ETSI Conference on
Non-Terrestrial Networks,
A Native Component of 6G

# Synergies between disruptive satellite navigation systems in LEO orbit and 5G NTN

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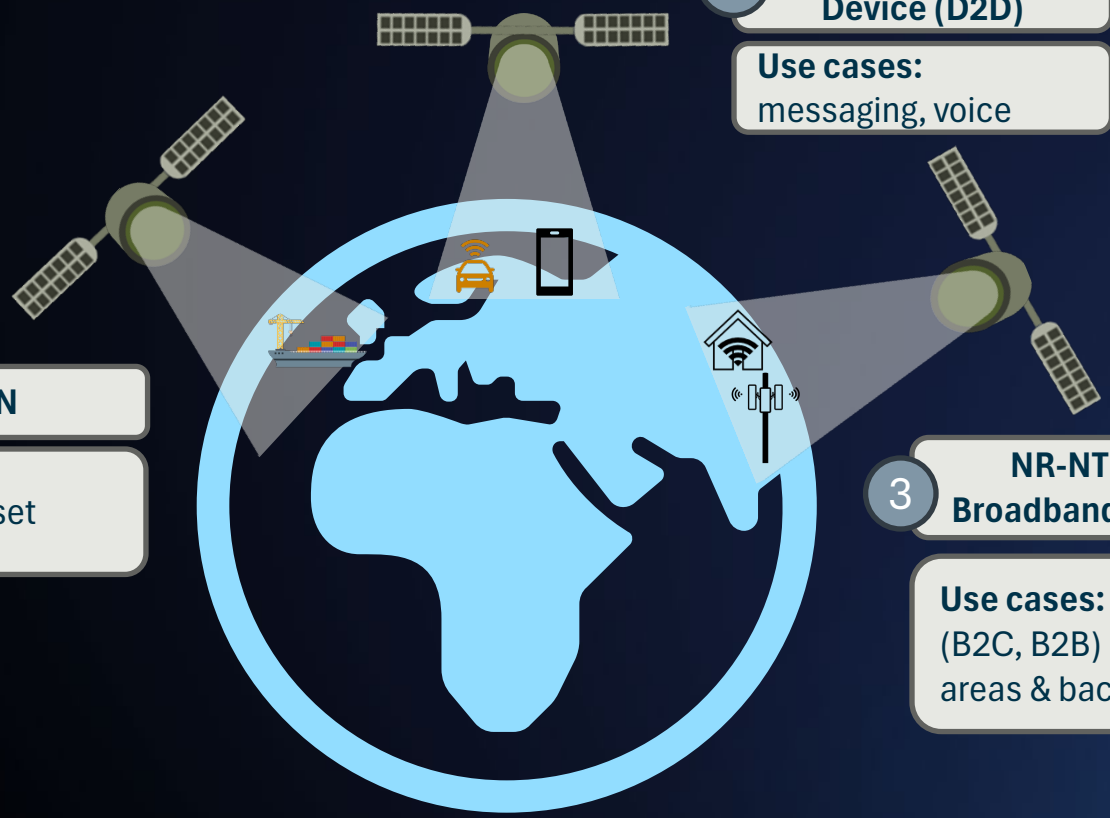
# 01 5G NR and IoT-NTN (Rel-18)

