Innovation Annual Report 2024

Where passion leads to excellence

ADVANS GROUP | AVISTO · ELSYS DESIGN · MECAGINE

> **In 2024, we turned challenges into opportunities, strengthening our leadership through bold investment and constant innovation.**
>
> **Radomir JOVANOVIC**
> **CEO — ADVANS GROUP**

The year 2024 was marked by major economic challenges that affected all sectors, including ours. However, despite this complex context, we not only managed to stay on course but also transformed these challenges into real opportunities for growth and innovation. Innovation remains at the heart of our strategy, and I am particularly proud of our teams' achievements this year. Among the key moments, we made bold decisions that position us sustainably in high-potential markets.

First, our investments in Akidaia, a company specializing in electronic and cryptographic software solutions for access security, position us at the forefront of digital security, a key sector for the future. Then, our entry into the capital of Crystal Quantum Computing allows us to be directly involved in the quantum computing revolution, a technology that will profoundly transform our industry.

Our commitment to innovation is also reflected in our support for technology startups. This year, we supported two promising startups as part of our ADVANS Accelerator program, in partnership with Rise Partners. These collaborations illustrate our desire to enrich the innovation ecosystem, providing entrepreneurs with the necessary resources and expertise to accelerate their growth.

Internally, we have expanded our intrapreneurship approach with the deployment of our Into the Lab program to all our international subsidiaries. Now accessible beyond France, this initiative allows our talents, wherever they are, to propose and develop innovative projects by leveraging the company's resources. It is a powerful lever to encourage creativity and innovation at all levels of our organization.

Finally, our integrated approach, which combines our expertise in R&D and consulting, continues to provide us with a competitive advantage. By closely collaborating, these two divisions transform our technological advancements into pragmatic and tailor-made solutions for our clients, ensuring that we remain at the forefront of innovation while effectively meeting market needs.

The successes of this year are the result of a clear strategy and a constant commitment to innovation. We remain resolutely focused on the future, determined to anticipate technological trends and seize the opportunities that will shape tomorrow.

L'équipe

Jean-François Béraud, Ph.D., PMP® - Innovation Director

Jean-François Béraud has over 20 years' experience in managing innovation, projects and complex programs. Currently Innovation Director at ADVANS Group, he is responsible for identifying partnership and investment opportunities with startups, while supporting strategic initiatives for the group. Previously, he held key positions such as Senior Business Manager at AViSTO and Chief Technical Officer at Altran, where he managed large-scale projects and improved the productivity of technical teams. Jean-François holds a PhD in computer science with a specialization in graph theory, has been PMP® certified since 2003, and recently obtained a Master's degree in Innovation Management from the Ecole Polytechnique.

Pierre Romet, Ph.D. - Scientific Manager

Pierre Romet, Scientific Manager at ADVANS LAB, is an embedded systems engineer with expertise in artificial intelligence applied to transport. He holds a PhD from the Université de Technologie de Belfort-Montbéliard, where he developed innovative solutions for the delivery of goods by drone and the optimization of autonomous vehicles. His experience also covers computer vision, mixed reality simulation, and the optimization of battery use in intelligent transport systems. Pierre is an active contributor in the academic field, with several publications, teaching experience, and a passion for technological innovation. He is recognized for his ability to integrate complex solutions in real-world environments, while collaborating effectively with multidisciplinary teams to achieve ambitious goals.

Théophile Charlet, MSc – Venture Capital Analyst and M&A Project Manager

Théophile Charlet is a venture capital analyst and M&A project manager with experience in financial analysis, investment strategy and mergers & acquisitions. Currently at ADVANS Group, he leads sourcing, top and bottom line analysis, and due diligence activities for M&A projects, while participating in the valuation of target companies in the indicative phase. At the same time, he acts as a venture capital analyst at ADVANS LAB, where he conducts due diligence and develops financial models. He also has experience in strategy consulting for the TMT sectors and credit analysis for SMEs. A graduate of engineering school, Théophile also holds an MSc in Quantitative Finance and is pursuing his Chartered Financial Analyst course, having already successfully passed the first two levels.

Highlights of 2024

ADVANS Startup Day

In January, ADVANS Lab organized the first edition of its "Startup Day", marking an important milestone in the growth of its ecosystem. The event brought together the ten technology startups in the ADVANS Lab portfolio, from regions including Sophia Antipolis, Nice, Paris, Lille, Grenoble, Aix-en-Provence and Marseille. Among them, four new companies joined the lab in 2023: Deki, Metyos, Nijta, and Seecly. In addition to financial investment, ADVANS Lab supports these young companies by offering them technological support, thanks to the expertise of its affiliated companies. This Startup Day also highlighted the acceleration of equity investments in seed-stage startups, in line with the objective of supporting three to four new companies a year.

Investment in AKIDAIA

In March 2024, ADVANS Lab strengthened its portfolio by acquiring a minority stake in Akidaia, a start-up specialized in securing access to professional sites. This collaboration follows Akidaia's participation in the first promotion of the ADVANS Accelerator powered by Rise Partner, where it benefited from technological and strategic support. Jean-François Béraud, Director of ADVANS Lab, emphasized that Akidaia's innovation represents a major breakthrough in cybersecurity for major national and international accounts.

Advans Accelerator 2023 final jury

In June 2024, at the finals of the six-month Advans Accelerator program in collaboration with Rise Partners, two startups stood out for their innovative solutions and were named winners out of the six in the running: Owneat and SeADvance.

Owneat, founded by Armen Aristakessyan and Pierre Marciniak, offers a digital solution for seamless management of restaurant orders and payments, optimizing table turnover while improving the customer experience and restaurant operators' bottom line.

SeADvance, the startup headed by Fabrice Ravignon, provides an innovative predictive maintenance solution based on the simulation of industrial equipment aging. Their technology enables long-term failure prediction, meeting the critical needs of industries in the transport, defense and utilities sectors.

Advans Lab took part in the co-creation of Owneat in September and invested in SeADvance in October.

Investment in CRYSTAL Quantum Computing

Last July, ADVANS Lab strengthened its commitment to cutting-edge technologies by acquiring a minority stake in CRYSTAL Quantum Computing, a deeptech start-up developing an innovative quantum computer based on trapped ion technology. This partnership marks a key step in ADVANS Lab's strategy of supporting promising quantum solutions. CRYSTAL Quantum Computing is distinguished by its ambition to eventually offer quantum computing services via the cloud, with potential applications in various sectors such as cryptography, healthcare and industrial simulation.

Launch of Into The Lab 2024

On September 6, 2024, ADVANS Group announced the launch of its annual call for projects via ADVANS Lab, open to all employees. Participants are invited to develop a Proof of Concept (POC) with the support of ADVANS Lab, encouraging the emergence of innovative ideas. This year, projects can focus on innovative technologies, with no set theme. Selection criteria include personal commitment and commercial and technological potential. The process begins with the submission of applications, followed by selection by all Group employees in November. Successful projects will benefit from full support and an investment of up to €100,000 for the creation of startups. ADVANS Lab looks forward to discovering the promising innovations that will result!

Into The Lab 2023 final jury

The 2023 edition of Into The Lab highlighted three promising projects, evaluated on technical, business and marketing criteria. Here's an overview of the main findings:

- **SpendMyCrypto:** This project offers an interesting solution for cryptocurrency payments, but targets a niche market held back by psychological barriers and security issues. Although the team is motivated and the project well structured, the market remains particularly complex.
- **Nagz:** An event management solution for employees, integrated with Microsoft Teams. The project is technically sound and could be developed in-house, but its potential is limited by its dependence on Teams.
- **Chipmover:** This ambitious project, centered on a multi-chipset software development solution, is facing a saturated market. Its technical originality makes it an attractive alternative to the big players in the field.

