strategy&
Part of the PwC network

Blazing a trail for European AI computing

AI stands on the verge of consuming Europe's data. How can Europe fully embrace AI?

Contacts

Germany

Marcus Gloger
Partner,
PwC Strategy& Germany
+49-173-5273-683
marcus.gloger
@strategyand.de.pwc.com

Germar Schröder
Partner,
PwC Strategy& Germany
+49-170-2238-426
germar.schroeder
@strategyand.de.pwc.com

Rusbeh Hashemian
Partner,
PwC Europe New Ventures
Leader, PwC
+49-151-1219-5626
rusbeh.h@pwc.com

Yanbing Jiang
Senior Executive Advisor,
PwC Strategy& Germany
+49-160-6092-966
yanbing.jiang
@strategyand.de.pwc.com

Andris Ogrins
Director,
PwC Strategy& Germany
+49-170-2238-531
andris.ogrins
@strategyand.de.pwc.com

Frederik Blachetta
Director,
PwC Strategy& Germany
+49-170-2238-819
frederik.blachetta
@strategyand.de.pwc.com

Florian Stürmer
Director,
PwC Strategy& Germany
+49-170-2238-375
florian.stuermer
@strategyand.de.pwc.com

Tanjeff Schadt
Director,
PwC Strategy& Germany
+49-1516-7330-436
t.schadt
@strategyand.de.pwc.com

Switzerland

Vincent Colonna
Senior Manager
PwC
+41-79-257-8840
vincent.colonna
@ch.pwc.com

About the authors

Marcus Gloger is a partner with Strategy& Germany, PwC's consulting business. Based in Munich, he advises executives in the semiconductor, software, as well as in automotive and communications technologies. He leads the technology sector for PwC in EMEA.

Yanbing Jiang is a senior executive advisor with Strategy& Germany, based in Düsseldorf. He advises clients globally in the semiconductor, software and telecommunications sectors, focusing on strategy, go-to-market and innovation.

Andris Ogrins is a director with Strategy& Germany, based in Munich. He advises clients in the semiconductor and electronics ecosystem on strategy, innovation as well as data & analytics topics.

Germar Schröder, Frederik Blachetta, Florian Stürmer, Tanjeff Schadt, Andreas Hoegen, Markus Schörghuber, Stanislav Huley of Strategy& Germany, and Vincent Colonna, Dr. Jeroen van Hoof, Stephan Bautz, Matthias Bock, Ulli Leucht and Daniel Reider of PwC Germany and Netherlands also contributed to this report.

EXECUTIVE SUMMARY

Artificial intelligence (AI) has almost unlimited potential to transform all facets of everyday life and work. As a consequence, demand for AI computing power continues to rise at an accelerating pace. We stand on the cusp of this change, which will see both technological advances and digital trust work hand in hand to deliver benefits for society and commerce.

We at PwC Strategy& propose that a sustainable way forward will require continuous, multilateral collaboration on investment, regulation, and adaptation of technology to keep pace with Europe's evolving AI needs.

Our analysis, based on the latest projections from IDC and Gartner, suggests that the proportion of all data generated outside the end devices themselves and analyzed using AI in Western Europe is about to increase massively. The volume of data being processed by AI in data centers today[1] accounts for around 2 percent of all European data; this proportion is expected to rise to more than 50 percent in 2025.

Keeping pace with this activity will require proactive upscaling of computing resources, drawing on the latest technology, right down to microchip level. At the same time, appropriate controls must evolve to ensure that data is protected, so governments, citizens and businesses can have confidence in AI-aided discoveries and the resulting decisions and actions.

Drawing on our research, and insights from over 40 world-class scholars and PwC and industry experts, this report considers how well positioned Europe currently is to capitalize on and deliver the next-generation of AI computing capability, and to retain sufficient control over matters of security, privacy and appropriate use of the technology. Although the European Commission sets out concerted plans for an EU 'ecosystem of excellence' and an 'ecosystem of trust' in its AI strategy, 'trust' has accounted for the majority of its focus to date. However, given the dynamic evolution of AI technologies, achieving trust and maintaining 'excellence' in the field cannot be separated and must be prioritized equally.

