

# European Radio navigation Plan and JRC study on time distribution

Łukasz .K. Bonenberg  
(European Commission JRC)

Metrology for Regulation  
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# EC Joint Research Centre

JRC provides independent, evidence based knowledge and science support to EU policies.





# A-PNT Rationale

The GNSS (Galileo) is the backbone of modern PNT, yet there is a strong rationale for additional A-PNT development:

- The importance of PNT to EU Economy;
- Evolving international context increasing probability of PNT disruptions;
- The economical benefits of development and implementation of A-PNT in EU.

This is also noted by:

- US and UK governmental studies.
- Feedback from EU stakeholders in preparation of 2023 ERNP.
- Public perception of the overreliance on GNSS of today's society.
- *The Economic Impact on the UK of a Disruption to GNSS*, London Economics, 2017
- *GPS Is Easy to Hack, and the U.S. Has No Backup*, Scientific American Dec 2019
- *Satellite-navigation systems such as GPS are at risk of jamming*, Economist May 2021



# A-PNT Aim and Objectives

Call for Tender DEFIS/2020/OP/0007 was open to GPA countries.

The call objective was to assess mature A-PNT technologies and to understand their capacity and limitation.

Technologies were to cover all of EU and were tested over 1, 14 and 100 days of GNSS outage.

Technologies had to main microsecond accuracy to UTC.



