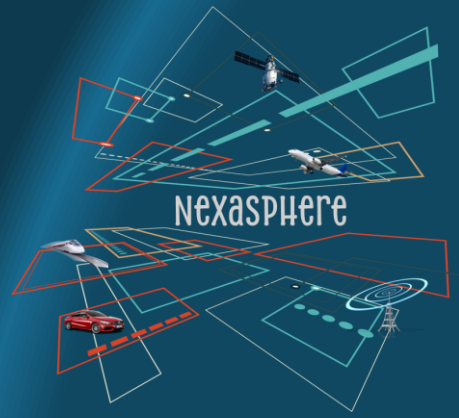


6GSNS

Co-funded by the European Union

Grant Agreement # 101192912

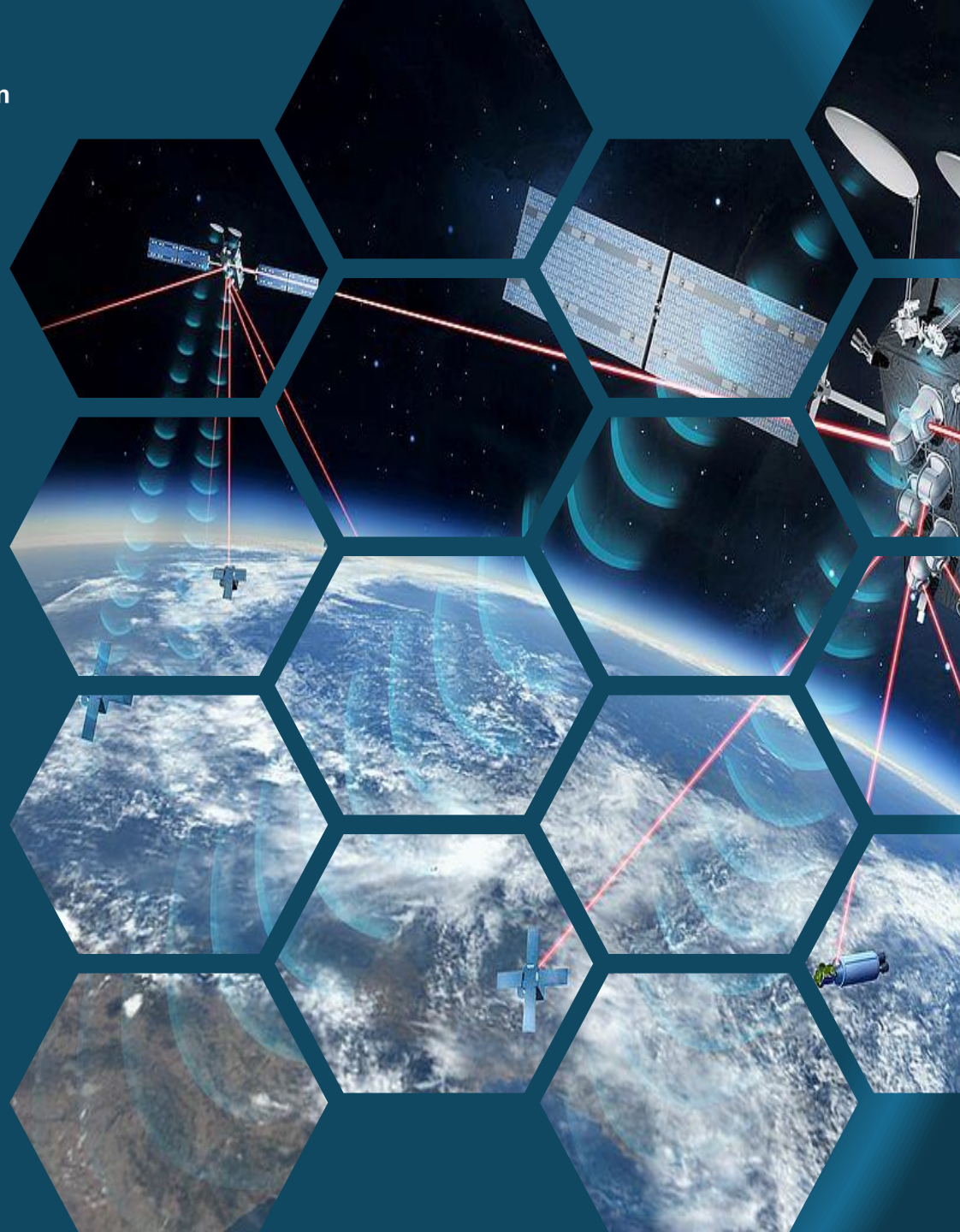
NexaSphere

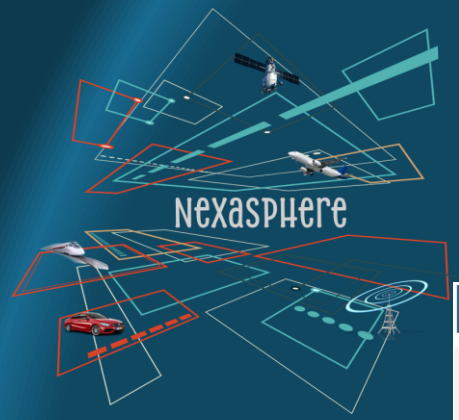
NexGen 3D Networks Spin Harmonies across 6G, AI, and unified TN/NTN.