For a variety of reasons, there was no winner this year in 2024, but this session has enabled us to grow and identify new ways of encouraging creativity.

A large-scale collaborative project

In early October, the collaborative project CEOS2030 was approved by the BPI. This project, in collaboration with a number of major partners including Thales Alenia Space, Steel Electronique, Tarides and IP-Maker, aims to redefine the limits of on-board computing technology for AI in satellites. The orchestration of multiple computing boards, FPGA or not, the use of specific mass memory and unikernel technology are at the heart of this ambitious project. ELSYS DESIGN will participate in both the design of the FPGAs and the realization of a change detection AI.

R&D projects 2025

For 2025, our R&D strategy aims to anticipate our customers' technological trends and strengthen our market position. We are implementing programs within our three subsidiaries, with Elsys Design focusing on four key initiatives: RISC-V, embedded artificial intelligence, embedded soft & hard testing and industry 4.0, while Avisto is concentrating on the two axes: software lifecycle and industry 4.0. Finally, Mecagine is working on the rapid analysis of thermal phenomena on electronic boards, as well as ergonomic robotics dedicated to increasing human physical capabilities.

Among our priorities, in addition to the collaborative R&D projects we are carrying out with the startups in our portfolio, certain customers and public research laboratories, we are ensuring the continuity of projects linked to RISC-V and artificial intelligence, with the continuation of a project to port an AI model to a processor target. In addition, in 2025, a new project focusing on AI on FPGA will be launched. The year 2025 will also see the release of scientific articles and publications based on our R&D activities.

Our innovation ecosystem

In order to be ready for our customers' future challenges, we have defined a global strategy that focuses on anticipating tomorrow's trends, creating partnerships and collaborative ecosystems, solving concrete problems through innovation, and proposing effective solutions. Our holistic, coordinated approach enables us to push back technological frontiers and stimulate innovation.

Anticipating technological trends

To anticipate technological trends, we maintain a constant watch. We closely follow scientific publications, keep an eye on innovative start-ups and stay informed via specialized sources. We strive to understand societal needs by identifying global challenges and anticipating regulatory developments. We closely observe opinion leaders and analyze the strategies of major technology companies. We actively participate in tech communities, taking part in events and contributing to online forums. We foster interdisciplinary collaboration by bringing together perspectives from different fields. Finally, we work closely with our customers and research laboratories, establishing partnerships, conducting co-creation processes and participating in collaborative research projects. This global approach enables us to anticipate future technological trends with precision and relevance.

Solving real-life problems through innovation

To solve real-life problems through innovation, we adopt a structured, collaborative approach. We start by accurately identifying the problem and actively involving our customers. Through interviews, workshops and field observations, we identify their real challenges and the associated stakes.

We then generate a multitude of ideas through brainstorming sessions and creative thinking techniques. These ideas are rigorously evaluated against user needs and field constraints. This scientific process is supervised by our PhD team.

We rapidly develop prototypes to test our hypotheses, working closely with end-users. Their feedback guides our iterations and adjustments.

Finally, we implement the solution progressively, remaining attentive to its impact and ready to adapt it. This iterative, user-centered approach enables us to transform innovative ideas into concrete, effective solutions to real-life problems.

Synergy between engineering and R&D

ADVANS GROUP has made remarkable progress thanks to the effective synergy between our engineering departments and the R&D led by ADVANS LAB. This close collaboration has stimulated innovation and strengthened our market position.

Our engineers are now at the heart of the R&D process. Their active participation in research projects enables them to acquire new skills and stay at the cutting edge of technological advances. This approach fosters continuous learning and maintains the expertise of our engineering teams at a level of excellence.

At the same time, we have set up an innovation training program for all our managers. This initiative develops their creativity and ability to identify new market opportunities, thus enriching our sales strategy.

The results of our R&D have led to the creation of high value-added business offers. By capitalizing on our technological advances, we have designed innovative services that meet the emerging needs of our customers.

The synergy between our engineering and R&D teams is a real catalyst for growth, strengthening our capacity for innovation, contributing to the professional development of our teams and constantly improving our commercial offering.

Creating partnerships

ADVANS Group is firmly committed to promoting innovation through the creation of a dynamic and diversified ecosystem. This approach is reflected in the establishment of strategic partnerships in three key areas:

Collaboration with industrial partners and research laboratories

ADVANS Group is actively involved in setting up collaborative projects, combining the expertise of leading industrial partners with the scientific excellence of renowned research laboratories. These synergies help catalyze innovation, by combining the resources and knowledge of different players to tackle complex technological challenges. This collaborative approach stimulates the creation of innovative solutions and strengthens our position at the forefront of innovation in our sector.

Helping Startups Solve Technological Challenges

Our Group has positioned itself as a partner of choice for startups seeking to overcome major technological hurdles. By making our technical expertise and resources available, we help these young companies develop solutions that break with the current state of the art. This mutually beneficial collaboration enables us to be at the heart of emerging innovations while supporting the entrepreneurial ecosystem.

ADVANS Accelerator Program: Growth Catalyst for Startups

In partnership with Rise Partners, ADVANS Group has launched the ADVANS Accelerator program, to support promising startups in their critical development phase. This program aims to accelerate their technological and commercial maturity. By combining our technical expertise with the know-how of Rise Partners, we offer tailor-made support, enabling them to reach decisive milestones in their growth and market positioning.

These strategic initiatives illustrate ADVANS Group's commitment to cultivating a thriving innovation ecosystem. By forging close links with various innovation players - from research laboratories to startups and industrial partners - we create an environment conducive to the emergence of disruptive solutions and the acceleration of innovation in our sector.

Fostering innovation

As in previous years, ADVANS Group is pleased to support its annual internal call for projects via ADVANS LAB, the Group's entity dedicated to technological innovation. This initiative is part of the Group's strategy of continuous innovation and external growth, driven by its employees and engineers, aimed at consolidating the Group's position as technological leader in its sector. The call for projects is open to all ADVANS Group entities, with no geographical restrictions.

The aim of this call for projects is to position the Group on the themes of the future. Engineers are invited to develop innovative Proofs of Concept (POC), with a view to creating viable startups or developing new service offerings. ADVANS LAB is committed to providing substantial financial and technological support, enabling participants to devote themselves fully to their innovative projects.

In an effort to promote collective commitment, all Group employees have the opportunity to participate in the selection process via a dedicated online voting platform. The most promising POCs, once validated, will be eligible for ADVANS LAB investment for the crucial start-up creation and development phase.

In the year 2024, ADVANS Group, true to its DNA, will give priority to projects based on cutting-edge technologies in electronics, software, artificial intelligence or mechanics. Particular attention will be paid to deep-tech projects, directly stemming from research and at the forefront of technological innovation.

Ethics at the service of the planet

ADVANS Group adopts a Business to Planet approach, integrating environmental concerns into its business models. Committed to sustainable development and innovation, the Group explores ways to reduce the environmental impact of businesses and make a positive contribution to society. In this way, it encourages companies to act with a view to sustainability and inclusion.

Into the Lab

Introduction

As a group of technology companies specializing in the service sector, ADVANS Group, through Avisto, Elsys Design and Mecagine, leads a large and varied community of specialized engineers. What's more, with ADVANS Lab, the group carries out R&D and innovation activities, which enable it to energize its own activities, as well as the startups in its ecosystem.

