



European
Global Navigation
Satellite Systems
Agency

Rail segment

This presentation can be interpreted only together with the oral comments accompanying it

Market sub-segments and applications



Asset Management includes several functions such as fleet management, needs-based maintenance, infrastructure charges and **intermodal logistics**. GNSS is increasingly seen as a standard source of positioning and timing information in these systems

Signalling and train control applications:



- **Low Density Line Command & Control Systems** will provide full signalling capabilities supported by GNSS on lines with small to medium traffic. These lines are usually located in rural areas, where cost savings can be vital for the viability of a service



- **Main Line Command & Control Systems** assist train command and control on main lines, referring primarily to the European Train Control System (ETCS) in Europe and some regions in the rest of the world, as well as Positive Train Control (PTC) in North America. GNSS can also be a source of additional input, e.g. for enhanced odometry in ETCS



Passenger Information systems on-board trains show the real-time location of a train along its route. The GNSS location of a train is also supporting online passenger information platform and services



Driver Advisory Systems provide additional information to the train driver based on accurate position acquired through GNSS fused with other track reference data and operational characteristics to enable energy efficient driving

E-GNSS contribution and added value

		Asset Management	Passenger Information systems	Driver Advisory Systems	Signalling and train control applications
GALILEO	Increased Accuracy				
	Increased Availability				
	Reduced Time To First Fix				
	Increased Resiliency				
	High Precision				
	OS NMA Authentication				
	Return Link Capability				
	Encrypted Authentication				
EGNOS	Increased accuracy				
	Integrity				

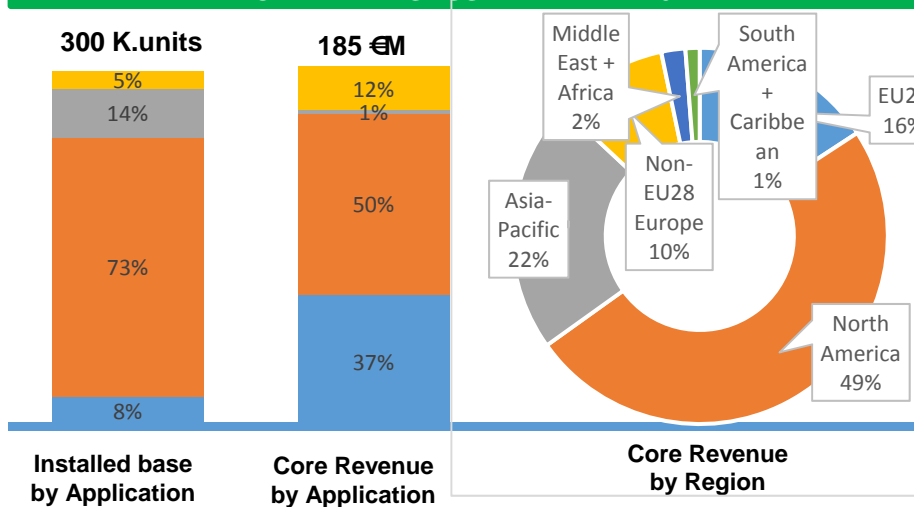
= None
 = Low
 = Nice to have (ameliorating apps)
 = Relevant (enabling new features in existing apps)
 = Extremely relevant (enabling new apps)

= Multi-GNSS Galileo value added
 = Galileo differentiator

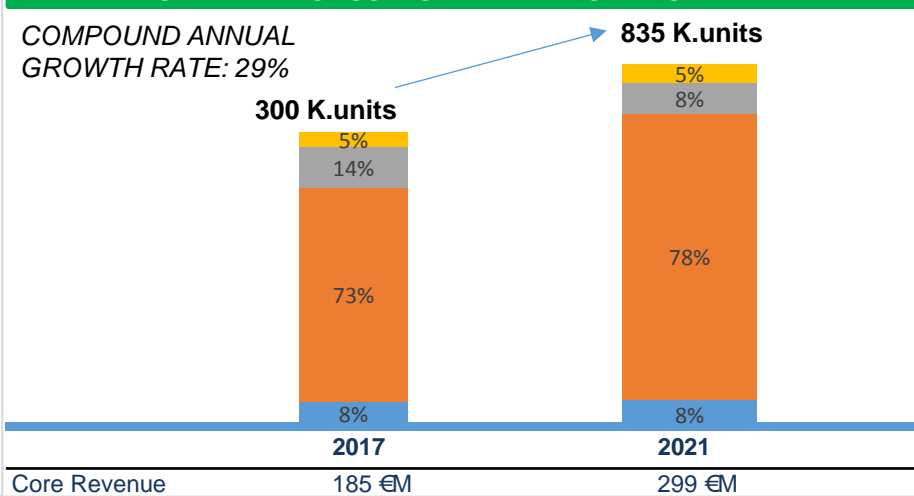
UTC = (Coordinated Universal Time)

