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# EU SPACE WEEK 2023

7 - 9 November - Sevilla, Spain

## Rail session

Daniel Lopour

07/11/2023 Sevilla



European  
Commission



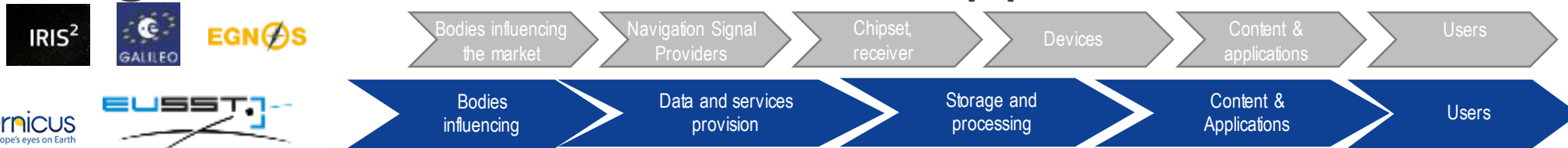
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# User Consultation Platform

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# All EU Space Program components with an integrated market/user driven approach



8 parallel sessions

Agriculture and Forestry



Environment



Road and Automotive



Rail



Public Transport



Resilient societies



Space



SST



## Market & User Knowledge



Extended **Market and technology** monitoring and forecasting

Extended and synergic **User Consultation Platform**

Better understanding the **MS needs** and adding Copernicus Other Users satisfaction survey

## Demand Support & users



A common **market segments** approach for all EU space downstream

Extended key account with **main players** of the value chain

## Offer Creation



Creation of new “made in Europe” products and services.

Large implementation of end-to-end solutions leveraging synergies.

Supporting entrepreneurship, SME and start-ups

# Report on Rail User Needs and Requirements

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Applications covered in 2023 edition

Sub-segments	Applications	Types of Application/ Level of Investigation	
MAINTENANCE IMPROVEMENT	Condition-based maintenance	A	●
	Infrastructure monitoring	A	●
	Predictive maintenance	A	●
ATTRACTIVENESS ENHANCEMENT	Passenger information systems	A	●
	Public Transport – Tram and Light Rail	C	○
SAFETY RELATED	Enhanced Command & Control Systems (CCS)	A	●
	Trackside personnel protection systems	A	●
	Hazardous cargo monitoring	B	◐
	Door Control supervision	B	◐
TRAIN DRIVING OPTIMISATION	Rail fleet management	A	●
	Driver Advisory Systems (DAS)	A	●

- Legend**
- EO only application
  - GNSS only application
  - Hybrid/synergetic application (combined use of EO and GNSS)
- A** ● An in-depth investigation
- B** ◐ A partial specification
- C** ○ Will be analysed in next versions

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# Rail session - Agenda

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# Space session - Agenda

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- 10:00 - 10:20: Session Agenda presentation: Daniel Lopour, EUSPA
- 10:20 – 10:40: EO – Introduction to Copernicus Services and performances: Arnis Kadakovskis, EUSPA
- 10:40 – 11:00: SATCOM – An option for FRMCS: Ricardo Campo, CEDEX
- 11:00 – 11:10: Discussion
- 11:10 – 11:25 Break
- 11:25 – 11:45: Signaling - Independent train localizer: Valentin Barreau, SNCF
- 11:45 – 12:05: Signaling - Virtual Balise, Digital map: Massimiliano Ciaffi, Giusy Emmanuele, RFI
- 12:05 – 12:25: Non-safety Critical applications – Infrastructure maintenance: Fabio Scarpa, Hitachi
- 12:25 – 12:45: EO use cases and requirements for Rail: Bo Larsson, Trafikverket
- 12:45 – 13:00: Discussion
- 13:00 – 14:00 Lunch Break
- 14:00 - 15:10: Discussion: GNSS-based localization requirements in Rail, Juliette Marais
- 15:10 – 15:30: R&D activities on EGNSS additional dissemination means, improved authentication solutions for EGNOS and Galileo and contribution to Ionospheric Prediction Service, Javier Ostolaza
- 15:30 – 15:45: Break
- 15:45 – 16:20: Discussion: EO requirements in Rail, Arnis Kadakovskis
- 16:20 - 16:55: Discussion: SATCOM requirements in Rail: Daniel Lopour & Ricardo Campo
- 16:50 – 17:00: Conclusions and next steps: Daniel Lopour

