# CONNECTING LAND, SKY, AND SPACE:
THE NEXASPHERE PROJECT

NexaSphere is an innovative project focused on creating the next-generation communication network — a 3D network that connects land, air, and space. Our goal is to build a seamless, multi-connected network that supports smart cities, mobile transport, and digital communities well beyond 2030. **NexaSphere** is paving the way for next-generation connectivity, enabling smarter, safer, and more connected transport systems across Europe and beyond.

NEXASPHERE 3D–NTN EDGE/ CLOUD CONTINUUM ARCHITECTURE
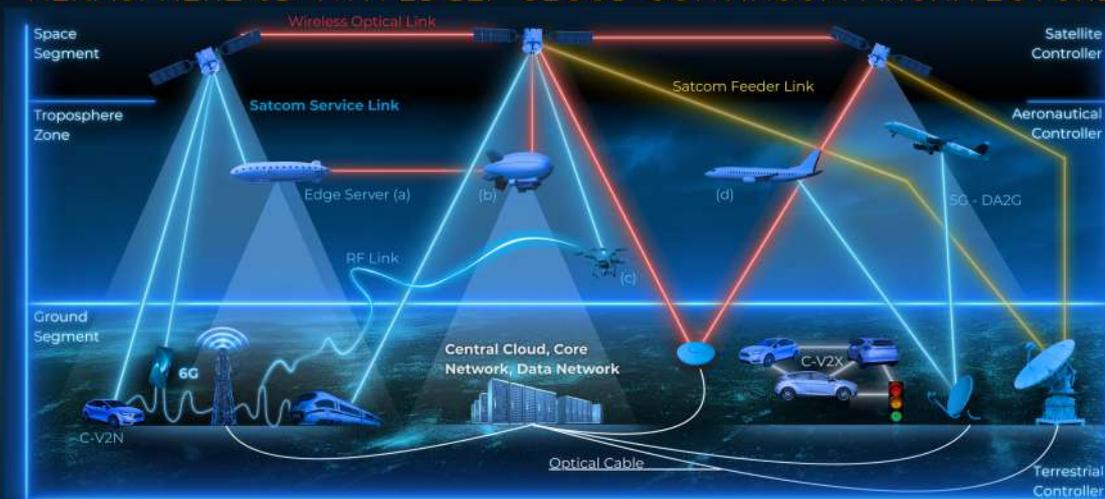
NexaSphere's mission is to design cutting-edge hardware and smart AI-driven software that make this multi-connected 3D network a reality. Focus on creating programmable, sustainable, and secure networks that can adapt to the fast-evolving needs of the digital world.

The objectives of the NexaSphere project reflect a bold and forward-thinking approach to the future of integrated terrestrial and non-terrestrial networks (TN-NTN) in the 6G era. At its core, **NexaSphere** seeks to pioneer innovative satellite network architectures that incorporate onboard processing, energy-efficient operations, and seamless integration with terrestrial systems. By combining RF and Free Space Optics (FSO) technologies, the project targets a resilient, high-capacity communication continuum across space and ground. It further aims to unlock sustainable and adaptive networking through intelligent orchestration, edge-cloud integration, and advanced resource allocation strategies. These objectives collectively enable end-to-end services across diverse verticals—including aeronautics, railways, and automotive—while ensuring alignment with European strategic interests through contributions to standardisation and roadmap development under the Smart Networks and Services (SNS) initiative.

STAY TUNED AS NEXASPHERE MOVES FORWARD TO REVOLUTIONIZE HOW WE CONNECT AND COMMUNICATE IN THE FUTURE!

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Pioneering the 6G Connectivity

NEWSLETTER 1

The NexaSphere project is bringing the vision of next-generation connectivity to life through its Proof of Concept—a practical demonstration of a futuristic 6G ecosystem. By blending AI, optical and radio technologies, and non-terrestrial elements into a unified 3D network architecture, NexaSphere is redefining how we think about seamless communication. With a structured validation process and sector-specific demonstrations led by top industry and academic partners, the project is paving the way for transformative applications in aviation, automotive, and railway sectors.

