

Thales unveils three quantum technologies set to revolutionise the world of tomorrow

- Thales welcomes France's ambitious quantum plan, which is crucial to supporting research in this sector.
- Thales researchers are playing a central role in the quantum revolution and are now developing the next generation of quantum solutions that will shape the world of tomorrow: quantum sensors, quantum communications and post-quantum cryptography
- Using cold atom technology, flawed diamonds and superconducting devices, the Group's teams are combining their efforts to harness unexploited properties of matter and unleash a whole host of new opportunities.
- As a major player in the Saclay ecosystem and Europe's leading industrial research laboratory in the field of physics, Thales is continuing to team with academia, industry and the start-up community to accelerate the development of sovereign quantum technologies

Accelerating the development of these technologies thanks to the France's quantum plan

Thales welcomes the ambitious quantum plan launched by the French government, which will speed the development of the promising, sovereign technologies of quantum sensors, quantum communications and post-quantum cryptography.

The Group continues to invest 1 billion euros annually in self-funded R&D, pushing back the limits of the possible and helping to sustain the excellence of French and European research to serve Thales customers.

Quantum sensors: augmenting and expanding human senses to better understand our environment

Smart homes, self-driving cars, automated trains, air traffic control, Industry 4.0, new energy sources, connected medical devices and services, latest-generation defence and security systems... None of this would be possible without the **countless types of sensors** that exist in the world today.

Sensors come in all shapes and sizes. From the simplest meat thermometer in the kitchen to the most sophisticated radars used in air traffic surveillance, sensors play a crucial role in improving human understanding of the world we live in.

In an environment that is more and more connected and digital, quantum sensors **augment and expand human senses to create new knowledge**. Research is underway at Thales laboratories into several types of sensors:

- **Superconducting quantum interference devices** (SQUIDs) are being extensively studied today with a view to developing **miniature quantum antennas** to detect communication signals over a very large portion of the radiofrequency spectrum and offer a competitive advantage, particularly at low frequencies. These superconducting devices could have applications in a wide range of areas, including brain imaging and particle detection.

- **Solid-state quantum sensors**, such as nitrogen-vacancy (NV) colour centres in diamonds, have demonstrated their ability to **measure extremely subtle magnetic fields**. This type of ultra-sensitive sensor could be used in numerous applications, ranging from bio-sensors to magnetic resonance imaging (MRI) and detection of defects in metals.
- **Rare earth ions** will be used to characterise and process radiofrequency and optical signals. Continuous, wideband **radiofrequency spectrum analysers** based on rare earth ions offer a way to relieve network congestion and optimise frequency utilisation — frequencies being a scarce resource — and could also have applications in military intelligence.
- Thales is also exploring the use of cold atom technology in future quantum inertial navigation systems for aircraft. At present, an aircraft taking off from Paris equipped with only a conventional inertial navigation system can land in New York with a precision of within a few kilometres. With future quantum sensors, aircraft will be able to navigate and land with a precision of within one metre.

Quantum sensors have a promising future in a broad range of sectors. New, ultra-sensitive, miniaturised magnetometers will revolutionise medicine, with numerous applications ranging from new-generation miniaturised MRI systems to diagnosis of brain tumours or changes in cognitive functions.

The key role of quantum communications: making communications completely trustworthy and managing future networks of quantum objects

In a digital economy where **communications play a vital role**, and with the relentless increase in data rates in fixed and mobile communication systems, quantum technologies will make it possible to **secure communications with inviolable cryptographic keys** based on the quantum properties of light. The principle of quantum communications has been established for some time in point-to-point networks, but the **quantum Internet** of the future will need to apply these concepts to large-scale networks. Thales is pioneering the design of these future network architectures, both for ground-based network elements and for the space-based components needed to share cryptographic keys over long distances. Thales is part of EuroQCI, a large-scale European project working to deploy a **quantum secured network** of this type to establish an ultra-secure Europe-wide network for sharing sensitive data.

Beyond quantum secured communications, **quantum data** such as qubits, the basic units of quantum information, could be shared across a **quantum information network**. This type of network could interconnect systems such as quantum sensors and quantum computers, leveraging quantum physics to build integrated systems delivering **order-of-magnitude improvements in performance**. Although it will be some time before these systems are available, the basic building blocks of quantum information networks, such as quantum memories, entanglement sources and protocols, are already being designed.

Post-quantum cryptography: acting today to protect our systems from the quantum computers of tomorrow

Communications security is a strategic necessity for governments, businesses and private citizens. Today, communications security mainly uses RSA crypto-systems, which rely on the

difficult mathematical problem of breaking down a number into its prime factors. The algorithm for future **quantum computers** that could break RSA encryption, **undermining the rationale behind existing cryptographic techniques**, is already known. Thales is building on its experience in information systems security to develop alternative encryption methods using other mathematical problems to withstand quantum computers. These methods, combined with the use of quantum keys, will provide deeper, more persistent and more unconditional protection for our data assets.

To know more :

- Discover the [open-editorial](#) about quantum from Patrice Caine, CEO of Thales, and his [latest speech](#) at the NOVAQ innovation forum on how to build a trustable future thanks to high technologies
- The Group's latest [podcasts series](#) on quantum science

About Thales

Thales (Euronext Paris: HO) is a global high technology leader investing in digital and “deep tech” innovations – connectivity, big data, artificial intelligence, cybersecurity and quantum technology – to build a future we can all trust, which is vital to the development of our societies. The company provides solutions, services and products that help its customers – businesses, organisations and states – in the defence, aeronautics, space, transportation and digital identity and security markets to fulfil their critical missions, by placing humans at the heart of the decision-making process.

With 83,000 employees in 68 countries, Thales generated sales of €19 billion in 2019 (on a basis including Gemalto over 12 months).

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