As part of this dynamic, ADVANS Lab has launched an internal call for projects called INTO THE LAB, starting in 2022. This internal call for projects is an intrapreneurial program aimed at Group engineers who are willing to undertake and lead innovative projects, in order to develop new products or services. Our intrapreneurs identify opportunities and are encouraged to take initiatives, while benefiting from key resources and the support of the whole Group.

Finally, the long-term objectives of this program are to animate our community, build loyalty among our consultants, and identify nuggets. Any nuggets identified may either be developed in the form of a startup, in which the Group will invest human and financial resources, or as a new Group service offering. However, at the end of this call for projects, some projects may not be mature enough to go straight to the startup stage. In this case, the project may continue to be incubated internally for a further year.

Structure of the call for projects

The INTO THE LAB program is structured in several stages.

It begins with the announcement of the call for projects. Each September, the terms and conditions of the program were communicated to all ADVANS Group France employees. As of this year, the INTO THE LAB program is now open to ADVANS Group consultants worldwide.

Next comes the project pre-selection process. The group's consultants have until October to mature their project (whether in a group or on their own), and receive personalized support from ADVANS Lab.

Once submitted, projects are put to the vote of all ADVANS Group employees, for a final selection in November. To do this, project leaders must prepare a web page to present their project, as well as a 3-minute video presentation.

Selected projects enter the realization phase. For this, they have 9 months to develop their project and proof of concept, with a view to a presentation, in the form of a pitch and technical demonstration, before the Group CEO and the directors of the various departments.

Finally, the jury decides whether to continue the project. This can take the form of co-creating a startup, setting up a service offering, or even, for a limited time, an in-house project to mature.

Resources and support

ADVANS Group provides all its teams with human and financial resources.

Initially, the engineers are given half a day a week by the Group to work on their project. In addition, as they need to develop both the technical and commercial aspects of their project, internal engineers are recruited over the February/September period , to help the project leaders accelerate their technical development. Those engineers are Group experts to help them with specific tasks.

ADVANS Lab provides monthly training courses to support project leaders. These focus on the user experience, setting up a business plan, pitch deck preparation and presentation to investors.

Finally, ADVANS Lab regularly monitors projects and responds to various requests.

Focus on PANDUZA

The **PANDUZA** project proposes a connected laboratory 2.0 solution in the form of an open-source platform dedicated to the management and control of laboratory equipment in the field of electronics and embedded systems.
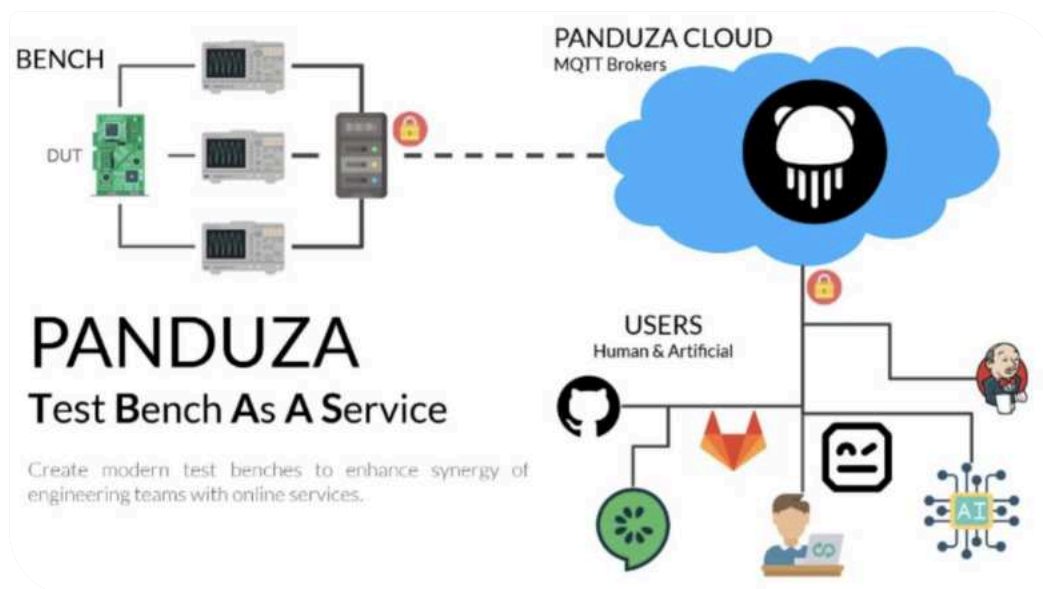
PANDUZA stands out for its modular, flexible approach, facilitating the integration of laboratory equipment through standardized interfaces. This innovative solution connects a multitude of devices, such as sensors, measuring instruments and control devices, to create a unified, intelligent ecosystem.

- Connectivity and automation: PANDUZA integrates standard communication protocols, enabling devices to be easily connected to the laboratory network. This simplifies equipment management and reduces manual handling.

- Real-time monitoring: Thanks to intuitive interfaces, users can supervise the status of their devices in real time, receive alerts and adjust parameters remotely, optimizing the precision and reliability of experiments.

- Customization and Extensibility: The platform is highly modular, enabling users to customize their configuration to suit their specific needs. Developers can also create and share new modules, enriching the PANDUZA community.

- Open-Source and Community: As an open-source solution, PANDUZA encourages collaborative innovation and the exchange of know-how between users, engineers and researchers. This community-based approach enables us to constantly improve functionality and adapt the platform to new technological challenges.

PANDUZA aims to make laboratories more efficient, connected and scalable, by offering a solution that adapts to the changing needs of engineers and researchers. By integrating the latest IoT (Internet of Things) technologies, PANDUZA facilitates the transition to intelligent, connected laboratories, capable of meeting the requirements of the industrial, academic and research sectors.

Complete equipment integration: PANDUZA connects a wide range of devices and sensors, centralizing control and management of your laboratory. This integration facilitates real-time monitoring and diagnostics of equipment, ensuring optimum performance.

Process automation: Thanks to its advanced technology, PANDUZA automates repetitive tasks and complex processes. You benefit from simplified experience management, reduced human error and increased productivity.

Remote monitoring and control: The platform offers remote supervision tools, enabling you to monitor equipment performance and adjust parameters from anywhere. This guarantees greater responsiveness and effective incident management.

Customization and modularity: With PANDUZA, you can adapt the solution to your specific needs thanks to its modular structure. Whether you have unique requirements or complex configurations, PANDUZA offers the flexibility to meet your challenges.