A market segment expected to explode in the upcoming years...

WORLDWIDE GNSS MARKET IN 2017



WORLDWIDE GNSS INSTALLED BASE EVOL. '17-'21



KEY MARKET AND TECHNOLOGY TRENDS

- **Growing interest in GNSS use for rail applications**
- Combination of GNSS and other technologies is **starting to offer the required performance**
- **OPEX savings** in comparison with legacy systems will play a major role in driving future demand for GNSS
- GNSS systems are **predominantly used for non-safety related applications**
- Safety related GNSS systems are **expected to complement traditional rail technologies**
- The use of GNSS for signalling and train control **will generate benefits for the whole rail industry** (e.g. PTC is already starting to influence the industry core revenue)
- Emerging applications **combining Positioning and Navigation with Earth Observation data**

LEGEND

■ Signalling and train control applications ■ Asset Management

■ Passenger Information

■ Driver Advisory Systems 4

...if physical and regulatory barriers hindering GNSS use will be removed



Stakeholders must define safety relevant requirements in the difficult rail environment:

- Unlike in Aviation, railway is **suffering multipath effects and signal outages** (cuttings, tunnels, urban canyons)
- **Minimum requirements on GNSS are difficult to define** and need additional performance testing to be conducted by railway experts with the support of satellite industry
- Current **ERTMS/ETCS technical specifications do not include GNSS** in order to allow localization

In **non-safety relevant applications** the solutions currently deployed make use of **legacy technologies** (e.g. barcodes, RFID) that still represent an efficient and cost effective alternative



Our 2020 objectives

Where
we want
to be

- E-GNSS adopted as one of the key elements of the train **command and control solutions** enabling safe and efficient operations **on low density lines**
- E-GNSS adopted as a part of future evolutions of **ERTMS**
- E-GNSS adopted for **train positioning subsystem** fostering the moving-block concept of **ERTMS Level 3 on main lines**
- **Multi-constellation use of GNSS** for multimodal logistics applications



Levers contributing to objectives

How to get there

- Work with key stakeholders **within the agreed roadmap for E-GNSS adoption within ERTMS:**
 - to define requirements in the challenging railway environment and designing specifications of the virtual balise, leveraging work with UNIFE (results by 2017)
 - cooperate with EC and associations to **foster the role of E-GNSS in the evolutions of ERTMS**
- Support EC in the **certification of EGNOS receivers** as a component of the **train positioning subsystem**: a study was launched in Jan 2016
- **Support the establishment of E-GNSS enabled asset and cargo tracking** solutions for positioning of rail as a key player in the future European multimodal transport

