



European
Global Navigation
Satellite Systems
Agency



GALILEO Programme Update

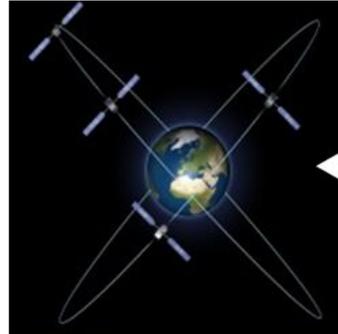
Working together, working for everyone

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

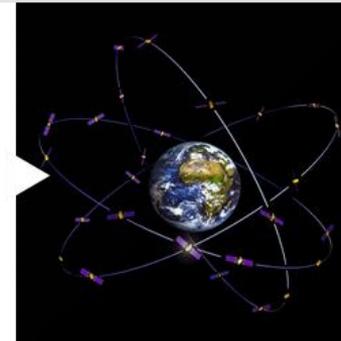


2015/2016
INITIAL GALILEO SERVICES
OS, SAR, PRS, CS demonstrator

2017/2019
EXPLOITATION
PHASE
FOC1 System



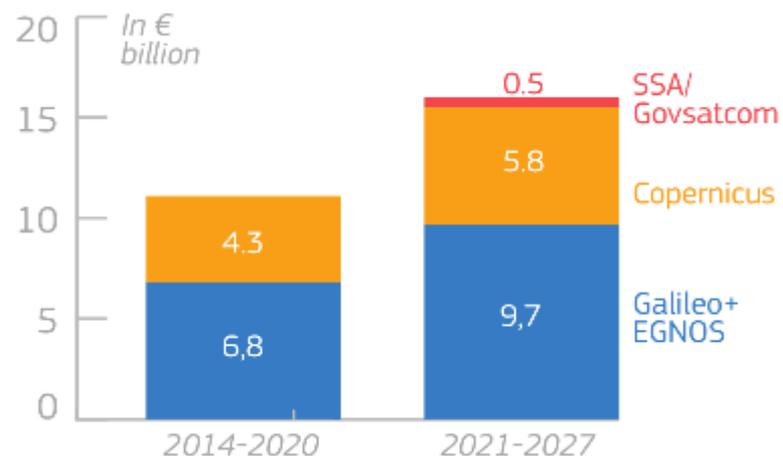
2020
FULL OPERATIONAL
CAPABILITY
24 operational
satellites
and complete ground
infrastructure



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

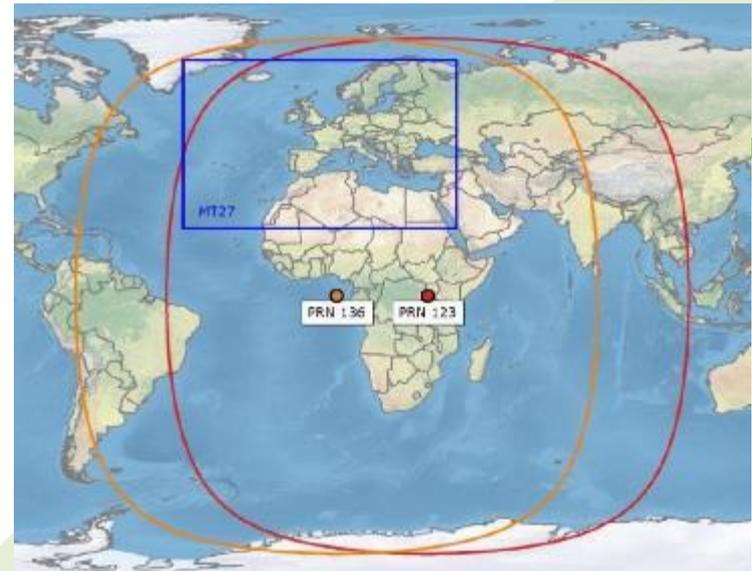
GALILEO + EGNOS

€ 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...

