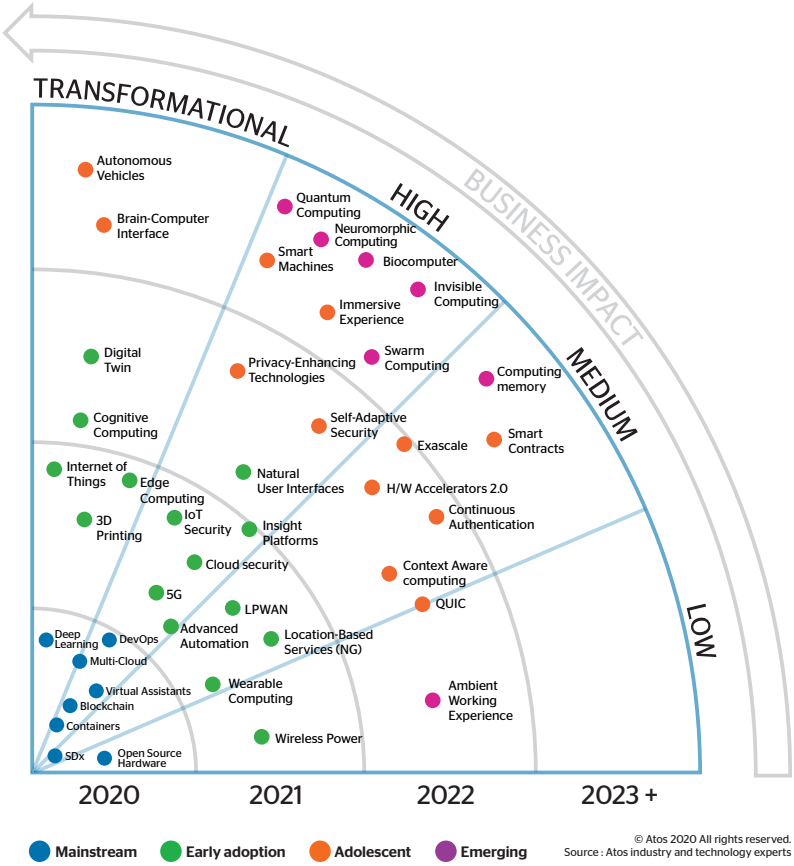
Which technologies will power your business tomorrow?

"Welcome to our latest Tech Trends Radar, powered by the Atos Expert Community!

Technology and its role within our lives is evolving at speed. As society is shaken by major external events, it becomes ever more important to understand and anticipate the world of tomorrow. We are here to help you on this journey. Designing, developing and delivering the secure and decarbonized digital solutions that will keep your business successful and sustainable in a changing world."

Sophie Proust
Group Chief Technology Officer, Atos



Source : Atos industry and technology experts

Look Out Technology Radar: key technologies set to impact you in the coming years.

Want to know more? Examine the Look Out Trends Radar Radar online to get deeper insights into these strategic technologies and understand the steps you should take today for success tomorrow: **atos.net/lookout**

Time of impact

2020 Look today at how solutions could address your needs.

2021 Consider potential solutions by running pilots, for example.

2022 Understand now. Consider potential implications and how these could be addressed in your strategic technology planning.

2023+ Follow for now. Watch how it's evolving.

Business Impact

Transformational Likely to require radical changes within organizations.

High Will have a high impact at work and in people's home lives.

Medium Will impact organizations' processes & services or affect users' & consumers' lives.

Low Will impact specific processes & services or affect some aspects of users' & consumers' lives.

Maturity

Mainstream There's a clear need and many clients are implementing solutions.

Early adopter Clients are starting to look for solutions.

Adolescent Discussed more widely by analysts and thought leaders.

Emerging Mainly seen in academia and a small number of specialized markets.

