



# EGNOS timing performances

**ICG-12**

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*The views expressed in this presentation are those of the authors and do not necessarily reflect the official position of the GSA/EC*

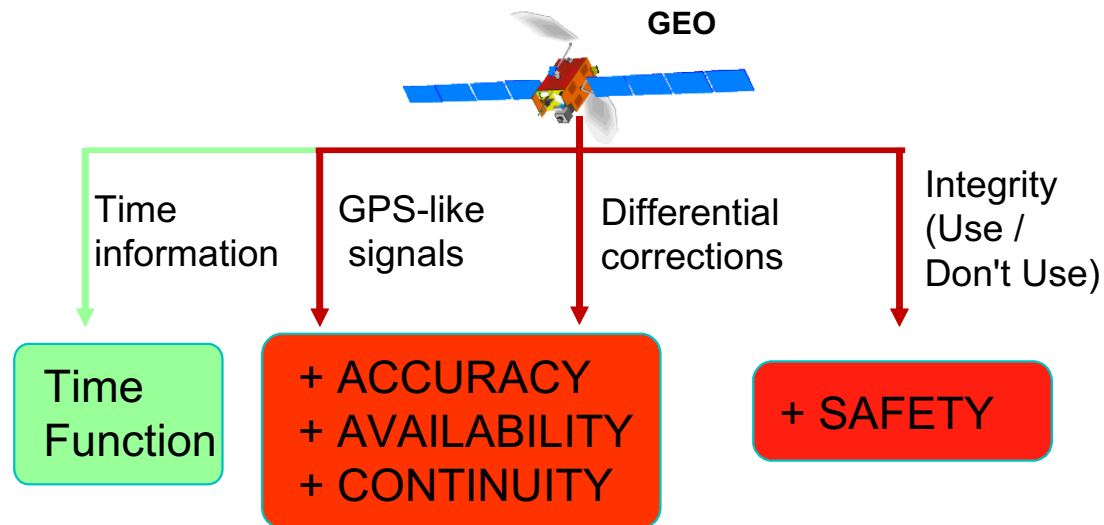
*The GSA is not responsible for any use that may be made of this information*





# EGNOS overview

**EGNOS = European Geostationary Navigation Overlay Service**  
**GPS SBAS over Western Europe**



**EGNOS services currently broadcast by 2 GEO :**  
**PRN 120 and 123 (operational)**  
**+ PRN 136 (back-up)**

**EGNOS Open Service : October 2009**  
**EGNOS Safety-Of-Life service : March 2011**



## EGNOS Network Time (ENT)

EGNOS system time = ENT

ENT is computed from differences between clocks in the EGNOS ground stations (obtained by GPS Common-View)

ENT is steered to GPST

ENT – GPST < 50 ns (5  $\sigma$ )

→ EGNOS System requirement

ENT is described in the ICG WG-D timing template available on the ICG web site

# ENT and UTC

## Link between ENT and UTC in Message Type 12 (MT12)

- Offset between UTC [or one UTC(k)] and SBAS system time
- Max update time : 300 s
- Validity time : 86400 s

UTC identifier	
0	UTC(CRL)
1	UTC(NIST)
2	UTC(USNO)
3	UTC
4	European UTC(k)
5-6	Reserved for future use
7	Not provided



**ENT – UTC accuracy < 20 ns (3 σ)**

→ EGNOS Mission requirement

(see MOPS Annex A)



**ENT – UTC(OP) accuracy < 10 ns (3 σ)**

→ EGNOS System requirement

**UTC – UTC(OP) accuracy**

→ UTC(OP) good performance



## **ENT and UTC(OP)**

### **An EGNOS station at Observatoire de Paris**

- Physically connected to UTC(OP)
- Time delays within this station
  - calibrated in real time through the use of dedicated GPS-like signals
  - transmitted to EGNOS system