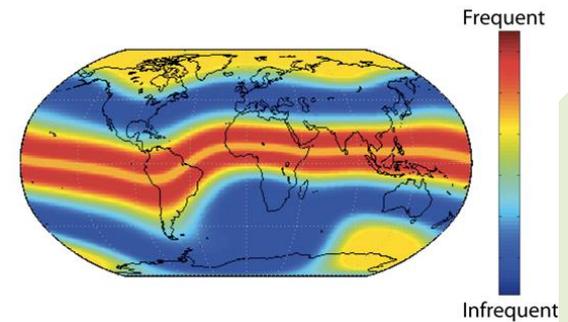
EGNOS FULLY OPERATIONAL

- 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

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



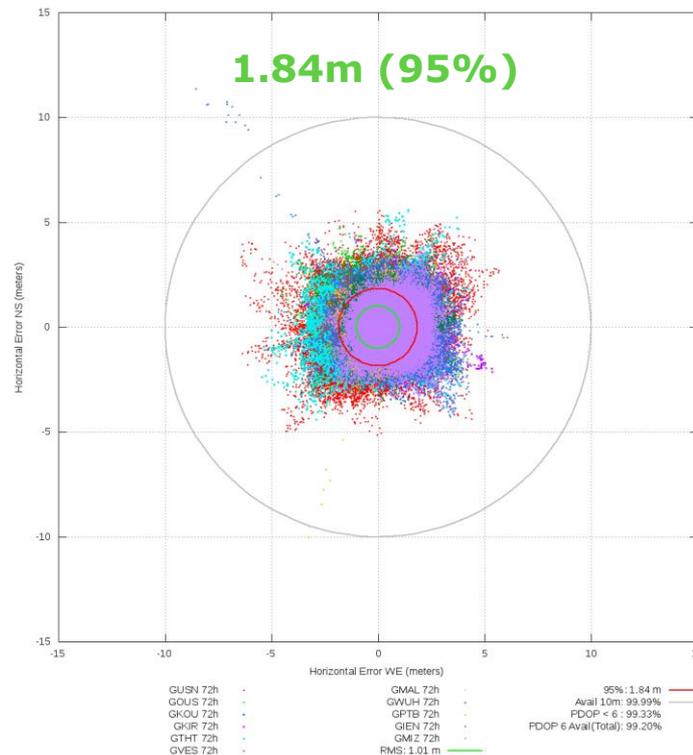
Safety-of-Life (SoL) - contribution

- 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)