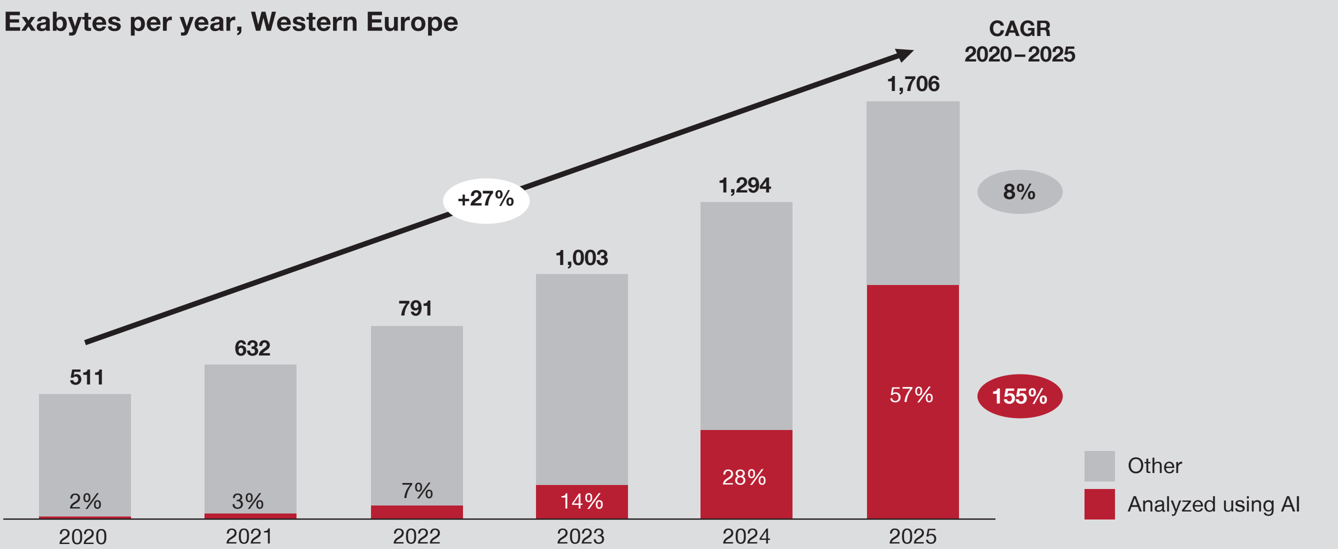
Today, Europe is highly dependent on other regions for AI technology and solutions. This is both a missed opportunity and a source of risk. Technology companies, together with governments in Europe, have an opportunity to create a regional powerhouse in this space, in response both to demand for AI technology and to the EU's specific requirements around data and digital governance.

1. Edge (field) data center locations as well as core data centers.

AI is anticipated to become the key method of Big Data data analytics by 2025

Today, only an estimated 2 percent of all newly-created data in Western Europe is processed using AI algorithms[2] once it has left the device on which data is captured or created. This proportion is expected to grow to well above 50 percent by the end of 2025 (*see Exhibit 1*). This estimate is based on a PwC Strategy& AI data model, which takes into account a range of factors.

EXHIBIT 1
Share of newly-created data analyzed using AI



PwC Strategy& analysis, IDC, Gartner. Newly-created data processed outside of the immediate data capture device, i.e. in edge and core data center locations. Share indicates functional application of AI algorithms for inference or training at least once.

2. Machine learning, deep learning, natural language processing, reinforcement learning, and similar algorithms. Share indicates functional application of AI algorithms for inference or training at least once.

Growth in the application of AI will be driven by a number of concurrent forces, of which the most prominent are:

- A rapid rise in the performance and fall in the cost of computing and storage for AI (as discussed in detail below);
- Increasing generation of data, particularly image and video data, which constitute more than 70 percent of all data analyzed beyondend devices[3]; AI algorithms are particularly suited to analyzing unstructured data of this nature;
- Better access to data for analysis, thanks to increased usage of cloud platforms and data management tools;
- Progress in the discovery of valuable new use cases, spanning everything from healthcare, environmental monitoring and management and smart manufacturing to next-generation discoveries in space and in our oceans;
- Proliferation of data science and data engineering skills, supported by software tools;
- Maturing AI and IoT software platforms, spanning end device, edge and core data center environments.

Initially, the total data growth is expected to happen predominantly in centralized, core data center locations, however, a much faster growth rate in data processing is expected in the so-called 'edge' locations – field computing deployments in factories, near cellular base stations, and similar. This shift will be driven by increased use of real-time analytics applications, as well as costs of data transfer and privacy concerns. Edge computing will become an increasingly viable option for data processing over time thanks to the growing availability of hardware and software in suitable forms for local use.

The total volume of data that is analyzed across both core and edge locations in Western Europe is expected to grow at an annual rate of 27 percent, more than tripling in scale between 2020 and 2025, based on PwC Strategy& estimates and data from IDC and Gartner. There is another growth trajectory that is even sharper, however. This is for the volume of data processed by AI algorithms, which is expected to increase by 155 percent per year between 2020 and 2025. This growth will be fueled by AI technology advances, as well as its increasing accessibility, affordability, ease of use, and the unprecedented insights enabled by AI across a wide range of use cases.

In short, AI algorithms will be applied to a massive amount of data compared to today, and will become a key method of analysis, insights, predictions and automated decision-making based on Big Data.

3. Source: Strategy& analysis based on IDC DataSphere data.

A significant upscaling of computing resources will be required to fulfill future demand

The application of AI at mass scale will require more widespread use of AI processing technology than is commonly the case now. Progress also assumes step improvements in AI technology itself, due to the substantially more intense computation employed by AI algorithms.