## Services Approach



**1 IoT-NTN**

**Use cases:** sensoring, asset tracking

**2 NR-NTN: Direct To Device (D2D)**

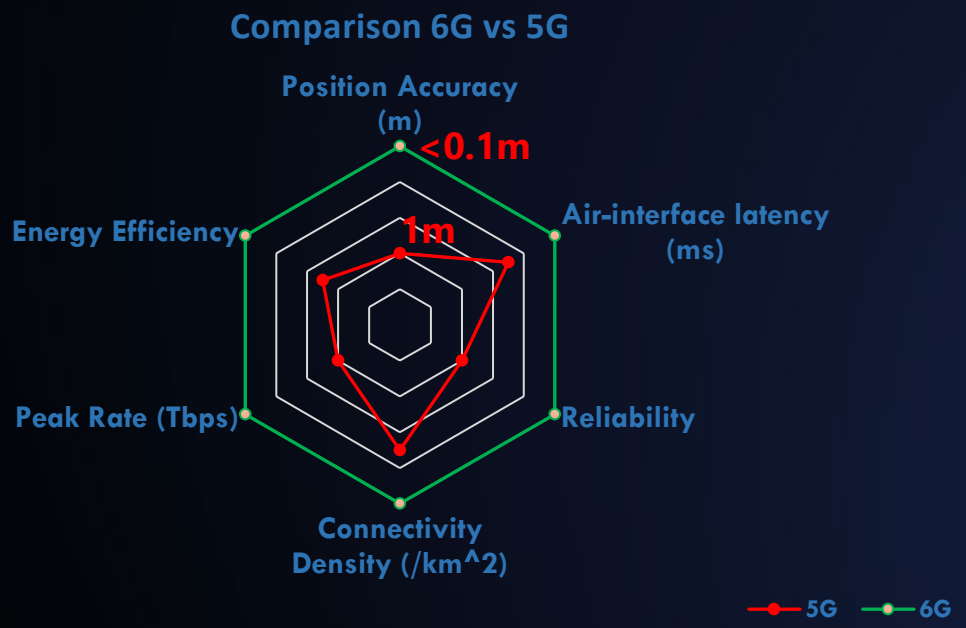
**Use cases:** messaging, voice

**3 NR-NTN: Home Broadband & Backhaul**

**Use cases:** Broadband (B2C, B2B) in remote areas & backhaul

**Several existing use cases (SOS and emergency messaging, asset tracking, etc.) and emerging use cases (see next slide) for 6G would require accurate and robust localization!**

# 01 KPIs and Use Cases for 6G
## Services Approach




*Jiang, Wei et al. "The Road Towards 6G: A Comprehensive Survey." IEEE Open Journal of the Communications Society 2 (2021): 334-366.*

Potential new service levels to be introduced in 6G: <10cm, 1cm

5G service levels from TS 22.261

| | | Horizontal Accuracy |
|---|---|---|
| 1 | Remote Healthcare using AR | < 1 mm |
| 2 | Health monitoring | < 1 mm |
| 14 | Autonomous Driving | N/A |
| 5 | Digital Twins for Manufacturing | < 1 cm |
| 25 | Automatic public security | 1 cm |
| 13 | Sensory Interconnection | cm-level |
| 27 | Innovative Agriculture | cm-level |
| 17 | Accurate positioning to support Unmanned Aerial Vehicle (UAV) missions and operations | 10 cm |
| 18 | Transport and inspection by drones for medical purposes | 50 cm |
| 8 | Tool assignment in flexible, modular assembly area in smart factories | < 0.3 m |
| 16 | Accurate positioning for shared bikes | = 0.2 m |
| 7 | Tool tracking in flexible, modular assembly areas in smart factories | < 1 m |
| 9 | Palette tracking | ≤ 1 m |
| 10 | AR in Industrial Training | ≤ 1 m |
| 15 | Traffic Control and navigation | 1 m |
| 19 | Asset and freight tracking (wagon, container) | 1 m |
| 20 | AR for Education | 1 – 3 m |
| 24 | AR for Gaming | 1 – 3 m |
| 3 | Person and medical equipment monitoring in hospitals | < 3 m |
| 12 | Target Advertising | < 3 m |
| 6 | Asset Tracking in Vertical Domains | 2 – 3 m |
| 21 | Lab equipment tracking | < 3 m |
| 22 | Waste management and collectors | < 3 m |
| 11 | Position-based Handovers | 1 – 5 m |
| 26 | Cloud-based XR computing | 1 – 5 m |
| 4 | Patient monitoring outside hospitals | < 10 m |
| 23 | Earth monitoring | 1 – 30 m |

**Study localization use cases and derive associated position accuracy targets during 6G Study Item in SA1 (09/2024).**

From NAVISP-EL1-063: PRISM study, ESA contract number: 4000141800

# 02 Perspectives for NTN-based Positioning, Navigation, and Timing (PNT): a new capability for 6G era

## Keystone

01

**Network-verified location**

For correct Core Network selection, Regulatory aspects (Emergency Services, Lawful interception, Public Warning), 10km target

**NTN-PNT for 6G**

## Drivers

02

**Reduce dependency on GNSS**

GNSS is needed at UE for initial access: time and frequency synchronization

03

**Emerging use cases and demanding requirements**

Use cases to be served by 6G

04

**Augment GNSS & 5G TN**

For better user experience

# 02 Perspectives for NTN-based PNT – a new capability for 6G era

Items

**In Release 20 (RAN1/2/3), 3GPP could study the technical feasibility of implementing localization services over NTN starting from the NTN network verified location baseline.**

**Scenarios to study:**

- From 1 SV (currently considered in NTN) to multi-SV approach, alongside the incorporation of GNSS and LEO SV
- Initial study from FR1

**Reference signals and measurements:**

- Adaptations to PRS/SRS
- Possibly new signals & solutions
- Time-based, etc.