**ENT-UTC(OP) comes as output of the composite clock algorithm  
(but UTC(OP) is not used to form ENT)**

**MT12 is uploaded to the EGNOS satellites and broadcast in each EGNOS PRN nav frame**

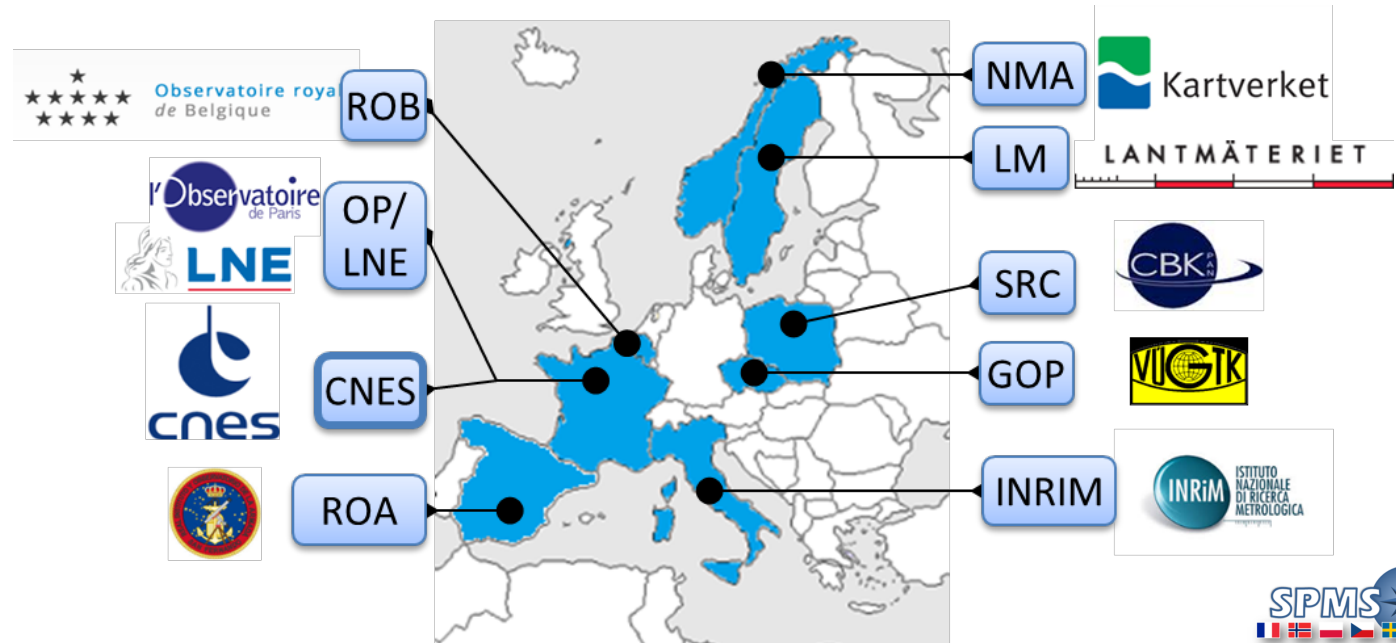
**The EGNOS user shall be aware that applying EGNOS corrections to its GPS measurements will turn its time reference from GPST to ENT and therefore to UTC(OP) if MT12 is used**

