EU SPACE POLICY AND PROGRAMMES

AUGUSTO GONZÁLEZ
A HIGHLY DEVELOPED SPACE INDUSTRIAL BASE AND RESEARCH COMMUNITY

- The European space industry sustains around 38,000 direct jobs
- Europe is successful in the commercial arena, with a significant market share of telecom and launch services worldwide
- European scientific communities are world-class and attract international cooperation
- Research and innovation centres are recognized worldwide
MAIN INSTITUTIONAL SPACE ACTORS IN EUROPE

NATIONAL SPACE AGENCIES

EUROPEAN UNION

EUROPEAN SPACE AGENCY
Historical starting point of European space efforts

Pursuit of national policy objectives:
- Service own citizens and priorities
- National defense
- Research and innovation
- National industrial base

Bilateral and multi-lateral cooperation in Europe and worldwide on an ad-hoc basis

Examples of national space budgets in Europe, 2014

Source: European Space Policy Institute report #54, November 2015
“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

- Over 50 years of experience
- 22 Member States
- Eight sites/facilities in Europe, about 2200 staff
- 5.2 billion Euro budget (2016)
- Over 80 satellites designed, tested and operated in flight
Article 189 of the Treaty on the Functioning of the European Union:

- **Objective:**
  - To promote scientific and technical progress as well as industrial competitiveness
  - Coordinate space exploitation and exploration efforts

- **Means:**
  - EU space policy
  - Programmes
  - Appropriate relations with ESA
2014 SPACE BUDGETS IN EUROPE

![Graph showing space budgets in Europe]

Source: European Space Policy Institute report #54, November 2015
WHY DOES SPACE MATTER TO THE EU?

- SPACE CONTRIBUTES TO ADDRESSING BIG SOCIETAL CHALLENGES AND TO CITIZENS' WELL-BEING

- SPACE GENERATE INNOVATION AND CONTRIBUTES TO ECONOMIC GROWTH

- SPACE CONTRIBUTES TO SECURITY AND DEFENCE POLICIES
EU SPACE PROGRAMMES

- Satellite navigation
- Earth Observation
- Space R&D
EU SPACE PROGRAMMES 2014-2020

Billion euros, current economic conditions
THE SENTINELS

S1: Radar Mission

S2: High Resolution Optical Mission

S3: Medium Resolution Imaging and Altimetry Mission

S4: Geostationary Atmospheric Chemistry Mission

S5P: Low Earth Orbit Atmospheric Chemistry Precursor Mission

S5: Low Earth Orbit Atmospheric Chemistry Mission

S6 (Jason-CS): Altimetry Mission
THE SERVICES

- LAND SERVICES
- MARINE
- ATMOSPHERE
- EMERGENCY
- SECURITY
- CLIMATE CHANGE
Copernicus Services Implementation Schedule

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Legend: ● Delegation agreement  ▲ Direct management  ○ Operational phase

Status 29/01/2016
Land monitoring – Pan EU & local In-situ coordination

Atmosphere monitoring
Climate change

Marine Environment monitoring

Security – Border Surveillance

Security – Maritime Surveillance

Security – Support to External Actions
DATA

Copernicus collects, processes, and archives massive amounts of data (approx. 8 Terabyte/day or almost 3 Petabyte/year when Sentinels-1, -2 and -3 are fully operational).