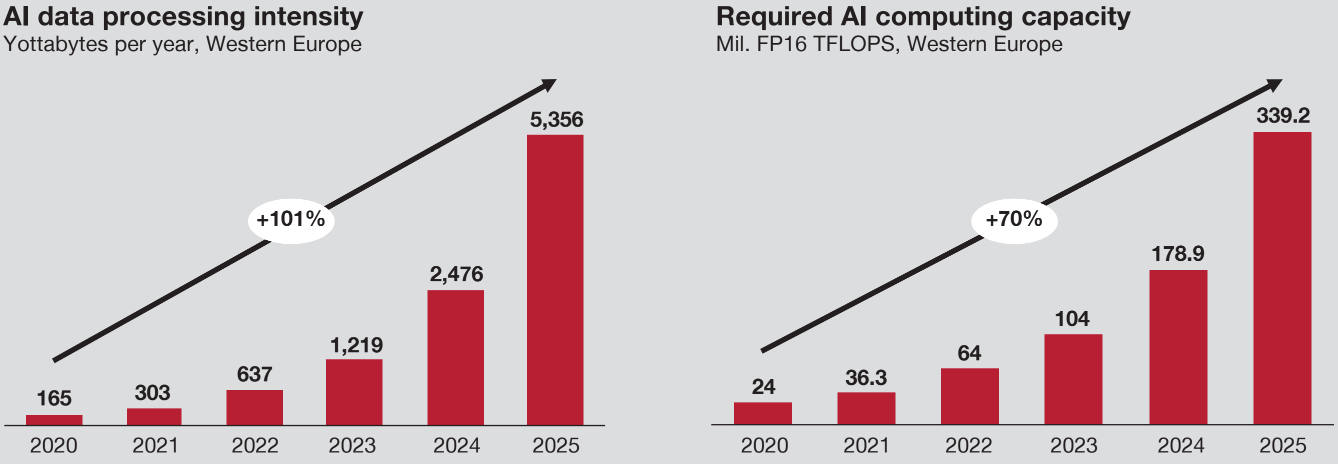
Whereas today more than 85 percent of AI computation taking place at edge and core locations is linked to AI algorithm training, a shift towards more inference-focused tasks (such as prediction) is expected imminently. Driven by the deployment of market-ready, large-scale AI-applications, inference tasks are expected to account for more than 50 percent of the data volume processed by AI by 2025.

These expected developments will require a significant increase in available computational capacity and infrastructure at both edge and core locations.

The required processing rate for data to support the use of AI algorithms, for example, is expected to grow at a rate of more than 100 percent annually between 2020 and 2025 (*see Exhibit 2*). This reflects the number of times the same data will be reprocessed by neural networks or other AI algorithms, the arithmetic intensity of this reprocessing, and the type of data involved – among other factors. Our estimates are supported by forecast shipment volumes of all types of AI acceleration products from different vendors in the coming years.[4]

EXHIBIT 2

Forecast of data processing intensity and required capacity for AI



Source: PwC Strategy& analysis, IDC, Gartner. AI analysis of newly-created data outside of the immediate data capture device, i.e. in edge and core computing locations.

4. Source: Gartner, IDC, Tractica, Allied Market Research, Insight Partners

This has two specific implications. Firstly, it means that the installed base of AI-specific hardware accelerators needs to expand. These are a class of specialized hardware accelerators or computer systems designed to speed up AI applications – primarily those involving machine learning, deep learning and natural language processing. Secondly, the technology itself must continue to advance – harnessing the latest innovations from microchips to software.

Strong, continued technological advances are needed to facilitate AI ambitions

The ability to apply AI broadly and affordably depends on the progress of several critical technologies, not least computing itself. The traditional central processing unit (CPU) is evolving via the addition of computing blocks specifically aimed at accelerating AI. The same is true for graphics processing units (GPUs) and field programmable gate arrays (FPGAs). Dedicated application-specific integrated circuits (ASICs) are becoming the fastest and most power-efficient solutions to some of the most widespread AI computing tasks.

The improving performance of AI computing accelerators is a result of intense research and innovation from technical communities in recent years. But to what extent have real-world analytics capabilities actually progressed?

Measuring the progress being made in AI hardware computing performance is not a straightforward task. This is due to rapid innovation in the field, which goes beyond the accelerator hardware itself – specifically involving evolution in AI algorithms, and particular ways to optimize specific AI analytics models. Meanwhile, actual hardware performance tends to deviate considerably from the designed performance. This is affected by multiple inherent performance limitations, such as peak bandwidth for memory traffic and the arithmetic intensity (determined by the nature) of the workload. Because of this, AI accelerators tend to be tuned for a given range of applications with inherent design compromises. Last, but by no means least, performance can be measured at different levels – at chip, module, or system level, affected in turn by the choice of system design (server, cluster, cloud system).