# EGNOS Service Performance Monitoring Support to GSA



## Independent consortium

- ❖ 10 public entities
- ❖ CNES coordinator



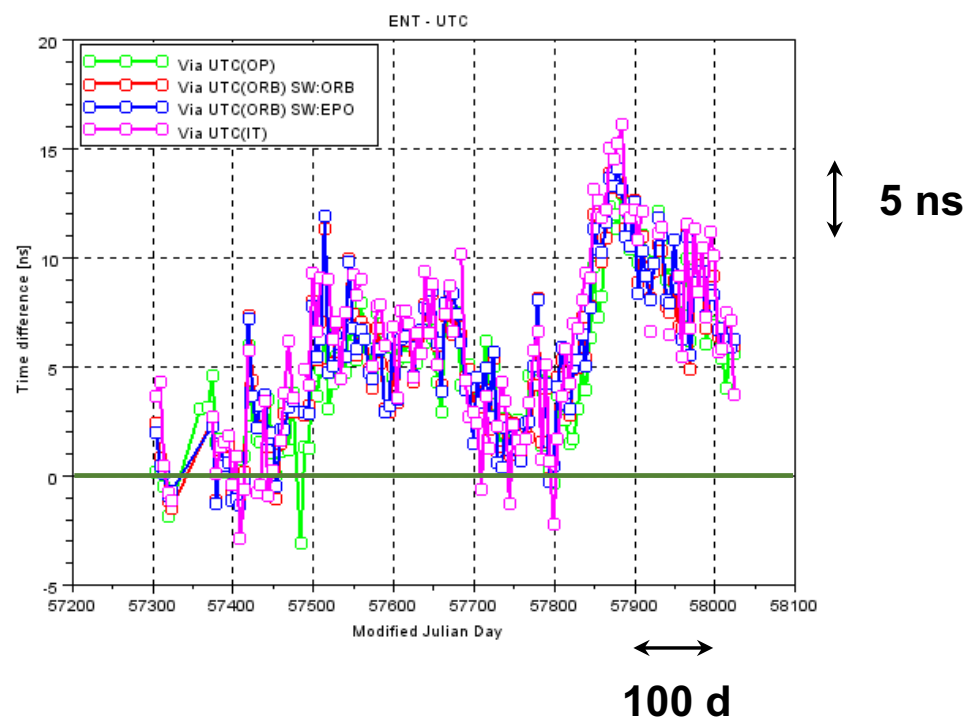
## SPMS: ENT perfo assessment

- ❖ 3 time calibrated GPS receivers referenced to UTC(OP), UTC(ORB), UTC(IT)
- ❖ 2 independent tools from ORB and CNES implementing 2 different methods (ionosphere corrections from EGNOS model or dual-frequency measurements)
- ❖ Use of different time transfer techniques (PPP, TWSTFT) to consolidate the analysis
  
- Good consistency of results from different tools
- Good performance of EGNOS Time



# ENT - UTC

The different methods provide very consistent results



(Oct. 2015 to Sept. 2017)

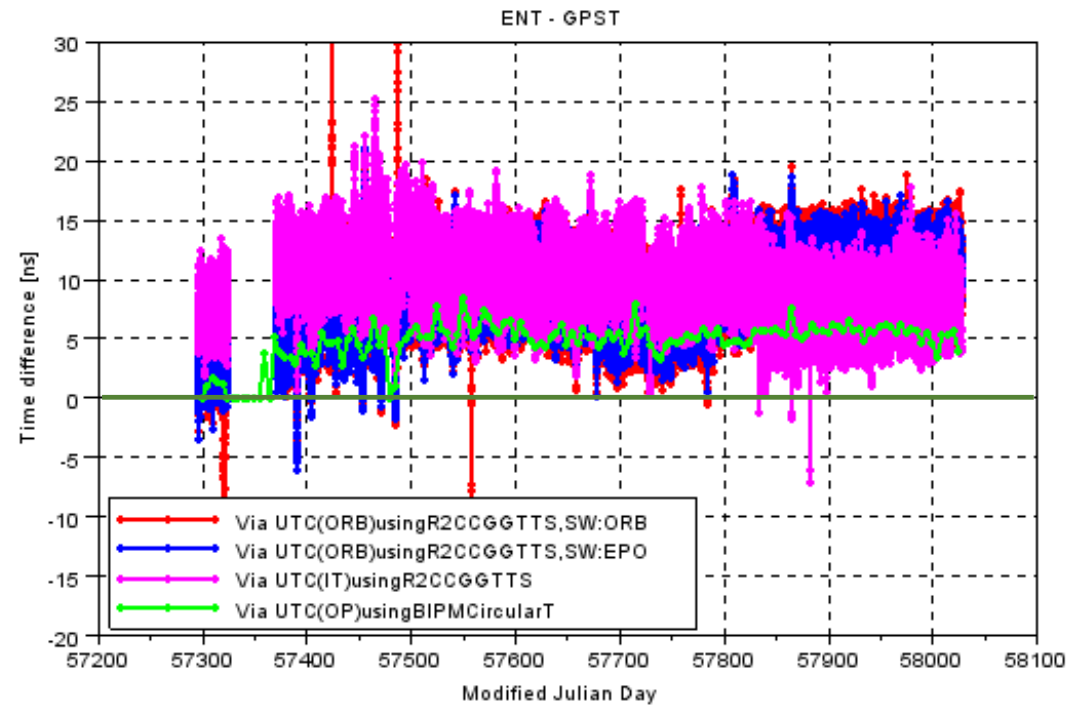


# ENT - GPST

## EGNOS Time offset to GPS Time

Spéc : < 50 ns (5  $\sigma$ )