3D Printing

3D printing (3DP), or additive manufacturing, is an innovative approach to manufacturing 3D objects, materializing them from virtual designs created using CAD (Computer Added Aided Design) programs. It can be used to create almost any shape or geometry, extending from nanoscale to complete buildings. To create the objects, the 3D printer superposes layer upon layer of material using various additive processes and not remove material as in traditional manufacturing methods. These layers may use different materials, such as concrete, polymers, metals, paper, or even foodstuffs.

5G

5G represents the next generation of communication networks and services. It is not intended to be only an evolution of legacy communication technologies but also a novel approach to fulfilling the requirements of future applications and scenarios. 5G requirements are based on three main public key infrastructures:

- Enhanced mobile Broadband communications
- Massive machine type communications
- Ultra-low latency communications.

Advanced Automation

Advanced Automation uses bots, RPA, AI-based tools (such as Arago HIRO) and other technologies to offer an automatic and timely response to incoming events or requests. It aims to ensure reliable 7x24 availability of IT-services combined with a further cost-reduction for these services. Depending on the use case and position along the service-chain, different solutions are available, from the administration of the IT-hard/software itself through the processing of data to the end-user experience.

Ambient Working Experience

Today's further adoption of digital working solutions, particularly through the rapid adoption of Cloud productivity and collaboration platforms, has enabled experiences to flow freely across devices as well as non-device interface and enabled the portability of the user persona across multiple create and consume device types. This will further evolve into a new ubiquity. Personal devices won't be a requirement in order to have a productivity or collaboration experience; instead the facilities in which we interact, such as the conference room, will identify users, meeting attendees and owners of Cloud-stored content. They will also provide fully integrated virtual assistant functionality and immersive collaboration experiences based on tools, content management, Artificial Intelligence (AI) and Internet of Things (IoT) experiences built into the space.

Autonomous Vehicles

Autonomous vehicles is an emerging field arising from the interaction of transportation vehicles and robotic capabilities, such as environmental sensors, context awareness and autonomous decision-making using Artificial Intelligence. These self-driving vehicles rely on these technologies to drive themselves while recognizing and responding to their surrounding environment.

Biocomputer

Biocomputers are computers that use biological materials such as DNA and proteins to perform computational calculations that involve the storage, retrieving and processing of data. They leverage the capabilities of living beings, relying on nanobiotechnology to engineer biomolecular systems that provide the computational functionality.

Blockchain

Blockchain is protocol. It's pure software that takes the form of distributed ledgers, using cryptographic techniques to store a list of records – or blocks – immutably, ordered chronologically. It is a new model where trust is established by design in a peer-to-peer network without the need for a trusted third party. Blockchains can be of various forms or flavors: private or public, permissioned or permissionless.

Brain-Computer Interface

The brain-computer interface (BCI) is a direct communication pathway between the brain and an external device based on neural activity generated by the brain. While many approaches use invasive devices, the most promising initiatives are based on non-invasive approaches. Electroencephalogram (EEG) devices record brain activity. EEG's fine temporal resolution, ease of use, portability and low set-up cost has made it the most widely studied potential candidate for a non-invasive interface.

Cloud Security

As Cloud adoption and Multi-Cloud deployments spread exponentially, organizations are faced with challenging questions like which type of Cloud to consume? Do I migrate to the Cloud by consuming a Cloud's Infrastructure (IaaS)? Do I transform my solutions by operating them on a Cloud's Platform (PaaS)? Do I move my software to a Cloud's Software as a Service (SaaS) offering? Or, do I go as far as containerizing my needs (CaaS). Whichever Cloud offering is chosen, there are unmanaged security risks and data exposure. The mitigation of these is known as Cloud Security. Organizations will need solutions for a single pane of glass security operation in their Cloud and hybrid environment. Solutions vary from simple usage monitoring and security exposure rating to very specific enterprise security policy enforcement. Compliance with data privacy regulations and other legal rules will also require better Cloud security testing and continuous compliance monitoring/control.