Technical Support and Training: We are committed to providing comprehensive support for the integration of PANDUZA in your laboratory. This includes dedicated technical support, and configuration services to ensure successful adoption of the platform.
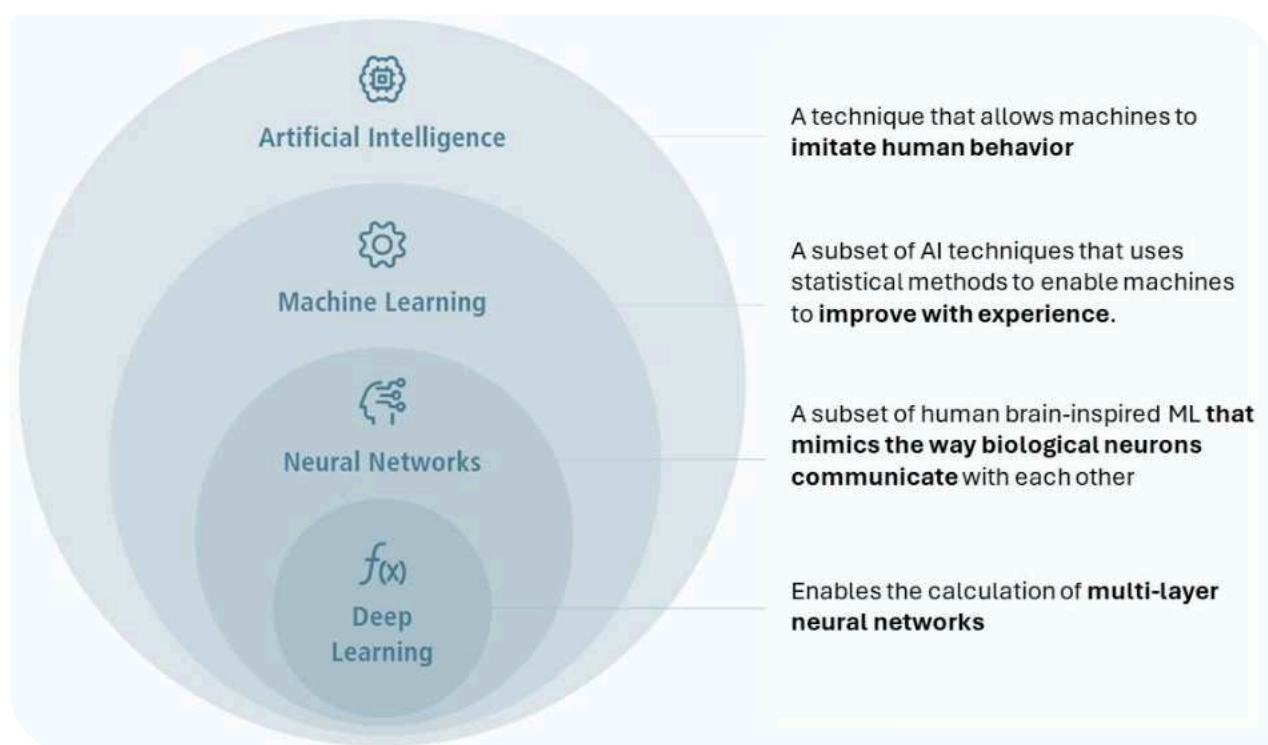
Deep Dive — Novel AI

Innovative AI is a subset of AI that refers to fundamentally new mathematics and algorithms.

What is artificial intelligence?

|	
Artificial Intelligence	A technique that allows machines to **imitate human behavior**
Machine Learning	A subset of AI techniques that uses statistical methods to enable machines to **improve with experience.**
Neural Networks	A subset of human brain-inspired ML **that mimics the way biological neurons communicate** with each other
$f(x)$ **Deep Learning**	Enables the calculation of **multi-layer neural networks**

What is innovative AI?

Novel AI refers to fundamental mathematical and algorithmic advances, introducing novel paradigms into products and services. Unlike applied AI, which exploits proven techniques in known contexts, Novel AI focuses on the creation of radically new ideas.

Some examples of innovative AI are TinyML, autonomous systems, semantic AI, explainable AI, homomorphic encryption and federated learning.

We've seen several waves of innovative AI over the years

AI has been around for some time. What was once a novelty is now commonplace.

	ARTIFICIAL INTELLIGENCE		MACHINE LEARNING AND DEEP LEARNING			IA GENERATIVE	IA NEW
	1950s Shape recognition	1970s AI Winter	1980s Classification	2000s AI Winter	2010s Prediction	2020s Generation	Future Creation?
Products & Solutions	Birth of AI		Handwriting classification		Google implements AI search	Text, image, audio and video generation	Protein design Autonomy level 5 ...
Progress	The Alan Turing test 1st neural network Nearest neighbor		RNN / CNN / LSTM Backpropagation Reinforcement learning		Transformers Lib Torch	LLMs Broadcast models	Fully homomorphic systems Hyena ...
Tools	von Neumann architecture		CPU progress		Big Data and AWS	Advances in GPU technology	TPU Memory calculation Quantum ...
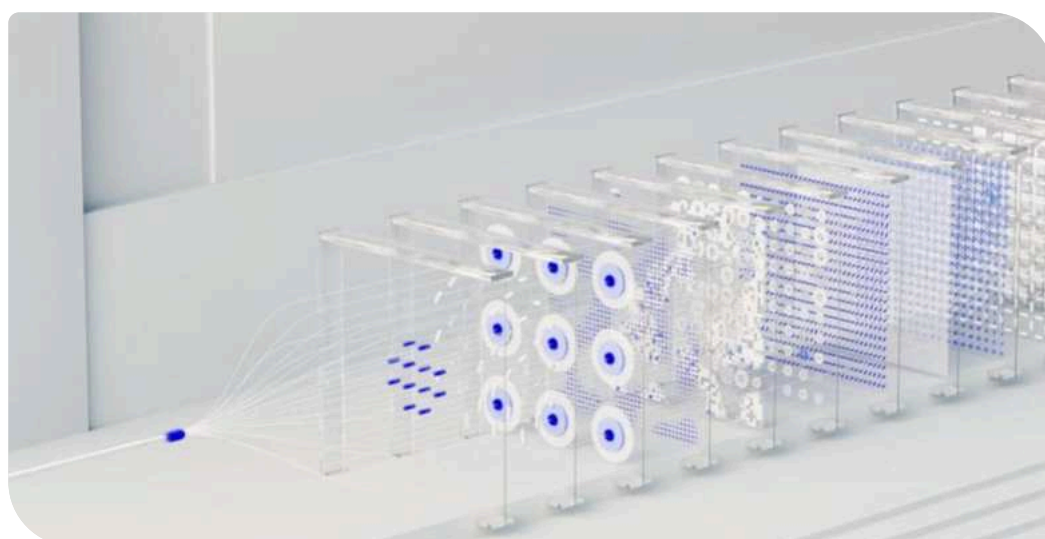
2024 was the year LLMs became commonplace. Where do we stand today?

Ever more powerful models

The year 2024 saw the launch of Llama 3.1 (Meta), an open-source model equipped with 405 billion parameters. It competes with proprietary models such as GPT-4 and Claude 3.5.
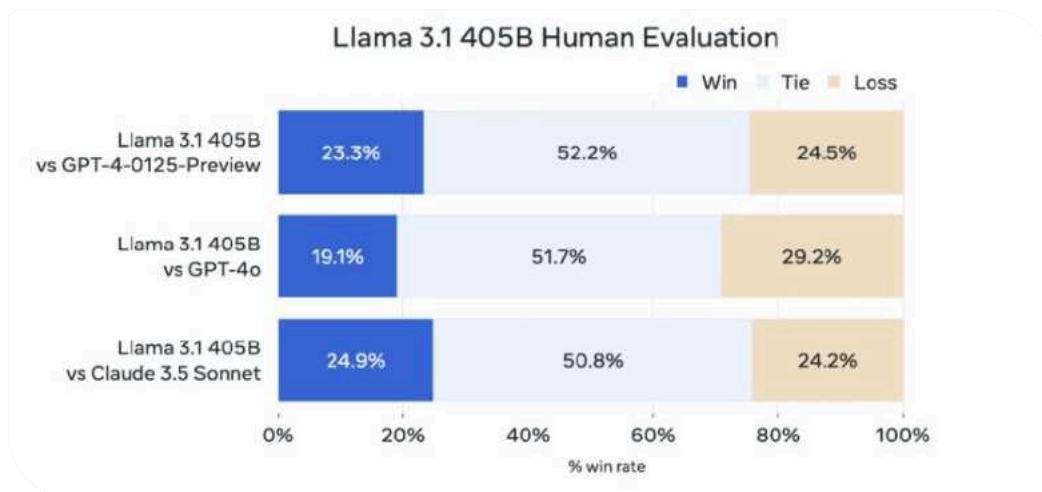
LLM limits

Models are formed from publicly available data and are therefore often outdated, toxic, hallucinatory, biased, factually incorrect and copyright-infringing. They are weakly reasoned and inexplicable, making them unreliable. Knowledge cannot be learned, so they lack the ability to work in different contexts. They also require large amounts of data and compute on specialized hardware, resulting in high energy consumption.