OK



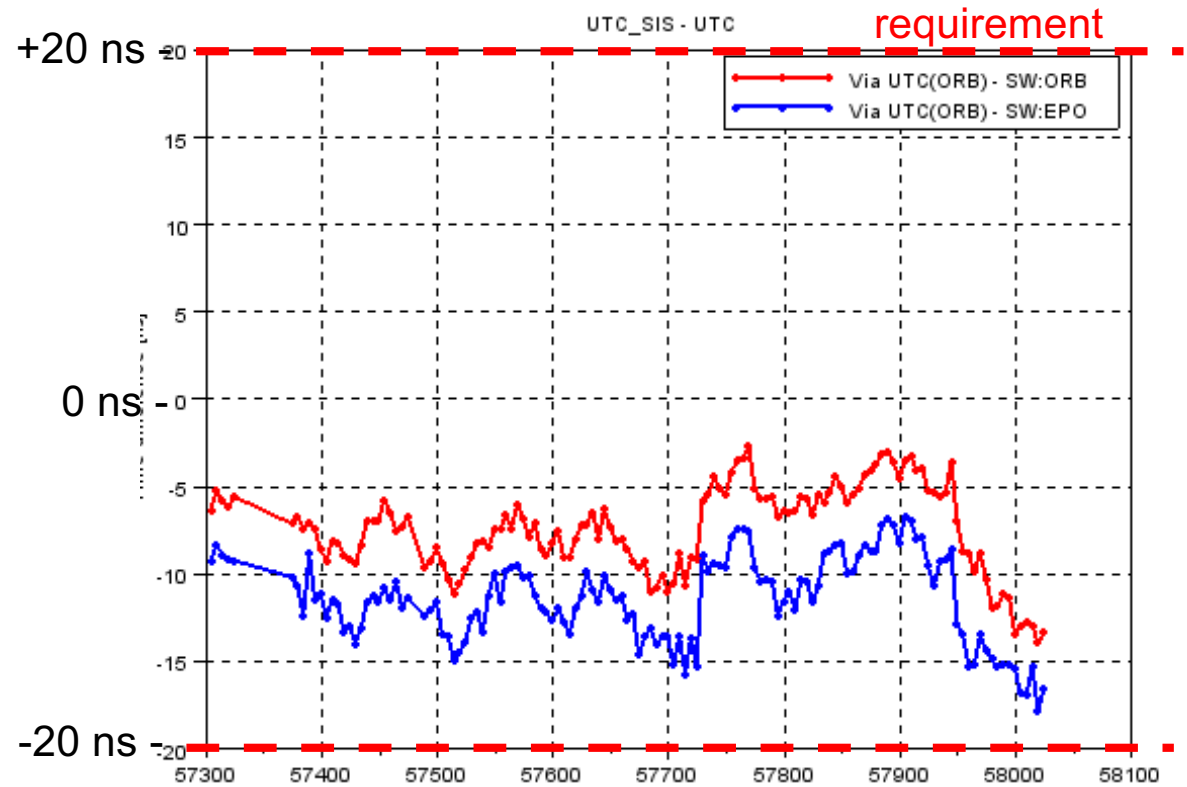
**ENT – GPS Time**  
(Oct. 2015 to Sept. 2017)



# UTC(SiS) - UTC

EGNOS transmits parameters to compute a realization of UTC in the graph "UTC(SiS)"

OK



**PRN120 UTC(SiS) – UTC**  
(Oct.2015 to Jul.2017)

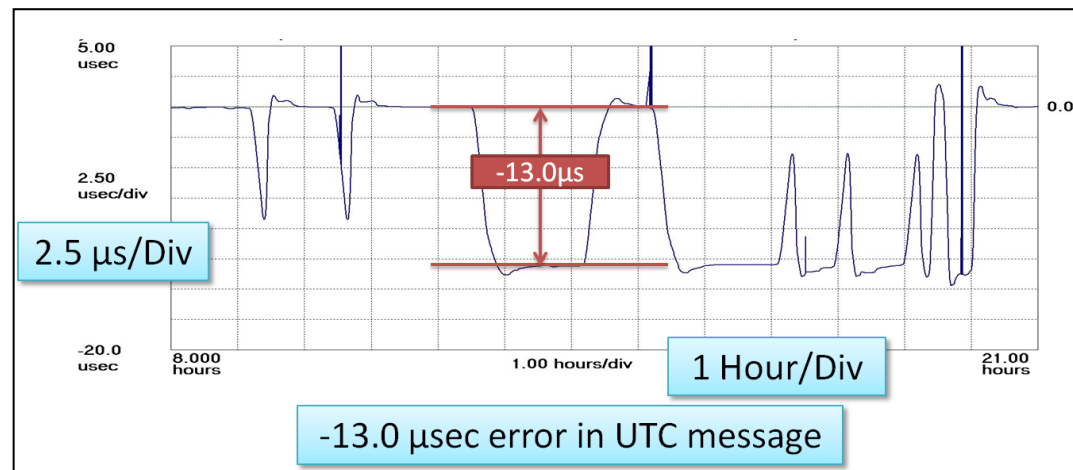


## ENT vs. GPS event

On 26 January 2016,  
**15 GPS satellites broadcast UTC parameters with an error of 13 microseconds.**