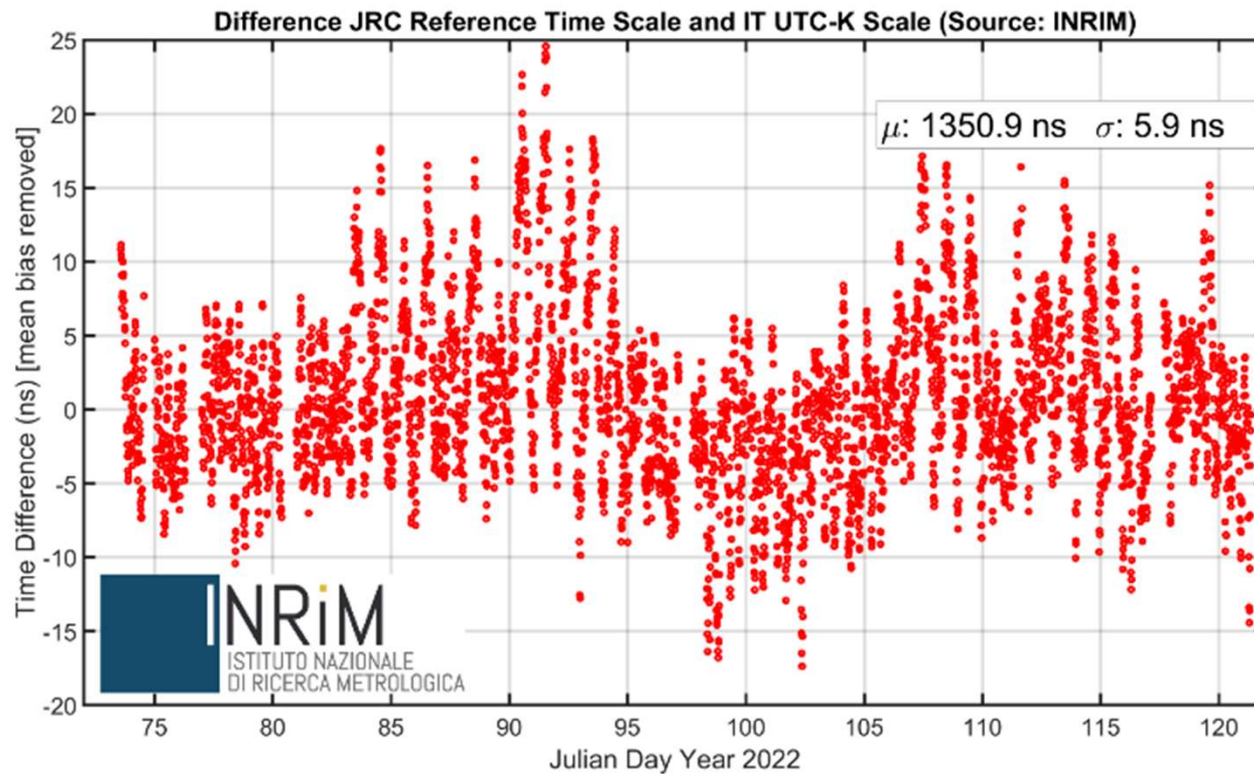
# A-PNT Test Campaign



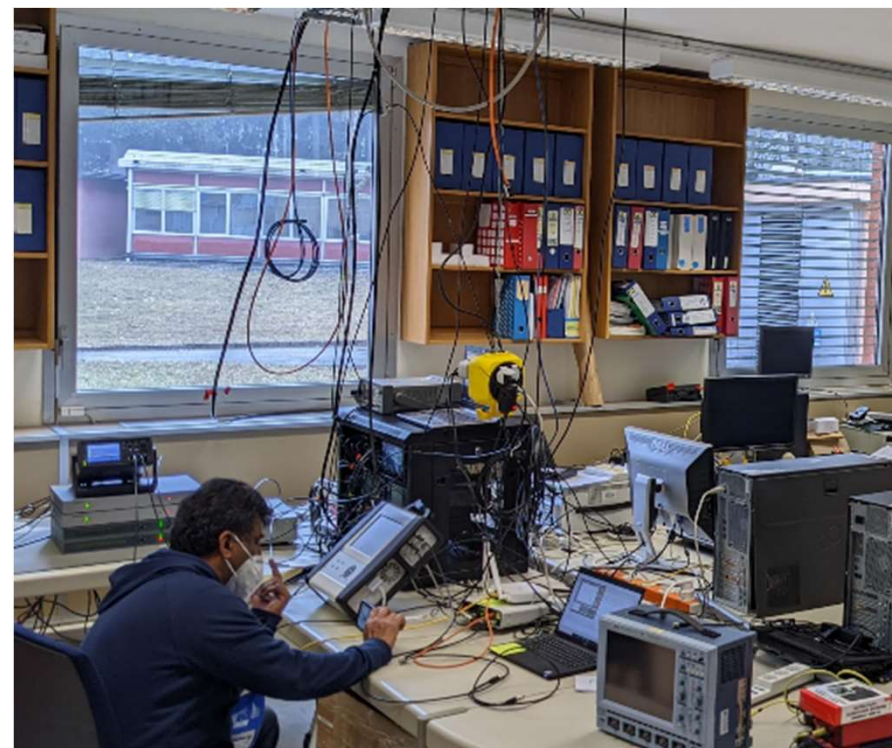
# A-PNT Technologies Tested

Company	Country based	Type of technology	Provision of
<b>OPNT BV</b>	Netherlands	optical wavelength modulation (fibre) and Over-the-Air (OTA)	Time and frequency transfer
<b>7 Solutions SL</b>	Spain	fibre	Time and frequency transfer
<b>SCPTIME</b>	France	electrical current modulation (fix telecom networks)	Certified time transfer
<b>GMV AD SAU</b>	Spain	Fix telecom networks	Time generation and transfer
<b>Satelles Inc</b>	USA	LEO, OTA	PNT
<b>Locata Corporation Pty Ltd</b>	Australia	<u>Pseudolite</u> , OTA	PNT
<b>NextNav LLC</b>	USA	<u>Pseudolite</u> , OTA	PNT