Presenter : Babak Mafakheri (Safran, Germany)

Project Coordinator

ASMS 2025 Sitges, 26-28 February 2025 SPSC 2025





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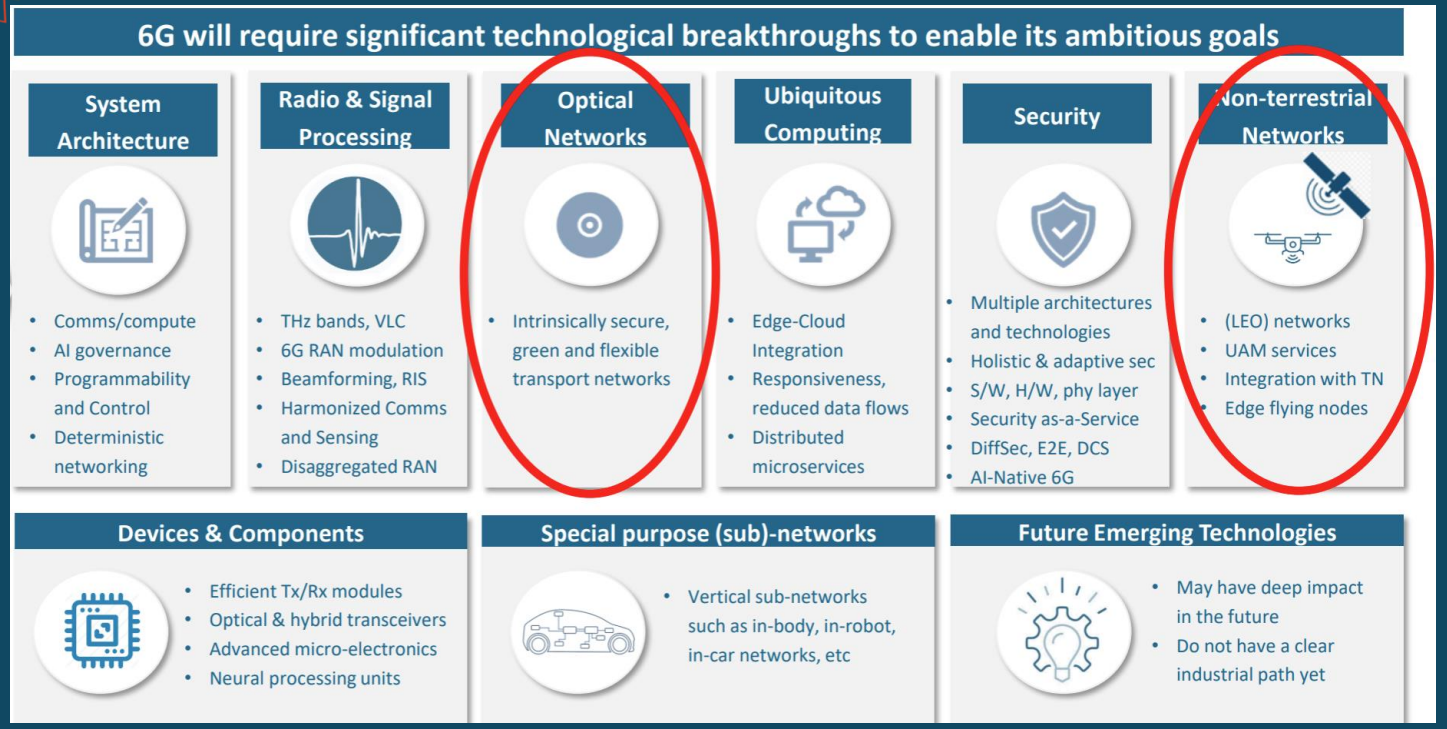
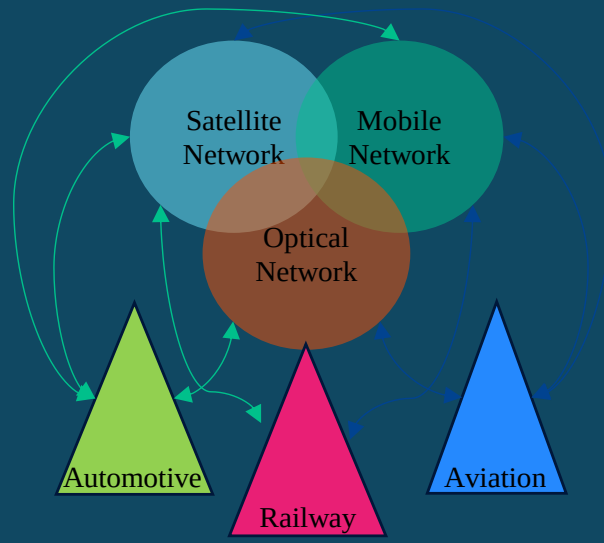
NexaSphere ambitious