Cognitive Computing

Cognitive computing can be seen as an integration of algorithms and methods from diverse fields such as Artificial Intelligence (AI), machine learning, Natural Language Processing (NLP) and knowledge representation to enhance human performance on cognitive tasks. It is able to learn and understand natural language as well as reason - and even interact more naturally with human beings than traditional programmable systems. Cognitive computing systems can supplement human work in three capabilities: increased engagement, improved evidence-based decision-making, and discovery of insights hidden in massive amounts of data.

Computing memory

Computing memory represents a new approach to solving the limitations of classical (Von Neumann) computing architectures. In this model, certain computational tasks are performed in place in a specialized memory unit called computational memory. This co-existence of computation and storage at the nanometer scale could enable ultra-dense, low-power, and massively parallel computing systems. Resistive memory devices, where information is represented in terms of atomic arrangements within tiny volumes of material, are poised to play a key role as elements of such computational memory units.

Containers

A lightweight virtualization technology that provides applications with an isolated environment inside a single operating system instance, containers provide users and applications running inside them with the illusion and experience of running on their own dedicated machine.

Context-Aware Computing

Context-aware computing consists of applications and services that take advantage of contextual data about a person or object to anticipate the user's needs proactively. It deduces context from the interactions among the data before triggering actions based on that contextual information to serve up the most appropriate content, product or service.

In short it greatly improves how computers and software understand the situation user's are in.

Continuous Authentication

Continuous authentication exploits behavioral (passive) biometrics (a form of biometrics that exploits dynamic human characteristics) to establish that an individual is who they say they are. Well-known examples include voice, typing style, mouse use, heart rate and walking pace. Like all biometrics, continuous authentication enables multi-factor authentication when combined with other security mechanisms such as smart cards.

Deep Learning

Deep Learning is a branch of Machine Learning, common Artificial Intelligence techniques used for Big Data processing with algorithms that provide the ability to automatically learn and improve the outcome from experience without being explicitly programmed. Deep Learning algorithms are based on artificial neural networks inspired by the way animal brains analyze and process information with their neurons. They transform data in more abstracted representations that are facilitating decision making. 'Deep' refers to the large number of layers through which the data is transformed, the level of abstraction improving along the number of layers the data is processed through. The process by which a Deep Learning algorithm learn is called 'training' and the process by which it runs in production is called 'inference'. In short, the training phase is based on a trail-and-error process to set and improve the parameters of the layers, while during the inference, the data is passing through the layers parametrized with the value obtained from the training. Lastly, this couple composed of an algorithm and its set of parameters resulting from its training is called 'model'.

DevOps

DevOps is a fundamental shift in the culture and philosophy for how to build and operate software that encourages teams to focus on business value, work collaboratively, deploy software more frequently in smaller increments, and build reliable solutions. Furthermore, DevOps requires continuous improvement across all of these dimensions.

Digital Twin

A digital twin is a digital replica of a physical asset, process, system or service across its lifecycle. This virtual representation of the physical world is, in essence, a simulation that extends the 3D renderings of computer-aided design (CAD) models, asset models and process simulations used by engineers for decades with real-time information gathered from sensors in the field. In that way, digital twins promote understanding, identify problems, help develop new opportunities and plan for the future.

Edge Computing

The growth of IoT and the emergence of ever-richer Cloud services together call for data to be processed at the edge of the network. Also referred to as fog computing, mesh computing, dew computing and remote Cloud, Edge computing moves applications, data and services away from the centralized model of Cloud computing to a more decentralized model that lies at the extremes of the network. Edge computing is related to the concept of Swarm computing, though control is handled in radically different ways. While Edge is an application that is split, spread and orchestrated over several devices located closer to the edge of the network, Swarm is several autonomous instances of an application working in collaboration and auto-organization.

Exascale

Exascale supercomputers refer to High-Performance Computing (HPC) systems capable of at least one billion billion calculations per second (one exaFLOPS) — a thousand-fold increase over today's petascale supercomputers. It provides a major step forward in addressing the new challenges of the 21st century at a time when all sectors (but particularly industry, academia and science) are demanding increasingly powerful computing systems for resolving problems involving ever-growing volumes of data.

