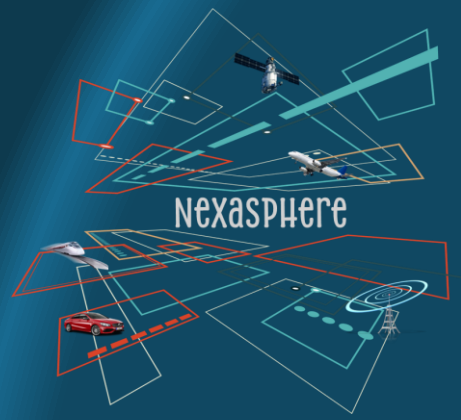


6GSNS

Co-funded by the European Union

NexaSphere

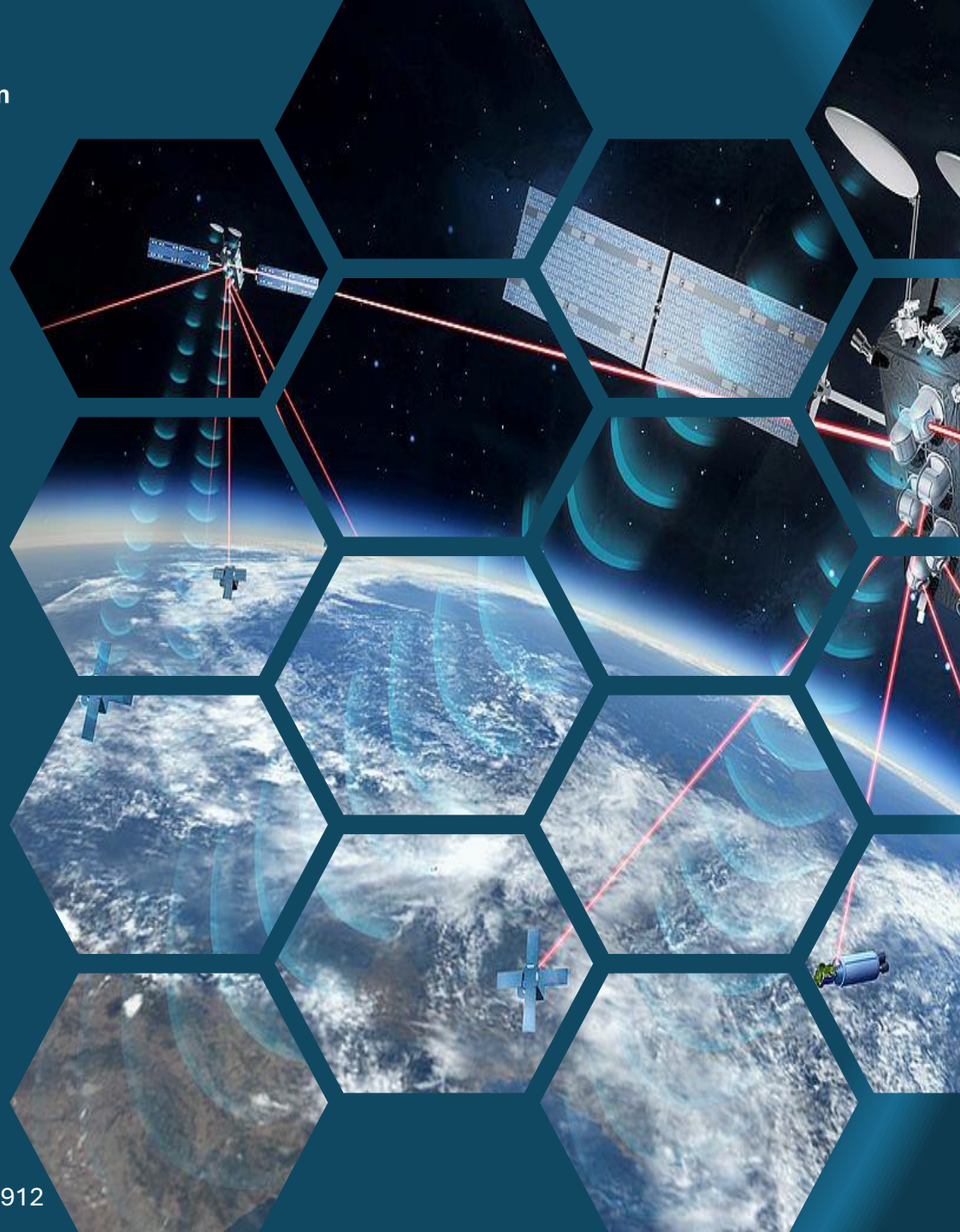
Paving the Way Towards an NTN-Native 6G Ecosystem