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# Session Guidelines

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# Space session - Guidelines



## ZOOM rules

- Raise your hand for questions
- Mute yourself once finished the interventions
- We have to respect the time constraints
- We will let you know (speaker) when to close

Thank you for your cooperation

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# Rail in context of the EU Space Programme

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# A new EU Space Programme

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EU space activities **under one umbrella**



## EGNOS

EGNOS “Makes navigation signals more accurate and trustable for Safety-critical applications”  
Operational in **400+ airports** & helipads in 23 countries



## Galileo

Global satellite navigation and positioning system (GNSS)  
More than **3 billion Galileo receivers** worldwide



## Copernicus

Earth Observation (EO) and monitoring based on satellite & non-space data  
**Nr.1 world provider** of space data and information (>20TB/day)



## GOVSATCOM

Secure satellite communications for EU governmental actors  
Rapid support over crisis areas



## Space Situational Awareness (SSA)

Space Surveillance and Tracking (SST)  
Space Weather Events (SWE)  
Near-Earth Objects (NEO)



## Others

Access to Space  
Research & Innovation  
Entrepreneurship  
Certification & standardisation  
Capacity Building

# Galileo and EGNOS Services



**Galileo Initial Services** are provided to worldwide users since **December 2016**

<b>Open Service (OS)</b>	Freely accessible service for positioning and timing*
<b>Public Regulated Service (PRS) – Governmental Service</b>	Encrypted service designed for greater robustness and higher availability – secure satellite communication
<b>Search and Rescue Service (SAR)</b>	Locates people in distress and acknowledges that the distress signal has been received
<b>High Accuracy Service (HAS)</b>	Delivers high accuracy services, freely accessible
<b>Under preparation</b>	
<b>Commercial Service Authentication (CS)</b>	Delivers authentication services for commercial applications

\* OS Navigation Message Authentication (OSNMA) is currently under testing

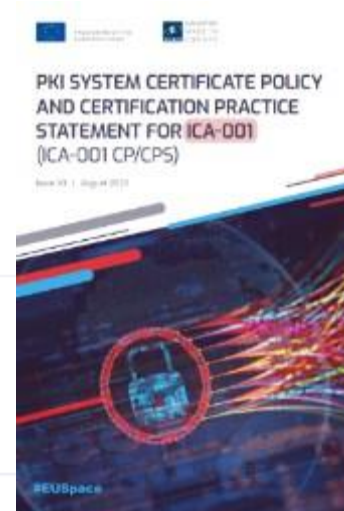


**EGNOS services** are provided to users since **October 2009**

<b>Open Service (OS)</b>	Improving GNSS accuracy, intended mainly for high-volume satellite navigation applications for use by consumers
<b>Safety of Life Service (SoL)</b>	Providing a high level of integrity for users for whom safety is essential (e.g. civil aviation, in accordance with ICAO standards)
<b>Data Access Service (EDAS)</b>	Offering EGNOS data with greater added value through internet, intended mainly for professional or commercial use

# OSNMA status and roadmap

- OSNMA SiS ICD (final format) and Receiver Guidelines published in Dec'2022
- Transmission of SiS as per OSNMA SiS ICD (final format) since August 2023
- Operational cryptographic data to be published by end 2023
- Initial Service Declaration (Service Definition Document publication and signal switch to 'operational' mode) foreseen by Q1'24



# What is the Galileo HAS

Galileo HAS provides precise corrections for satellite orbit, clock and signal biases

