

Satellite and FRMCS

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- ✓ ESA Space4Rail Initiative
- ✓ Relevance of Space Assets in Rail
- ✓ SatCom & FRMCS
- ✓ ESA ARTES 4.0 & Opportunities on rail

Space4Rail is a cross-directorate ESA initiative to support the railway community by raising awareness of the added value that space-based assets can bring to the digitalisation of railway.



<http://space4rail.esa.int>

Earth Observation

Providing an **effective** and **frequent** way to **monitor land and resources**, and can also facilitate **change detection**.

Facilitates applications related to the **monitoring of railway assets, infrastructure** and surrounding areas, or **augmented reality** applications enhancing the user experience.



Satellite Navigation

Enabling **global positioning** functions.

Supports applications such as **enhanced train localisation, interactive indoor and outdoor mapping** of train stations and **predictive maintenance**. The use of sensors with satellite navigation may improve the position and velocity performances (relative and absolute).



Satellite Communications

Providing **ubiquitous coverage**, enabling an extension of **reliable** and **secure connectivity** to complement terrestrial communications.

Supports **5G** architectures, that is key to the **Future Railway Mobile Communication System**, superseding the current GSM-R infrastructure. Can also support satellite-based **Internet of Things** for rail freight, cargo monitoring and rail predictive maintenance, and satellite **broadband** for enhanced on-board and in-station passengers connectivity.



Signalling

- Opportunities: Low cost signalling using GNSS and SatCom through virtual balise and multi-bearer solutions, innovative solutions at level crossing.
- Activities: 3InSat, Sat4Train, SBSRailS, EMUSER, 3TIMS, etc



Railway Infrastructure monitoring

- Opportunities: railways stability and subsidence analysis, landslides and rock fall prevention, predictive maintenance
- Activities: LIVE LAND, DinoS5G, etc



Tracking

- Opportunities: railway asset monitoring for safety and operational effectiveness
- Activities: RANGLO, SAMOLOSA, IRISS, etc



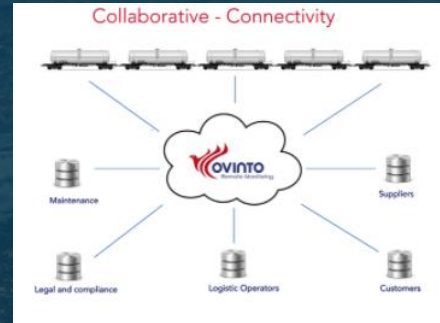
Broadband to passengers

- Opportunities: internet and entertainment in case of lack of terrestrial coverage in rural areas complemented by terrestrial networks
- Activities: SODOR, etc



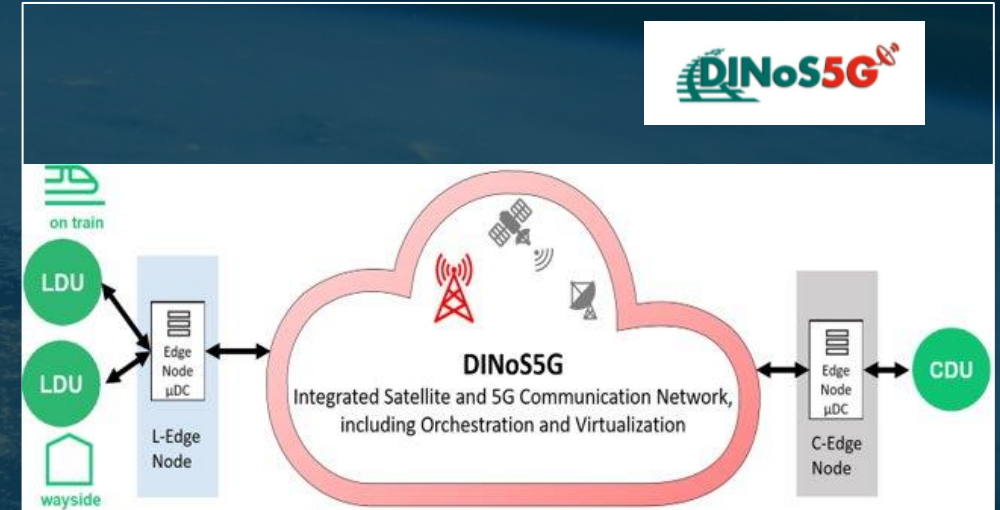
RANGLO

To deliver data integration and Predictive analytics service for rail freight in UK.