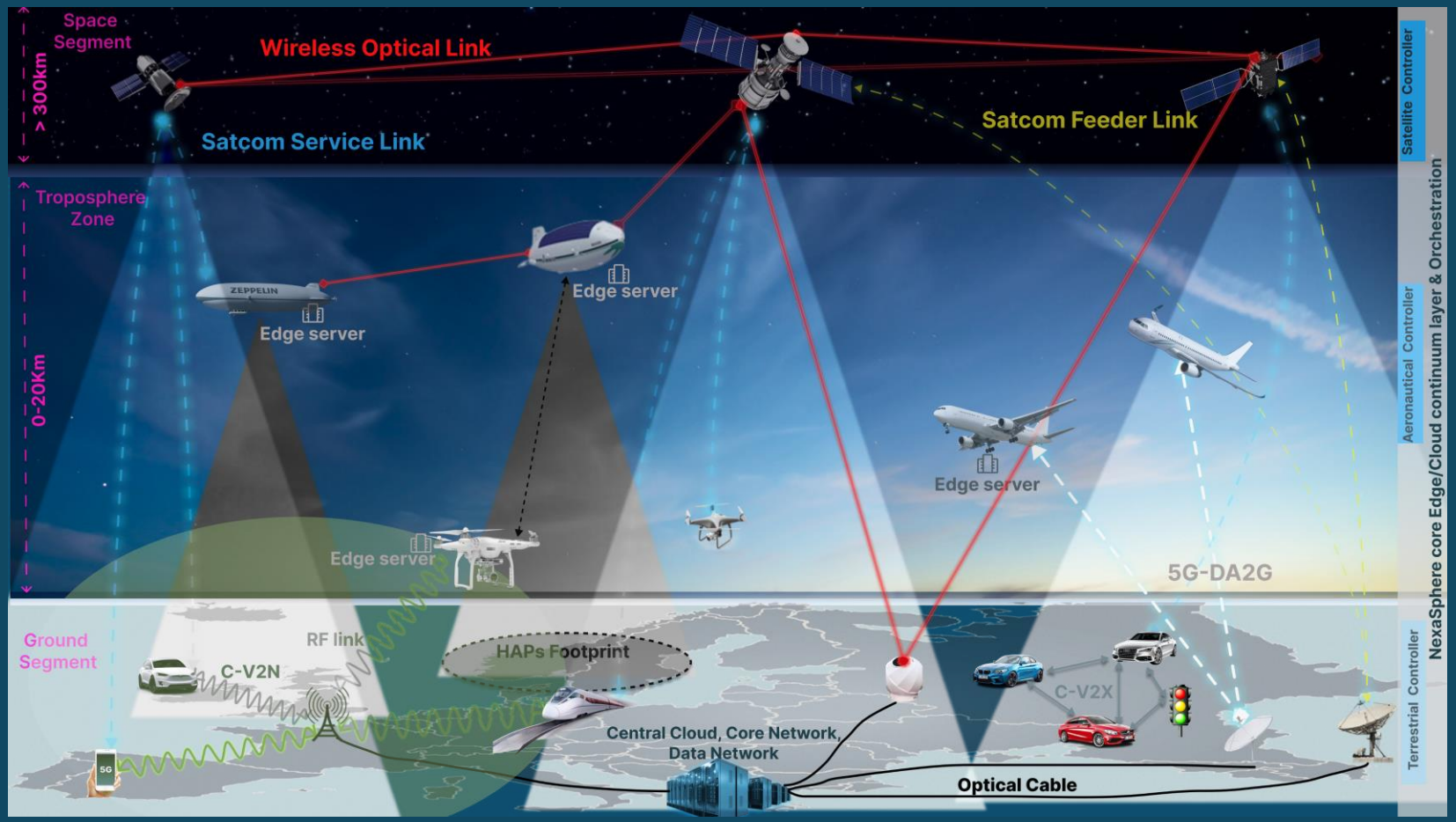


- Source: Networld Europe SRIA - https://www.networldeurope.eu/sria-and-whitepapers/

- 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.