Safety issues

Increasingly powerful models have caused concerns about the safety of AI risks to explode. The alignment of AI is the growing fear that artificial intelligence systems will come into conflict with humanity. Many are worried about the existential threat AI could pose in the future (for example, Geoff Hinton who left Google).

Open Source

Recent years have seen the return of open-source, which has levelled the playing field, as API-based LLM abuses are easier to spot. In contrast, closed-source software offers greater security and control, but less transparency, and carries a higher risk of proliferation and misuse.

GPUs, a competitive advantage

Many companies buy GPUs to gain a competitive edge, and many founding companies sell shares to buy computing capacity to form large-scale systems. Nvidia has posted record revenues in this way.

Different regulations in different jurisdictions

Regulators and policymakers around the world are questioning how best to regulate AI, and whether new laws and regulations are really necessary. New frameworks are emerging, such as the EU AI Act and the EU-US AI Code of Conduct, while other new principles are being introduced, such as the Frontier AI Taskforce in the UK and the US Security Centre in the US.

New trends and opportunities are emerging to make models safer and more efficient

Addressing model safety concerns

There are many security issues concerning model bias, accuracy, reliability and performance. In addition, RLHF (Reinforcement Learning from Human Feedback) could compound model security issues by rewarding hacking. It is possible to address these concerns and decode the "black boxes" to better understand the exact decision-making processes.

Addressing model safety issues

We are witnessing a new wave of "cybersecurity for AI", as existing cybersecurity tools are not yet adapted to AI. These tools aim to solve the security problems associated with model and data theft, data poisoning and jailbreak detection.

Need more training data

It is estimated that we will have exhausted the stock of high-quality linguistic data by 2025. This could result in a need for additional synthetic data, or accelerate the use of private data, or change the way data is used, for example by training it for longer.


Applications in biology and healthcare

Medicine is one of the fastest-growing applications of AI. AI can be applied to personalized medicine, predictive analysis, medical image reading and more. A growing number of diffusion models are also being applied to the determination of de novo (newly synthesized) proteins.

Quantum

True General Artificial Intelligence might need the power of quantum to accelerate AI algorithms and enable the calculation of more complex models.
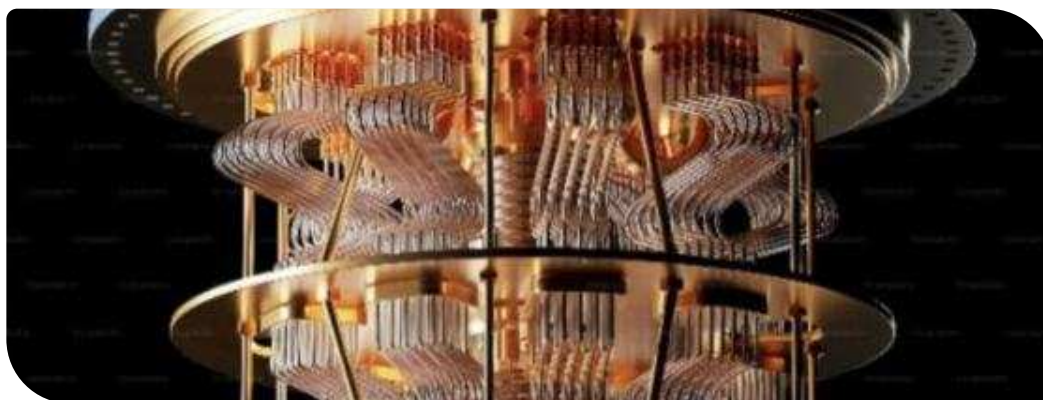
Exciting areas to watch

Smaller models (SML)
It is widely recognized that models cannot continue to get bigger and bigger, especially given the resource intensity required for their formation and deployment. Instead, it will be important to better optimize these models. We are beginning to see interest in smaller models (SML) with more specialized data sets. For example, Microsoft has proven that it can compete with models 50 times larger in certain contexts

Domain-specific models
Some argue that reference models will become commodities. While most models are trained on public data, the most interesting data is private data. Value creation could therefore come from using proprietary data to refine models. More domain-specific models will emerge for specific use cases.

New architectures
Existing architectures are often probabilistic and therefore fail to take account of the realities of the world. New architectures may emerge, such as those using a symbolic approach in which models are built from world truths and become part of long-term memory. This enables rules to be learned and then applied to a variety of contexts. Similarly, there are new models such as Stanford's Hyena model, which achieves higher levels of accuracy with less computing power.

Alternative approaches to reinforcement learning
Reinforcement learning (RL) is difficult, expensive, biased and can pose safety problems. A wave of new alternatives is being studied, such as conditional pre-learning, where human feedback is part of the pre-learning phase, and constitutional AI, where supervision comes from a set of principles that govern the AI's behavior.

Privacy Enhancing Technologies (PET)

Valuable information derived from data can come at the expense of privacy, as data is at risk when stored, in transit or in use. PETs enable the production, consumption, sharing and collaboration of sensitive data while respecting the confidentiality of the underlying data, by eliminating or reducing information leakage during data analysis. PETs vary according to their objectives, and include homomorphic encryption, differential confidentiality, secure multiparty computing and zero-knowledge disclosure proofs.

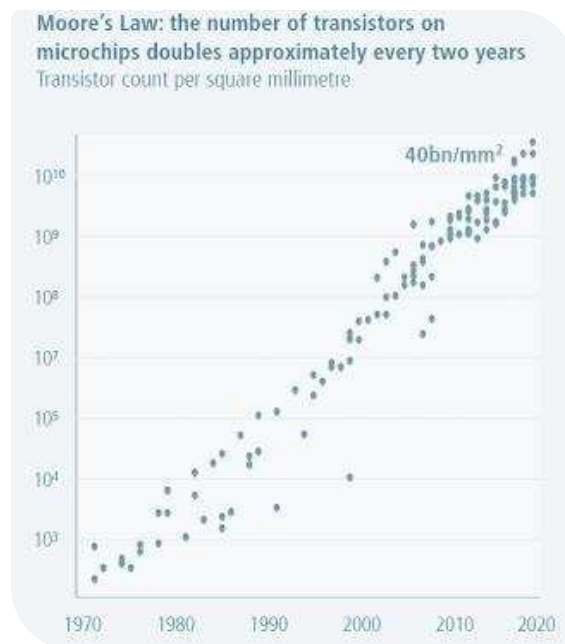# Deep Dive — Future of Compute

An exponential need for computing power...