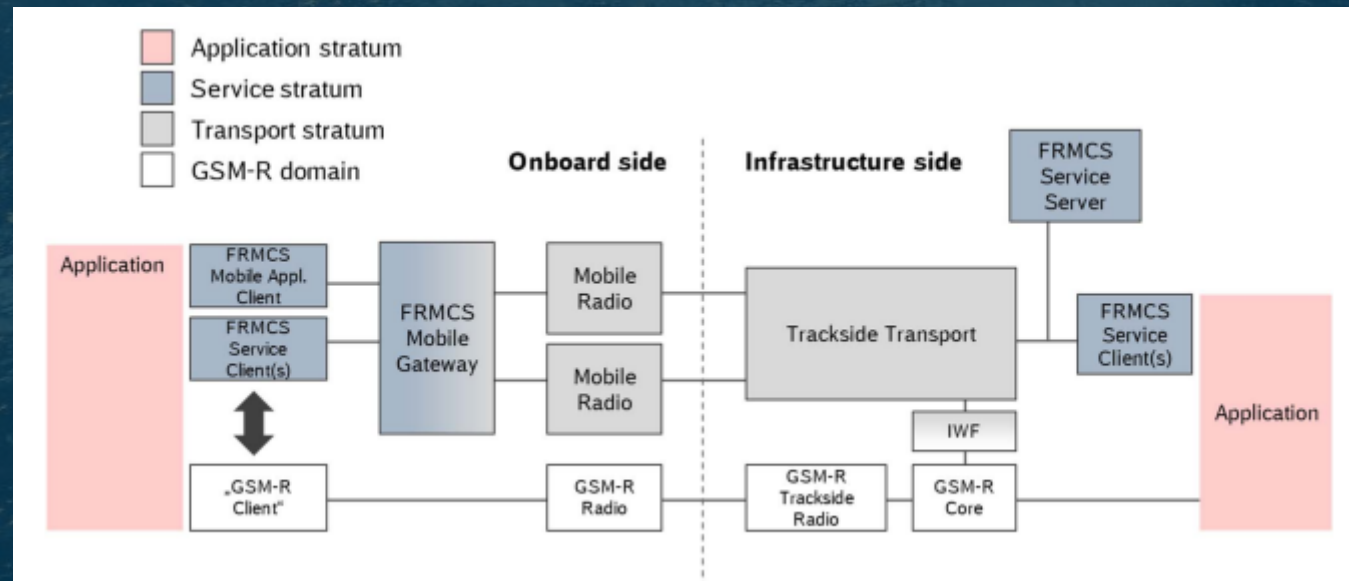
SBS Rails 2.1

Technology Demonstrator for the Certification of a satellite-based ERTMS L2 regional line solution (ERSAT Program)



Creates an integrated communication infrastructure to serve large-scale and fine-grade diagnostics of civil assets, tracks and equipment constituting the national railway environment of a major country like Italy, for the purpose of smart predictive maintenance.