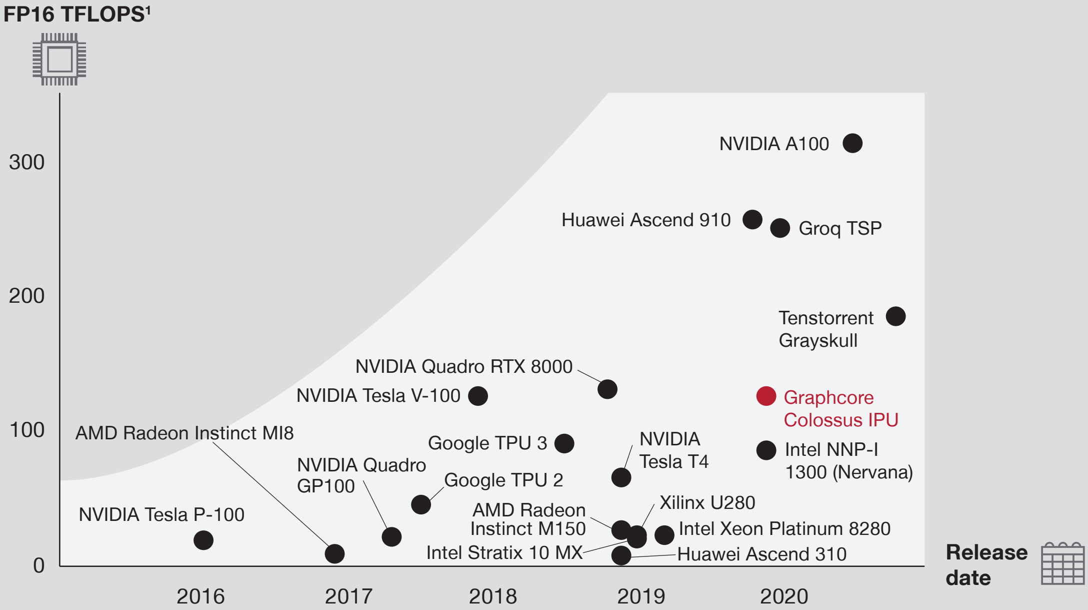
Base comparisons tend to be made using the nominal designed arithmetic performance in (tera) floating point operations per second (FLOPS). By this measure, the computing power of leading-edge commercial AI computing products has risen 17-fold over the last four years (*see Exhibit 3, next page*).

Achieving absolute, designed performance is very important for data center operators, since it allows much denser computing, saving floor-space and the need for other components. However, most of the running costs of providing AI computing are down to power consumption and cooling.[5] By the measure of performance per unit of power consumption, leading-edge AI accelerators have improved by a factor of 11 over the last four years (*see Exhibit 4, next page*).

5. Datacenter Total Cost of Ownership Modeling, NUVIA, https://medium.com/silicon-reimagined/datacenter-total-cost-of-ownership-modeling-90d41f48fa37.

EXHIBIT 3

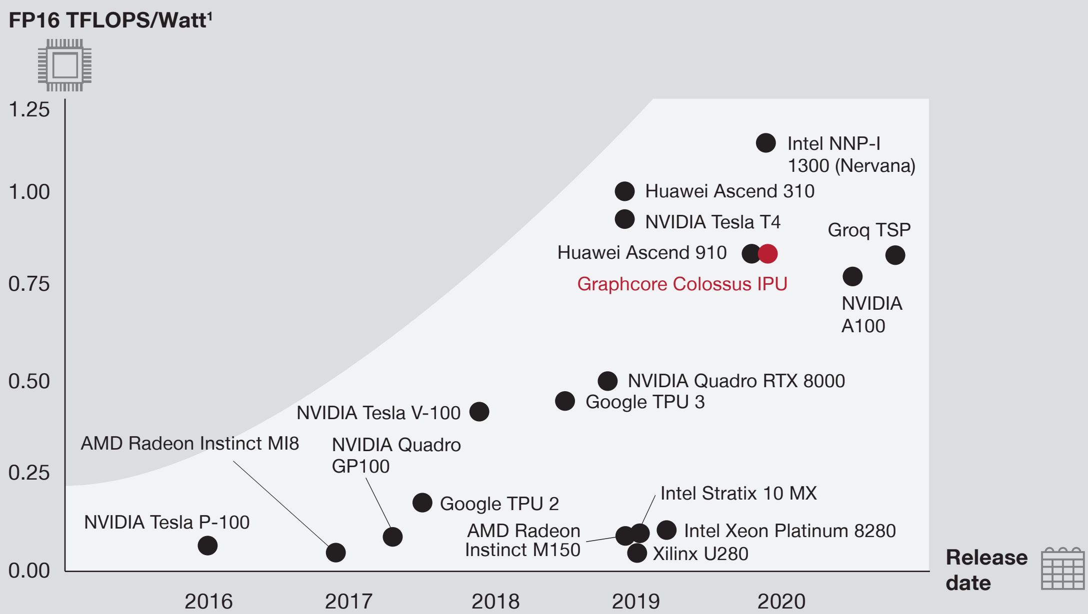
Designed performance of AI computing processors



1. Performance of all chips normalized to FP16 to allow comparability
Source: Strategy& desktop research

EXHIBIT 4

Designed performance of AI computing processors per unit of power consumption



1. Performance of all chips normalized to FP16 to allow comparability
Source: Strategy& desktop research

While real-world step changes in performance may take time to filter through, we foresee further improvements coming down the line. PwC's AI Computing Technology Radar (below) presents an overarching view of different innovation directions and frontiers that will determine the outlook for AI, including architecture and hardware-specific developments.