EuCNC, Workshop 8

Terrestrial and non-terrestrial networks unification towards 6G

Tuesday, 3 June 2025

Babak Mafakheri



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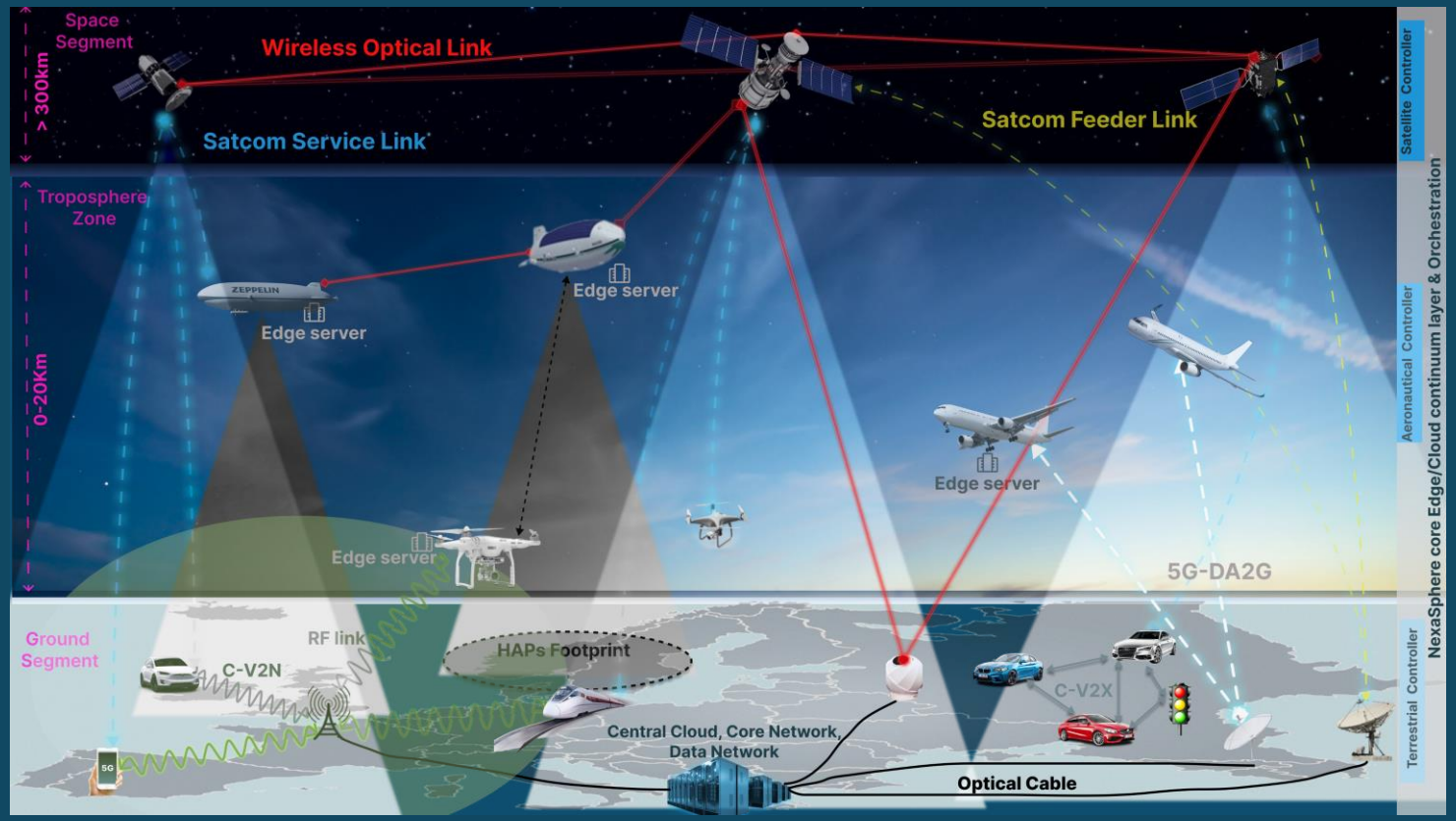
NexaSphere ambitious



- Integrate Radio-Optical wireless technologies for unified TN/NTN 3D connectivity systems,
- Support innovative solutions to the verticals, notably in the field of transportation,
- TRL 4-5 outcomes -> Technology validated in the lab.

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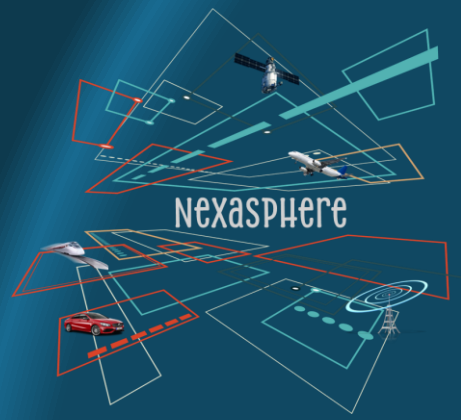
NexaSphere Fact Sheet



