Galileo & Copernicus

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ESA/ESOC
Überblick

1. Galileo Update
2. GNSS Performance
3. Copernicus
Galileo system architecture

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

MEO: Medium Earth Orbit
TT&C: Telemetry, Tracking and Command
IOT: In-Orbit Testing
## The Galileo Services

<table>
<thead>
<tr>
<th>Service</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Open Service (OS)</td>
<td>Freely accessible service for positioning, navigation and timing</td>
</tr>
<tr>
<td>Public Regulated Service (PRS)</td>
<td>Encrypted service designed for greater robustness in challenging environments</td>
</tr>
<tr>
<td>Search and Rescue Service (SAR)</td>
<td>Locates distress beacons and confirms that message is received</td>
</tr>
<tr>
<td>Commercial Service (CS)</td>
<td>Delivers authentication and high accuracy services for commercial applications</td>
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</tbody>
</table>

**Integrity Monitoring Service**

Provides vital integrity information for life-critical applications.

The former "Safety-of-Life" service is being re-profiled.
Galileo Update – Zeitplan

Galileo Implementation Plan

Galileo is implemented in a step-wise approach

By 2020 Galileo will be:
- fully deployed and recognised
- adopted by the widest user communities
- a civilian infrastructure delivering robust positioning and timing services with high degree of performances

Full Operational Capability
Full services, 30 satellites

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

In-Orbit Validation
4 operational satellites and ground segment

GIOVE A/B
2 test satellites
2005/2008

Galileo System Testbed v1
Validation of critical algorithms
2003

1. Galileo Service Operator
   - Ausschreibung für Galileo Betreiber ist im Gange
   - Auftragsvolumen, ca. 1 Mrd. €

2. Satellitenstarts
   - Mai 2016, 2 Satelliten (13 und 14)
   - Okt/Nov 2016, 4 Satelliten mit Ariane 5 (15 - 18)

3. Services
   - Initial Services geplant für 2016
   - Full Galileo Services geplant für 2020
GNSS Performance – Galileo 2 Frequenzen, Precise Orbits

GPS L1–L2 / GAL E1–E5a
Broadcast Orbits / Code / 11–13 SV
NNOR / 31–03–2016 / 04:30–06:00 UTC
RMS(2D): 0.717 m / STD(2D): 0.596 m

GPS L1–L2 / GAL E1–E5a
Precise Orbits / Code+Phase / 12–14 SV
NNOR / 31–03–2016 / 04:30–06:00 UTC
RMS(2D): 0.019 m / STD(2D): 0.015 m
GNSS Performance – Multi GNSS, Precise Orbits

Precise Orbits / Code+Phase / 17–20 SV
MAS1 / 08–04–2016 / 15:00–15:45 UTC
RMS(2D): 0.008 m / STD(2D): 0.006 m
Horizontal Position Accuracy

ESOC precise Real-Time PVT solution
Standard Real-time PVT solution
Was ist Copernicus?

Copernicus ist ein Europäisches System zur Erdbeobachtung
• Dienste und Produkte werden generiert für Umwelt- und sicherheitsrelevante Aspekte durch
• Prozessierung von Satelliten-Daten und InSitu Sensor-Daten
• Operationelle Perspektive bis 2030
GMES/Copernicus Key Milestones

- 2014+: First Sentinel satellites launched
- 2014: EU-ESA Copernicus Agreement for 2014-2020
- 2014: Revision of the ESA GSC Declaration
- 2014: EU Regulation of the Copernicus programme
- 2013: EU Delegated Regulation for Copernicus data access
- 2010: Commission proposal for a Regulation on GMES initial operations (2011-2013)
- 2008: ESA Ministerial Council in The Hague provided next major funding contribution by ESA Member States; Signature of EU-ESA Delegation Agreement on GMES
- 2005: ESA Ministerial Council in Berlin: first funds committed to the Copernicus Space Component
- 2001: ESA Ministerial Council in Edinburgh: first Copernicus services funded
Komponenten und Kompetenzen

Overall Programme Coordination

In-situ Daten unterstützen die Space und Service Komponenten

Coordinators:

Partners:

Industries
Private companies
National Space Agencies
Eumetsat

Services Komponente

Space Komponente

European Commission

Coordination

Service operators

Private companies

EMCWF
Mercator Ocean
EMSA
FRONTEX
EUSC
EEA
JRC


European Space Agency
<table>
<thead>
<tr>
<th>Sentinel</th>
<th>Type and Mission Details</th>
<th>Launch Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1A/B</td>
<td>Radar Mission</td>
<td>3 Apr 2014/22 Apr 2016</td>
</tr>
<tr>
<td>S2A/B</td>
<td>High Resolution Optical Mission</td>
<td>23 June 2015/2017</td>
</tr>
<tr>
<td>S3A/B</td>
<td>Medium Resolution Imaging and Altimetry Mission</td>
<td>16 Feb 2016/2017</td>
</tr>
<tr>
<td>S4A/B</td>
<td>Geostationary Atmospheric Chemistry Mission</td>
<td>2021/2027</td>
</tr>
<tr>
<td>S5P</td>
<td>Low Earth Orbit Atmospheric Chemistry Mission</td>
<td>2016</td>
</tr>
<tr>
<td>S5A/B/C</td>
<td>Low Earth Orbit Atmospheric Chemistry Mission</td>
<td>2021/2027</td>
</tr>
<tr>
<td>S6A/B</td>
<td>Altimetry Mission</td>
<td>2020/2025</td>
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Copernicus – Missionen, die Daten für Copernicus zur Verfügung stellen

**Optical MR and LR missions**
- PROBA-V
- SPOT (VGT)

**SAR missions**
- COSMO-Skymed
- TerraSAR-X
- Tandem-X
- Radarsat

**Altimetry missions**
- Cryosat
- Jason

**Atmospheric missions**
- Deimos-2
- RapidEye

**Copernicus Contributing Missions**
- DMC
- Pléiades
- MetOp
- Meteosat 2nd Generation

**Other Missions**
- SPOT (HRS)
- COSMO-Skymed
- MetOp
- Meteosat 2nd Generation
Sentinel Data Policy = FREE and OPEN access

- Joint COM/ESA Sentinel Data Policy Principles have been prepared in 2009 - adopted by ESA MSs in Sep 2009

- EU Delegated Act on Copernicus Data and Information Policy has been published on 12 July 2013 (C(2013)4311, final)

- Main principles of Sentinel data policy:
  - Open access to Sentinel data by anybody and for any use
  - Free of charge data licenses
  - Restrictions possible due to technical limitations or security constraints

- Info über Datenzugriff: Sentinel Online portal (sentinels.copernicus.eu)
Danke für Ihre Aufmerksamkeit