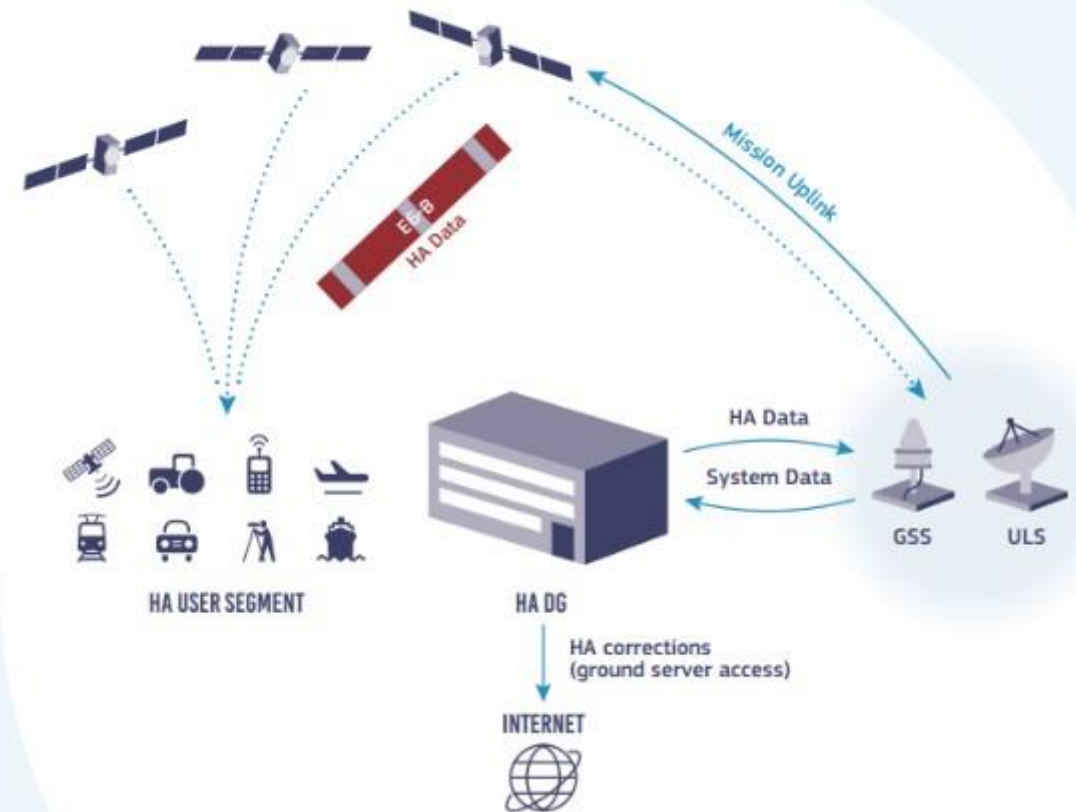
Galileo HAS corrections distributed via

Galileo satellites, E6-B signal (1278.75 MHz)

Internet

Typical accuracy in the decimetre level (after convergence), with Precise Point Positioning (PPP) receivers

(Almost\*) global coverage and free



*\*global coverage of corrections but no global performance commitment yet*

# EGNOS Services

EGNOS services are provided to users since October 2009

## Open Service (OS)

Improving GNSS accuracy, intended mainly for high-volume satellite navigation applications for use by consumers

## Safety of Life Service (SoL)

Providing a high level of integrity for users for whom safety is essential (e.g. civil aviation, in accordance with ICAO standards)

## Data Access Service (EDAS)

Offering EGNOS data with greater added value through internet, intended mainly for professional or commercial use

## EGNOS System state-of-play

### EGNOS V2 is the current System in Operations

Delivering SoL service for Aviation since 2011, based on GPS-only augmentation

Constant improvement in answer to user needs (e.g. coverage extension, service for Maritime, robustness improvements)

Need to extend the service provision of EV2 to ensure the handover with EV3 including risk of additional delay ☑ LIFEX 1&2 System Releases to be procured by EUSPA to TAS-F

Security enhancement: initial SECMON capability at GSMC

### EGNOS V3 is the new generation of EGNOS

Bringing Galileo use into EGNOS System and SoL services

Augmenting both GPS and Galileo

Improved performance and geographical coverage thanks to dual-frequency & dual-constellation

Built-in security (with SECMON from GSMC)

Future extensions to Africa and neighbourhood (e.g. Ukraine, North Africa)

# EGNOS services perspectives

## Primary means of navigation for Aviation in 2030

- Performance Based Navigation (PBN)
- Better availability (99.9%), more resilience, EU autonomy (with Galileo)
- New Airspace users (helicopters, small aerodromes, drones, ...)