FRMCS (Future Radio Mobile Communications Systems), designed by UIC, expected to replace GSM-R
SatCom opportunities in FRMCS (multi-bearer approach, non 3GPP and 3GPP solutions)



Source: ETSI TR 103 459 V1.2.1 (2020-08)

FRMCS and SatCom addressed at different fora (e.g. 3GPP and ETSI Railways Telecommunications)

Pillar 1 – non 3GPP solutions

P1 – Use of non 3GPP solutions RAT and proprietary network management & control

Pillar 2 - 5G based & Interoperable solutions

P2.1 (convergence)
Like P1 with 3GPP compliant network management & control to ensure interoperability among sat & terr networks

P2.2 (integration)
Definition and Use of 3GPP/5G NR solutions

Use of slicing – Multi-tenancy – Edge Cloud computing technologies

- P1 not interoperable solution (e.g. for CCS, possibly for local lines; current & short term solutions)
- P2 interoperable solutions (e.g. for CCS, for main lines; medium/long term solutions):
 - ETSI RT is working on P2.1 and P2.2 (with high priority) as per EC mandate
 - Opportunity/Importance for railways stakeholders & SatCom operators to be involved in ETSI RT/3GPP to shape the standards according to their needs

ARTES 4.0 – How do we support industry



Strategic Lines

Responding to societal/economic objectives



Space for 5G/6G



Space Systems for Safety and Security



Strategic Technologies e.g. Optical Communications

Total Subscriptions of 1.57 B€
used to support our industry
between 2019-2022

ARTES tools

supporting the full spectrum of activities

Implemented with tools



Studies
(future preparation)



Technologies and Products
(Innovation)



Partnerships
(Collaboration Projects)



Downstream Applications
(delivering use-cases)