GSA cooperates with key stakeholders

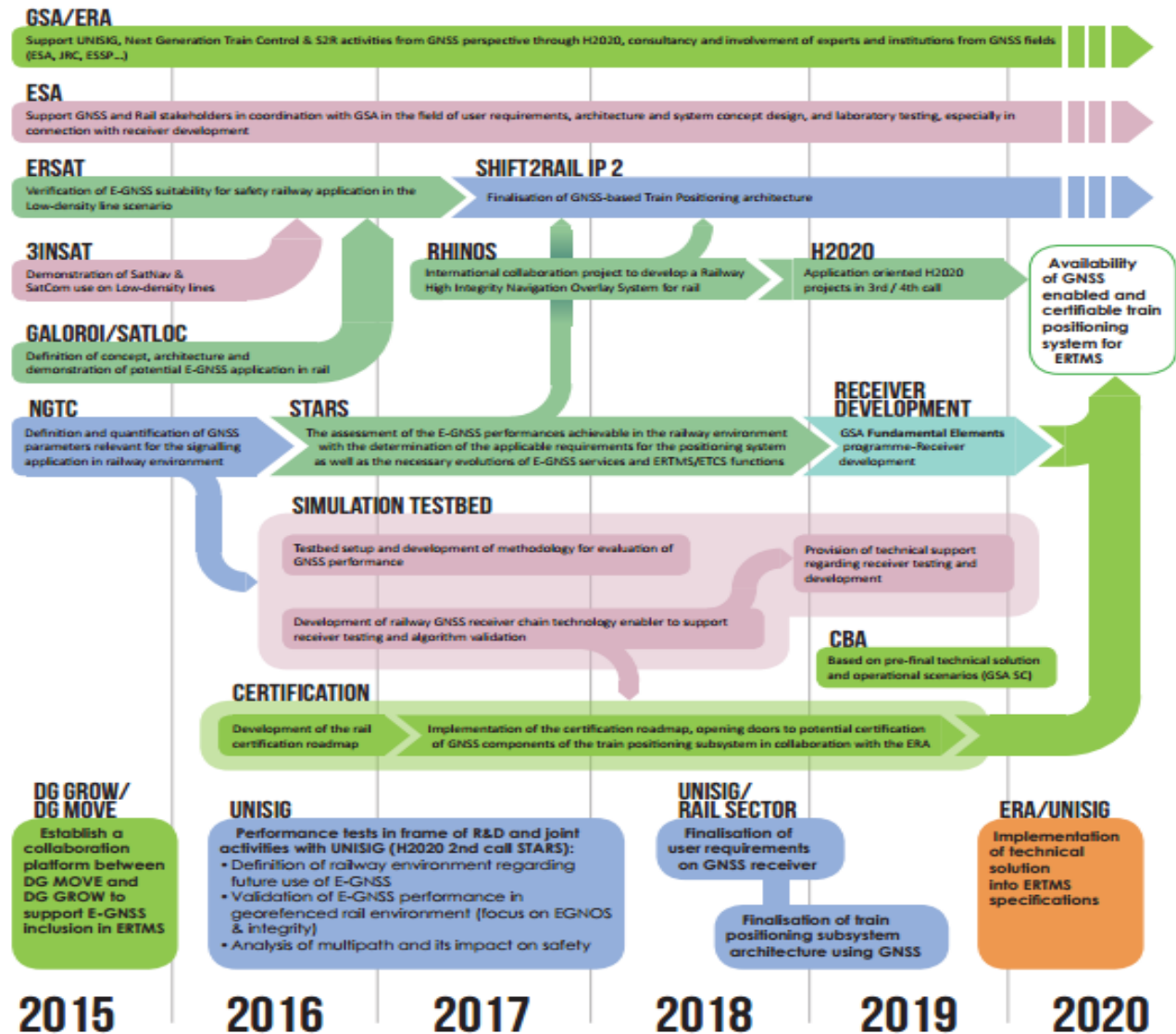
GSA activities in rail are actively developed with main stakeholders groups interested in European GNSS potential in railway signalling applications leading towards inclusion of E-GNSS into ERTMS



- ✓ EC high level collaboration between **DG MOVE** and **DG GROW** to support E-GNSS inclusion in ERTMS
- ✓ **GSA/EUAR/CER/Shift2Rail**
- ✓ **GSA/ESA** coordination of R&D activities
- ✓ **GSA/Shift2Rail** R&D coordination of R&D activities especially in relation to Innovation Programme 2 linked to railway signalling
- ✓ **UNISIG** European signalling industry association working group with key influence on ERTMS development is actively working with GSA on possible inclusion of GNSS into future ERTMS evolutions