Proof of Concept 1: Next-Generation In-Flight Connectivity (IFC)

NexaSphere Proof of Concept 1 brings the project's multi-connectivity and AI-driven orchestration to aviation. The goal: a seamless, multi-band, multi-constellation IFC system powered by predictive AI and intelligent antenna management.
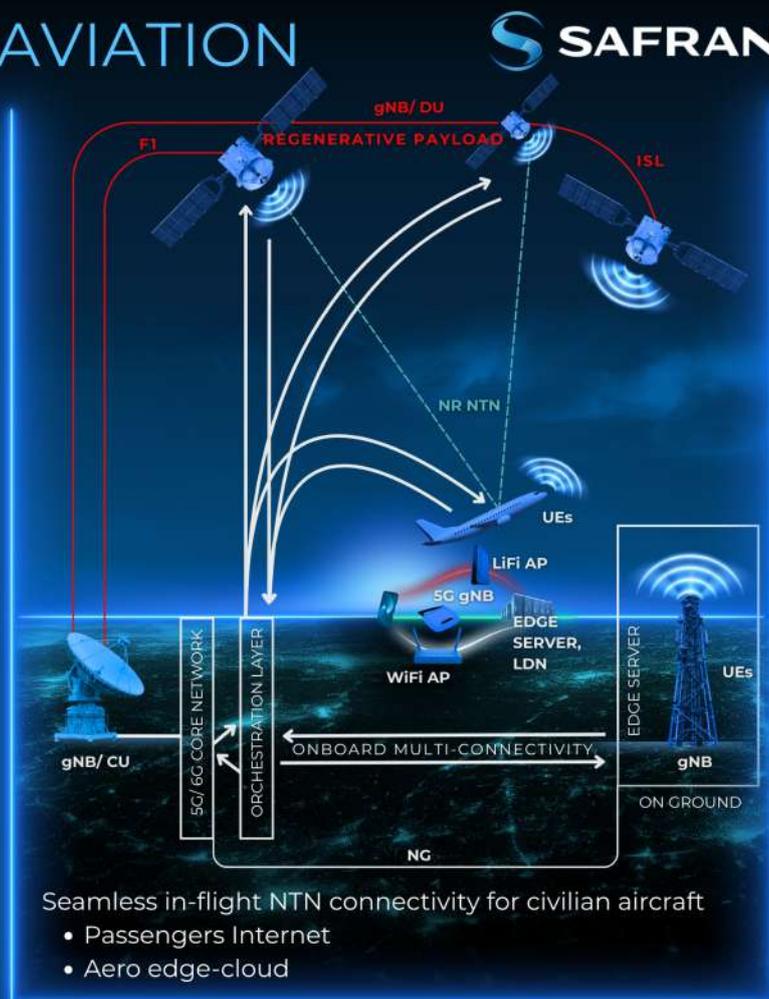
◆ KEY HIGHLIGHTS

- Electronically steerable antennas connect across LEO, GEO & terrestrial networks.
- AI models forecast the best links, balancing power, latency, and data rates.
- Autonomous orchestration manages deployment of containerized applications across aircraft, ground, and space.
- Multi-connectivity models enable seamless use of both 3GPP and non-3GPP links for in-flight connectivity across TN and NTN..
- LiFi integration boosts onboard and gate connectivity for faster IFE access and content loading.

◆ POTENTIAL IMPACT

- Seamless, high-quality internet connectivity for passengers.
- More efficient multi-orbit avionic antenna concepts.
- Enhanced connectivity to support next-generation In-Flight Entertainment services.

AVIATION

SAFRAN

gNB/ DU
REGENERATIVE PAYLOAD
F1
ISL
NR NTN
UEs
LiFi AP
5G gNB
EDGE SERVER, LDN
WiFi AP
EDGE SERVER
UEs
gNB/ CU
5G/ 6G CORE NETWORK
ORCHESTRATION LAYER
ONBOARD MULTI-CONNECTIVITY
gNB
ON GROUND
NG

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

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AUTOMOTIVE

STELLANTIS

Seamless 6G geographical coverage offered by TNs & NTNs

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

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

PROOF OF CONCEPT 2: SMARTER AUTOMOTIVE DATA MANAGEMENT

NexaSphere Proof of Concept 2 addresses the challenge of data overload in 6G by optimizing the volume and quality of data exchanged in automotive systems. Using AI-driven strategies and a seamless terrestrial–non-terrestrial 3D architecture, it ensures smarter, greener, and uninterrupted connectivity—even in remote areas.

◆ **KEY HIGHLIGHTS**

- AI-based optimization reduces redundant data and transmission overhead.
- Edge-enabled data exchange supports safety and non-critical services.
- FOTA, predictive maintenance & EV range prediction.

◆ **POTENTIAL IMPACT**

- Up to 30% reduction in data exchange, storage, and energy use.
- Faster, safer, and more sustainable connected mobility.

PROOF OF CONCEPT 3: SEAMLESS INTEGRATION FOR RAILWAY APPLICATIONS

NexaSphere Proof of Concept 3 advances railway communications by integrating terrestrial and non-terrestrial networks (TN/NTN) to support critical, performance, and business applications. The goal: greater safety, efficiency, and passenger experience across railway operations.