Grant Agreement # 101192912

System Overview



NexaSphere vision of a unified TN/NTN for aviation, automotive, and trains connectivity

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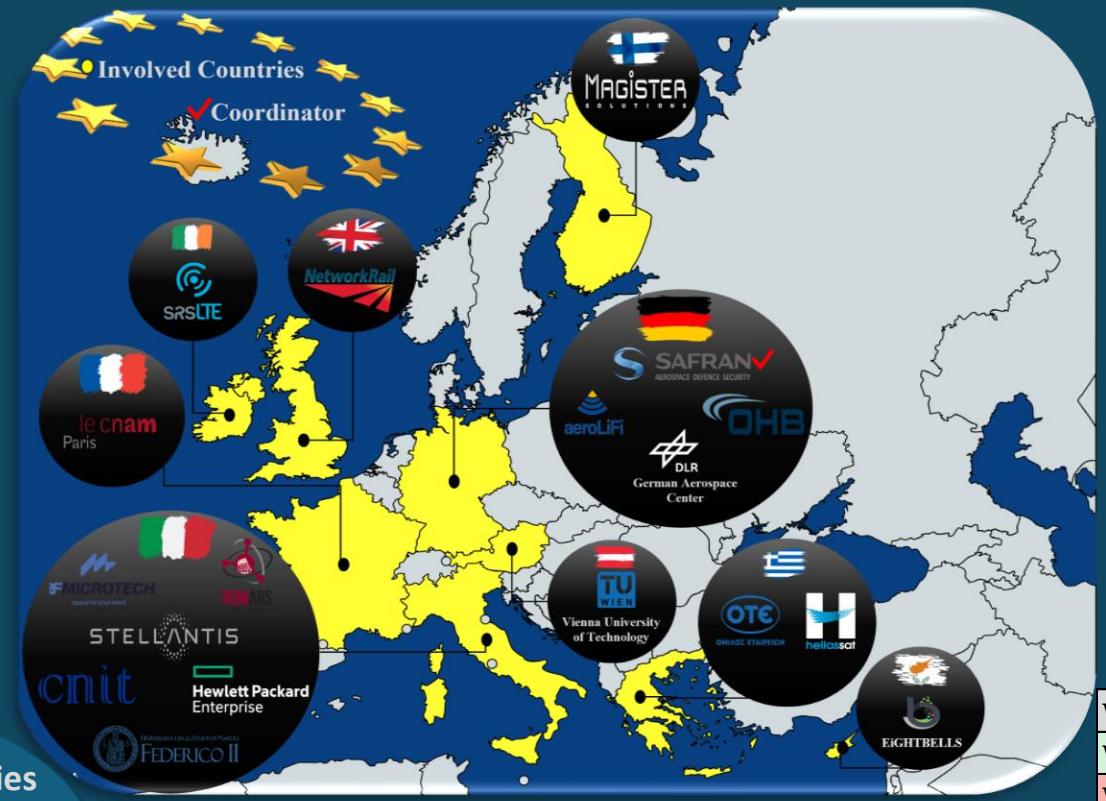
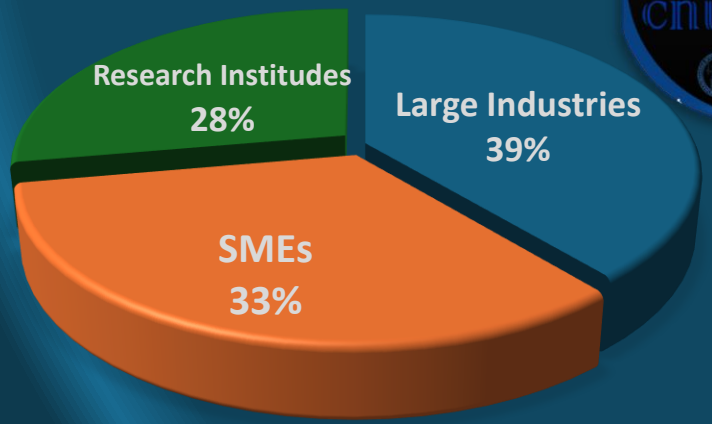
NexaSphere Fact Sheet

Co-funded by the European Union

- ✓ 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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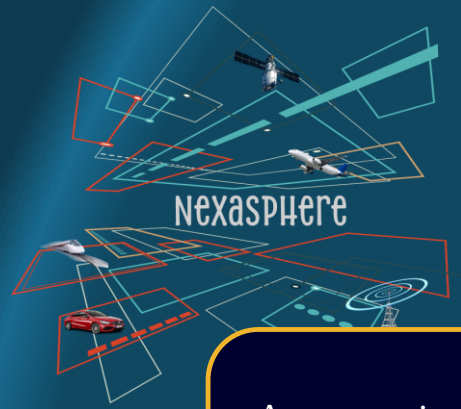

NexaSphere Objectives

Co-funded by the European Union

- Assess societal impact of a 3D TN-NTN integrated network
- Define technical specification for the 3D TN-NTN integrated communication system architecture
- Study, design, and analyze a 6G-based satellite network
- Achieve sustainable data communication through energy-efficient air-interface operations
- Achieve effective coexistence of TN and NTN by means of advanced data-driven multi-path connectivity solutions
- Achieve edge-cloud continuum through space and ground network nodes by means of flexible cross-domain orchestration concepts
- Achieve optimal resource allocation across the whole 6G 3D integrated network
- Design, implement, and demonstrate E2E services over a fully integrated TN-NTN advanced network architecture
- Contribute to the development of a European Research and Technology roadmap integrated by engaging in standardization activities