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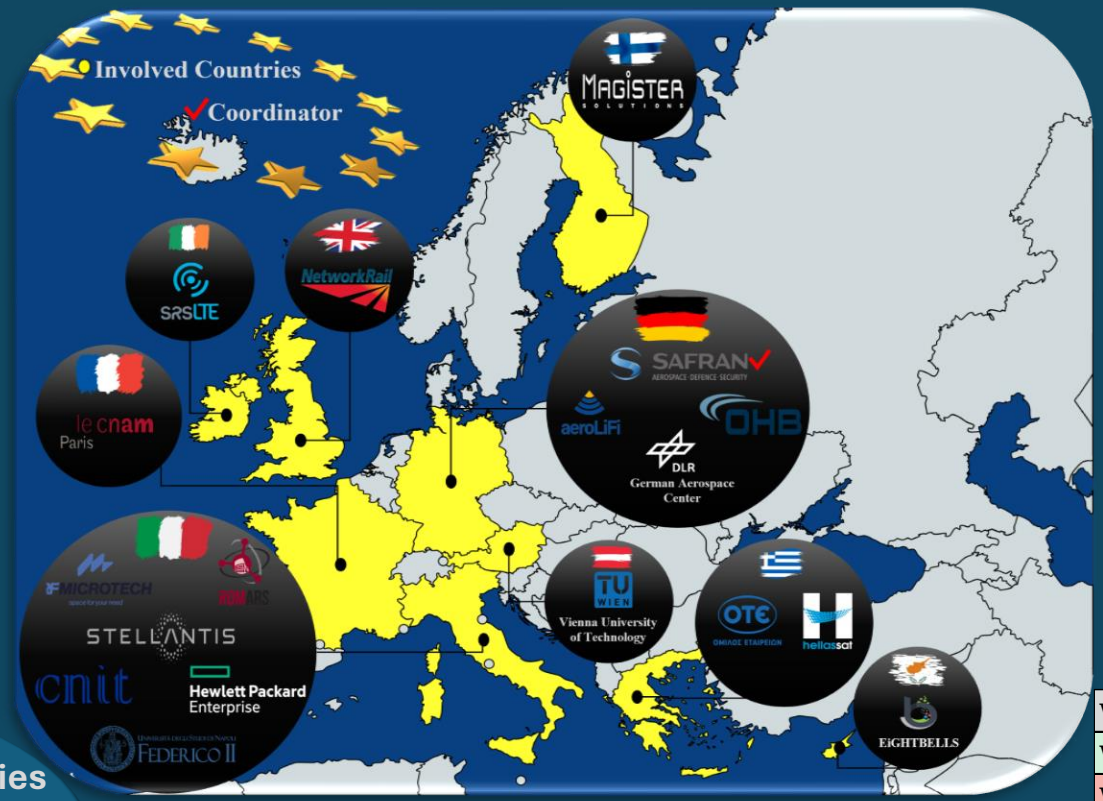
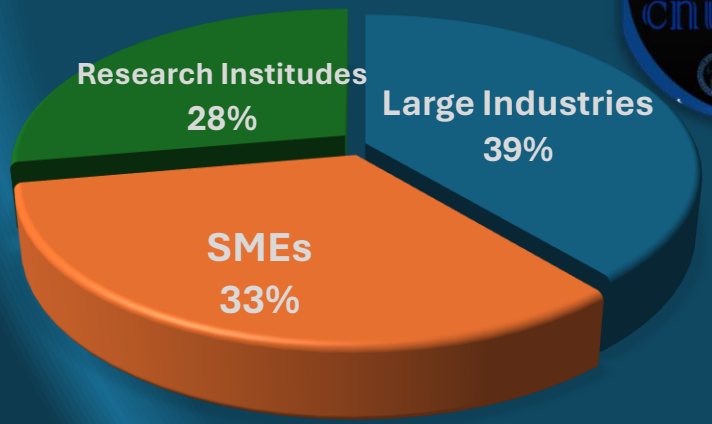
- ✓ 18 partners
- ✓ 9 countries
- ✓ € ~8.5M
- ✓ 36 months (Jan 2025 – Dec 2027)





Project Coordinator:
Dr. Babak Mafakheri
(Safran Germany, SPI)
Technical Manager:
Dr. Tomaso deCola
(German Aerospace Center, DLR)

WorkPackage	PM	Percentage
WP1 (Project Management)	60	7%
WP2 (System Design)	124	15%
WP3 (Technical works)	151	18%
WP4 (Technical works)	146	17%
WP5 (Technical works)	103	12%
WP6 (PoCs)	167	20%
WP7 (Impact & Visibility)	95	11%
Total	846	100%

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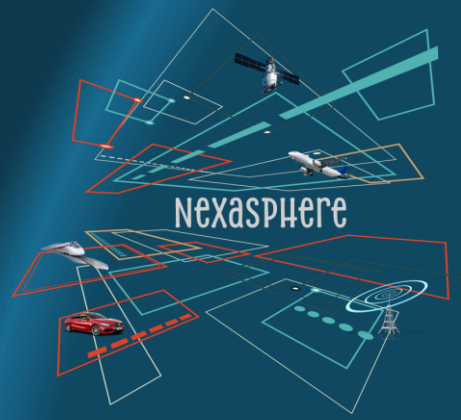