Based on our research we forecast that technology innovation could collectively yield a 20+ times performance gain per AI computing module in the next five years, with even larger gains expected over a 5- to 10-year horizon (*see Exhibit 5, next page*). This includes improvement in raw computing power per individual computing unit as discussed above, as well as adjacent innovations. More efficient accelerators will be among the many contributors to greater mainstream AI accessibility in the future, too.

The scope for ongoing advancement is likely to span:

- Improvements in AI algorithms and the way they are implemented and deployed;

- Improvements to computing hardware architectures to support the algorithms, all the way down to semiconductor materials;

- Linking computing subsystems with better networking hardware and software;

- Co-optimization of software and hardware at a system level. This will include joint design of workflow tools, model compilers and schedulers, optimized processing hardware, and system-level scheduling mechanisms to optimize workload distribution.

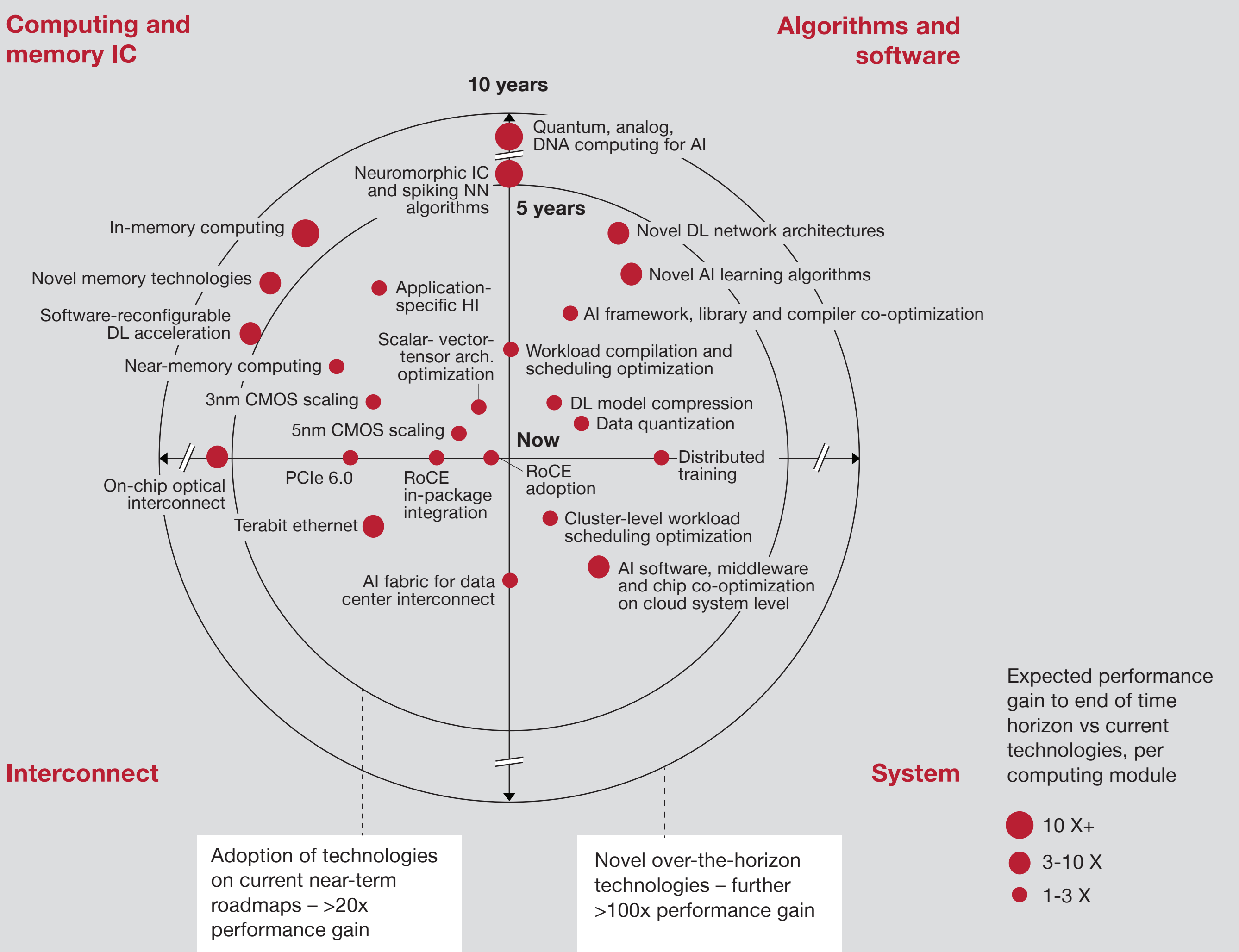
Technology: AI's 'most wanted' list

With all of these developments in mind, where should the various AI stakeholders with an interest in the European market be looking for specific opportunities and returns?