# JRC Time Reference Traceability to UTC(IT)

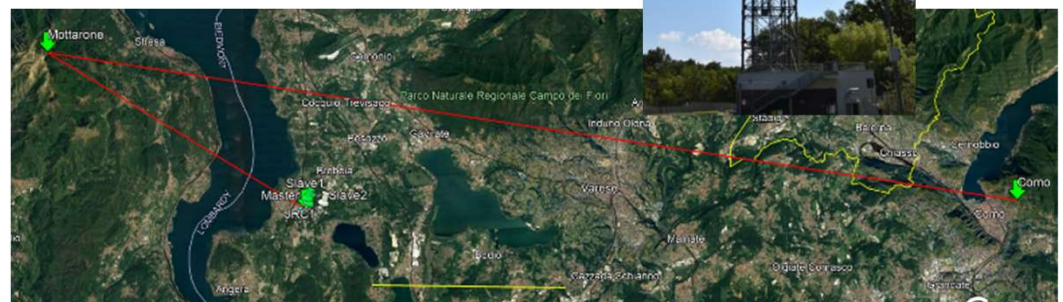
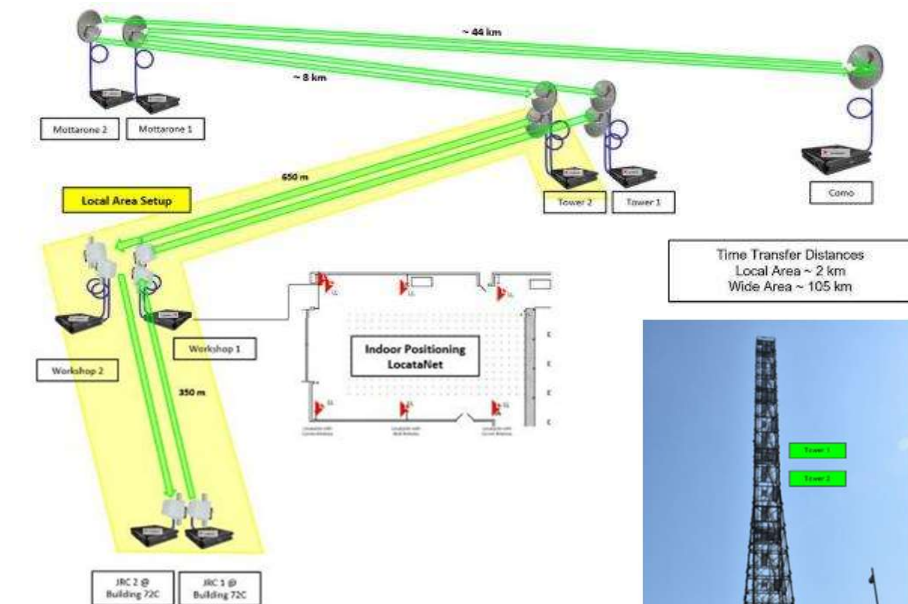


