

Advanced Materials for the Future of High-Speed Communications

Delivering low-power, ultra-high-bandwidth photonic and RF solutions for next-generation telecom infrastructures.



About

LUMINA is a European research and innovation project developing a new generation of ultra-high-speed, low-power photonic and optoelectronic technologies for future communication networks. By combining graphene, electro-optic polymers, and advanced photonic integration, LUMINA aims to overcome the performance and energy limitations of today's telecom infrastructure. The project targets breakthrough devices including modulators, photodetectors, and optoelectronic mixers with bandwidths exceeding 500 GHz. These technologies will be integrated into scalable, CMOS-compatible photonic platforms and demonstrated in real-world wireless and optical communication scenarios for future data centers and 6G networks.





Vision

LUMINA envisions a future where communication systems can sustain exponentially growing data traffic without increasing their environmental footprint. By unlocking the potential of innovative advanced materials, the project seeks to redefine how photonic integrated circuits are designed, manufactured, and deployed. The long-term vision is to

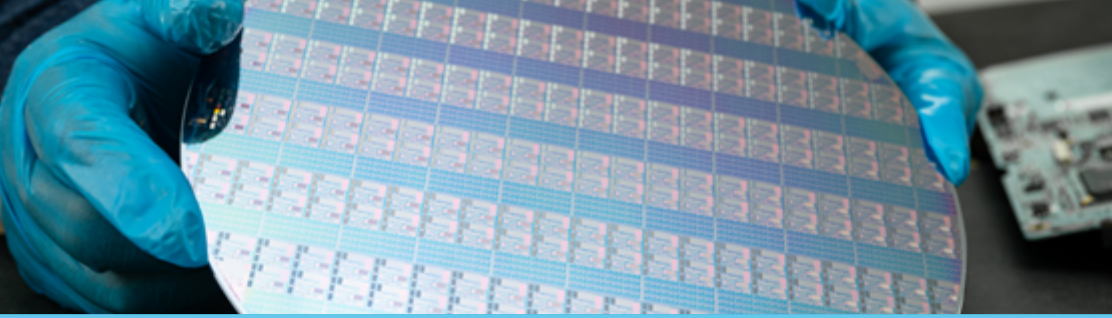
enable terabit-scale wireless and optical communications that combine extreme bandwidth, low energy consumption, compact footprints, and industrial scalability. Through a fully European value chain and advanced manufacturing ecosystem, LUMINA aims to strengthen Europe's leadership in next-generation photonics and communication technologies.



Motivation

The world's digital infrastructure faces a growing challenge: data traffic is increasing dramatically, driven by AI, cloud computing, immersive applications, and future 6G services. At the same time, communication networks and data centers already consume significant amounts of energy, creating both economic and environmental pressures. Existing photonic technologies struggle

to simultaneously deliver higher speeds, lower power consumption, and scalable manufacturing. LUMINA addresses this gap by exploring disruptive material platforms such as graphene and electro-optic polymers, which offer unique opportunities to achieve unprecedented bandwidth, energy efficiency, and integration density for future telecom systems.



Mission & Objectives

LUMINA's mission is to demonstrate that innovative advanced materials can enable a new class of high-performance photonic devices for future communication systems. The project will develop ultra-fast modulators, graphene-based photodetectors, and optoelectronic mixers capable of operating at bandwidths up to and beyond 500 GHz. It will also establish scalable wafer-level integration