Computing power demands
Performance in petaFLOP days
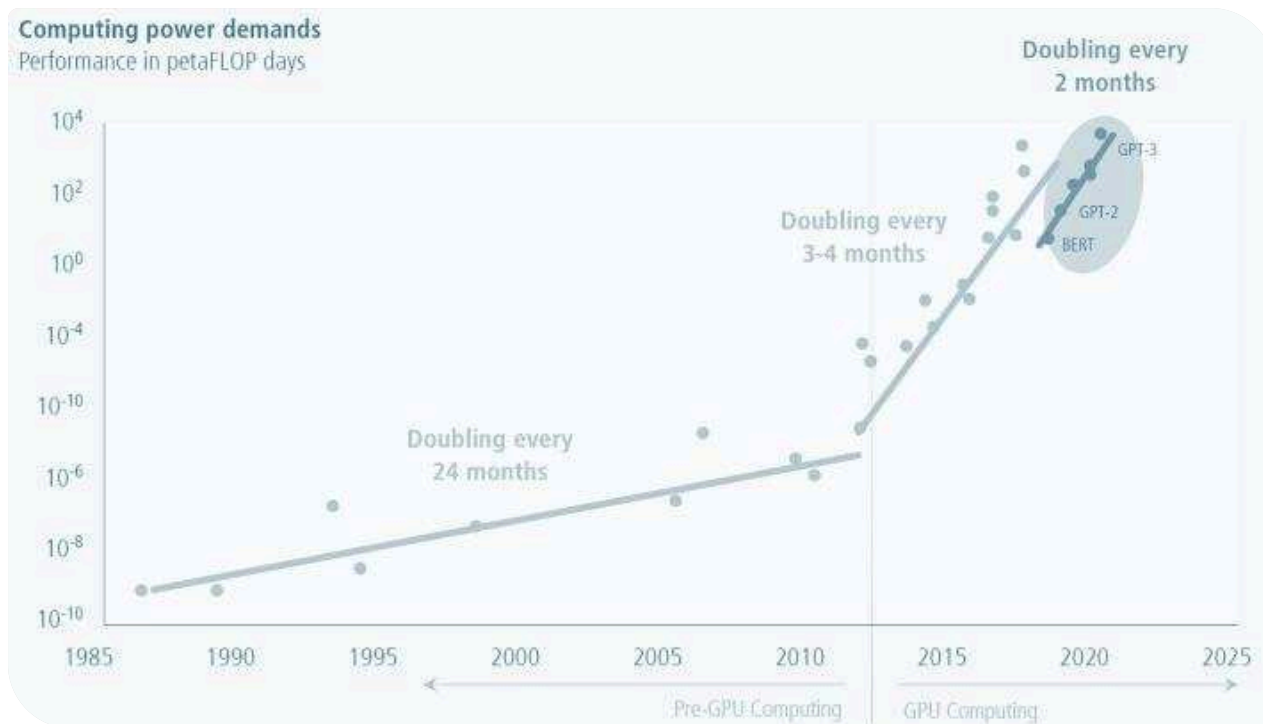
The tsunami of data the world has witnessed over the past decade, combined with the accelerating adoption of AI in consumer and enterprise applications, has created an ever-increasing need for more robust and powerful IT infrastructures, whether in terms of processing, storage, interconnection or workload orchestration. With ever larger AI models, the end of Moore's Law and pressing societal considerations, a paradigm shift is needed in the way this infrastructure is designed, built and operated. This is what the future of computing is all about: inventing the architectures and technologies of tomorrow that will continue to stimulate innovation and bring a new era of prosperity to the greatest number of people. Some experts believe that, in 2025, a company will spend over $1 billion to train just one major AI model...

...while computing power only doubles every two years

We generally think that calculations double and become cheaper every year. However, Apple's latest M3 processors using TSMC's 3 nm node use transistors just 6 atoms wide. It's clear that we're fast approaching the reduction limit for traditional silicon transistors in mainstream processors. New technologies will be needed to meet the growing demand.

Moore's Law: the number of transistors on microchips doubles approximately every two years
Transistor count per square millimetre

Increasing computing power means tackling limiting factors

Reducing energy requirements
The exploration of new materials, such as 3 nm transistors or analog and neuromorphic approaches, promises greater energy efficiency.

Tackling the memory bottleneck
Solutions such as in-memory computing reduce data transfer between memory and processor, thus improving performance.

Increase network throughput
Optical computing, and in particular silicon photonics, could also bring about upheavals in processing or interconnection. Photonics has the potential to eliminate bottlenecks in data transmission, particularly in situations where large sets of servers need to be interconnected.

Alternatives to digital computing
Neuromorphic computing takes a brain-inspired approach to computing over the classic Von Neumann architecture, taking advantage of scarcity and processing data as it arises; it promises more efficient, low-power real-time processing, but requires the adaptation of data pipelines.

A quantum approach

Quantum computing could be a category in its own right, given its disruptive promise and the interest it is arousing in academia, among entrepreneurs and investors; start-ups and companies are building different types of qubits: superconductors, trapped ions, photonics, neutral atoms, and so on.

Quantum computers offer great promise
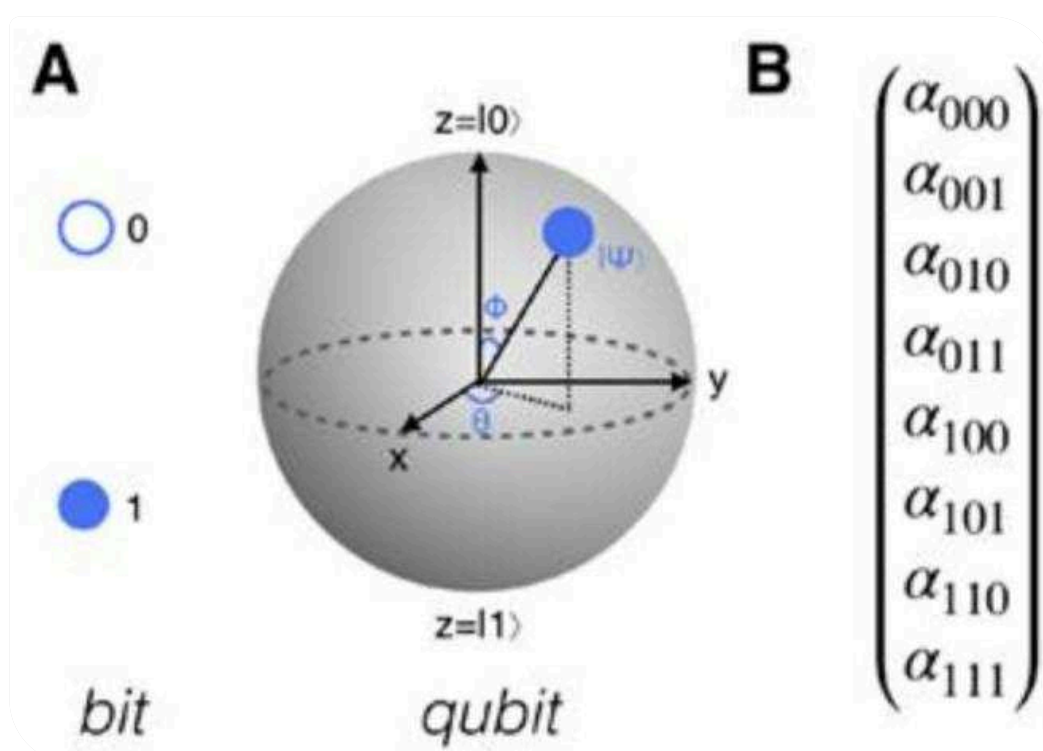
Traditional computers work with conventional bits, which are limited to binary 0s or 1s, and cannot exploit parallelism.

Quantum computers exploit the principles of superposition and entanglement, enabling qubits to exist in multiple states simultaneously (0 AND 1 at the same time). This enables them to perform specific complex calculations in parallel, making them exceptionally efficient for tasks such as factoring large numbers or searching vast databases.

Achieving practical fault-tolerant quantum systems will be a game-changer, enabling longer and more complex quantum computations. Combined with the discovery of new quantum algorithms tailored to specific industries and problems, this will unlock the true potential of quantum computing.

In addition, the development of quantum communication technologies will pave the way for secure quantum information exchange on a global scale, impacting a variety of sectors, including finance and defense.

Finally, the emergence of Quantum AI (QAI) will unleash more creative, sustainable and powerful fundamental models.