GALILEO IMPROVES SEARCH AND RESCUE

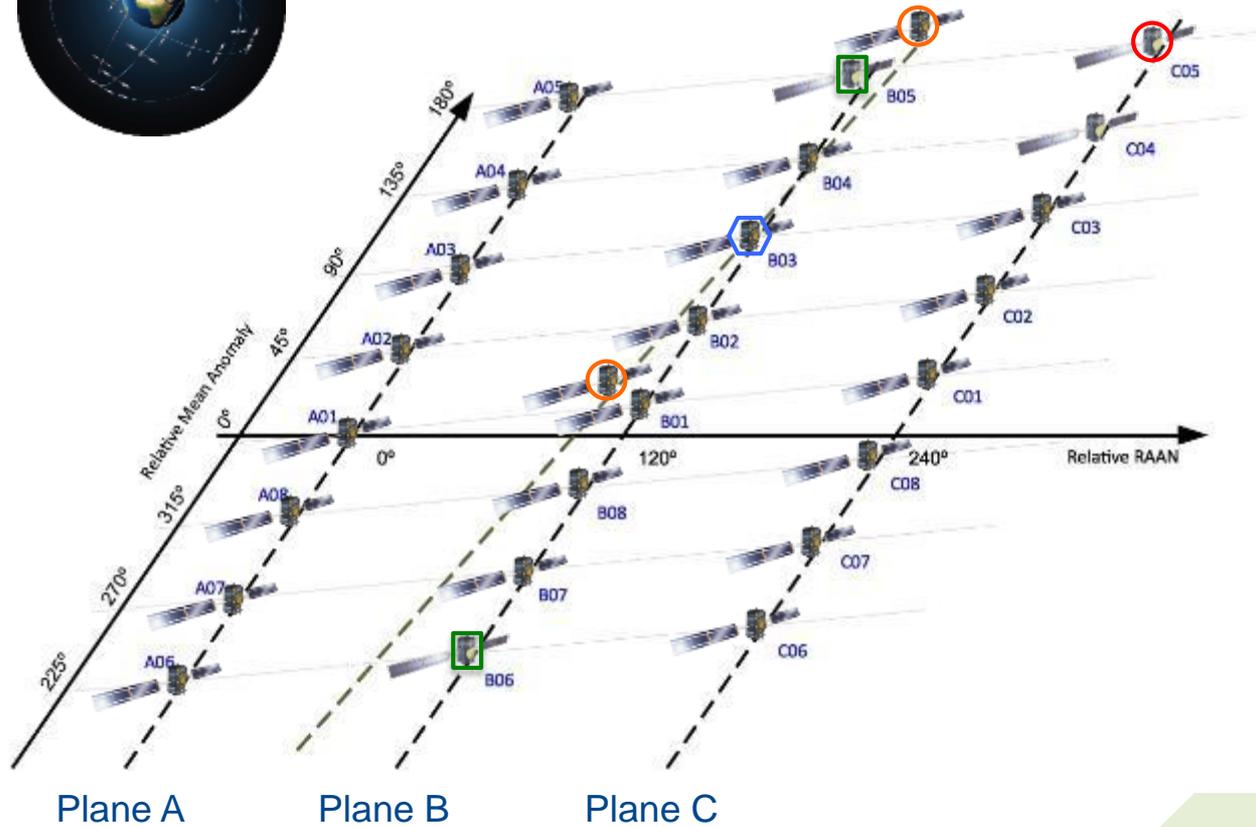


GALILEO INCREASINGLY CRITICAL TO EU POLICIES

- **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)

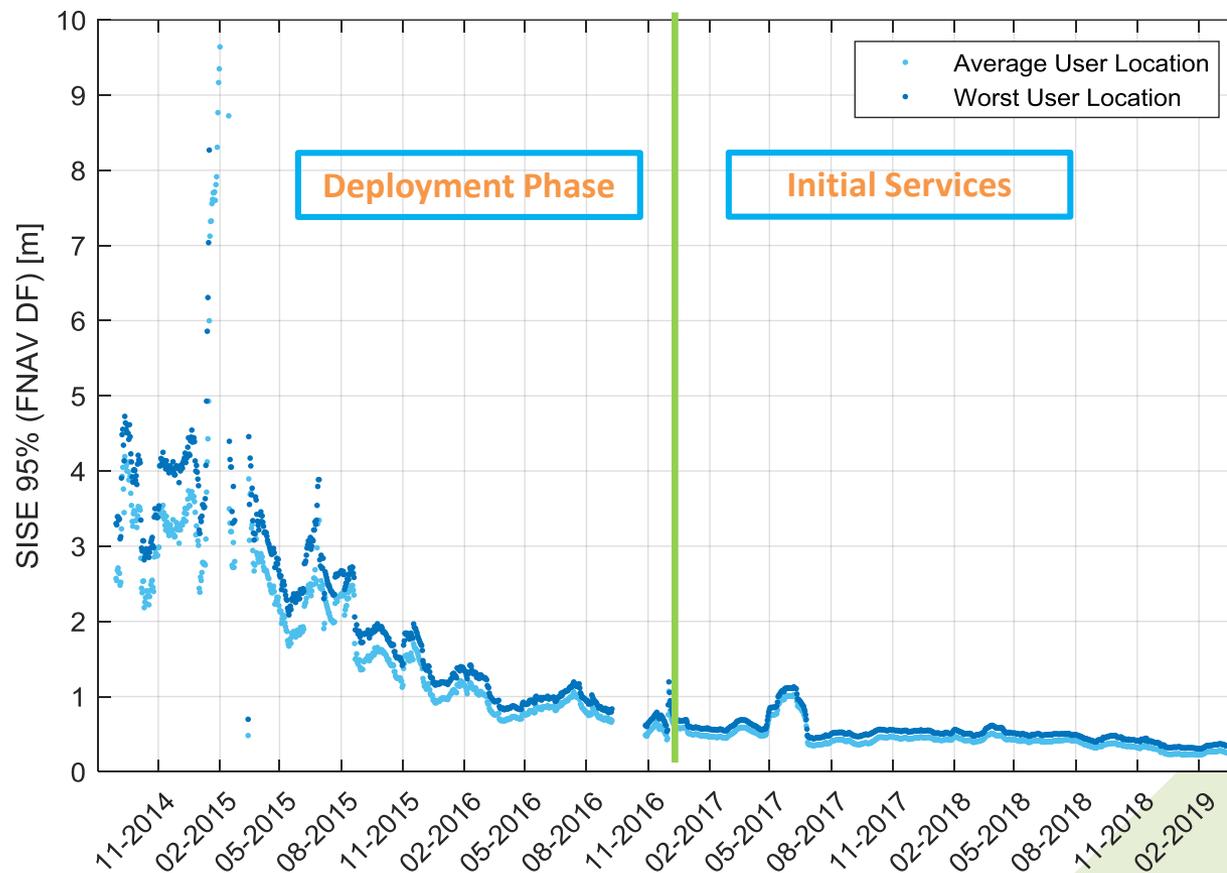
-  2 out of 26 satellites with no SAR Transponder
-  0 under commissioning
-  1 spare