H/W Accelerators 2.0

With Moore's Law in serious jeopardy, general-purpose computing devices are no longer sufficient to satisfy highly demanding applications. Hardware accelerators are highly specialized computing devices targeting a narrow field of computing. They have a long history behind them, starting from numeric co-processors and including consolidated technologies, such as encryption accelerators, GPUs or FPGAs, that are gaining importance recently in scenarios such as Deep Learning or Blockchain. However, as other computing trends advance, the field keeps evolving to provide custom hardware for specific workloads where general-purpose computers are less efficient. New neural accelerators, new neuromorphic processors and new specialized Artificial Intelligence (AI) components are clearly a trend on the roadmap of Intel, IBM, nVidia, AMD and even governments such as China, USA or the EU, so we could talk about 'Hardware Accelerators 2.0.'

Immersive Experience

An immersive experience is one that is designed to allow users to disconnect from the real world, in full or in part, and lose themselves in a simulated environment. The best fictional example of an immersive technology is the holodeck in the popular Star Trek science-fiction series. We now are fairly close to developing the majority of the technologies needed for creating fairly complete simulated environments: virtual reality, augmented reality, 3D displays, haptic devices and even holographic user interfaces.

Insight Platforms

Insight platforms (aka data fabrics) are the third generation of business analytics platforms, after the Business Intelligence and Big Data phases. They represent a combination of new and existing technologies that collect and analyze massive data sets from connected environments in real time, rapidly transforming that data into actionable (prescriptive) insights. Their objective is to provide a holistic view of data, whether it is physically located in a private or public Cloud or in a physical data center, beyond the simple and often not realistic vision of a central and homogeneous data lake. It also promotes access to insights in a way similar to the access to raw data. Examples include the combination of streaming analytics analyzing data in motion in real time to accelerate time-to-insight; distributed analytics analyzing data in situ within a distributed architecture; and prescriptive analytics, which makes predictions based on its Big Data analysis and then suggests decision options.

Internet of Things

The Internet of Things represents a ubiquitous communication network that effectively captures, manages and leverages data from billions of real-life objects and physical activities. Networks of spatially distributed sensors and actuators (nodes), each with a transceiver and a controller for communicating within a networked environment, detect and monitor events (sensors) or trigger actions (actuators). Each has a unique identifier and the ability to transfer data over a network without human-to-human or human-to-computer interaction.

IoT devices range from human interaction devices, autonomous devices, as well as Industrial connected objects (IIoT) or Operational Technology (OT) devices.

Invisible Computing

Due to their nature, computing devices have long been at the center of our attention. Smartphones, tablets, our laptops and desktops all take up a huge percentage of our focus and mental reasoning capacity. However, with the rise of technologies like speech recognition, chatbots, XR (AR/VR/MR) and advanced machine learning, the long-kept promise of devices that deeply and naturally integrate into our everyday lives finally becomes within reach. In time, this will result in IT becoming invisible and ready-to-hand.

IoT Security

Trusted IoT devices are software-powered objects and connected machines that are made secure and trustworthy in order to protect data and process availability, integrity and confidentiality. IoT devices range from human interaction devices such as smartphones and payments terminals; autonomous devices such as smart homes and smart machines; as well as Industrial connected objects (IIoT) or Operational Technology (OT) devices used as a control system for a power station or the control network for a rail system. Trusted devices rely on high-security design, hardened software and hardware, and intensive certification processes provided by trusted third parties (notably leveraging 'common criteria' norms).

Location- Based Services NG

The ability to know the exact position of a person, device or item along with the capability to represent it in its surroundings opens a myriad of uses. This information becomes richer when we know the relative positions of items with respect to each other, their orientation and speed.