The potential spectrum of innovation is broad, with a range of technologies in different stages of maturity. Software innovation will be just as important as hardware. However, when it comes to the absolute must-haves in enabling AI, the core computing unit is critical to delivering the processing performance that will be needed.

EXHIBIT 5

AI computing technology radar (edge and core applications)



Source: PwC Strategy& research and analysis. Proximity to origin indicates approximate expected time of commercial adoption. Non-exhaustive. DL: deep learning, NN: neural networks, HI: heterogeneous integration, RoCE: RDMA over Converged Ethernet. Performance gain per average computing module in a computing server. Not all technologies will be adopted in each module, and some performance gains will be less than multiplicative

PwC Strategy&'s AI Computing Technology Radar (*see Exhibit 5, page 8*) illustrates that further advancement in AI will rely on collaborative innovations from various players with different know-how and capabilities. One of the most critical battlegrounds for AI technology innovation is around AI processing hardware at the integrated circuit (IC) level. But it is important to frame this in the context of the broader architecture that will facilitate the next waves of AI progress.

European stakeholders considering their best strategy for innovation should consider the following development trends of different AI processing architectures:

CPUs are processing most AI inference tasks today, but ASICs offer most potential
Central processing units (CPUs) play a significant role in supporting AI processing tasks – in orchestrating workloads, handling simulation, pre-and post-processing tasks, and processing more 'exotic' AI workloads. CPUs tend to handle inference tasks in core data centers and at the edge; we also see a significant proportion of AI training workloads being handled at the edge using CPUs. The x86 architecture-based products of Intel and AMD are dominant in this architecture group, while ARM-based designs are gaining ground – with all players gradually incorporating acceleration features for AI into their CPUs.

Our research suggests that CPUs currently account for slightly less than 10 percent of total AI processing tasks, a share that will decrease steadily as better options take over.

These include graphics processing units (GPUs). Originally developed to support the high demands of graphics processing, modern GPUs provide superior processing power, memory bandwidth and efficiency over their CPU counterparts. They are up to 100 times faster in tasks that require multiple parallel processes, such as machine learning and Big Data analysis, making them the ideal choice for AI workloads today. The GPU is currently the most deployed and used AI accelerator, accounting for more than 50 percent of all AI workloads in the core and at the edge. We expect that GPUs will remain a key architecture in 2025, before gradually conceding dominance to application-specific integrated circuits (ASICs). With ASICs, instead of relying on a graphics card to solve complex algorithms, a chip fulfills the task – at much higher speed.

> "In the short term, large performance gains will likely come from more integrated chip packaging and networking, as well as software-hardware co-design of AI accelerators. But if one looks at the longer-term horizon, there is lots of research being done on completely new technologies such as neuromorphic chips and in-memory computing which promise larger improvements."
>
> **Kurt Shuler, Vice-President of Marketing, Arteris IP**

Field programmable gate arrays (FPGAs) will also continue to play a niche role in AI computing in the cloud. FPGAs are semiconductor devices that can be reprogrammed for a desired use case after manufacturing. FPGAs currently handle around 1 percent of AI computing workloads in edge and core data center locations and, due to their flexibility and low latency, continue to play a useful role in scenarios of continuous and significant AI model evolution. However, over time more hybrid designs of FPGAs will be required to keep up with the progress of application specific architectures, by incorporating ASIC building blocks. In the long run, mature ASICs will always outperform FPGAs as the better and cheaper alternative.

Already, ASICs drive about 20 percent of AI workloads in the core and at the edge, and we expect them to become the mainstream technology within two years, and to continue to strengthen their market position over time.

The challenge now is for European stakeholders to command their share of the action. Currently, ASIC development is seeing active participation from global hyperscalers (an example being Google with its Tensor Processing Unit), as well as countless startups with bleeding-edge innovation. These companies' investment in future ASIC AI accelerators will not only drive technological breakthroughs, taking hardware performance to new heights, but also force down the costs of AI hardware – making AI computing much more widely accessible and affordable.

The EU envisages a coordinated approach to unlock the full value of AI, but must look beyond trust and security issues as its focus

Europe, in common with other major regions of the world, recognizes the huge value offered by AI. Citizens across the region will be able to reap economic and societal benefits, including improved health-care, better public services, and new consumer experiences, for instance. Businesses, meanwhile, have an opportunity to strengthen their position in a wide range of contexts. AI-based data analytics could transform machinery, transport, farming, the green and circular economy, healthcare, cybersecurity, fashion and tourism, to name just a few areas. In the public sector, such technology could help reduce the cost of services, improve sustainability, ensure security, and safeguard individual rights and freedoms.