Implement E-GNSS rail roadmap

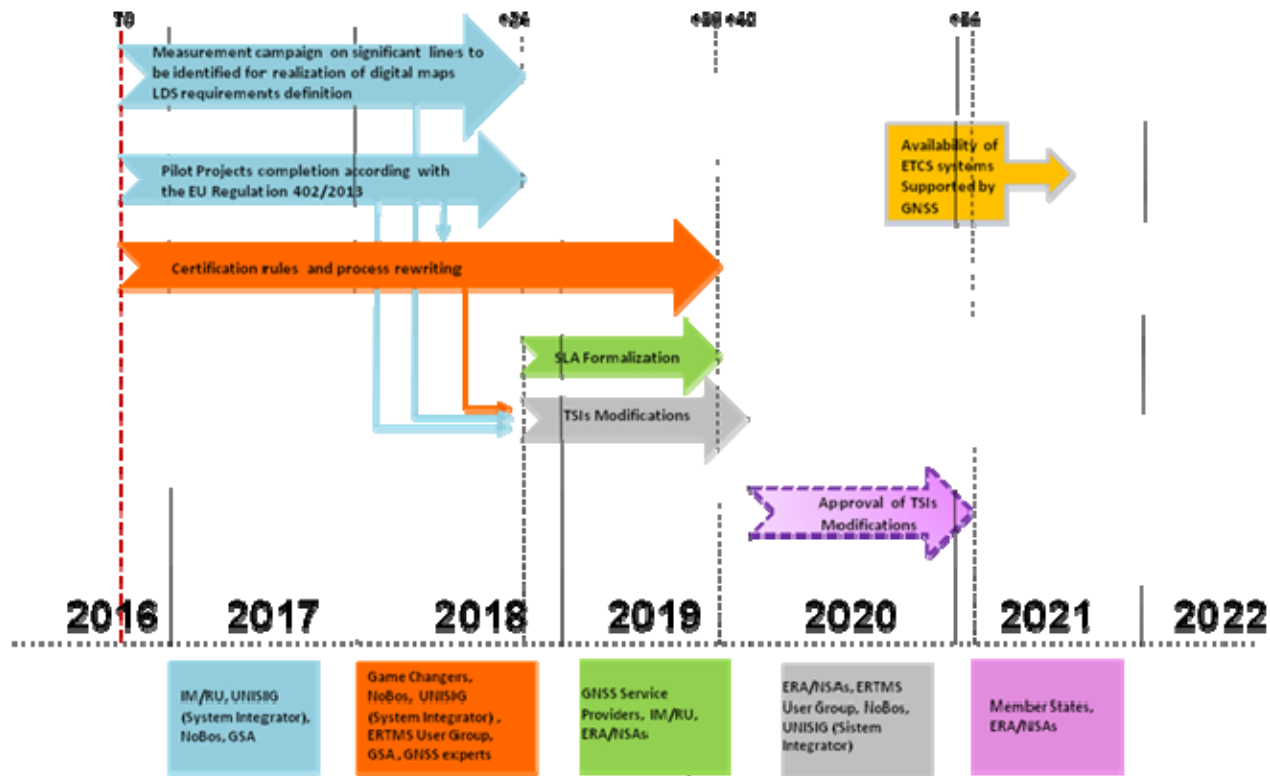
- GSA
- GSA ACTIVITIES H2020
- GSA ACTIVITIES FUNDAMENTAL ELEMENTS
- ESA ACTIVITIES
- INDUSTRY / EXTERNAL STAKEHOLDERS
- ERA & INDUSTRY WITH EXTERNAL GSA SUPPORT



GSA will support certification effort

GSA started to work on certification aspects of GNSS introduction into ETCS in 2016 and met European NoBos in early 2017

Activities, Actors and proposed timing



Certification roadmap

- Pilot projects according to regulation 402/2013 CSM
- Amendment of the certification rules and processes to support E-GNSS
- Service level agreement



Successful R&D projects laid foundation to opportunities for GNSS in rail signalling



FP7 GRAIL 2 objective was to define, develop and validate an ETCS odometry application based on GNSS. The proposed system is based on **Enhanced Odometry, in a context of high speed lines.**

First preliminary CBA for LDL was conducted, showing that EGNSS-ERTMS based train control/protection system is especially beneficial in terms of operating costs compared to other solutions for upgrading the local/regional infrastructure,



Benefit/Cost ratios of 2.2. at the European level and a remarkable increase of safety



Successful R&D projects laid foundation to opportunities for GNSS in rail signalling

FP7 GaLoROI - used EGNOS to provide integrity and increased positioning accuracy in combination with Eddy current sensors



FP7 SATLOC developed and demonstrated in Brasov (RO) innovative GNSS Safety of Life rail application for the train control, speed supervision, traffic control and traffic management of UIC-E lines (low density lines)





ERSAT EAV – low density pilot line in Sardinia

H2020 ERSAT EAV project will leverage the achievements of FP7 and pave the way for inclusion of E-GNSS into future evolutions of ERTMS

ERSAT is focused on verification of the suitability of EGNSS (including EGNOS and Galileo early services) for safety railway application for Low density lines.