◆ **KEY HIGHLIGHTS**

- Seamless TN/NTN integration for dispatcher–driver voice communication and emergency response.
- Supports ETCS, Automatic Train Operation (ATO), and Rail Emergency Call (REC).
- Optimized connectivity for critical safety systems, real-time monitoring and passenger broadband.

◆ **POTENTIAL IMPACT**

- Enhanced safety & coordination with uninterrupted communication.
- Reliable train control systems to keep services safe and on-time.
- Smoother, more efficient train operations for better punctuality and energy use.
- Better passenger connectivity, enabling seamless on-board digital services.
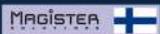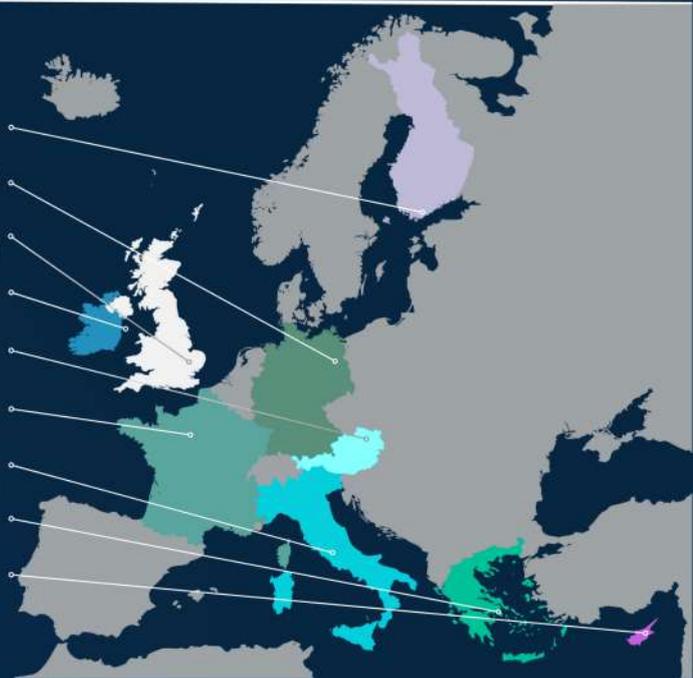
RAILWAYS

NetworkRail

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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Inside the NEXASPHERE Consortium

The NexaSphere consortium unites 18 partners from 9 countries, bringing together a diverse range of expertise to advance the development of next-generation 3D networks. Large industrial organizations contribute extensive experience in systems engineering, communications infrastructure, transportation, and integration. Small and medium-sized enterprises (SMEs) provide specialized technical solutions in networking, hardware, simulation, and integration tasks. Complementing these efforts, research and academic institutions focus on system architecture, algorithm development, evaluation, and play a key role in standardization and dissemination. This well-rounded partnership ensures NexaSphere is equipped to deliver innovative, reliable, and scalable solutions for the future of connectivity.

MEET THE NEXASPHERE PARTNERS:
NVOLVED COUNTRIES

MAGISTER — FINLAND

COORDINATOR
SAFRAN

OHB DLR LiFi — GERMANY

NetworkRail — UNITED KINGDOM

SRS — IRELAND

TU WIEN — AUSTRIA

le cnam — FRANCE

STELLANTIS
cnit Hewlett Packard Enterprise
ROMARS RFMICROTECH — ITALY

OTE sat — GREECE

EIGHTBELLS — CYPRUS

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MEET THE NEXASPHERE PARTNERS:

Safran Passenger Innovations, a business unit of the Safran Group, coordinates the NexaSphere project and leads specific use cases. SPI plays a central role in system architecture, onboard Satcom integration, AI/ML-based prediction models, and edge-cloud infrastructure with certified aero devices. It also actively supports dissemination, exploitation, and standardization efforts.

The **German Aerospace Center (DLR)** serves as the technical coordinator of NexaSphere, contributing to system design, technical requirements, and key innovations in Satcom, Free Space Optics, and NTN antenna design. DLR's departments focus on energy-efficient FSO systems, advanced NTN antennas for automotive, and multi-connectivity for non-terrestrial networks. Also supports edge-in-space development, technology integration for use cases, and contributes to dissemination and standardization activities

aeroLiFi (AER), an innovative German SME, leads specific packages in NexaSphere and brings expertise in indoor LiFi and integrated LiFi/5G systems. Focus on developing next-generation energy-efficient LiFi transceivers and contribute to multi-connectivity by integrating non-3GPP technologies. AER also supports use case integration and helps explore project results.