In addition to improvements in traditional semiconductor physics, new processing approaches using quantum mechanical phenomena have recently demonstrated significant improvements in solving certain types of problem.

We can assume that several players will achieve this by 2030. The first sector to be affected will be fundamental physics research, followed by materials science and chemical innovation, and then simulation in the broadest sense. Europe has the best talent and efficient capital, but limited access to private capital and large technology companies.
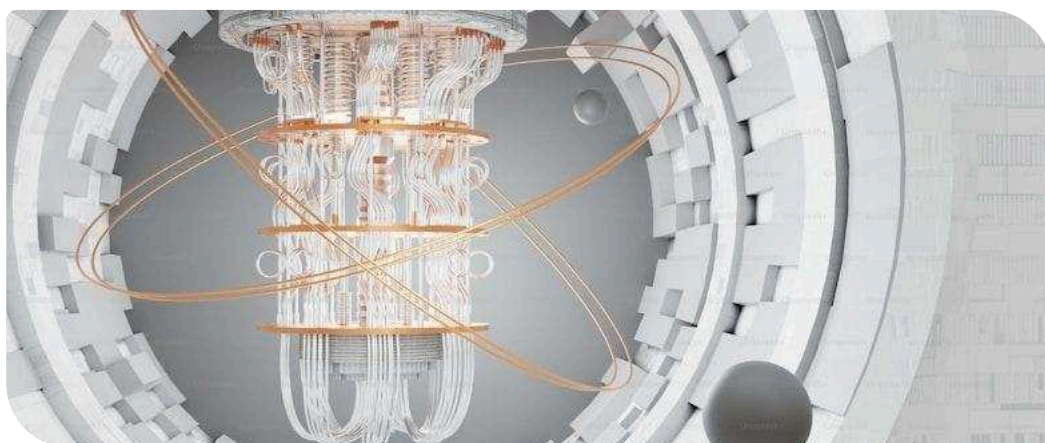
Wearable computing is the future of mobile computing

Mobile computing, which is today dominated by phones and tablets, is moving on to wearable computing, such as smartwatches, smart glasses/contacts and headphones that you can control by speech, movement or thought. Since the ultimate aim of computers is to save time, the faster the computer understands your intentions and provides you with the information you need, the more efficient it will be in its work.

Although countless ethical and legal questions can be asked about these technologies and how they are allowed to operate, their ultimate existence seems inevitable.

Meta is currently the dominant player in the AR/VR/XR/MR category with the Quest headset and Ray-Ban smart glasses. Apple entered the market this year with the Apple Vision Pro, and EssilorLuxottica strengthened its position with the acquisition of Nuance Hearing. In this dynamic, the group also acquired **Pulse Audition**, a startup co-founded with **Advans Lab**, specializing in smart auditory glasses. This strategic acquisition allows EssilorLuxottica to expand its expertise beyond optics by integrating advanced auditory technologies, providing a discreet and efficient solution for people with mild to moderate hearing loss. With this acquisition, EssilorLuxottica accelerates the convergence between visual and auditory health, reinforcing its leadership in the innovation of portable devices that combine performance and design.

Major technology companies in the mobile phone industry are continuously expanding in the earphone segment, with Apple's AirPods (recently approved by the FDA), Google's Pixel Buds, and Samsung's Galaxy Buds.

In the smartwatch sector, the Apple Watch continues to dominate, while Google's acquisition of Fitbit aims to create a competitive offering. Samsung is also continuing to invest. The sector is also fragmenting into specialized areas such as health and sports.

Companies specializing in brain-computer interfaces (BCI) continue to make progress, but they are still far from a commercially viable product, even for severely disabled individuals.

New formats are also starting to be experimented with, such as Humane's smart pin.
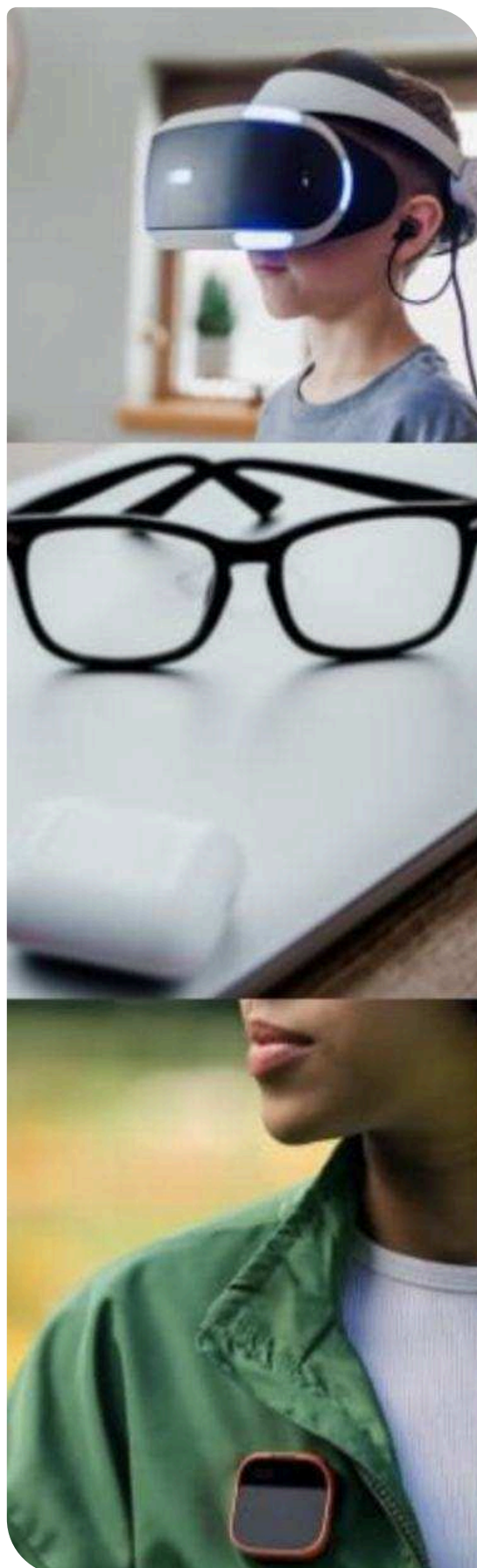
Ambient computing will replace desktop computing

Desktop computing, including laptops and smart TVs, is moving to ambient computing. Ambient computing can be described as an evolution from the devices you use when you're in a fixed location and that belong exclusively to you, to the integration of computing into the spaces in which we live including our homes, workplaces, transportation, social spaces and commercial venues.

The way people use these tools in an ambient computing context will be multimodal, taking advantage of historical input/output methods such as keyboards, remote controls, screens and speakers, while integrating new modes of interaction such as voice, gesture, facial expression and object detection.

Desktops/laptops

Desktops and laptops will evolve from personal computers to stateless computers, to which multiple users can connect and securely access their unique environment.

Televisions / smart screens

Users will be able to securely access all their content and files directly from any screen, using a variety of data entry methods.

Smart speakers

Les haut-parleurs tels que Apple HomePod, Google Home, Amazon Echo, Meta Portal et Zoom Meeting Rooms passeront du statut d'appareils indépendants à celui de nœuds totalement intégrés dans un système ambiant holistique.

Intelligent cars

Cars will increasingly define a key "third space" where major technologies (Apple CarPlay and Android Auto) will compete with automotive brands like Tesla for the user engagement experience on the move. This phenomenon will accelerate with the widespread adoption of autonomous driving.

Smart appliances

As connectivity and peripheral intelligence penetrate deeper into small appliances, fridges, toasters, doors and windows will start to look like extensions of an overall ambient experience rather than disconnected monofunctional products.