 0 unoccupied reference slots

GALILEO KEEPS IMPROVING

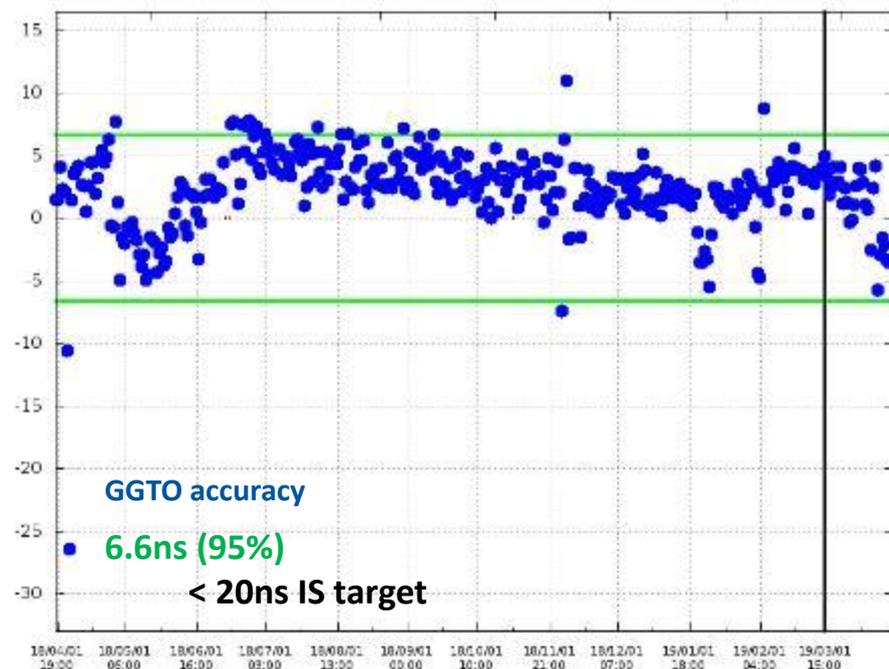
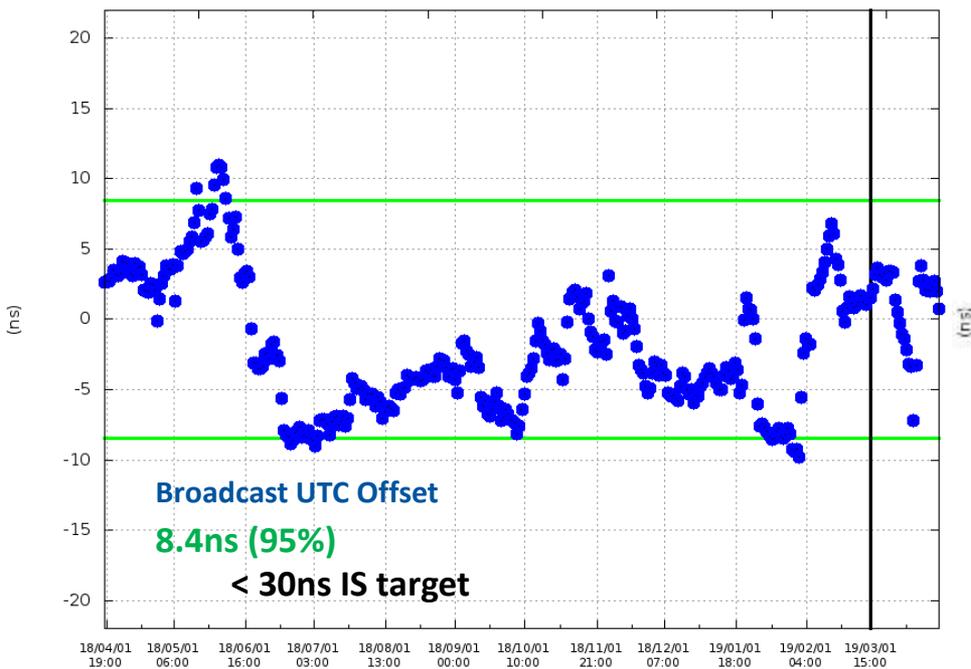
- **Excellent overall performance** driven by the good satellite clock technology and the fast refresh rate of the navigation message through the worldwide uplink stations
- Per satellite availability 99.42%, well above 87% target
- **SISE** has decreased significantly during the last 2 ½ years, to a 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