Energy-Efficient Radio-Optical 3D Network Components

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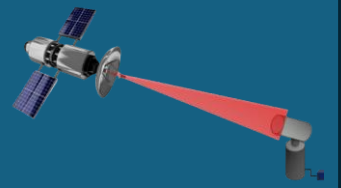
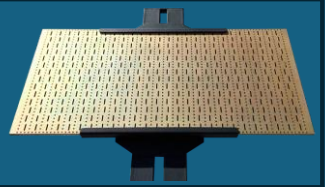
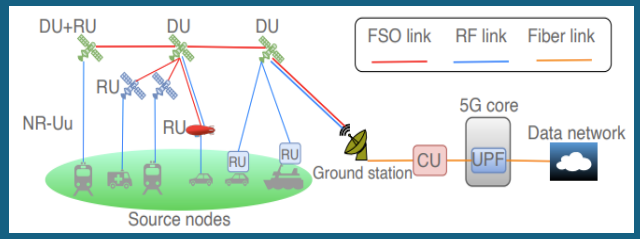
- Wireless Optics
  - Energy-efficient free-space optics and satellite transceivers with on-board computing,
  - Design and prototype implementations of LiFi components and transceivers.



- NTN Antenna
  - Avionic low-profile & more sustainable combined Ku/Ka band antenna
  - Automotive smaller flat antenna in either Ka or Ku band



- Disaggregated RAN
  - An NTN-capable gNodeB with support for LEO & GEO scenarios, with extensions to allow for multi-DU support with NTN & TN DUs



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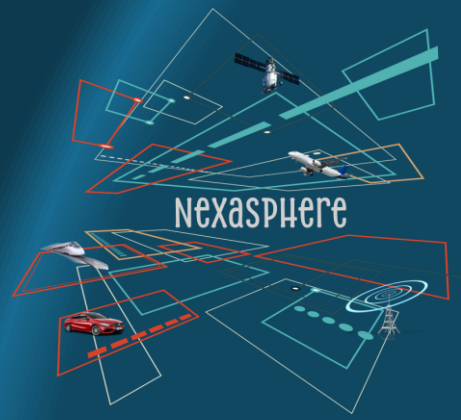

Multi-Connectivity Solutions for Integrated Wireless Radio-Optical 3D Networks

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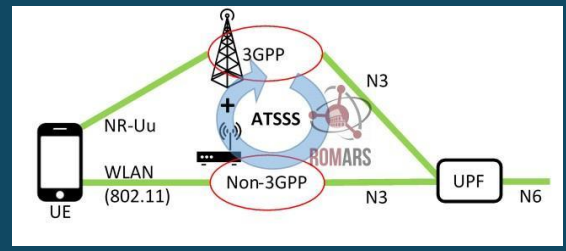
- Multi-Connectivity Solutions for Integrated Wireless Radio-Optical

- Prediction-based models for sustainable connectivity in heterogeneous 3D networks.

- Develop large-scale simulation models for multi-connectivity in 3D networks.



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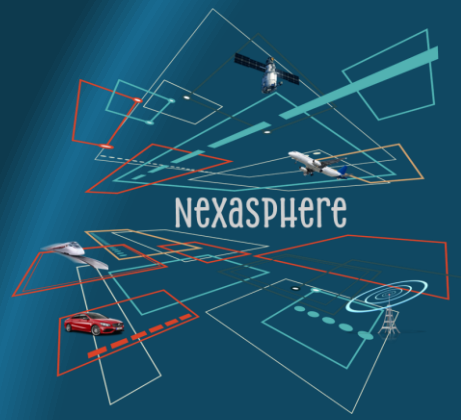
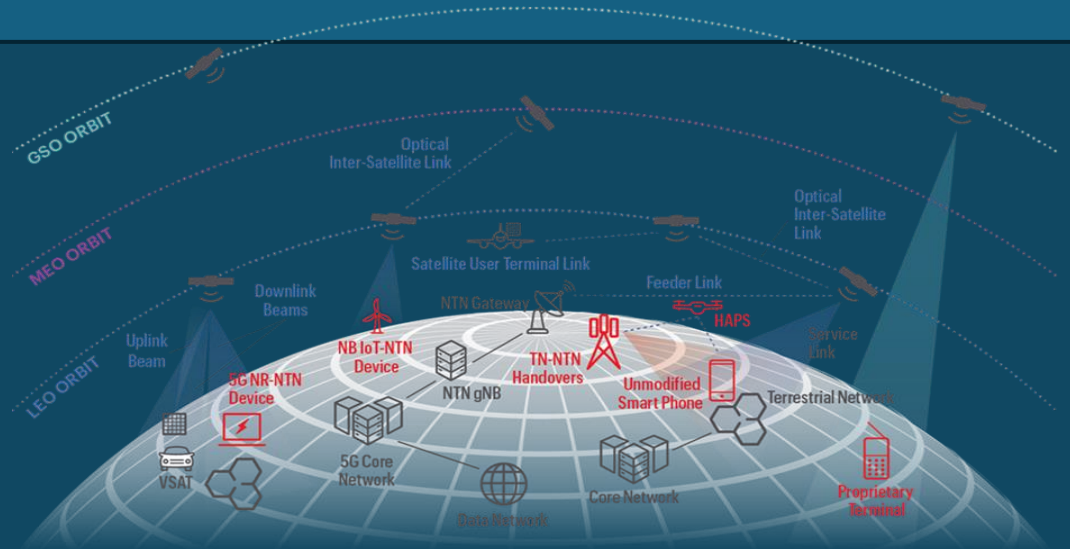