# A-PNT Time Transfer Testing

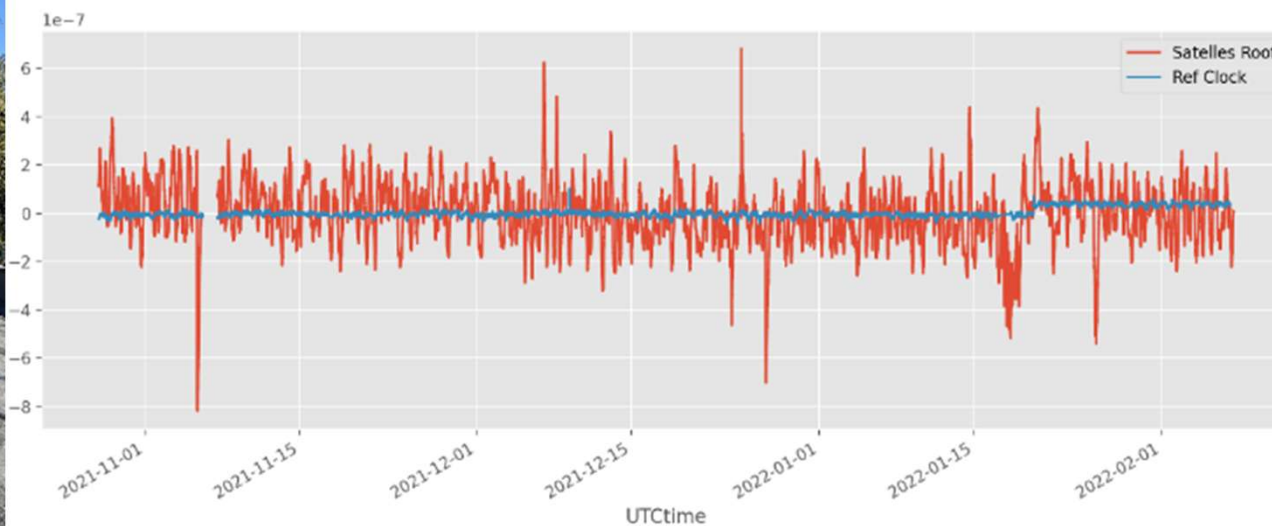




# A-PNT Radio Beacons (pseudolites) deployment

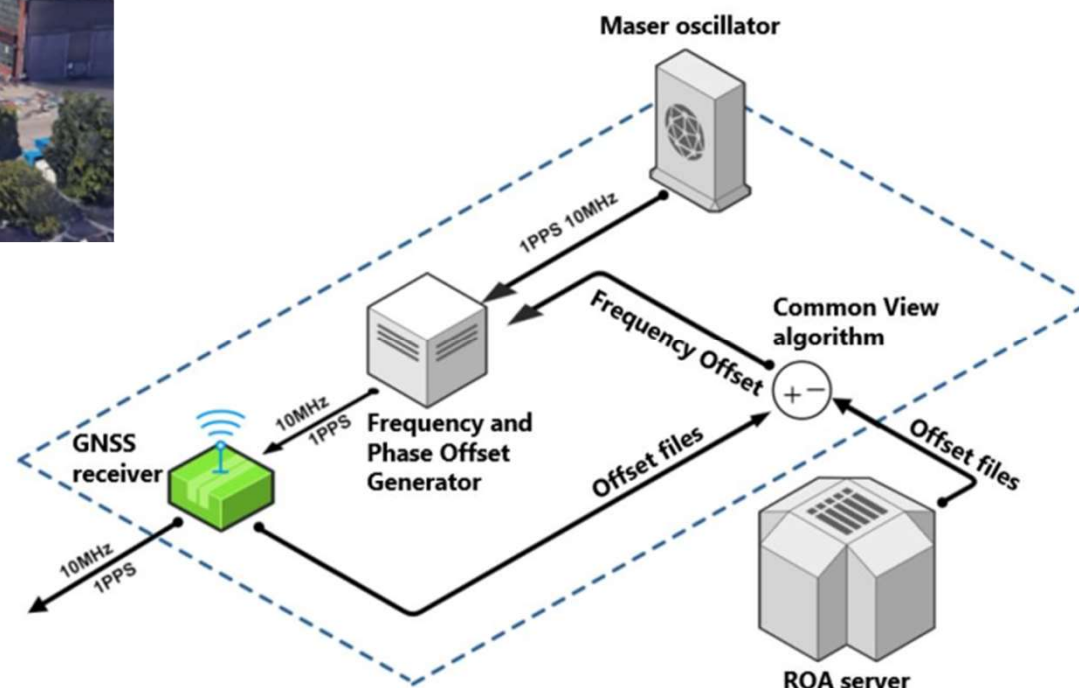


# A-PNT LEO Indoor and Outdoor Testing





# A-PNT testing outside of JRC

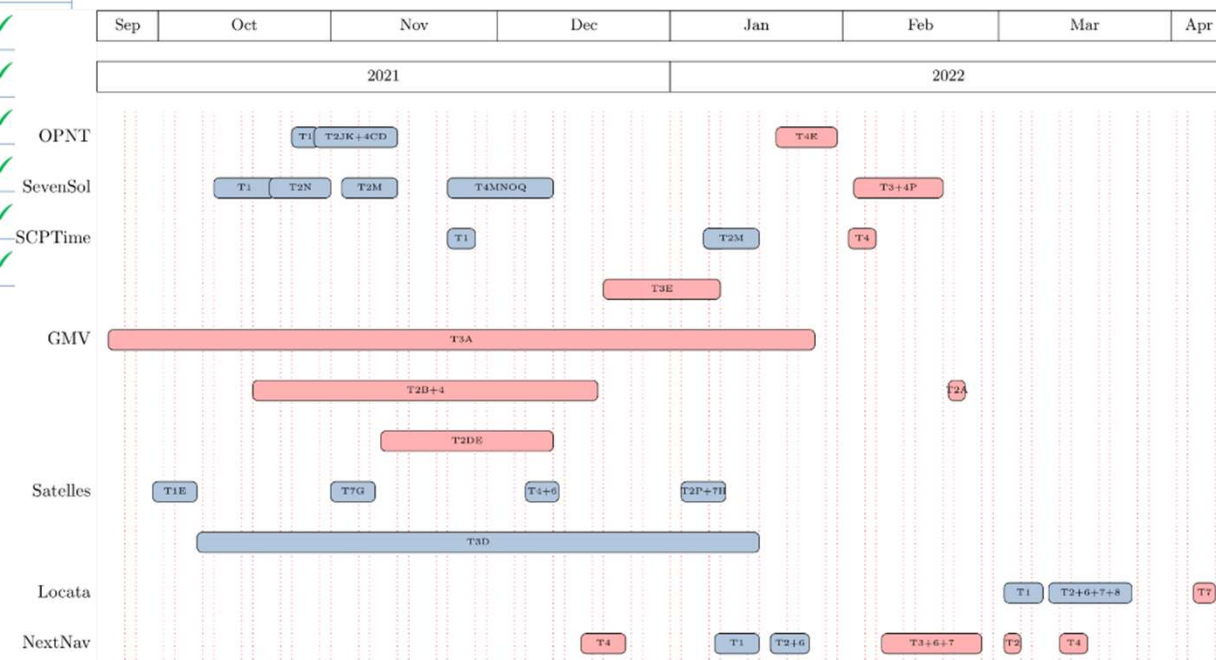


# A-PNT Test Campaign



	Time Generation	Holdover	Time Transfer Fibre	Time Transfer Networks	Time Transfer OTA Outdoor	Time Transfer OTA Indoor	Resilience
OPNT	(*)	(*)	✓		✓		✓
7 Solutions SL	✓	✓	✓				✓
SCPTIME	✓	✓		✓			✓
GMV	✓	✓	✓	✓			✓
Satelles Inc	✓	✓			✓	✓	✓
Locata	(*)	✓	✓	✓	✓	✓	✓
NextNav LLC	✓	✓			(*)	✓	✓

	Static outdoor	Static indoor	Kinematic Outdoor	Kinematic Indoor
Satelles Inc	✓	✓	✓	
Locata	✓	✓	✓	✓
NextNav LLC	✓	✓	✓	✓





# Results and Conclusions



## Results of the **A-PNT** Test Campaign

Timing Performance	Time Generation [days]	MTIE [ns]	Time Transfer Fibre [ns]	Time Transfer Networks [ns]	Time Transfer OTA Outdoors [ns]	Time Transfer OTA Indoors [ns]
OPNT BV	N.A.	N.A.	0.057	N.A.	< 200 ( $\pm 100$ )	N.A.
7 Solutions SL	80	280	0.089	N.A.	N.A.	N.A.
SCPTIME	1	< 1000	N.A.	35	N.A.	N.A.
GMV AD SAU	100	57	1	500	N.A.	N.A.
Satelles Inc	110	364	N.A.	N.A.	145	< 340
Locata Corp	1	< 1000	0.4 (4.9)	0.4 (6.1)	0.7 (6.1)	0.2 (5.2)
NextNav LLC	11.6	40	N.A.	N.A.	N.A.	< 39

*Summary of the time performance at 99.7 percentile*

Given the Test Campaign objective, presented results should not be treated as a **qualitative assessment** of the tested technologies.







