Deutsche Telekom
Fraunhofer IIS
Toyota ITC
DOCOMO
Thales
BT

Motivation for New SID – High accuracy positioning of NR

20/02/2017

ESA UNCLASSIFIED - For Official Use

General Motivation

SA1 documents identifies accuracy targets and requirements for multiple use cases

- Regulatory requirements : 50m Horizontal accuracy
- Multiple High accuracy use cases with targets below 1-3m Horizontal accuracy - typically, autonomous vehicles

There is a growing demand from industry verticals to use high accuracy positioning technologies and operators aim to provide this with 5G

TS 38.913 defines requirements for 5G positioning – qualitative only

- Recognizes hybrid positioning : RAT-dependent, RAT-independent
- But beside regulatory requirements : undefined quantitative requirements, on a "best-effort, per use-case" basis

It is important to clarify contribution among technologies and **consolidate NR requirements, with associated standardization needs and operational and complexity aspects**

- Understand apportionment among positioning technologies (RAT-dependent and RAT-independent)
- Provide relevant inputs to NR positioning requirements
    - Enabling development of service opportunities relying on hybrid technologies
    - Accounting for realistic technological and network operation constraints and costs

Preliminary Techno mapping exercise (1/2)

Scope

- Considered positioning technologies : typical RAN-dependent and RAN-independent
- User environments representative of 5G : rural → urban → deep indoor
- Mapping to use-cases' Horizontal Accuracy targets

Environment Scenario	Open rural	Sub-urban	Urban	Light Indoor	Deep indoor
Multi GNSS Including High Accuracy positioning (PPP or RTK)	< 1 – 2 m (99.5%) High accuracy: < 0.3m (95%)	1 – 2 m (90 %) High accuracy < 0.3m (Partial availability > 70% TBC)	2 – 4 m (80%) High accuracy < 0.3m (Partial availability => 50% TBC)	50 m (TBC) High accuracy: N/A	N/A High accuracy: N/A
5G Network-based	4G: >30 m (90%) , both figures are location dependent	4G: >30 m (90%), both figures are location dependent	NR: 1 – 3 m (80%) (TBC)	NR: 1 m (80%) (TBC)	NR: 1 m (80%) TBC
Terrestrial Beacon Systems	20 – 50 m (location dependent)	20 – 50 m (TBC, location dependent)	50 m (TBC, location dependent)	50 – 100 m (TBC, location dependent)	TBD
UE External Sensors	Depends on device cost and calibration interval (for example, by above technologies) – typical values: [1 m -> 100 m] – full availability				

Preliminary Techno mapping exercise (2/2)

Mapping to regulatory requirements (50m Horizontal Accuracy)

- By 2020 : most RAT-dependent and RAT-independent technologies should be able to meet the target as standalone technologies – either outdoor or indoor
- Some level of hybridization of existing technologies (TBS, WLAN, 4G) might be needed to provide indoor/outdoor seamless positioning within the 50m target.

Coarse accuracy use cases (in particular, regulatory requirements) do not seem to carry opportunities and drivers for NR positioning

Mapping to high accuracy positioning (<1-3m Horizontal Accuracy)

- None of the existing terrestrial technologies seems able to satisfy alone high accuracy services
- NR could be the primary source of high accuracy indoor
- GNSS is the primary source of high accuracy in rural and sub-urban outdoor environments
- UE external sensors are mandatory to fill availability gaps of GNSS and NR in urban areas

Assuming NR achieves meter-level accuracy, GNSS and UE sensors are a must to the widespread provision of High Accuracy service

There is a clear opportunity for NR to efficiently support high accuracy use cases along with other positioning technologies

Objectives of the SI: High Accuracy positioning of NR

The objectives of this SI are to

- Understand the contribution of each technology to **High Accuracy positioning use cases** in 5G, and derive the performance apportionment among technologies (RAT-dependent and RAT-independent)
- Identify potential impacts on NR standard to **support High Accuracy use cases** (requirements would be addressed in subsequent WI): RAN-embedded technologies, necessary signaling and network synchronization assumptions, etc.

Foreseen approach

- Analysis and consolidation of inputs to RAN for **High Accuracy use cases with NR and hybrid technologies**
    - Hybrid solutions for positioning and synchronization
    - Subsequent targets for the RAN to support positioning as envisaged
- Performances assessment metrics, methodologies and assumptions, both stand-alone and hybrid
- Performance analysis related to positioning: Both stand-alone and hybrid positioning techniques
    - RAT-dependent (NR) and RAT-independent
    - Mapping to Use Cases and performance apportionment between technologies
- Propagate the conclusions of performances analysis to interested parties, including potential impacts on future NR requirements (typically: RAN1, RAN2, RAN3 and RAN4)

Thank you

Back-up slides : Background on the European Space Agency

THE EUROPEAN SPACE AGENCY

UNITED SPACE IN EUROPE

January 2017

ESA facts and figures

- Over 50 years of experience
- 22 Member States
- Eight sites/facilities in Europe, about 2300 staff
- 5.75 billion Euro budget (2017)
- Over 80 satellites designed, tested and operated in flight

Purpose of ESA

"To provide for and promote, for exclusively peaceful purposes, cooperation among European states in **space research** and **technology** and their **space applications.**"