GALILEO AS-OBSERVED RANGING PERFORMANCE



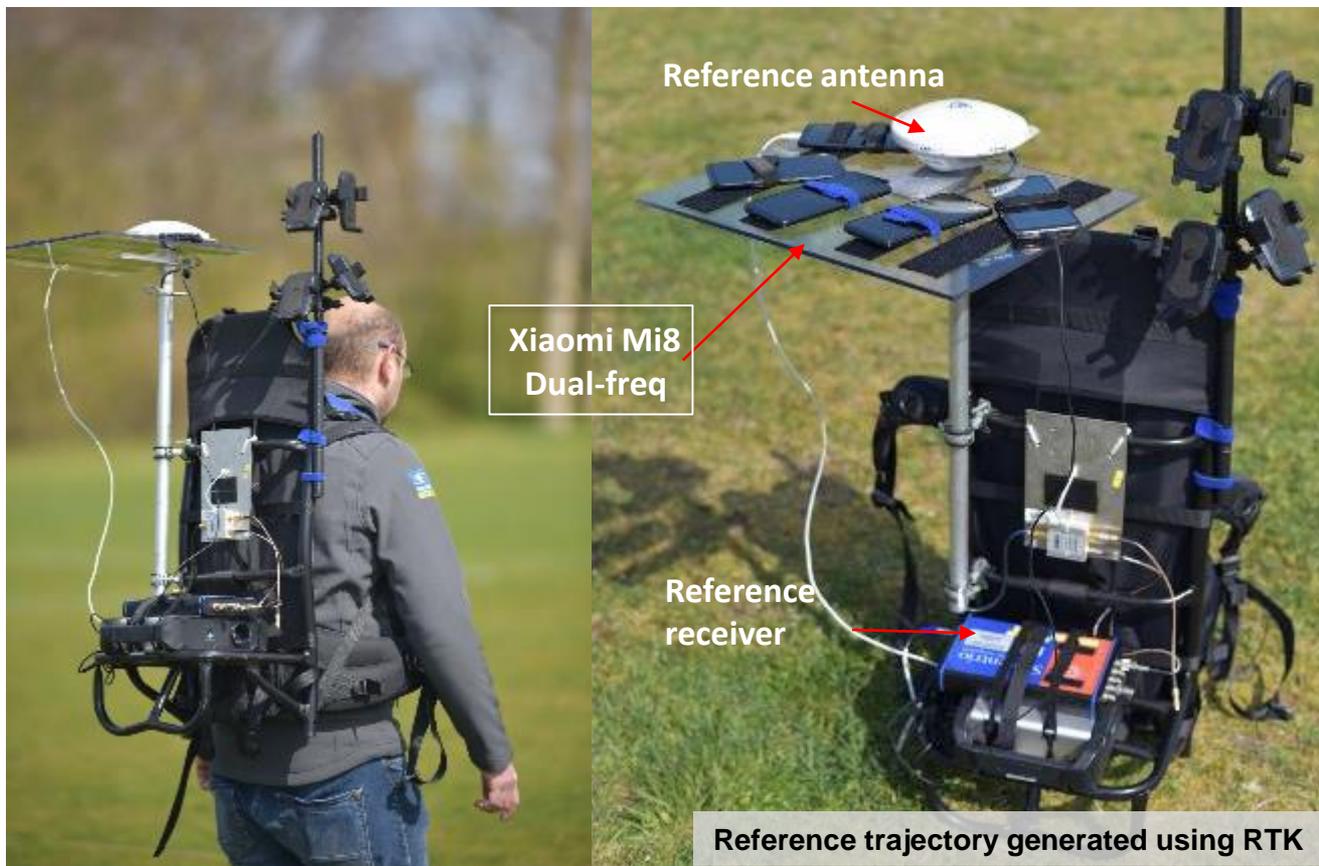
- Decreasing **Ranging Error** trend due to increasing number of satellites and ground segment improvements
- **Ranging accuracy (95%) 0.24m** all satellites in March 2019 (FNAV)

GALILEO TIMING PERFORMANCE



- 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



GALILEO SUB-METRE POSITIONING ACCURACY WITH DUAL FREQUENCY GNSS CHIPSET



GPS+GAL
L1 only

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



GPS+GAL
L1/L5

Pedestrian test @ ESTEC football pitch

THANK YOU

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&

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<http://ec.europa.eu/galileo>