The cloud is divided into a centralized cloud and a distributed cloud.

Cloud computing such as AWS, GCP and Azure is experiencing a bifurcation between centralized and decentralized/distributed cloud computing. While we expect centralized cloud providers, such as the large companies mentioned above, to continue to provide a centrally managed solution, where they control resource allocation internally, we are also seeing the emergence of new technologies that offer credible alternatives using hardware that is not wholly owned by a company.

In concrete terms, we expect businesses and individuals to be able to store files and run computing workloads on other people's devices via an operating system and infrastructure that manages resource allocation, privacy, security and compensation for those who lend their device to the network for use.

Trivial use-case examples include a student rendering a video on other students' laptops while they sleep, instead of paying AWS, or a company training an ML model on other companies' hardware when it's not being used internally, instead of using Azure. While large technology companies are likely to offer this capability to users of their hardware, we also believe that a new hardware-agnostic approach can benefit from a wider pool of compute resources to deliver superior performance.

Blockchain technologies are beginning to explore how these types of tools might look, and we expect continued innovation in this area.

The battle for the operating systems of the future is on

The big tech companies are investing heavily to create the operating systems of tomorrow, hoping to reinforce their dominance. Apple, Google and Amazon, among others, see an opportunity to control even more digital value, impose their rules and generate billions. At the same time, startups, the historical sources of innovations like Android, have a chance to break through. If they manage to remain independent, they could become the new technological leaders of this digital era.

Deep Dive — Space Tech

Since the 1960s, the space landscape has evolved from government competition to a diverse ecosystem in which private companies and new national players play a crucial role. SpaceX has led the way with its reusable rockets, reducing launch costs by a factor of 10, with Starship set to achieve even more dramatic reductions.

History of space exploration

Space exploration was born of intense competition between world powers, originally fueled by political, societal and economic rivalries. The Soviet Union's emblematic launch of Sputnik triggered the United States' ambitious Apollo program, which culminated in Neil Armstrong's historic lunar landing in 1969.

However, this era of triumph was short-lived, as the Apollo program was quickly suspended just three years after the lunar landing. The high costs and risks associated with space exploration led to a period dubbed the "winter of space". It was not until almost five decades later that mankind resumed its lunar aspirations, culminating in the Artemis missions.

The current spatial landscape

What was once a domain dominated by governments has evolved into a diverse ecosystem. New participants such as India, China, various Arab states and private companies like SpaceX, Amazon and OneWeb have entered the scene, suggesting a burgeoning landscape of opportunities. Europe's role in this new era lies in exploiting its strengths to make significant contributions.

In contemporary space, two fundamental trends are reshaping the landscape. Firstly, SpaceX's pioneering efforts to develop reusable rockets, exemplified by the successful landings of Falcon 9 rockets in 2015, have radically altered the economics of space travel. Launch costs have plummeted from 50,000USD per kilogram in the Space Shuttle era to 5,000USD per kilogram, and further 10-fold reductions are expected with the arrival of Starship. Secondly, governments are recognizing the geopolitical importance of access to space and the utility of space assets. These assets now perform essential functions that go beyond defense to include climate change monitoring, forest fire and water management, and global asset tracking.


Future prospects

Looking to the future, space exploration is set to undergo a transformation. The limitations imposed by mass on commercial models are about to be resolved with the introduction of super-heavy launchers such as Starship. This change should enable a shift from miniaturization to the construction of larger, more easily manufactured infrastructures, such as very large satellite classes and private space stations.

However, the space industry is still young and faces many supply chain challenges. Many companies will be striving to make supply chains not only faster, but also more resilient.

The future trajectory foresees the rise of regional champions, underlining the importance of sovereignty in space. This means a change in the dynamics of space exploration, transforming it from an exclusive domain accessible only to a few into an arena open to a wider range of players, each contributing to expanding the frontier of human endeavor beyond Earth.
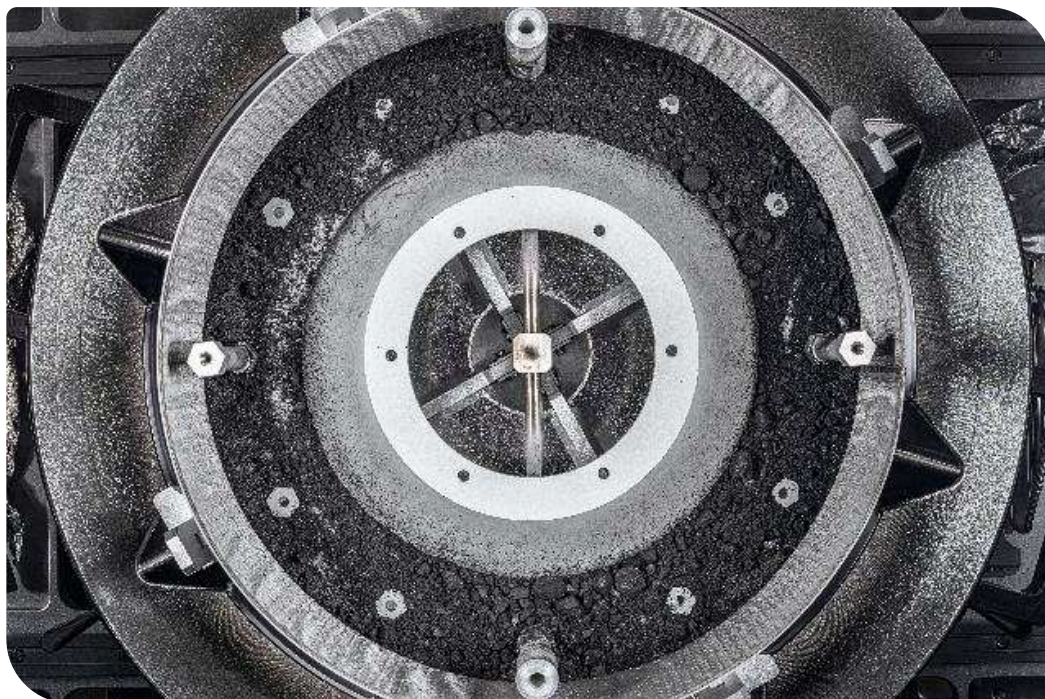
The influence of space technology on our lives is already enormous, and is set to grow thanks to a host of exciting new use cases.

Communication
Internet connectivity and broadcasting, provided by space-based satellites, enable global communication, guaranteeing uninterrupted access to information and entertainment worldwide.

Earth observation

Meteorological satellites provide vital data for forecasting and monitoring weather conditions, and for issuing early warnings of natural disasters. They contribute to agricultural planning, crop health assessment, water resource management and the monitoring of environmental change.

Navigation

GNSS technology (GPS, Galileo...) integrated into various devices facilitates precise location, improving everyday activities such as driving, route-finding and the use of car-sharing applications, by guaranteeing efficient and accurate navigation.

Future use cases

The future potential of space technology extends to diverse fields such as asteroid mining, organ and semiconductor manufacturing in space, offering innovative opportunities to revolutionize industries and address a variety of challenges on Earth.

Moreover, governments have realized that space is the new frontier, as well as a crucial infrastructure technology.

Satellite image showing a 64 km convoy of military vehicles entering Ukraine

Ukraine turns to Elon Musk and Starlink as Russian forces disable terrestrial internet

Chiffres clés

8
Number of R&D projects.

3
No. of patents/soleau envelopes/IP credentials

TRL1
Average TRL at entry

TRL4
Average TRL at exit

99
No. of FTEs, including 3 Serbs.

18
Nationalities.

6.9M
Amount spent in €.

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