LPWAN

Low-power WAN (LPWAN) is a wireless wide area network technology that interconnects low-bandwidth, battery-powered devices with low bit rates over long ranges. Created for machine-to-machine (M2M) and Internet of Things (IoT) networks, LPWANs operate at a lower cost with greater power efficiency than traditional mobile networks. They are also able to support a greater number of connected devices over a larger area. Most LPWANs have a star topology where, similar to Wi-Fi, each endpoint connects directly to common central access points.

Multi-Cloud

The new computing continuum will be a heterogeneous environment based on the decentralization and federation of diverse computing entities and resource typologies. These will include multi-Cloud (and Cloud federation) models with their diverse, decentralized and autonomic management and hybrid Cloud models that cross boundaries between internal and external Cloud services or between public, private and community providers. Then, Cloud Service Integration (CSI) provides a flexible means for assembling these various Cloud-based elements in support of business process that transverse IT domains.

Natural User Interfaces

A natural user interface (NUI) is a system designed to make human-computer interaction feel as natural as possible. It is the outer layer of software that allows the human-to-computer interaction to be more similar to the human-to-human interaction, and allows users to manipulate the contents and communicate with the computers in more a direct way using more natural movements, actions, gestures or voice commands. NUIs use a variety of technologies to interpret human actions to control a computer system. They process a large amount of data from sophisticated sensors, such as webcams, extracting meaningful signals or features, which they use to control a system in a natural manner.

Neuromorphic Computing

Neuromorphic Computing refers to computational paradigms inspired by the way human brain processes information and hence it is intended to mimic neuro-biological architectures similar to those of nervous systems of living beings to provide new ways of information representation, adaptation to change, fault-tolerance, and to incorporate learning and self-development capabilities to computation to contrast the traditional Von Neumann computing architecture. Since the original works pioneered by Carver Mead in 1980, the concept has evolved to integrate hybrid analog/digital structures, event driven, distributed, fault tolerant, and massively parallel computing with the promise to outperform existing most powerful computers yet remaining energy efficient.

Open Source Hardware

The open source hardware model extends the ideas and methodologies popularized in open source software development to hardware development. Documentation — including schematics, diagrams, list of parts and related specifications — are published with open source licenses so other teams can modify and improve them, based on specific needs. These are sometimes combined with more traditional open source software, such as operating systems, firmware or development tools. For instance, both Linux and Android operating systems are being used in embedded devices.

Privacy-Enhancing Technologies

Privacy-enhancing technologies (PETs) refer to technologies involved in protecting or masking personal data (whether employees, customers or citizens) to achieve compliance with data protection legislation and sustain customers' trusted relationships. PETs not only protect very sensitive data (such as credit card information, financial data or health records), they also shield the very personal information (including purchasing habits, interest, social connections and interactions) that digital users are keen to allow some services to leverage, but only provided some privacy is respected.

Quantum Computing

Quantum physics bring a new computing paradigm that is much richer than, while complementary to, the famous Boolean computing that is the foundation of computer science. Built over the basic element of the qubit, the so-called 'Quantum computer' uses quantum-mechanical phenomena to execute operations on data. A theoretical concept born in the early 1980s, Quantum computing's first technological implementations were demonstrated 15 years later. Since then, the Quantum computer has not yet reached the mainstream, though tremendous advances have been emerging on both the hardware and application sides.

QUIC

QUIC is an experimental protocol, created by Google and standardized in 2016 through IETF. The name stands for 'Quick UDP Internet Connections', which is due to the fact it allows the fast and easy sending of simple packets over the connectionless User Datagram Protocol (UDP). It's very similar to TCP+TLS+HTTP2 but a new multiplexed and secure transport built on top of UDP. QUIC provides multiplexing and flow control equivalent to HTTP/2; security equivalent to TLS; and connection semantics, reliability and congestion control equivalent to TCP.