UTC realization from  
 a GPS time receiver →

Duration: 13 hours



Source : Prof Charles Curry, BEng, CEng, FIET, FRIN Chronos Technology Ltd

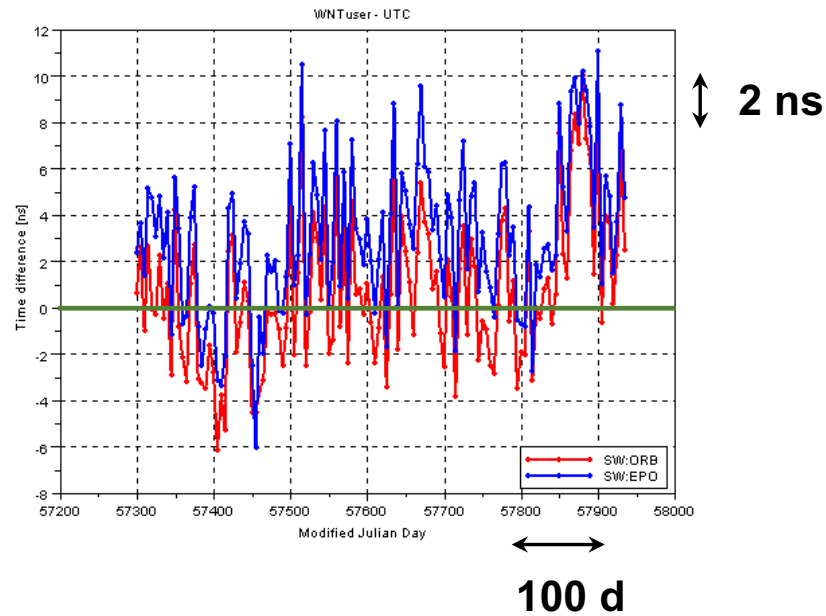
➤ EGNOS Time remained stable and **EGNOS UTC parameters were not affected** ✓

# WAAS Network Time (WNT)

WAAS Network Time is also monitored using IGS station USN7

$$WNT_{user} - UTC = \boxed{WNT_{user} - UTC(USNO)} + \boxed{UTC(USNO) - UTC}$$

Applying WAAS corrections on USN7 Circular T

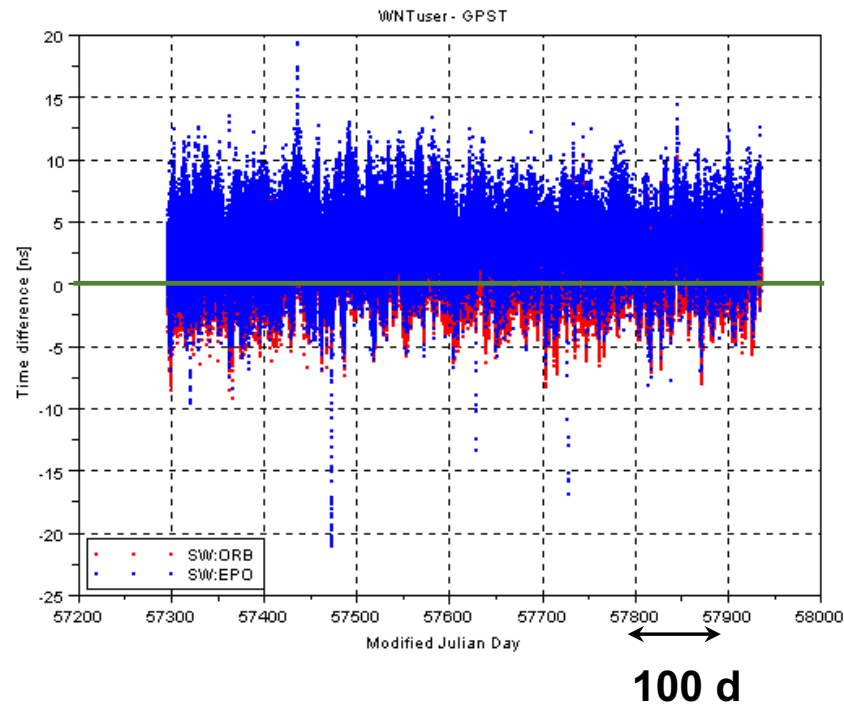


# WAAS Network Time (WNT)

$$WNT_{user} - GPST = WNT_{user} - UTC(USNO) + UTC(USNO) - GPST$$

Applying WAAS corrections on USN7

Using USN7 CGGTTS files



## Acknowledgments

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- **CNES** : Amale Kanj, Norbert Suard, Jérôme Delporte



❖ Thank you for your attention

❖ Questions ?



EGNOS  
Service  
Performance  
Monitoring  
Support

SPMS activities are co-funded by GSA and SPMS consortium partners