6G TN/NTN Network Management and Orchestration

Co-funded by the European Union

- Development of TN/NTN 3D edge-to-cloud platform development with AI-driven orchestration & resource provisioning.

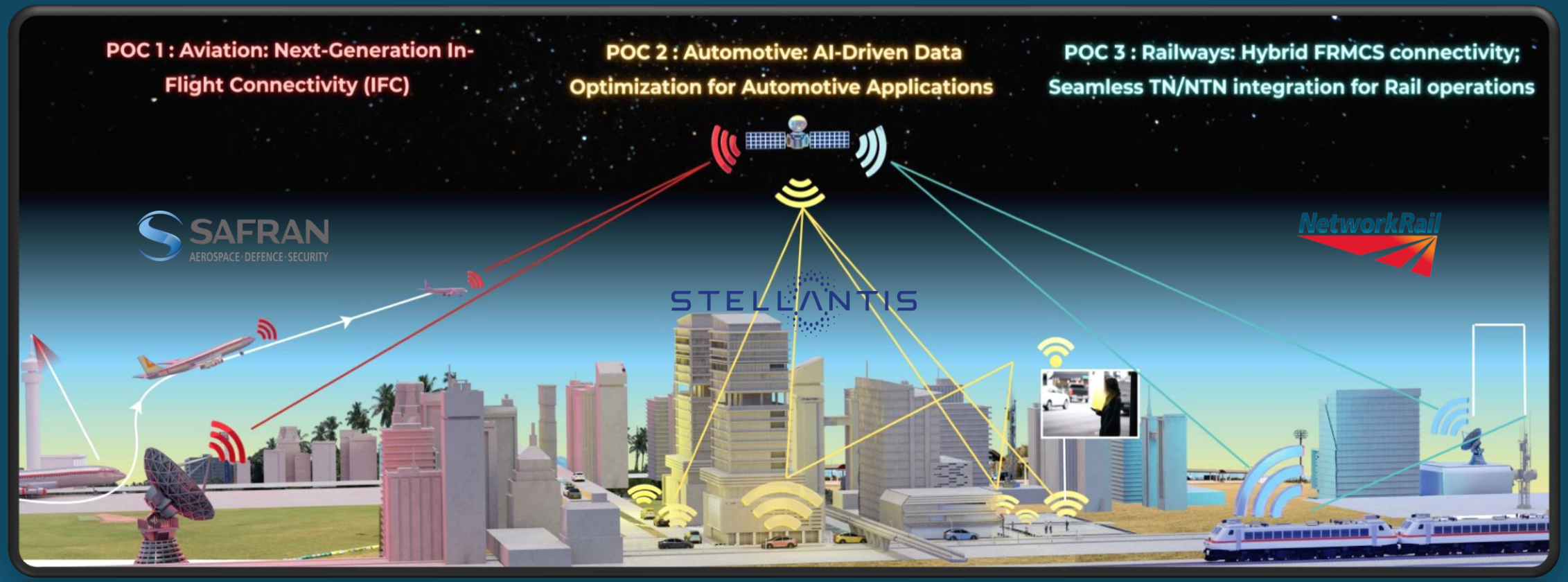
- Design a 6G system architecture with a holistic energy and performance optimization approach across the hyper-distributed edge-to-cloud continuum



3D Continuum

Use-case Integrations, Validation and Demonstration (PoC)