## Maritime

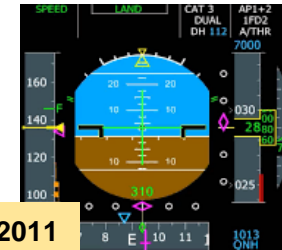
- Initial service in 2023 for maritime and in-land navigation
- Towards autonomous vessels navigation and zero-emissions shipping
- Not only EGNOS: end to end solutions using HAS/OSNMA and Copernicus

## Rail

- Making ERTMS accessible on all lines
- R&I substantial investment to prepare railway operators and signalling industry
- A new service under preparation, facing the challenge of Rail safety standards



Agriculture since 2009



Aviation since 2011



Maritime in 2023



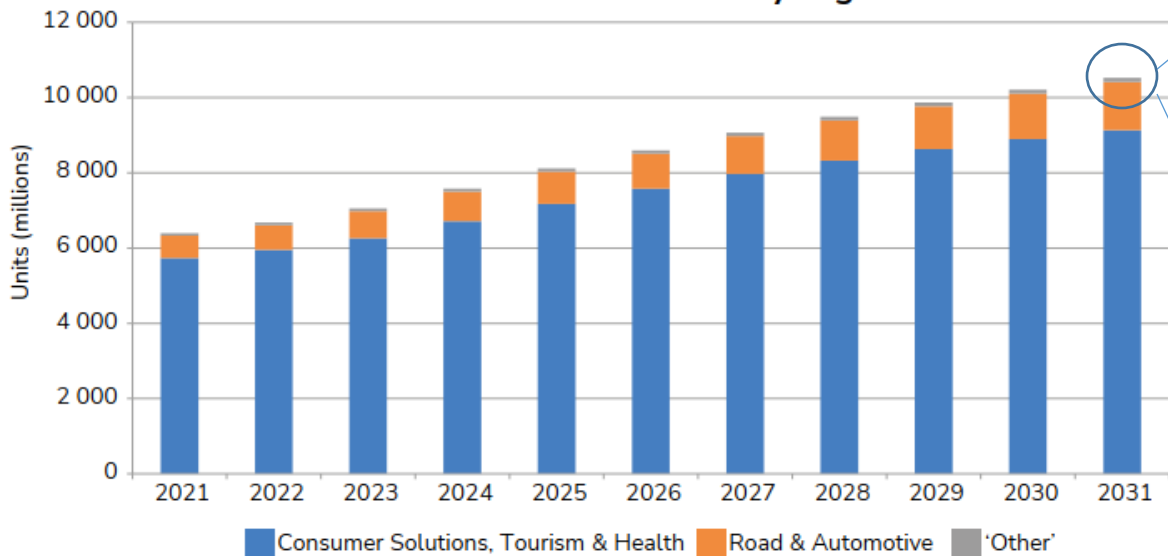
Rail in preparation



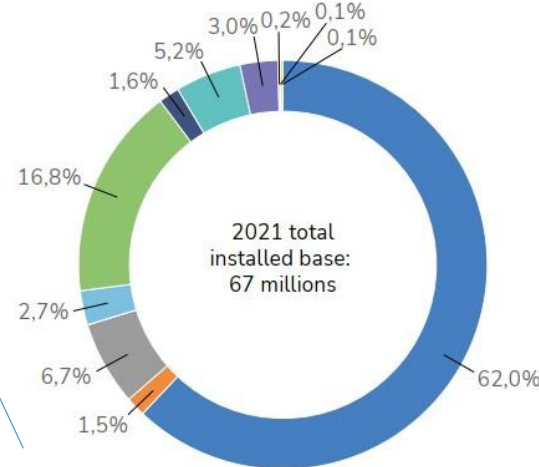
# Transport holds the largest GNSS Rx installed base, in non mass market segments