Dedicated Sentinel-data and Copernicus information are being made available on a full, open and free-of-charge basis.
EASY ACCESS TO AND USE OF THE DATA

- A robust data dissemination infrastructure
- Make the most of new technologies to facilitate use of the data and avoid duplications
- Improved interoperability (both EO and non-EO data)
- Creating critical mass of EO data around Copernicus
FOSTERING THE ADOPTION OF NEW BUSINESS MODELS IN THE DOWNSTREAM SECTOR

- **Framework conditions**
  - Improving predictability: clear boundary between public and private, dialogue with industry

- **Supply-side measures**
  - Incubators, ICT skills, financial instruments, internationalisation

- **Demand-side measures**
  - Innovative public procurement, awareness of end users
GALILEO PROGRESSIVE DEPLOYMENT

- **Galileo System Testbed v1**
  - Validation of critical algorithms
  - 2003

- **GIOVE A/B**
  - 2 test satellites
  - 2005/2008

- **In-Orbit Validation**
  - 4 operational satellites and ground segment
  - 2013

- **Initial Services Provision**
  - Initial services for OS, SAR, PRS, and demonstrator for CS
  - 2016

- **Full Operational Capability**
  - Full services, 30 satellites
  - 2020
GALILEO SPACE SEGMENT

FIRST FOUR SATELLITES (IOV) LAUNCHED IN 2011 AND 2012
SATELLITE 5 & 6 ARE RECOVERED AND SAFE ON IMPROVED ORBITS
SATELLITE 7 & 8 LAUNCHED ON 27 MARCH 2015
SATELLITE 9 & 10 LAUNCHED ON 11 SEPTEMBER 2015
SATELLITE 11 & 12 LAUNCHED ON 19 DECEMBER 2015
SATELLITE 13 & 14 LAUNCHED ON 24 MAY 2016
30 SATELLITES IN ORBIT BY 2020

Nov. 17
Ariane 5 • Galileo 15-18
Launch window: TBD
Launch site: ELA-3, Kourou, French Guiana
SYSTEM ARCHITECTURE

- 5 mission uplink stations
- 6 TT&G stations
- 2 control centres
- 2 launch and early operations centres
- Constellation of 30 MEO satellites
- IOT centre
- 16-20 Galileo sensor stations

Users & service providers
GALILEO DIFFERENTIATORS

EGNSS differentiators

- Improved performance of a GNSS T&S Service (e.g. availability)
- Independent solution under EU control
- European CI can rely on European GNSS for T&S
- Increased robustness to spoofing
- Galileo service will provide authentication functions
- Improved resilience
- Redundancy
- Continuity of service
- Interoperability with GPS
GALILEO SERVICES

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<td>Stable good quality signals</td>
<td>Initial Services</td>
<td>Initial service combined with GPS</td>
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<td>Initial service</td>
<td>Enhanced service</td>
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<td>Public Regulated Service</td>
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<td>Enhanced service</td>
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<td>Search and Rescue</td>
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<td>Full service</td>
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<td>Commercial Service</td>
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<td>Initial service</td>
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- **Open Service**
- **Public Regulated Service**
- **Search and Rescue**
- **Commercial Service**
TURNING POINT

Galileo Deployment Phase

Deployment of Galileo Core Infrastructure

Completion of the space infrastructure

Initial Services Provision

System Operations

Management and continuous improvement of the Ground Segment

Development of future generations

Galileo Exploitation Phase

2017
GALILEO – DESIGNED FOR SERVICE

EXPLOITATION HEADQUARTER
- European GNSS Agency (GSA)

CORE INFRASTRUCTURE
- Launch and Early Orbit Phase (2x)
- In-Orbit Testing
- Control Centre (2x)
- Time and Geodesy

SERVICE INFRASTRUCTURE
- PRS & Security Monitoring Centre (2x)
- SAR Galileo Data Service Provider
- GNSS Service Centre
- Galileo Reference Centre
**REFERENCE DOCUMENTATION**

**Galileo Open Service Signal In Space Interface Control Document (OS SIS ICD)**
Version 1.2 published end 2015

**Galileo NeQuick Ionospheric Model**
Version 1.2 published in Sept 2016

**Galileo SIS Operational Status Definition**
Version 1.1 published in July 2016

**Galileo OS Service Definition Document**
First version in 2016 with Initial Service performance
Updated version in 2017-18 with more consolidated FOC performance
GALILEO SERVICE CENTER (based in Madrid, operated by GSA): A one-stop shop for Galileo users

www.gsc-europa.eu CENTER

Regular Publication of Notice Advisories to Galileo Users (NAGUs)] and publication of Galileo constellation progress reports.

