Towards a multi constellation GNSS in aviation

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A civil and military organisation with **38 Member States**.

**Ensure safety** building a seamless, pan-European Air Traffic Management (ATM) system to cope with capacity needs and environmental aspects.

**Core business :**
- Development of European ATM Network
- Pan-European functions (e.g. Flow Control, Central charging)
- Provision of regional ATC services
- SESAR: R&D on the future air traffic management (ATM) network across the European continent.
- Support to EU regulation and system performance review

**Partnership with European and international stakeholders (e.g. EC, ICAO, FAA,ESA…)**

**More information:** [http://www.eurocontrol.int/](http://www.eurocontrol.int/)
EUROCONTROL role on GNSS

25 years contributing to GNSS addressing safety, technical, operational, standardisation, economical, institutional and legal matters.

- **Common strategies and policies for Europe**
- **Aviation user requirements for GNSS**
- **Operational validation of GNSS performance**
- **Support harmonised pan-European implementations**
Use of GNSS in aviation applications

Civil domain

- Surveillance (ADS-B)

- Navigation
  - Positioning and Time (4D NAV)

- Timing in communications (e.g. Datalink)

Military domain (based on GPS PPS & Galileo PRS)
Aviation needs for a Multi-constellation GNSS

Better **Performance** for increasing number of more demanding applications (e.g. from 5 to 1 NM, LPV 200, ADS-B,..)

More **Robustness** against vulnerabilities (iono, interferences)

**Interoperability**, doing things better working together for a global aviation
Towards a multi constellation GNSS

- **2009**
  - 30 GPS L1
  - 1 GPS L1/L5
  - 19 GLONASS
  - Remove NDBs and VORs
  - Keep DME and ILS

- **2010**
  - 24 GPS (L1/L5)
  - 4 Galileo satellites (E1/E5)

- **2015**
  - EGNOS (APV 1)
  - GBAS CAT I
  - 24 GLONASS
  - 4 Galileo satellites (E1/E5)

- **2018**
  - 24 GPS (L1/L5) and 30 Galileo (E1/E5)
  - New RAIM capabilities
  - GBAS CAT II/III (GPS-Galileo)

- **2020**
  - Evolution towards a multi constellation GNSS
  - Performance & robustness

- **GNSS**
Aviation is a global business and interoperability is a key element to enable:

- Global harmonisation
- Standardisation process
- Reduce avionics costs (installation, certification,...)
- Seamless navigation performance

**UN ICAO** standards (SARPS) ensure global interoperability of aviation systems like SBAS and GBAS:

- A SBAS receiver that works in the US (WAAS) will work in Europe (EGNOS)
- Same aircraft can use a GBAS station in Australia, Brazil, US or Europe.

**UN ICG:** Extend interoperability from signals to integrity at core constellations levels.
### Towards a Multi constellation GNSS: increasing robustness, performance and interoperability

<table>
<thead>
<tr>
<th>Today (around 60% of fleet)</th>
<th>Tomorrow (all aircraft)</th>
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<tbody>
<tr>
<td>GPS L1</td>
<td>GPS, Galileo, GLONASS and COMPASS??</td>
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<td><strong>Performance:</strong> Smaller and better characterised failures</td>
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<td><strong>Robustness</strong> (against iono and interferences): Multi frequency</td>
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<td><strong>Interoperability</strong> : Comparable commitments</td>
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<tr>
<td>GPS/RAIM: Horizontal integrity</td>
<td>Multi constellation RAIM: Vertical integrity?</td>
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<tr>
<td>2010 EGNOS (SBAS): Vertical integrity</td>
<td>A light integrity channel, SBAS evolution?</td>
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<tr>
<td>2010 GBAS (GPS): CAT I</td>
<td>GBAS (Multi constellation) : CAT II/III</td>
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European aviation needs:
- Gradual reliance on a multi-constellation GNSS for all phases of flight and many aviation applications.
- Performance, Robustness and Interoperability.

EUROCONTROL work on GNSS is based on cooperation:
- European level: EC, ESA and aviation stakeholders
- Global level: ICAO and UN ICG

Key areas of cooperation within UN ICG:
- Extend interoperability from signals to integrity
- Defining future GNSS baseline for European aviation (SESAR)
- Technical studies (e.g. SESAR, RAIM, ionosphere impact on aviation applications during next solar max)