Co-funded by the European Union



PoC1: Aviation

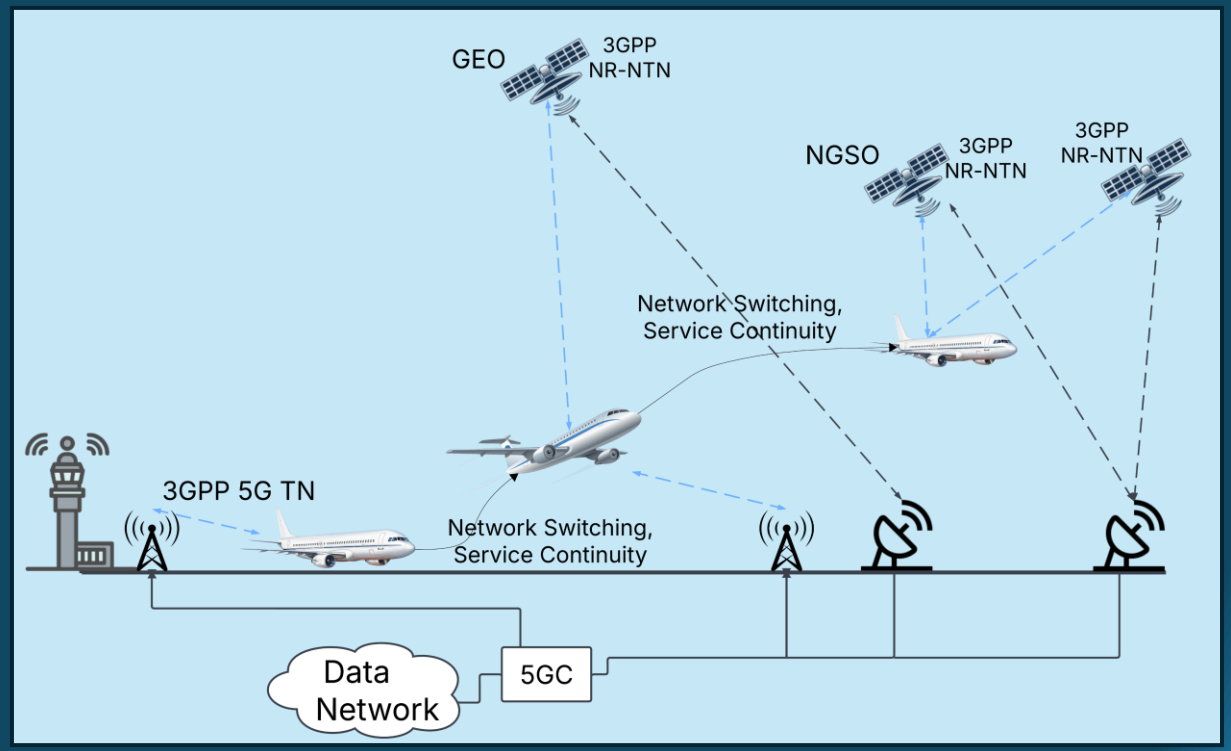
Co-funded by the European Union

Next-Generation In-Flight Connectivity (IFC)

Offboard Connectivity for internet access
Onboard Connectivity to IFE

Use cases:

1. Joint Terrestrial and Satellite In-Flight Connectivity
2. Integration of 3GPP and non-3GPP technologies for access to offboard connectivity
3. Joint connectivity for User Access to In-Flight Entertainment
4. Joint Connectivity for Gate data transfer
5. Resource optimization for In-Flight offboard connectivity
6. Resource Optimization for In-Cabin Access Networks