Response to increasing numbers of visits and enquiries from users.

New functionalities being developed:
- Subscription services;
- Monthly service report.
EGNSS R&D
GNSS IMPORTANT FEATURES

**Availability:** Percentage of time the minimum number of satellites are in view, so the position, navigation or timing solution can be computed by the user.

**Accuracy:** difference between true and computed position (absolute positioning).

**Continuity:** Ability to provide the required performances during an operation without interruption, once the operation has started.

**Integrity:** Additional user information on the reliability of the signal within the operational requirements.

**Robustness to spoofing and jamming:** Authentication information provided to users ensuring the signal comes from a satellite in space (enabling sensitive applications).

**Indoor penetration:** Ability of signal to penetrate inside buildings, e.g. through windows.
GNSS MAIN MARKET SEGMENTS

- LOCATION BASED SERVICES
- ROAD
- AVIATION
- RAIL
- MARITIME
- AGRICULTURE
- SURVEYING
- TIMING AND SYNCHRONISATION
<table>
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<td>Galileo</td>
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EGNSS RESPONSE TO USERS' REQUIREMENTS
EGNOS Service Area

Geostationary Satellites
- INMARSAT AOR-E 3F2 (15.5 W)
- INMARSAT IOR-W 4F2 (25 E)
- SES 5 – (5 E)
- ASTRA 5B – ordered (31.5 E)

6 Navigation Ground Stations

40 Ranging & Integrity Monitoring Stations (RIMS)

GPS Signals

2 Support Centers

4 Mission Control Centres
HORIZON 2020 SPACE

Satellite Navigation (Galileo and EGNOS)
- Applications
- EGNSS evolution

Earth Observation (Copernicus)
- Applications
- Data
- Copernicus evolution

Competitiveness of the European Space sector
- Technologies for European non-dependence and competitiveness
- Independent access to space
- Space Science and Exploration

Protection of the European Space Assets
- Space Surveillance and Tracking
- Space Weather, Space Debris, Near Earth objects

Bottom-up engagement of SMEs in space R&D (SME Instrument)

Fast Track to Innovation pilot
SPACE SURVEILLANCE AND TRACKING

EU legal framework to establish a space surveillance and tracking capability at European level and with an appropriate level of European autonomy.

Support provided for the networking of Member State ground-based and/or space-based sensors; the operation and processing of data to produce SST information; SST services.

SST services: collision and uncontrolled re-entry risk assessment; generation of avoidance alerts and relevant re-entry information.
ONGOING REFLECTION - CHANGING SPACE ENVIRONMENT

- TRANSFORMATIVE IMPACT OF SPACE DATA
- INCREASED GLOBALISATION AND COMMERCIALISATION OF SPACE ACTIVITIES
- DISRUPTIVE TECHNOLOGIES AND BUSINESS INNOVATION
- SHIFT FROM PUBLIC SECTOR DOMINATED ACTIVITIES TOWARDS A GROWING INVESTMENT BY PRIVATE ACTORS
- INCREASED IMPORTANCE OF SECURITY AND DEFENCE CHALLENGES WHICH CALL FOR GREATER SYNERGIES BETWEEN CIVIL AND MILITARY ASPECTS
ENCOURAGE THE UPTAKE OF SPACE SERVICES, DATA AND DEVELOPMENT OF APPLICATIONS

FOSTER A COMPETITIVE AND INNOVATIVE EUROPEAN SPACE SECTOR

ENSURE EUROPEAN AUTONOMY IN ACCESSING AND USING SPACE IN A SAFE AND SECURE ENVIRONMENT

PROMOTE INTERNATIONAL COOPERATION
THANK YOU FOR YOUR ATTENTION