But Europe's AI opportunity is not only as a beneficiary of new waves of innovation; there is also substantial potential for regional stakeholders to create and advance the technology. Europe has excellent research institutes, innovative start-ups and world-leading positions in robotics, manufacturing, automotive, healthcare, energy, financial services and agriculture. There is also a large volume of public and industrial data in Europe that is currently under-utilized.

However, governments in Europe also anticipate risks associated with AI applications. These are linked to the potential for opaque decision-making, discrimination, privacy violation, and more, as automated algorithms take over from human processing of data. Up to now, identifying and addressing these challenges has been the primary focus of the European Commission (EC) in its strategy-making[6]. Its take on AI has been less linked to the race to dominance, and more on how to safely and usefully embrace the technology.

6. PwC Strategy& analysis of the 2020 European Commission White Paper on Artificial Intelligence.

In its 2020 white paper on the EU's AI strategy, the European Commission sets out its recommendations of a coordinated approach to, firstly, mobilize resources across the EU to achieve an 'ecosystem of excellence' along the entire value chain; and secondly, create a unique 'ecosystem of trust' giving citizens the confidence to take up AI applications, and companies and public organizations legal certainty as they look to innovate using AI.

Through its envisioned 'ecosystem of excellence', the EC aims to promote the uptake of AI technology by aligning efforts at both EU and national levels. Such efforts should include:

- Providing EU-level funding to attract and pool investment;
- Coordinating the research and innovation community to build scale and avoid fragmentation of competency;
- Developing AI talent;
- Collaborating across different sectors and all sizes of companies;
- Securing access to data and infrastructure to improve data sharing between European companies and authorities.

The EU is also considering the potential for building alliances with selected non-EU countries and international organizations.

"High-performance computing is a good place to develop new high-end, alternative products. This area benefits from European support, and the EU has established a roadmap to regain sovereignty for high-end microprocessors, with first applications in exascale supercomputing."

Philippe Notton, CEO of SiPearl, a European startup 'fabless' chipmaker; former General Manager of the European Processor Initiative (EPI) project

The ‘ecosystem of trust’, which accounts for as much as 80 percent of the strategy detail in the EC paper, focuses on mitigating potential risks associated with AI. Planned measures include: building a compliant, human-centric AI capability for Europe; matters around privacy and data governance; transparency, diversity, non-discrimination and fairness; societal and environmental wellbeing; and accountability. While the existing EU legal framework applies to AI, a future regulatory framework for high-risk AI application is planned.

Digital sovereignty

The EU is actively pursuing a strategy of ‘digital sovereignty’, distancing itself from digital platforms and technology providers that are not seen to adhere to its regulations and requirements, while at the same time looking to improve data sharing between European companies and authorities. Although it is not policy or law (yet), the EU is developing a framework of regional norms and values, and expects all technology vendors to operate within this. Some member states have started out with rules around procurement for the public sector, involving more stringent checks and restrictions around allocation of contracts and technology sourcing.

Post-Brexit, the UK seeks to diverge from EU data protection rules, but has said it plans to establish its own ‘sovereign’ controls on data and digital technologies. Other non-EU countries in Western Europe are taking similar positions – Norway, for example, has launched its own GAIA[7] project on digital sovereignty and autonomy.

The AI technology ecosystem is vast, and its contribution is vital for regulating AI

Although, for now, the EU has focused primarily on matters of trust over homegrown technology innovation, it is clear that the latter will contribute significantly to maintaining appropriate safeguards and controls as AI grows ever smarter and more powerful.

Deep understanding of the evolution of AI technologies, algorithmic approaches, and their limitations is crucial for their effective regulation. The societal benefits of AI depend on commercial stakeholders, which must adhere to applicable regulations as closely as feasible and practical, in light of technology evolution.

The global ecosystem of developers and influencers that could play a part in shaping appropriate regulation around AI is vast, representing multiple layers of products and services (*see Exhibit 6, next page*). These strong voices should be included in any dialogue about potential new measures, since regulatory approaches are often borne out of technological insights.

Commitment to funding will be crucial, too. Up to now, the scale of investment in AI innovation in the EU has been limited compared to the government-backed subsidy and investment seen in China and substantial private-sector investment in the US. This is something that should change now, not least because the pledge to European digital sovereignty will put pressure on foreign technology suppliers to adapt their own technology roadmaps and go-to-market strategies, to include a more regional ecosystem for Europe.

7. Source: Project Gaia, https://www.gaia-project.info.

EXHIBIT 6
Ecosystem of AI technology

Source: PwC Strategy& analysis

So how can stakeholders across Europe maximize their position and accelerate innovation in the region?