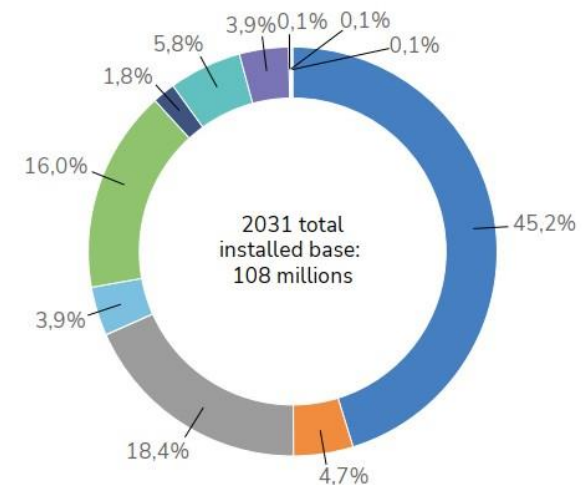
Installed base of GNSS devices by segment



Installed base of 'Other' by segment (2021)



Installed base of 'Other' by segment (2031)



- **Automotive** is the second largest market segment (after consumer solutions) in the next decade

- In 'Other' segments, **Aviation and Drones** are the biggest segment
- **Maritime** is the second largest market in 2021 and keeps stable by 2031
- **Rail** grows more than x3 by 2031



# ERTMS remains to be „in the focus“



European Parliament supports GNSS inclusion in ERTMS (resolution of 7 July 2021 on railway safety and signaling), calling on the EU rail industry to develop technical solutions in order for the GNSS to enable the ERTMS on a large scale

- ✓ Points out the need to ensure synergies between the ERTMS and the European Global Navigation Satellite System (GNSS) as soon as possible
- ✓ Calls on the EU rail industry to develop technical solutions in order for the GNSS to enable the ERTMS on a large scale
- ✓ Calls on the Commission to consider introducing the GNSS in the upcoming ERTMS TSI CCS revision in order to close the remaining technological gaps and embrace innovation
- ✓ Calls for cooperation between the Agency (ERA) and the GNSS Agency (EUSPA) to be stepped up in order to phase the GNSS into ERTMS standard

# EU Space support to rail



- **Close coordination with ERA and ERJU:**

- EUSPA participates as gateway to space within EU-Rail System pillar SG
- **ERTMS Change request 1368:** Updated documentation for including EGNOS Augmentation in ERTMS provided as input to next steps within the EU-Rail System Pillar
- Work breakdown structure to close the residual gaps towards demonstrating the feasibility of GNSS for train signaling within EU Rail demonstrators agreed at working level between EUSPA, ESA, EU-Rail and EUG

- Further progress achieved within adoption in non-safety relevant applications

- **EUSPA Fundamental elements programme:** 2 projects on receiver/antenna prototype development in final stage, demonstrating the prototypes (TRENI and GALITS)

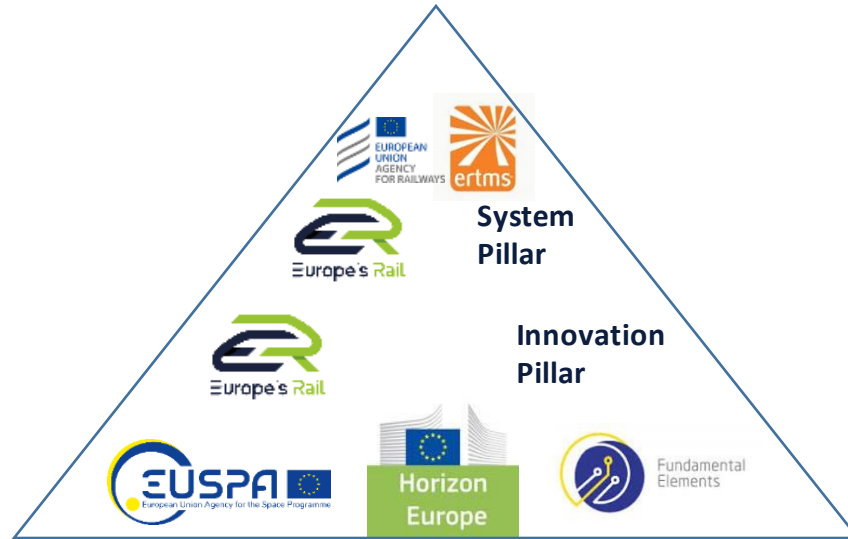
- EGNOS Adoption Grants in progress (BETRIAN & EGNOS AIR)