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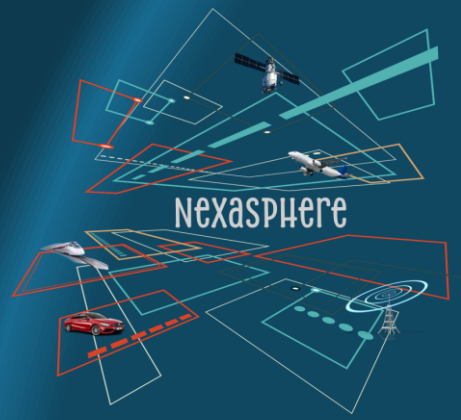
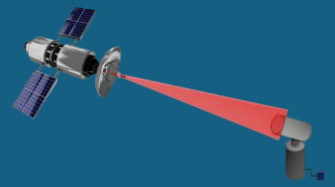


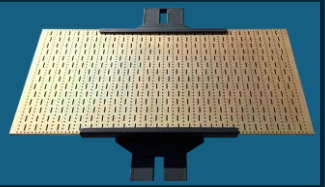
Energy-Efficient Radio-Optical 3D Network Components

Co-funded by the European Union

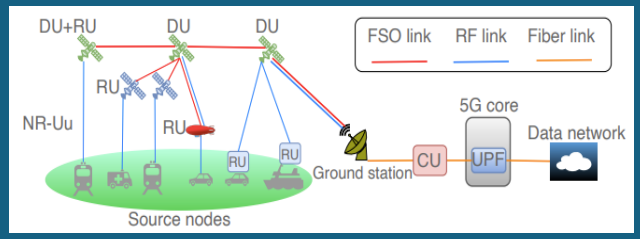
- Wireless Optics
  - Energy-efficient free-space optics and satellite transceivers with on-board computing,
  - Design and prototype implementations of LiFi components and transceivers.



- NTN Antenna
  - Avionic 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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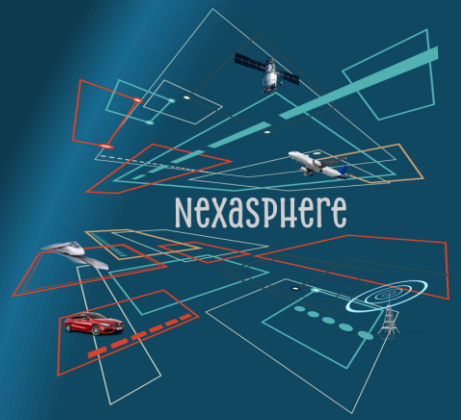
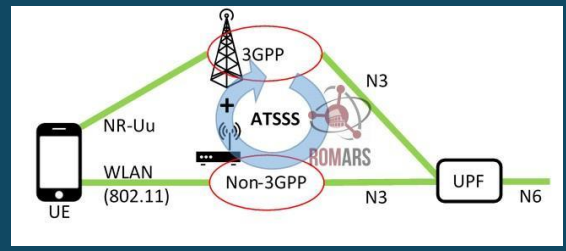


Multi-Connectivity Solutions for Integrated Wireless Radio-Optical 3D Networks

Co-funded by the European Union

- 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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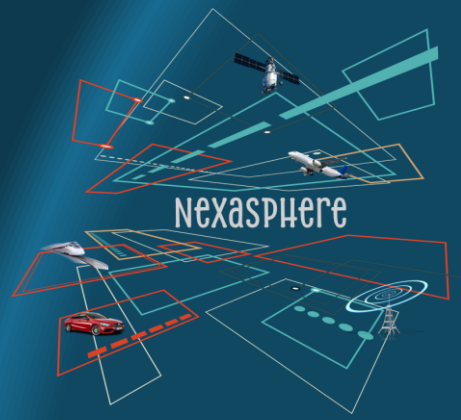
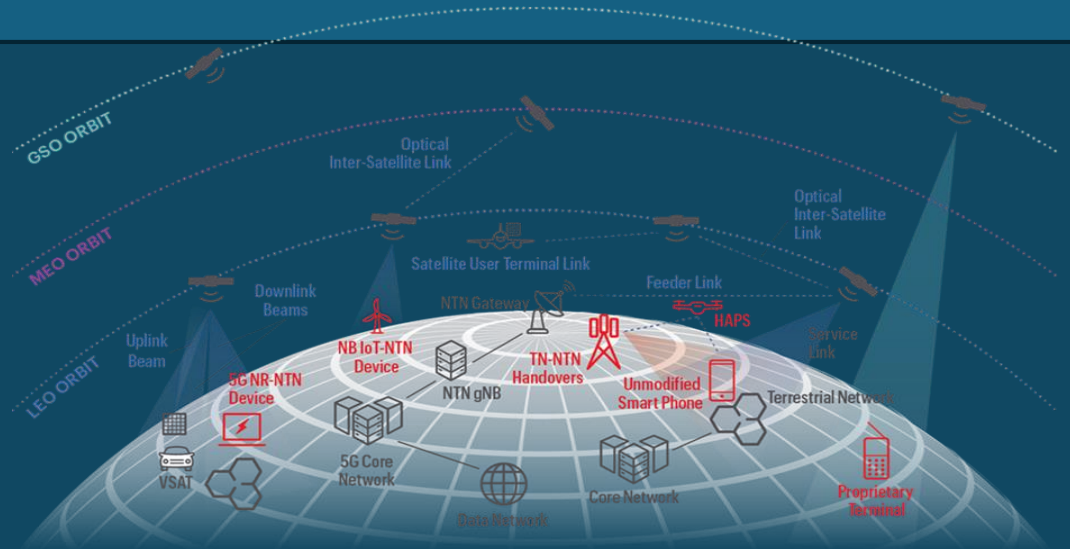