# Towards the optimal EU implementation

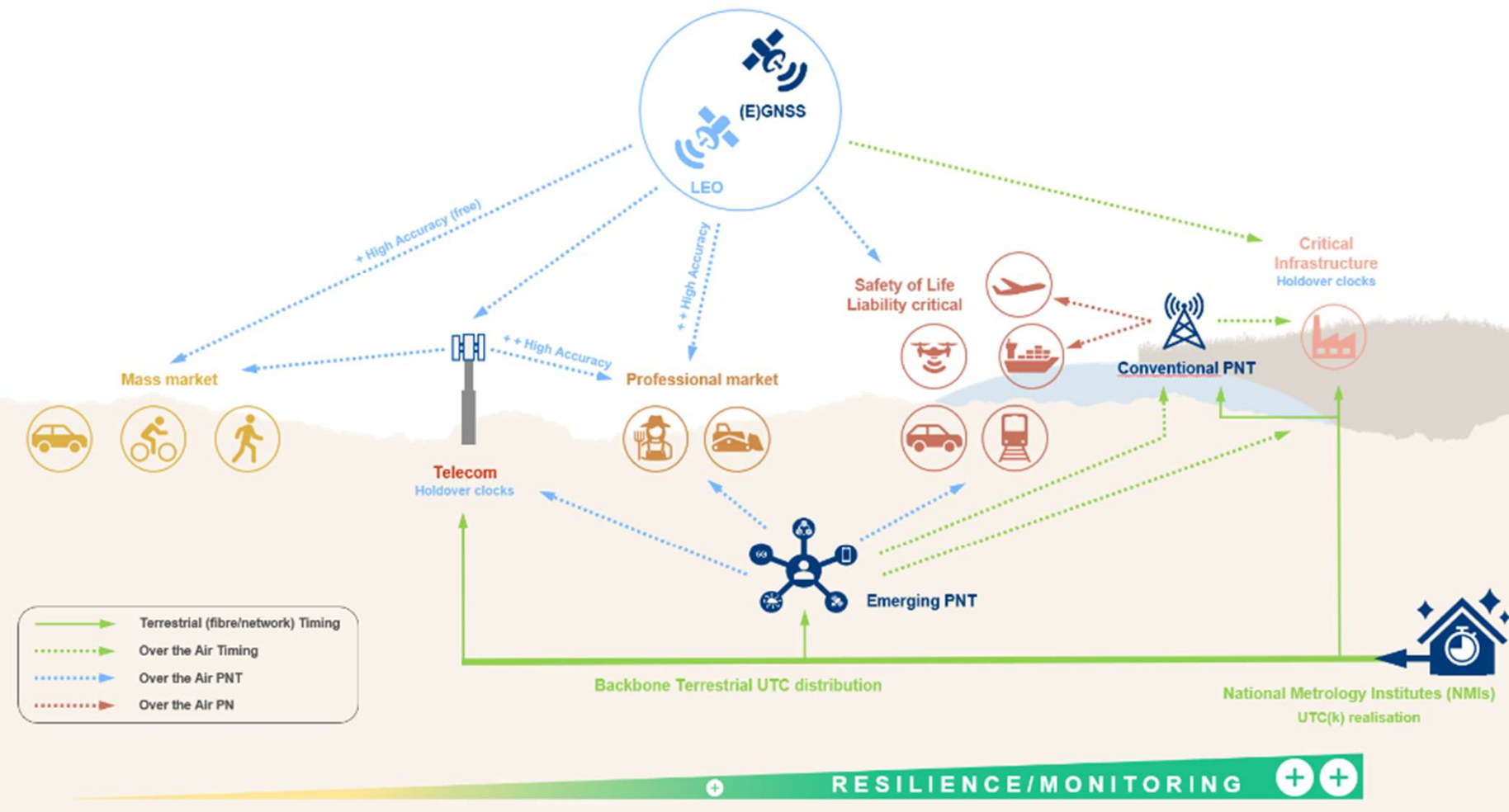
- "Entities are not to be multiplied beyond necessity." Occam's Razor

→ **IDEAL SOLUTION** ←

- “(...)there is always a well-known solution to every human problem — neat, plausible, and wrong.” H.L. Mencken



# Towards the **EU PNT** vision







## Suggested Next Step

EC working on multiple solutions to enhance the resilience of EU PNT:

- evolution of Galileo and EGNOS, and design of IRIS2;
- regulations (CER, NIS2) for critical infrastructure and cybersecurity;
- education and awareness (ERNP).

Additionally A-PNT report suggest following steps:

- Interconnecting European NMIs, with possible local atomic clocks backups;
- EU PNT system of system approach supported by the industry standards to ensure (as a minimum) interoperability to UTC and ETRF.
- Investigate feasibility of the dedicated EU terrestrial PNT spectrum band.

*An A-PNT Technical Report and ERNP draft is available at*

*[https://joint-research-centre.ec.europa.eu/scientific-activities-z/alternative-pnt\\_en](https://joint-research-centre.ec.europa.eu/scientific-activities-z/alternative-pnt_en)*

