GALILEO Programme Update
Working together, working for everyone

Workshop on the Applications of Global Navigation Satellite Systems • Suva, Fiji, June 2019
GALILEO MOVING AHEAD

2005
DEVELOPMENT
SYSTEM TESTBED
GIOVE A/B

2013
IN-ORBIT VALIDATION
4 satellites
initial ground infrastructure

2015/2016
INITIAL GALILEO SERVICES
OS, SAR, PRS, CS demonstrator

2017/2019
EXPLOITATION
PHASE
FOC1 System

2020
FULL OPERATIONAL
CAPABILITY
24 operational satellites
and complete ground infrastructure

After 2020
TOWARD GALILEO 2nd GENERATION
EU SPACE PROGRAMME PROPOSAL 2021-2027

• EU investment in Space:
  – 2007-2013, €5 billion
  – 2014-2020, €11 billion (plus Member State investments)

• Next multiannual financial framework (MFF) proposal:
  – 2021-2027, €16 billion

• EU investments guarantee long-term provision of services
GALILEO + EGNOS

€ 9.7 billion: 61% of the total allocated budget (continuity 60%, evolution 1%)

⇒ Continuity of the operations and service provision
⇒ Investment in launchers and satellites to sustain a Galileo constellation of 30 satellites.
⇒ 2nd generation gradually operational from 2030 with higher precision and greater resilience, providing new services for drones, internet of things, driverless cars...
EGNOS FULLY OPERATIONAL

- EGNOS Open Service, operational since October 2009
- EGNOS Safety of Life service, operational since March 2011
- The EGNOS Data Access Service (EDAS) available since July 2012
- Around 600+ approach procedures approved using EGNOS for aircraft landings in 20+ Countries
GALILEO SOME KEY FEATURES

• CIVIL
  – Not managed by Defence

• MASS MARKET DUAL FREQUENCY (L1/L5)
  – Less impact from solar conditions/ionosphere

• DIGITAL SIGNATURE (Authentication)

• SEARCH AND RESCUE RETURN LINK
GALILEO SERVICES

- **Open Service (OS)**
  - *Freely accessible* service for positioning, navigation and timing

- **Public Regulated Service (PRS)**
  - *Encrypted service* for greater robustness and higher availability

- **Search and Rescue (SAR) - contribution**
  - *Helps locate people in distress* and confirms that help is on the way

- **Commercial Service (CS)**
  - *Authentication* and *high accuracy* services for commercial applications

- **Safety-of-Life (SoL) - contribution**
  - *Provides vital integrity* information for life-critical applications
GALILEO POSITIONING PERFORMANCE & AVAILABILITY

- 4 more satellites operational in February
- Satellites in operational constellation: **22**
- Availability of H. Accuracy <10 m **100%** (Average User Location)
- Global PDOP ≤6 availability **99.99%** (Average User Location)
- Availability for Timing Service **100%**

**Measured PVT Accuracy (Source TGVF)**

![Diagram showing position accuracy distribution](image)
GALILEO IMPROVES SEARCH AND RESCUE

Without Galileo, localisation is up to 4h and 10 km.

With Galileo, localisation is down to 10 min and 2 km.
GALILEO INCREASINGLY CRITICAL TO EU POLICIES

• **ENERGY UNION** policy: more energy-efficient, modern and cleaner mobility solutions

• Road: eCall, Digital Tachograph, eTolling
  • Incorporated into EU Regulations

• Aviation: PBN, Drones, Surveillance & Tracking, ....

• Timing for Critical Infrastructures

• Approved as a **Global Maritime Distress & Safety System**

• European Radio-Navigation Plan
  • modernise infrastructure
  • rationalise investments
  • synergies between sectors
GALILEO CONSTELLATION STATUS

Navigation Payload (22 Operational)
- 26 satellites in orbit
- 0 under commissioning
- 2 in testing
- 1 spare
- 1 unavailable

Search and Rescue Payload (23 Operational)
- 2 out of 26 satellites with no SAR Transponder
- 0 under commissioning
- 1 spare

0 unoccupied reference slots

Plane A                  Plane B                  Plane C
• Excellent overall performance driven by the good satellite clock technology and the fast refresh rate of the navigation message through the worldwide uplink stations
• Per satellite availability 99.42%, well above 87% target
• SISE has decreased significantly during the last 2 ½ years, to a current value <0.50m 95% Global Average (constellation average), well within the 2m Initial Services (IS) target
• UTC(SIS) dissemination accuracy below 8.4ns (95%), well within the 30ns (95%) IS target
• GPS-Galileo Timing Offset (GGTO) dissemination accuracy is below 6.9ns (95%), well within the 20ns (95%) IS target
• Decreasing Ranging Error trend due to increasing number of satellites and ground segment improvements
• Ranging accuracy (95%) 0.24m all satellites in March 2019 (FNAV)
• Evaluated with calibrated timing GPS/Galileo receiver operated in UTC(k) laboratory (PTB, INRIM)
• Performance significantly better than Initial Services target
• Some GGTO outliers will disappear when the new Precise Timing Facility is deployed in the Ground Control Centres
GALILEO PEDESTRIAN TEST SETUP

Reference antenna

Xiaomi Mi8 Dual-freq

Reference receiver

Reference trajectory generated using RTK
GALILEO SUB-METRE POSITIONING ACCURACY WITH DUAL FREQUENCY GNSS CHIPSET

- Performance evaluated using PPP processing
- Illustration of what can be achieved in the future using the new High Accuracy Service! (by 2020)

Pedestrian test @ ESTEC football pitch
THANK YOU

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