6G TN/NTN Network Management and Orchestration

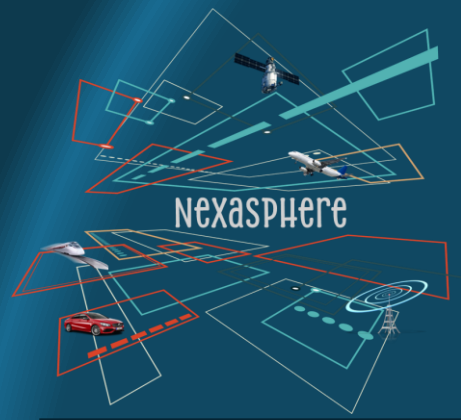
Co-funded by the European Union

- 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)

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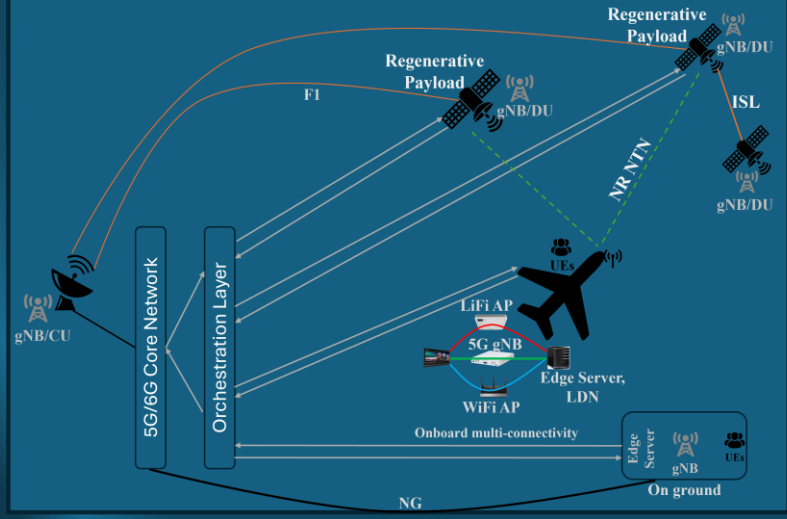
Aviation

- Seamless in-flight NTN connectivity for civilian aircraft
  - Passengers Internet
  - Aero edge-cloud



Automotive

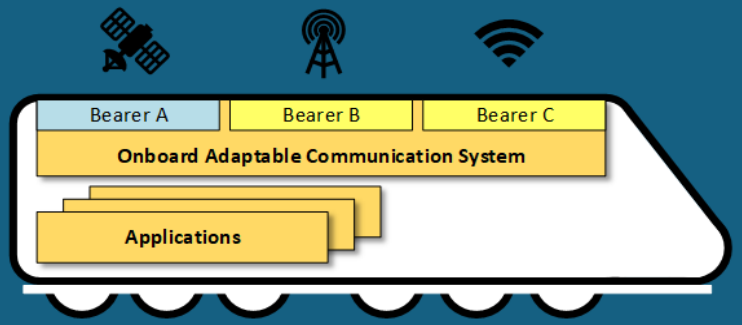
- Healing data hoarding disorder for connected vehicles, with AI-based data distillation
  - Predictive maintenance
  - EV range prediction

Seamless 6G geographical coverage offered by TNs and NTNs

- Advanced Driver Assistance Systems (ADAS)
- Automated Driving Functions (ADFs)

Railways

- Train on-board integration of NTN for improved connectivity, reliability, safety, and operations
  - Predictive maintenance, real-time monitoring, energy management
  - Passenger experience: Ticketing, on-board connectivity, information systems.