Conservatoire national des arts et métiers (CNAM), a Paris-based research and education institution, leads technical management in NexaSphere and contributes to multi-connectivity protocols like MPTCP and MPQUIC. CNAM also develops AI-based resource management and supports disaggregated RAN development. Play an active role in Proof of Concepts integration, exploitation, and dissemination activities.

Software Radio Systems Limited (SRS), based in Ireland, contributes to NexaSphere with an NTN-capable gNodeB supporting LEO and GEO scenarios, multi-DU support, and TN/NTN handover. They also provide Near and non-real-time RIC support with advanced service models. SRS is involved in technology integration for Proof of Concepts and exploitation of project results.

8BELLS (BELL) specializes in ICT and business modeling, focusing on AI/ML model development and market analysis within NexaSphere. In this project they support deployment and orchestration of the integrated TN/NTN edge-cloud continuum with a focus on sustainability, and actively contribute to communication, dissemination, standardization, and exploitation activities.

Hewlett Packard Italiana Srl (HPE) plays a key role in NexaSphere by providing a Mobile Core Network for validating and integrating components. Contributes to system design, multi-connectivity validation for 3GPP and non-3GPP access, and offers a disaggregated core enabling edge-cloud continuum architecture. They support use case integration and actively disseminate results through major events and 6G-IA Working Groups.

Stellantis N.V. (STLA) leads the automotive use case in NexaSphere, offering technical guidance on automotive aspects. Also STLA contribute to AI/ML-based resource management and actively participates in dissemination and exploitation activities.

RF Microtech (RFM) brings expertise in advanced antenna design to NexaSphere, focusing on high-efficiency NTN antennas for air mobility and railways. They support system design, use case requirements, and contribute to integration and exploitation activities.

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MEET THE NEXASPHERE PARTNERS:

National, Inter-University Consortium for Telecommunications (CNIT), a leading Italian research institution in telecommunications, contributes to NexaSphere with expertise in edge-cloud orchestration and data-driven service management. CNIT supports system design, TN/NTN integration, use case implementation, and actively engages in dissemination and exploitation, while also leading specific work packages.

The Distributed Systems Group (DSG) at the Technical University of Vienna (TUW) brings expertise in distributed systems, edge-cloud computing, and Serverless architectures to NexaSphere. They develop ML/DL-based models for sustainable 3D connectivity, SLO-aware middleware, and resource management algorithms. DSG also supports system design, Proof of concept demonstrations, and dissemination activities.

Magister (MAG) supports NexaSphere through network simulation and evaluation of communication links. They define scenarios, assess technologies, and contribute to Proof of Concepts integration, standardization, dissemination, and exploitation activities.

Network Rail, owner and manager of most of Great Britain's railway network, plays a key role in NexaSphere, railways use case. They provide expertise to validate and implement project proof-of-concepts. Network Rail also contributes to system architecture, dataset provision for AI/ML, and dissemination activities.

RomARS (ROM), a university spin-off, brings expertise in satellite, 5G, and virtualized networks to NexaSphere. They support non-3GPP multi-access, ATSSS validation, LiFi specification, and contribute to integration and exploitation activities.

Hellas Sat (HSAT) provides satellite communication services across Europe, the Middle East, and Africa. In the NexaSphere project, HSAT contributes primarily to antenna design and supports onboard computing. They also participate in system architecture design and multi-connectivity and provide satellite capacity and infrastructure for Proof-of-Concept validations. HSAT is actively involved in dissemination and impact activities .

OTE, Greece's leading telecom operator, contributes its extensive EU project expertise in defining use cases, requirements, and architecture; developing multi-connectivity solutions and datasets; and integration, testing, validation, and demonstrations. It also supports dissemination, exploitation, and liaison activities. OTE provides 5G NSA/SA testbeds with satellite backhauling for global demo coverage, plus ICT Cloud infrastructure for application hosting.

OHB System, the largest company in the OHB SE group, specializes in complete space systems. It leads scenario and use case definition, supports satellite system design with onboard computing and integrates and validates antennas and modems . OHB also actively contributes dissemination.

University of Naples Federico II (UNINA) is the largest university in Southern Italy, with strong expertise in automotive connectivity. Within NexaSphere, UNINA focuses on defining scenarios and PoCs for automotive use cases, and supports automotive antenna development. Also will contribute to application development particularly for predictive maintenance and EV range prediction.

KEY MILESTONES

Bringing us closer to a seamless and sustainable future of mobility through key milestones..

REDEFINING 6G CONNECTIVITY ACROSS AIR, LAND & SPACE.

2025–26.	mid-2026	2027
Use cases, requirements, KPIs & architecture	PoC specs & testing plan	Validation & demos

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