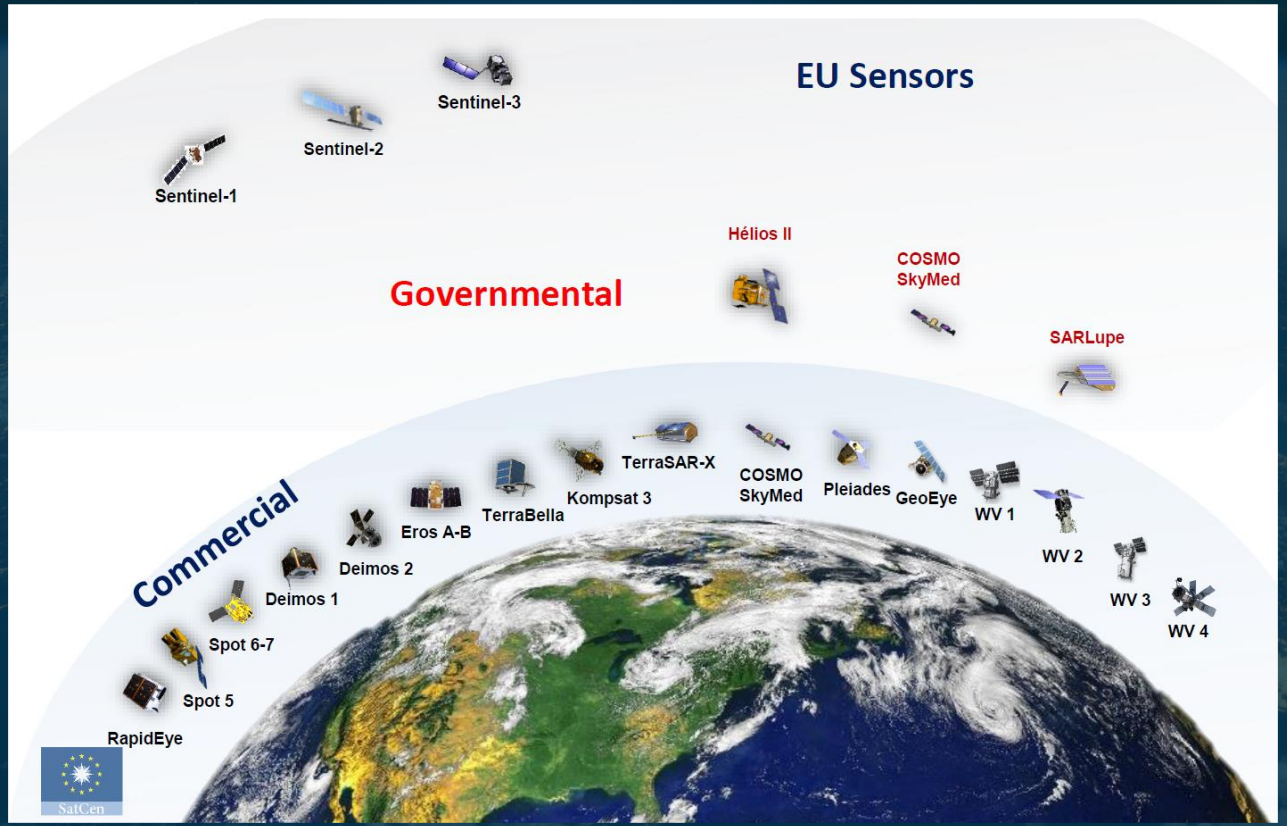
06-19/09/2017

SUPPORT TO EU NAVFOR – MED - SOPHIA



Misratah Port 3D scene – SatCen product *(City Engine – Esri)*

SENSORS


EU Sensors
Sentinel-3
Sentinel-2
Sentinel-1
Governmental
Hélios II
COSMO SkyMed
SARLupe
Commercial
TerraSAR-X
COSMO SkyMed
Pleiades
GeoEye
WV 1
WV 2
WV 3
WV 4
Kompsat 3
TerraBella
Eros A-B
Deimos 2
Deimos 1
Spot 6-7
Spot 5
RapidEye
SatCen

THANK YOU !

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