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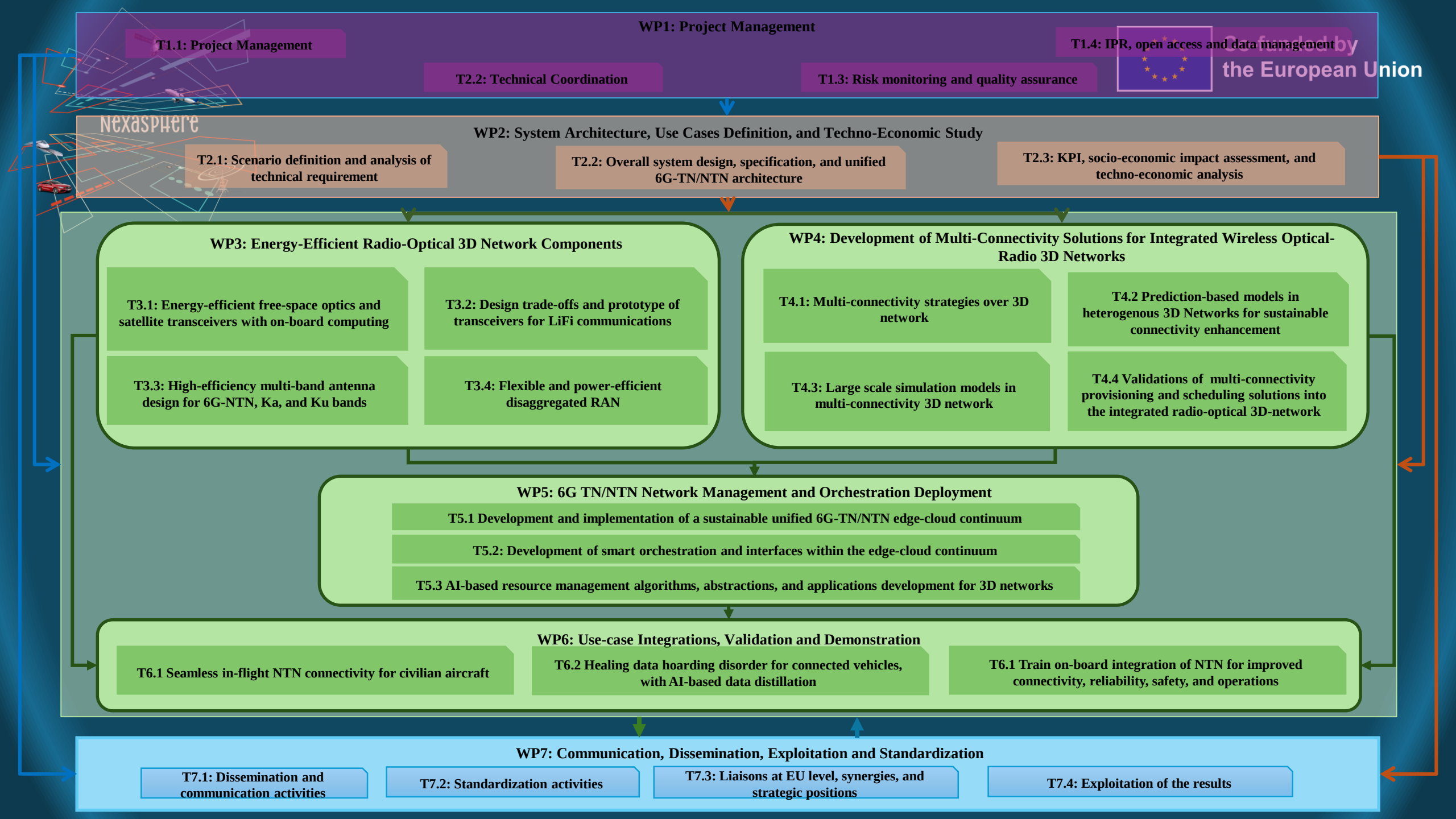
WP1: Project Management
T1.1: Project Management
T2.2: Technical Coordination
T1.3: Risk monitoring and quality assurance
T1.4: IPR, open access and data management
Co-funded by the European Union
Nexasphere
WP2: System Architecture, Use Cases Definition, and Techno-Economic Study
T2.1: Scenario definition and analysis of technical requirement
T2.2: Overall system design, specification, and unified 6G-TN/NTN architecture
T2.3: KPI, socio-economic impact assessment, and techno-economic analysis
WP3: Energy-Efficient Radio-Optical 3D Network Components
T3.1: Energy-efficient free-space optics and satellite transceivers with on-board computing
T3.2: Design trade-offs and prototype of transceivers for LiFi communications
T3.3: High-efficiency multi-band antenna design for 6G-NTN, Ka, and Ku bands
T3.4: Flexible and power-efficient disaggregated RAN
WP4: Development of Multi-Connectivity Solutions for Integrated Wireless Optical-Radio 3D Networks
T4.1: Multi-connectivity strategies over 3D network
T4.2 Prediction-based models in heterogenous 3D Networks for sustainable connectivity enhancement
T4.3: Large scale simulation models in multi-connectivity 3D network
T4.4 Validations of multi-connectivity provisioning and scheduling solutions into the integrated radio-optical 3D-network
WP5: 6G TN/NTN Network Management and Orchestration Deployment
T5.1 Development and implementation of a sustainable unified 6G-TN/NTN edge-cloud continuum
T5.2: Development of smart orchestration and interfaces within the edge-cloud continuum
T5.3 AI-based resource management algorithms, abstractions, and applications development for 3D networks
WP6: Use-case Integrations, Validation and Demonstration
T6.1 Seamless in-flight NTN connectivity for civilian aircraft
T6.2 Healing data hoarding disorder for connected vehicles, with AI-based data distillation
T6.1 Train on-board integration of NTN for improved connectivity, reliability, safety, and operations
WP7: Communication, Dissemination, Exploitation and Standardization
T7.1: Dissemination and communication activities
T7.2: Standardization activities
T7.3: Liaisons at EU level, synergies, and strategic positions
T7.4: Exploitation of the results