- **Continued support in frame of EUSPA R&D**

- HORIZON-EUSPA-2022-SPACE – projects in GAP phase - to be launched in Q1/2024
- HORIZON-EUSPA – Call launched – deadline in February 2024



# ...R&D coordination is the key



★ EUSPA R&D as a technology driven contributor to the ERJU Innovation pillars



# EUSPA R&D – where the story began



Complementing the existing European Train Control System (ETCS) odometry system through an on-board GNSS+EGNOS-based multi-sensor fusion architecture enabling absolute safe train positioning and navigation whilst also transforming the way train localisation is done today.



Development of a shared high integrity and high accuracy platform for train signaling and other applications such as connected and driverless cars or UAV for surveillance of roads and railways.



Development of tools for designing high integrity and accuracy ground truth and digital trackside map indispensable for train positioning with EGNSS and other sensors including procedures for automated collection of in field measurement data with commercial trains.



Development of a drone-based technology to monitor the physical status and electronic functionality of both non-safety-critical and safety-critical railway signalling assets and to execute specific maintenance activities



# Copernicus services

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<https://atmosphere.copernicus.eu/>



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 **ECMWF**

<https://marine.copernicus.eu/>



**MERCATOR  
OCEAN**  
INTERNATIONAL

<https://land.copernicus.eu/en>



**European  
Environment  
Agency**



<https://climate.copernicus.eu/>



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<https://www.copernicus.eu/en/copernicus-services/security>



**FRONTEX**  
EUROPEAN BORDER AND  
COAST GUARD AGENCY

**EMSA**  
European Maritime Safety Agency

<https://emergency.copernicus.eu/>



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# Copernicus - Railway specific applications

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## Monitoring of subsidence and landslide risks

Copernicus can contribute to solutions providing monitoring capabilities and risk indications related to railway infrastructure protection, helping to ensure seamless rail infrastructure operation incl. e.g. monitoring of soil moisture

## Monitoring of vegetation

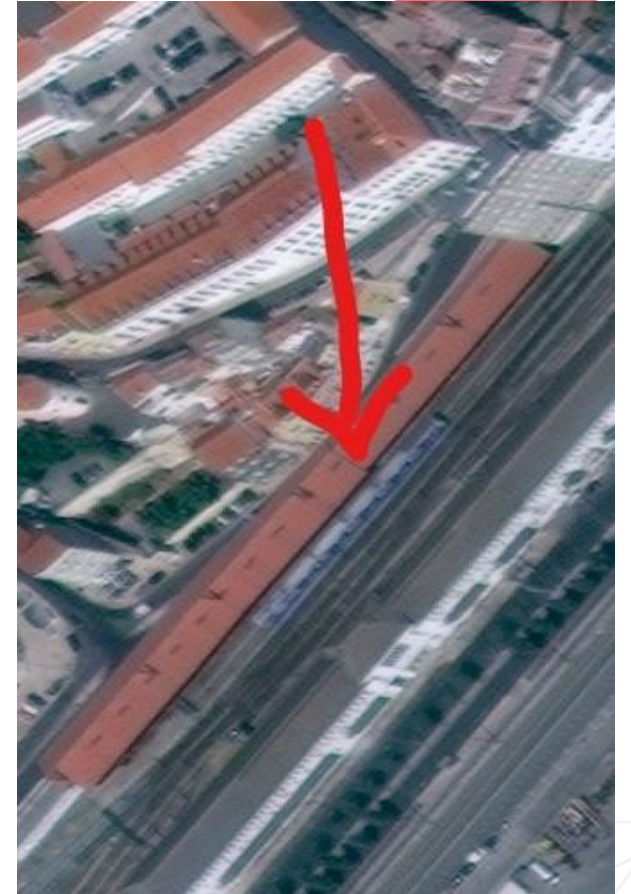
Copernicus data is present within the mix of Earth observation techniques for protection of train gabarit from risks associated with vegetation growth