Article 2 of ESA Convention

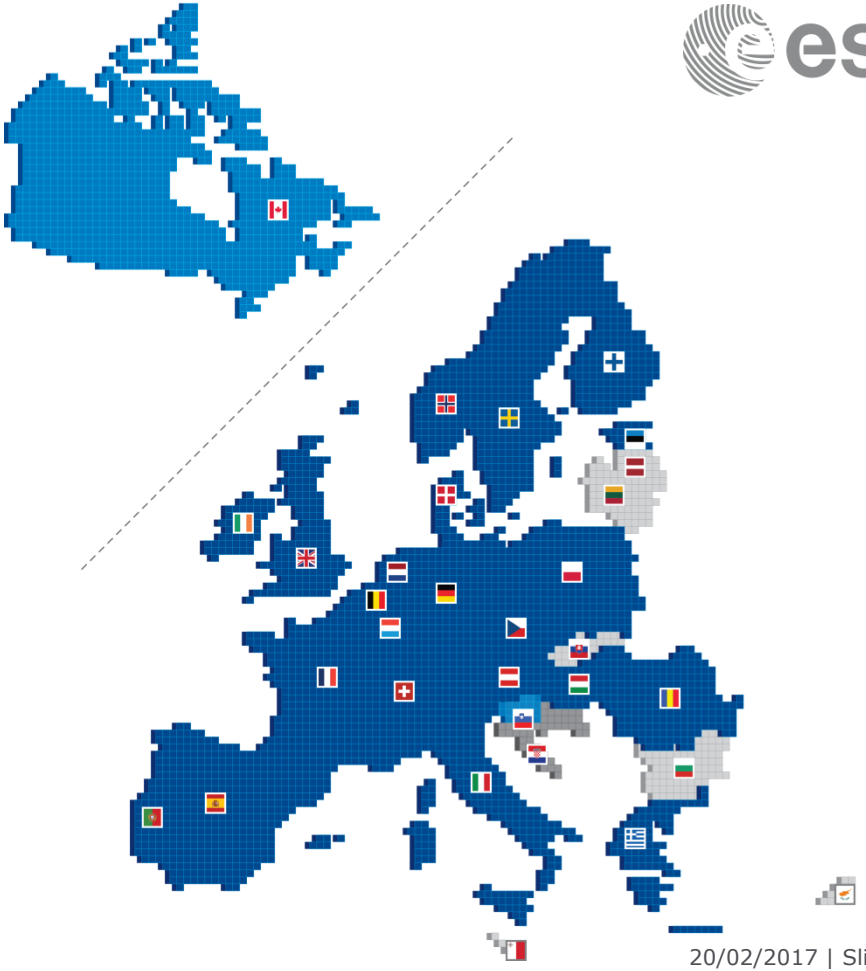
Member States

ESA has 22 Member States: 20 states of the EU (AT, BE, CZ, DE, DK, EE, ES, FI, FR, IT, GR, HU, IE, LU, NL, PT, PL, RO, SE, UK) plus Norway and Switzerland.

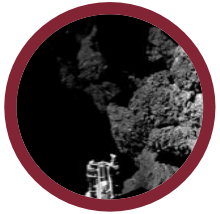
Seven other EU states have Cooperation Agreements with ESA: Bulgaria, Cyprus, Latvia, Lithuania, Malta and Slovakia. Discussions are ongoing with Croatia.

Slovenia is an Associate Member.

Canada takes part in some programmes under a long-standing Cooperation Agreement.



Activities


space science

human spaceflight

exploration

ESA is one of the few space agencies in the world to combine responsibility in nearly all areas of space activity.

earth observation

launchers

navigation

operations

technology

telecommunications

* Space science is a Mandatory programme, all Member States contribute to it according to GNP. All other programmes are Optional, funded ‘a la carte’ by Participating States.

NAVIGATION

Galileo: ‘made in Europe’

Putting Europe at the forefront of this strategically and economically important sector, **Galileo** will provide a highly accurate, guaranteed global positioning service under civilian control.

Full Operational Capability – 18 satellites now in orbit. Deployment of remaining ground/space infrastructure ongoing (full system – 24 satellites, plus orbital spares to prevent interruption in service).

ESA is the system architect for Galileo, managing its design, development, procurement, deployment and validation on behalf of the EU. ESA will maintain this role, providing technical support to the European GNSS Agency, designated by the EC to run the system and provide Galileo services.

Dec 2016 – start of Galileo **Initial Services**, the first step towards full operational capability.

EGNOS, Galileo applications and NAVISP

- Since 2010, **EGNOS** has been improving accuracy and augmenting GPS, offering safety-critical applications for aviation users.
- **Galileo** is expected to spawn a wide range of applications, based on positioning and timing for transport by road, rail, air and sea, infrastructure and public works management, agricultural and livestock management and tracking, e-banking and e-commerce.
- It will be a key asset for public services, such as rescue operations and crisis management.
- With the new ESA Navigation Innovation and Support Programme (**NAVISP**), research will focus on integration of space and terrestrial navigation and new ways to improve GNSS.

Would you like to know more?

Visit www.esa.int