Space for 5G and 6G – Roadmap



5G/6G Standardisation

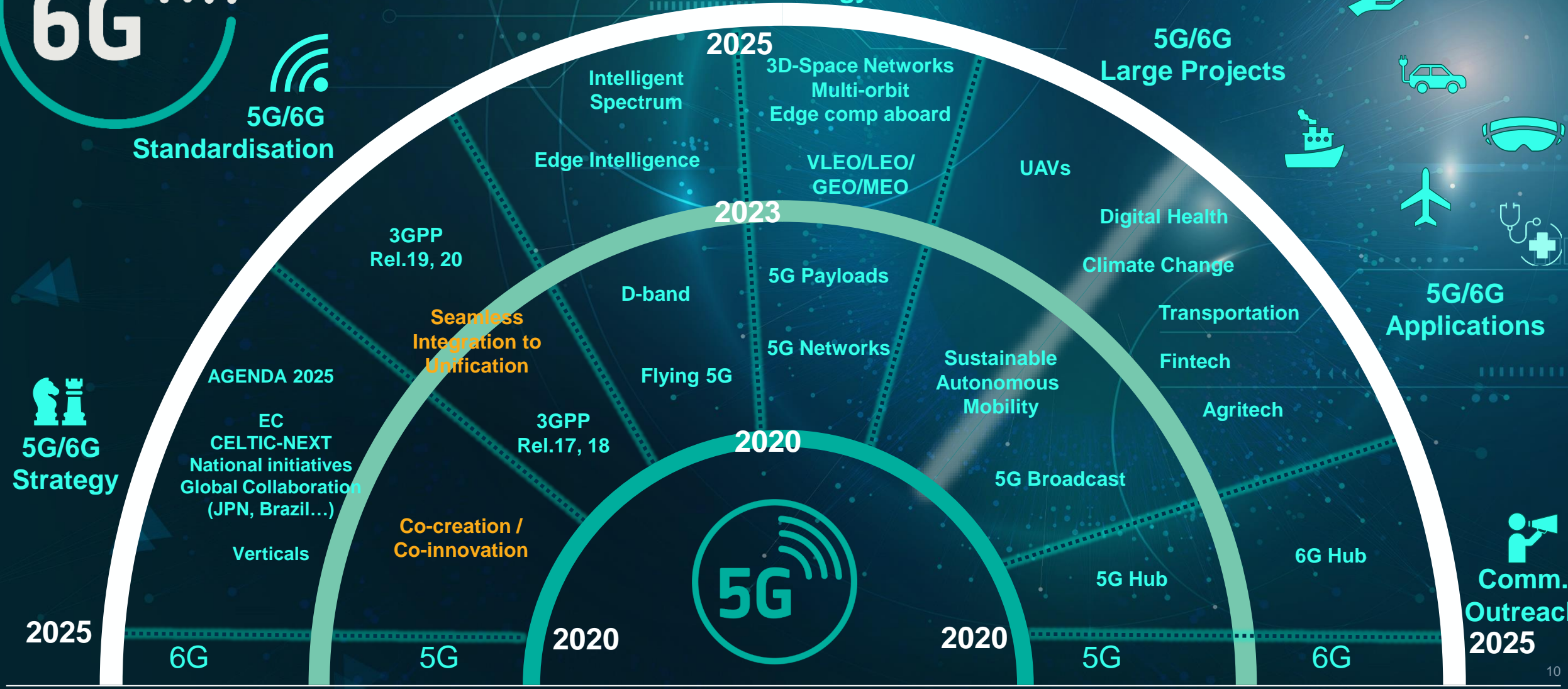
5G/6G Strategy

5G/6G Product & Technology

5G/6G Large Projects

5G/6G Applications

Comm. Outreach 2025

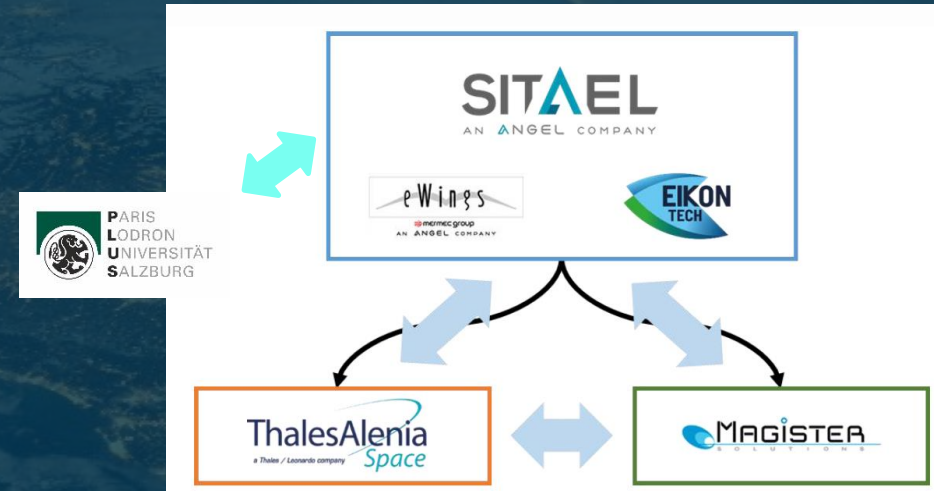


ESA activity in support of P2

SAIRCC – Satellite Air Interface for Railways Control Communications

Objective: To develop and demonstrate in the lab a 5G NR air interface over satellite for railway control communications @ user plane.

*Dissemination of intermediate results (e.g. scenarios, service requirements, traffic characterization, capacity analysis)
Planned mid June 2022*



SAIRCC follow up – Integration of Satellite and Terrestrial Railway Control Networks

Objective: To develop and validate the 5G NR air interface over satellite for railway control communications @ control and management plane (i.e. necessary functions for the integration of satellite and terrestrial railway control networks)

Procurement activities on going (negotiation phase)

ESA Space4Rail Downstream Applications CfP

To support the exploitation of space-based assets in **applications/services in railways**

The Open Call for Proposal (AO11026) addresses:

- Activities in **direct negotiation**.
- **Feasibility Studies:** to assess business opportunity and technical feasibility.
- **Demonstration Projects:** to implement and validate pre-operational services with potential customers engagement.

<https://space4rail.esa.int/opportunities/ba-s4r>



Thank you

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