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PoC2: Automotive

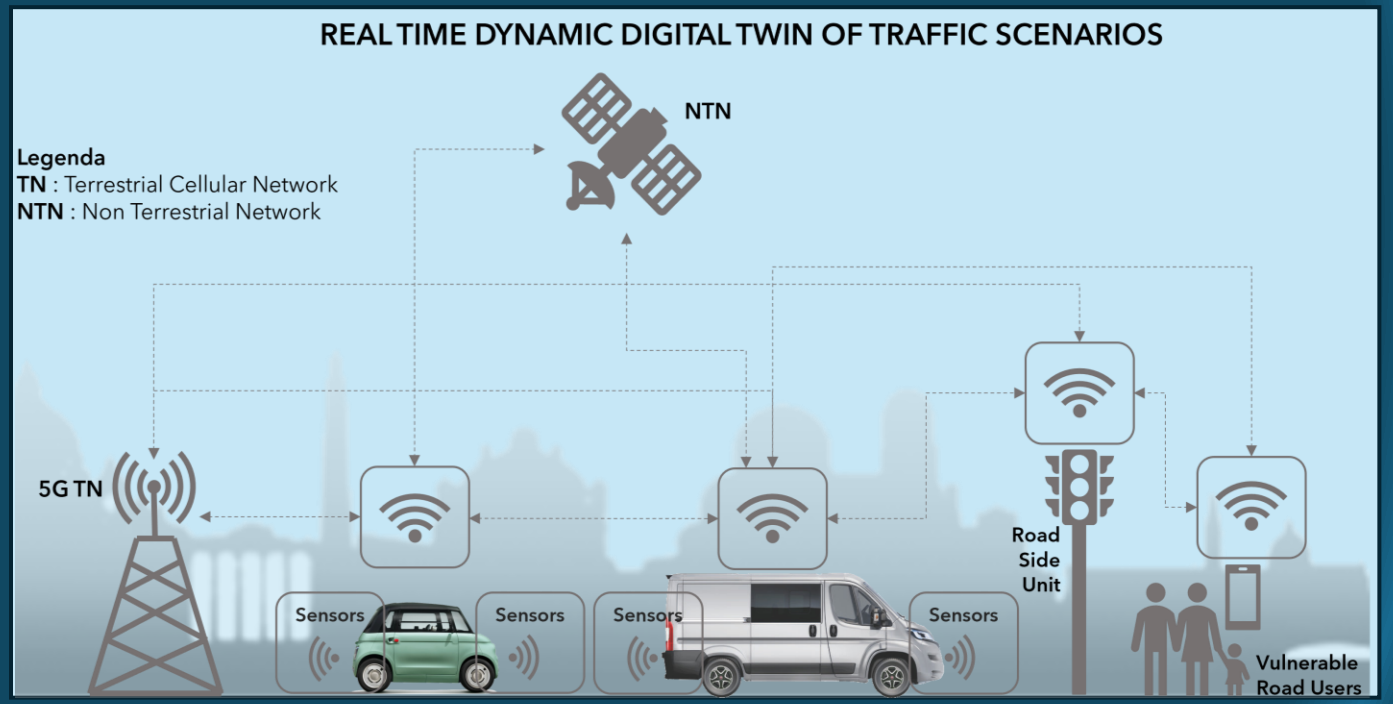
Co-funded by the European Union

AI-Driven Data Optimization for Automotive Applications

Traffic Situation Awareness
Automation Operational Design Domains

Use cases:

1. Connected Automated Passenger Cars in Urban Scenario
2. Hazardous Location Warning
3. Software Update (Autonomous-Urgent)
4. High-Definition Sensor Sharing
5. In-Vehicle Entertainment (IVE) – High-Definition Content Delivery, On-line Gaming and Virtual Reality
6. Coordinated, Cooperative Driving Maneuver



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PoC 3: Railways

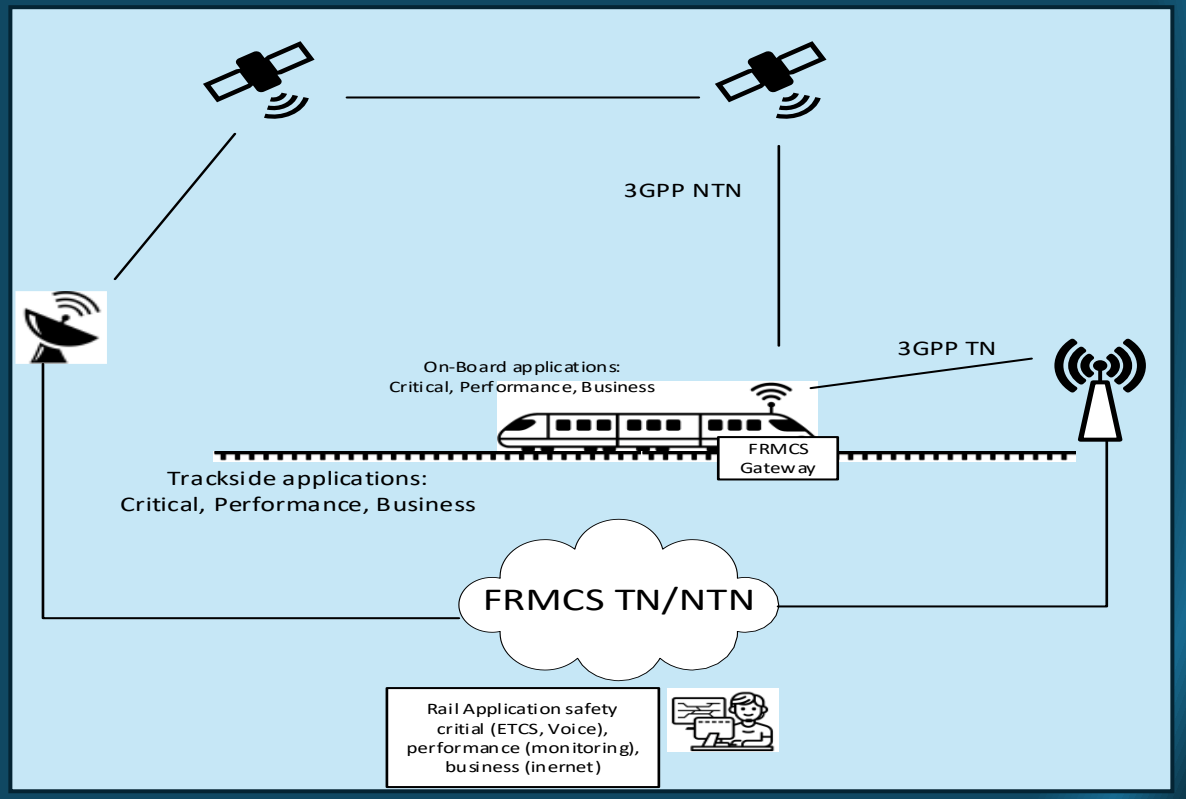
Co-funded by the European Union

Hybrid FRMCS connectivity; Seamless TN/NTN integration for Rail operations

Onboard applications
Trackside applications

Use cases:

1. Joint Terrestrial and Satellite on-board connectivity
2. Optimized Mobility Management and Resource Orchestration for High-speed Trains
3. Ubiquitous IoT Integration for Railway Monitoring
4. Joint Connectivity for User Access to On-board Entertainment



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NexaSphere Structure

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Project Management, Technical Coordination Risk Monitoring ,IPR, Open access

System Architecture

- Scenario definition, Use cases
- Overall System Architecture design
- KPIs, Impacts

Components

- FSO & OBC
- LiFi
- NTN Antenna
- Disaggregated RAN

Algorithms

- Multi-connectivity
- Prediction models (AI)
- Simulation models
- Initial validation

Network Management

- 3D Edge-cloud continuum
- Smart orchestration
- Resource management

Visibility & Impact

Integration, validation, Demonstration (PoCs)

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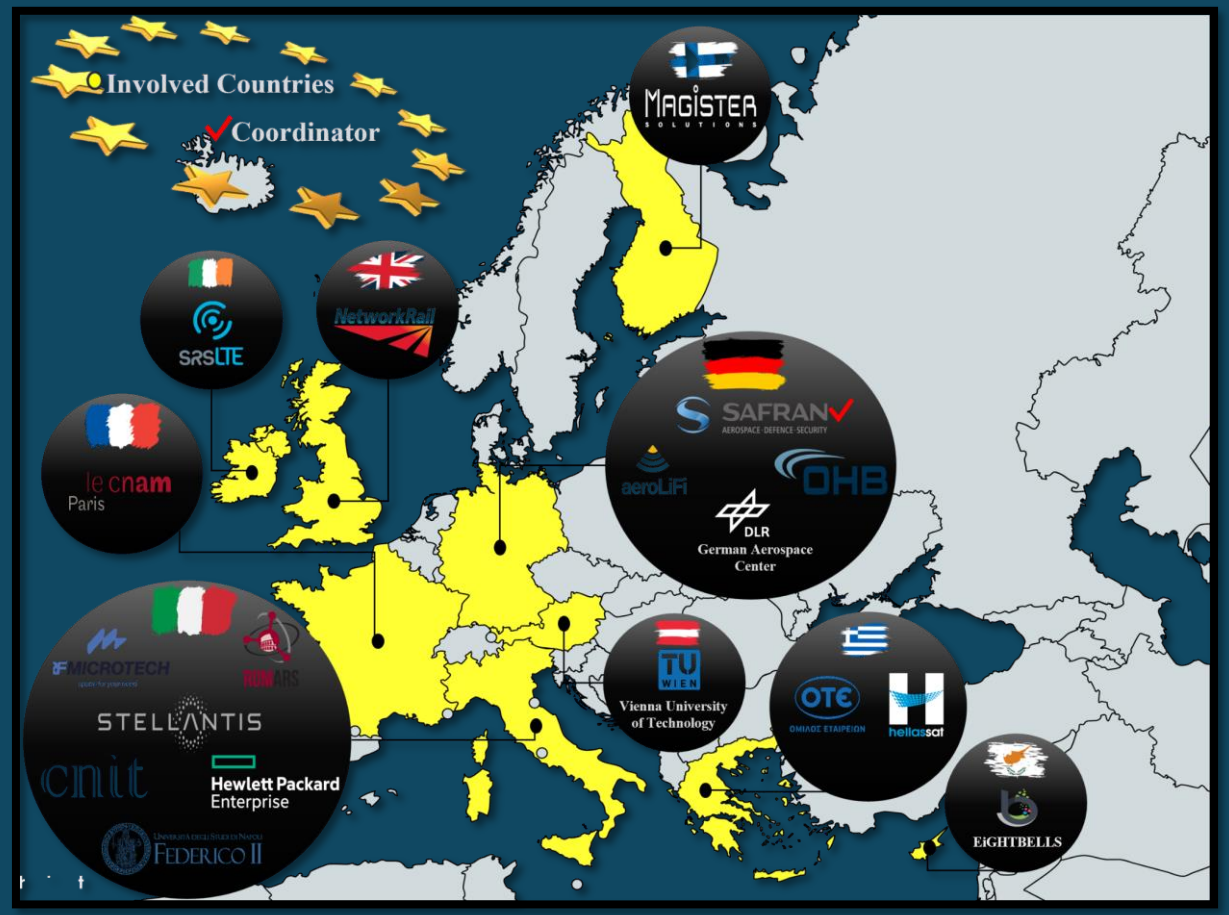
Thank you!

Babak Mafakheri
(Babak.Mafakheri@zii.aero)



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