## Construction monitoring of railway infrastructure and its proximity

Copernicus can be used within applications focused on centralized monitoring of construction works on the infrastructure as well as construction around it with the objective to mitigate any possible negative effects on operations

## Infrastructure maintenance

Copernicus can help to indicate changes in status and condition of railway infrastructure assets, supporting decisions regarding necessary corrective or preventive maintenance

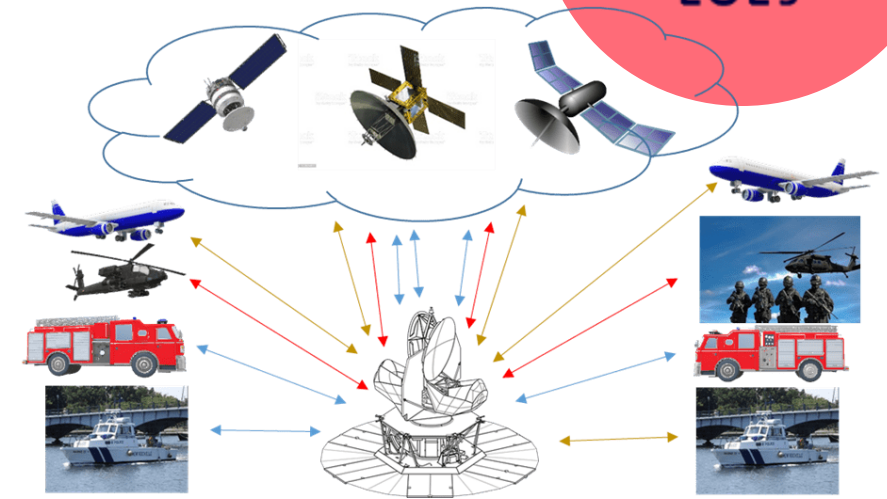


# GOVSATCOM (Governmental SATellite COMMunications) – an alternative for terrestrial communication in ERTMS?

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Today the fragmentation of military, governmental and civilian users results in:

- suboptimal use of resources,
- interoperability issues



- ❖ Under EU GOVSATCOM the existing satellite communication capacities (nationally owned + commercial ones) and services will be combined into a common Union pool with appropriate security requirements.
- ❖ The pooling of satcom resources and the aggregation of user demand will optimise the match between the GOVSATCOM demand and the supply, will support additional security features and foster interoperability.
- ❖ **1 km of GSM-R infrastructure costs approximately 50k EUR – Could EU SATCOM serve as an alternative in the future?**

## **GOVSATCOM to support major infrastructures**

where the absence of proper communication links can be detrimental to the security and safety of the EU, the Member States and its citizen, including transport (e.g. ATM or ERTMS)

# EUSPA Horizon Europe call of 2023

(HORIZON-EUSPA-2023-SPACE-01)



**Deadline: February 2024**

Type of Action	Topic	Indicative budget (EUR mln)
IA	EGNSS - Transition towards a green, smart and more secure post-pandemic society	3.5
IA	EGNSS - Closing the gaps in mature, regulated and long lead markets	8
RIA	Copernicus-based applications for businesses and policy-making	7
RIA	Designing space-based downstream applications with international partners	6
IA	EU GOVSATCOM for a safer and more secure EU	10
<b>Total budget:</b>		<b>34,5</b>

**Innovation action (IA)**

Activities to produce plans and arrangements or **designs for new, altered or improved products, processes or services.**

**Research and innovation action (RIA)**

Activities to **establish new knowledge or to explore the feasibility** of a new or improved technology, product, process, service or solution.





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