Safe localization of the trains, based on E-GNSS will be defined and developed, leading the way for the **harmonization with the European ERTMS standard.**





RHINOS aims to overcome the limitations of the railway environment

Key pillar of **H2020 RHINOS** (Railway High Integrity Navigation Overlay System) project is the GNSS infrastructure realized for the aviation application with additional layers that aim to **meet the railway safety standards, given the environmental constraints.**



RHINOS will also contribute to the definition of a standard for the Railway High Integrity Navigation Overlay System leveraging on **the EU-US Cooperation Agreement on ARAIM.**



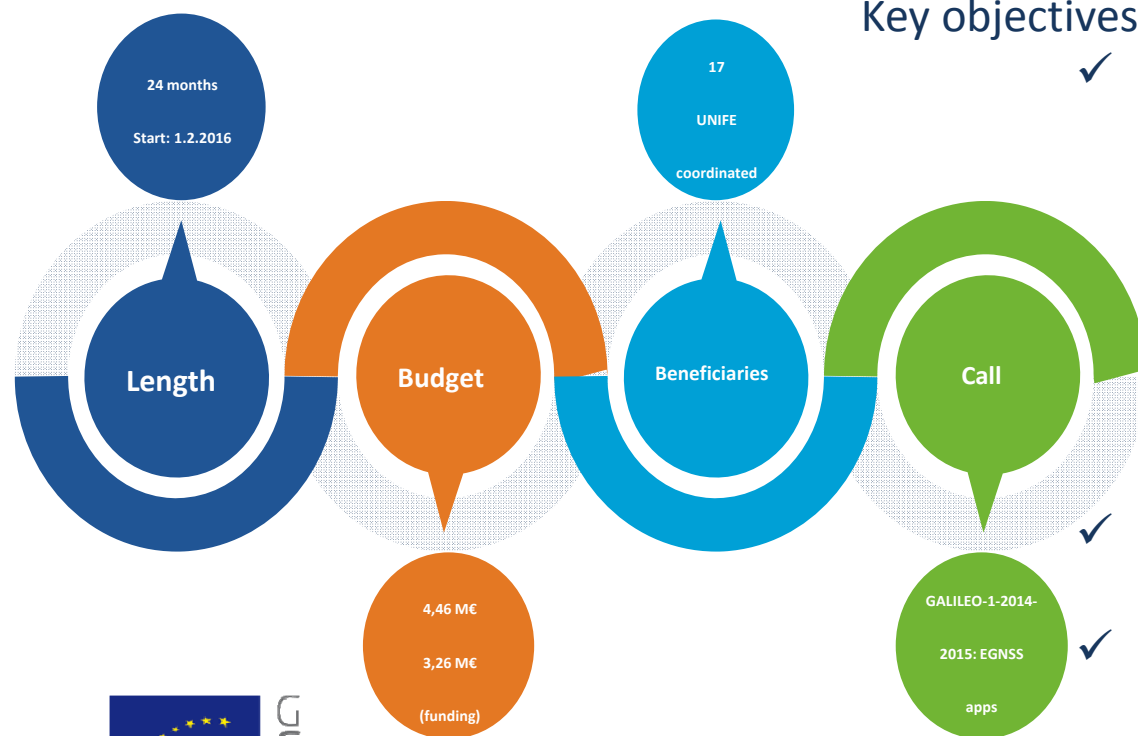


STARS project will help to finalize the requirements on rail GNSS receiver

The aim of H2020 STARS project is to fill the gap between ERTMS needs for safety critical applications and E-GNSS services, through a **characterization of the railway environment** and of GNSS performances assessment in that environment.

Key objectives of the project are:

- ✓ To develop a universal approach to predict the achievable GNSS performance in a railway environment, especially for safety critical applications within ERTMS and to determine the necessary evolution of ETCS to include GNSS services
- ✓ To achieve interoperability between equipment of different suppliers
- ✓ To allow inclusion of GNSS into ERTMS





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QUESTION TIME

Thank You!