**Positioning architecture and protocols:**

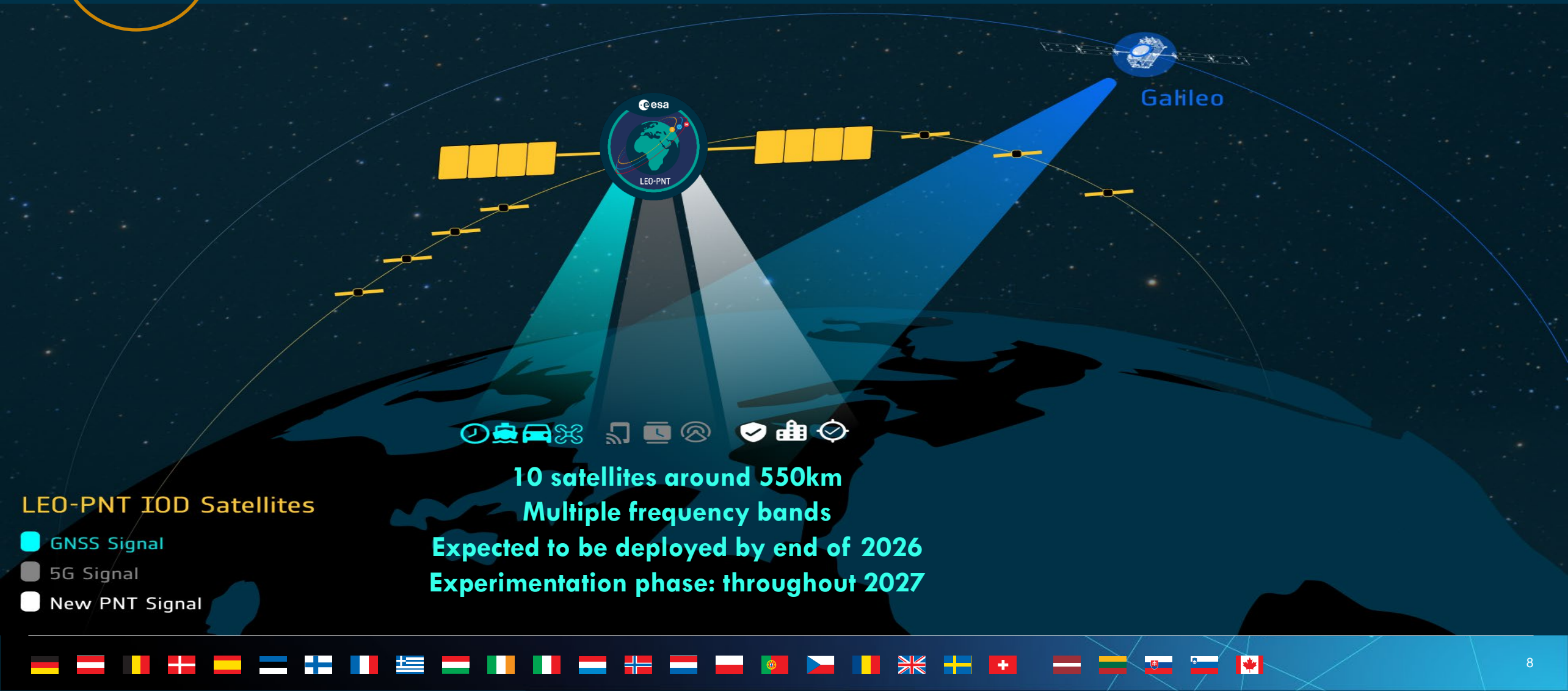
- Leverage positioning framework will be studied by 3GPP for 6G, it should account for NTN in addition to TN and RAT-independent
- Study low energy localization solutions (signals, protocols, etc.) for IOT NTN
- Address security and privacy issues related to NTN – based localization

**Error sources:**

- The approach currently used to disseminate NTN ephemeris, i.e. SIB19, is not very accurate – errors of hundreds of m to few km in the position of satellites due to LTE model.
- Atmospheric disturbances (e.g., troposphere, iono) will impact the ranging performance

# 03 ESA's LEO-PNT In Orbit Demonstration

## A first real-life experiment of NTN – based localization



# 04 Synergies between NTN and LEO-PNT systems

## COM2NAV

The UE can process communication signals to (1) estimate location information according to positioning methods specified by 3GPP and using NTN satcom signals and (2) retrieve assistance data for high accuracy e.g., GNSS corrections, etc.


NTN

## NAV2COM

Considering GNSS and LEO-PNT functions, the UE can exploit positioning, ranging, and time synchronization to improve data acquisition task by channel estmation, beam alignment (RRM), Medium Access Control, etc.

# Thank you for your attention

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