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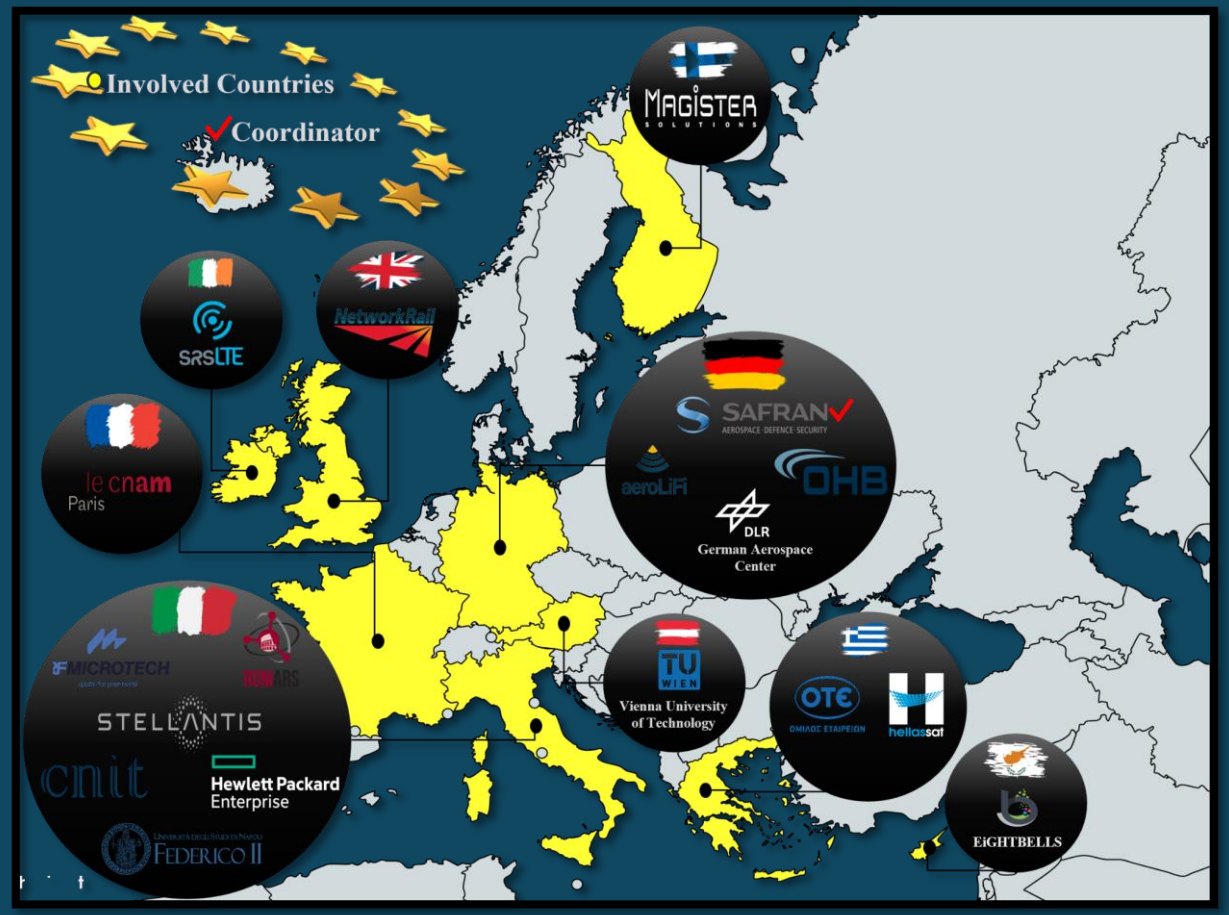
Thank you!

Babak Mafakheri
(Babak.Mafakheri@zii.aero)



NexaSphere Linkedin
https://www.linkedin.com/company/nexasphere-eu

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