SDx

Software-defined anything/everything (SDx) is an approach that replaces legacy — and often specialized — hardware controlled by physical mechanisms with software running on commodity hardware platforms. The concept may be applied to a wide variety of aspect of an IT system including networking, compute, storage, management, security and more.

Self-Adaptive Security

With the growth of Cloud, APIs and the IoT, cybercrime is constantly increasing in volume, sophistication and impact. Cyber-defense strategies have evolved toward new self-adaptive security principles. This approach moves the emphasis from protection to real-time detection and response, which adapts defenses immediately. Technologies and processes incorporate Security Operation Centers (SOC), which rely on new generation Security Information and Event Management (SIEM) technologies enhanced with machine learning and prescriptive analytics. Self-adaptive security also relies on new generations of context-aware security technologies that dynamically adapt to threats.

Smart Contracts

Used extensively and exclusively within blockchain, smart contracts are digital peer-to-peer contracts written into lines of programming code. They are executed automatically to enforce a contract. Smart contracts allow business rules agreed by the parties to be embedded across a distributed, decentralized blockchain network and executed as part of a ledger's transactions, ensuring transparency and mitigating any conflict. A contract in its simplest form is a piece of software program/code and associated data that are stored in a block that is part of a Blockchain network to perform tasks such as store data, send data, manage another contract with one or more parties, or even provide function or service to other contracts.

Smart Machines

The term smart machines refers to systems embedded with cognitive computing capabilities. Their combination of AI and robotics allows them to make decisions and solve problems without human intervention. AI provides adaptability and capability to process complex situations. Robotics provides the capacity to perform physical actions. Smart machines perform activities and tasks traditionally conducted by humans, boosting efficiency and productivity. They come in different shapes and sizes: autonomous vehicles, self-flying drones, warehouse robots and even robotic pizza ovens!

Swarm Computing

Swarm computing is the emergent collective intelligence of groups of simple agents having characteristics of self-healing, self-configuration and self-optimization. It is a group of similar elements (the swarm) behaving through mutual interaction to achieve an outcome as a collectivity. Learning from nature in the man-made world, swarm computing combines IoT, local networking and Cloud capabilities to create on-demand, autonomic and decentralized computing. While Edge computing is the initial step towards the decentralization of computing, swarm computing will consolidate this trend by exploiting IoT devices' increasing rich computing, co-operative intelligence and intelligence close to it' source. Combining complex multi-Cloud architectures with Edge computing will enable swarm computing scenarios to develop. Swarm instances will be temporal infrastructures created on demand in response to specific needs.

Virtual Assistants

Virtual assistants are software agents that perform services or tasks on our behalf. They understand queries and can answer them in a natural language. They exploit artificial intelligence, natural-language processing, machine learning, voice processing and reasoning and knowledge representation to make human-machine interactions simpler, more natural and more appealing.

Wearable Computing

Miniature electronic devices with integrated sensing, computing and communication capabilities that are worn on the body. They leverage the wearer's context — detected by embedded sensors — to deliver either general or specific services that enable the wearer to act in real time based on the information they provide. Although most popular wearables today are smart watches and bracelets, smart clothes are going to grow in the coming years and we will also have specific wearables that can be found in different places of our body: headbands and helmets, contact glasses, earphones, globes, digital pens, jewelry, and even tatoos.

Wireless Power

Wireless power describes the transmission of electrical power without solid wires, using electromagnetic fields instead. There are two types of wireless power: near-field charging, which uses inductive or capacitive charging, and far-field or radiative charging, which uses beams from electromagnetic devices.

About Atos

Atos is a global leader in digital transformation with 110,000 employees and annual revenue of € 12 billion. European number one in cybersecurity, cloud and high performance computing, the group provides tailored end-to-end solutions for all industries in 73 countries. A pioneer in decarbonization services and products, Atos is committed to a secure and decarbonized digital for its clients. Atos operates under the brands Atos and Atos|Syntel. Atos is a SE (Societas Europaea), listed on the CAC40 Paris stock index.

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Let's start a discussion together

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