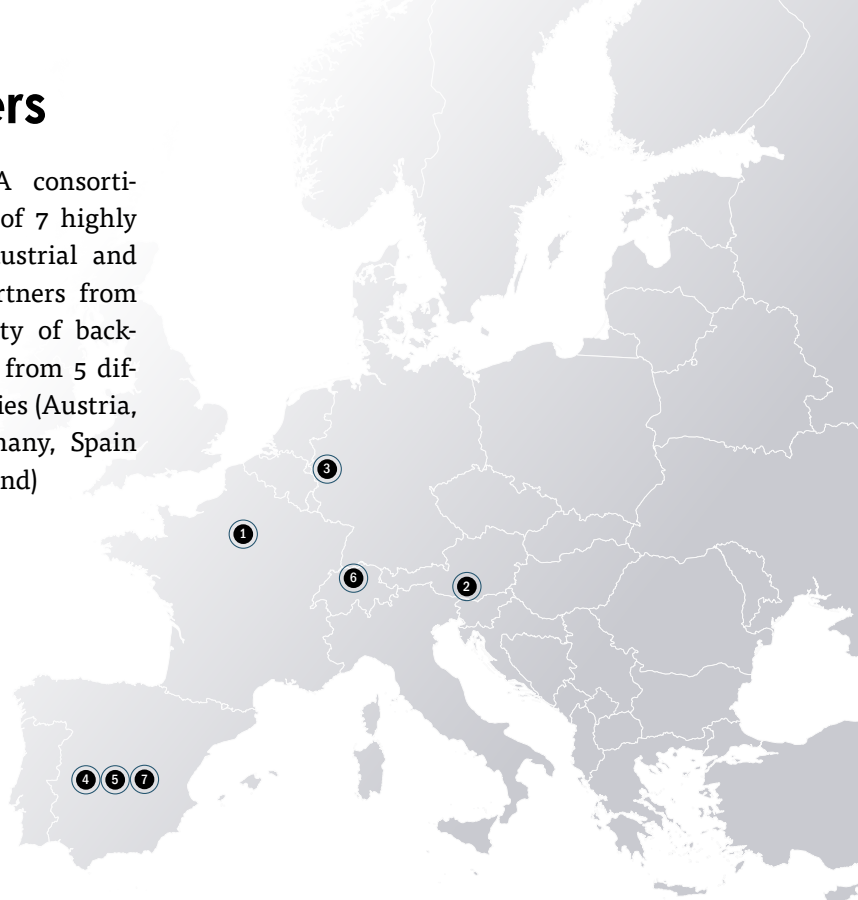
processes, advanced packaging technologies, and low-loss optical interconnects compatible with industrial manufacturing. These developments will culminate in fully integrated prototype transmitters and receivers for wireless 6G and optical data-center applications, validated under realistic operational conditions and advanced to TRL6 readiness.

LUMINA pursues the following objectives:

- Demonstrate EO polymer-based ultra-high-speed, low power consumption, low footprint modulators
- Demonstrate high bandwidth, low power consumption graphene-based optoelectronic mixers with state-of-the-art conversion efficiency
- Demonstrate graphene-based ultra-high-speed and high responsivity photodetectors
- First hybrid integration on wafer-scale of graphene, EO polymers and Al-based plasmonic resonators
- Demonstrate low-losses optical interconnect thanks to additive manufacturing of polymer-based freeform optics
- First integration and packaging of prototypes with a 500GHz RF bandwidth

Partners

The LUMINA consortium consists of 7 highly qualified industrial and academic partners from a wide variety of backgrounds and from 5 different countries (Austria, France, Germany, Spain and Switzerland)



1

THALES

THALES
France [Palaiseau]

2

TECHNIKUN

Technikon Forschungs- und
Planungsgesellschaft mbH
Austria [Villach]

3



AMO GMBH
Germany [Aachen]

4



LEAPWAVE TECHNOLOGIES
S.L.
Spain [Leganés]

5



UNIVERSIDAD CARLOS III
DE MADRID
Spain [Madrid]

6

ETH zürich

EIDGENOESSISCHE TECHNISCHE
HOCHSCHULE ZUERICH
Switzerland [Zürich]

7



TELEFONICA INNOVACION
DIGITAL SL
Spain [Madrid]

Facts



Budget

€ 4.8 Million
€ 4.8 EU-funded



Consortium

7 Partners
5 countries



Duration

48 Months
09/2026 - 08/2030

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