Sustainable progress requires multilateral collaboration in regulation, investment and technology adaptation

The realization of the European dream of trusted, safe, secure and societally-beneficial AI, leveraging the best of the world's technologies, will require strategic investment and extensive multilateral cooperation. European regulators as well as private sector players will need to actively collaborate to make this dream a reality.

Specific actions will be required of both private- and public-sector organizations across two areas of aspiration: the pursuit of AI excellence (technology and innovation); and achieving trust in AI.

In the final section of our report, we have set out some practical steps that should be considered now.

1. Excellence in AI (technology and innovation)

Public sector stake-holders	**Mobilize a full spectrum of technology stakeholders for input on regulation**. One of the most effective and efficient ways to accelerate progress will be through closer coordination between the various stakeholders right across the AI ecosystem. This includes representatives from government and regulators, security and standards bodies, technology vendors, service providers, application developers, specialist startups and end-user communities. Global links will be important too, so that stakeholders in Europe build on and tailor existing best practice to meet regional requirements. Leveraging the best of European and global expertise will be critical to successful progress.
	Promote targeted technology by making substantial strategic investment. The development of advanced technologies has seldom taken place without some degree of state support. European governments should prioritize funding for commercial and research efforts after carefully identifying the areas where impact will be optimal. Having a European 'moonshot' project is not out of the question: new disruptive technologies should be considered (*see Exhibit 5*), but with a view to creating commercial value, rather than simply for the purposes of research.
	Facilitate co-investment. Private-sector participation in funding and driving relevant AI-related innovations will be important, enabling real improvements in how Europe designs its own programs and schemes. The AI ecosystem should be regarded as strategic, and Europe may consider leveraging its experience with the European Aeronautic Defence and Space Company (EADS), or other relevant regional programs around the world.
Private sector stake-holders	**Localize operations to Europe**. Computing service providers, and software and hardware technology vendors, should be urged to consider expanding and localizing their operations in Europe, locate administration within the region, and develop the ability to segregate relevant categories of European data, to comply with evolving European requirements of privacy, security and quality standards.
	Develop European talent and regional innovation activities. Maintaining European skills and competencies in core AI technologies will be crucial in ensuring that AI applications and technologies are developed with European goals in mind. This addresses both the ambition of regional AI excellence, as well as trust among European citizens and businesses.

"To better integrate real security on larger chips, we need advanced-process chip design expertise. This is currently a low priority in Europe."

Philippe Notton, CEO of SiPearl

> Atos is developing dedicated European intellectual property for integrated circuits, servers and software, moving towards a differentiated portfolio and satisfying the long-term goal driven by the EU digital sovereignty agenda."
>
> **Arnaud Bertrand, Fellow & Senior Vice-President/Head of Strategy, Innovation & R&D, Atos Big Data & Cybersecurity (BDS) Division**

2. Trust in AI

Public sector stakeholders	**Harmonize regulations across the EU, encourage non-member states to follow**. One of the most immediate challenges European policymakers must pursue is developing a set of clear AI regulations that are readily implementable across the member states. Non-member states should be actively encouraged to follow the European vision.
	Negotiate bilateral and multilateral agreements with other regions. European policymakers must drive regulation efforts taking both an internal and an external view. There are already several areas of legal contention between pursuits in Europe, the US and China, which create great difficulties for private stakeholders, especially those with global reach. Europe may be able to take a leading mediation role to ensure that global private- and public-sector parties move in concert.
	Promote open software and hardware initiatives. Promotion of open hardware and software is likely to foster collaboration and accelerate innovation, while ensuring that technology can be independently vetted and validated. Beyond direct AI technology, advancement in adjacent technologies for data generation and communication should be tracked, too, as these are likely to have a bearing on regional progress and on controls over data security and local sovereignty.
	Facilitate the operation of AI testing, inspection and certification organizations. Ensuring that AI is deployed according to European principles and regulations will require deep technical expertise. Private organizations can be encouraged to step in to fill this gap, as they do already in other areas, such as automotive or agriculture and food.

Private sector stake-holders

Incorporate European principles in product and market strategy. Private sector parties with a long-term global perspective should consider incorporating European expectations for trusted, safe, secure and societally-beneficial AI into their core principles of operation. They should recognize that actions preferred in Europe are not a hindrance or purely a cost of doing business.

Create product features in software and hardware that are needed to ensure and maintain trust. Leading global chipmakers, hyperscale data center operators, software players, and the many start-ups should consider relevant additional design features – such as geo-tagging, AI model security and trusted execution – possibly in local versions of their products. This could help them to 'land' more smoothly in Europe. The most visible project in this area currently is the European Processor Initiative (EPI), and the EPI-backed European start-up SiPearl.

Adopt open software and hardware, and be prepared to open own designs. At the chip level, promotion of RISC-V open standards architecture should be strongly considered. Suitable for AI/IoT applications, today this is promoted as a license-free, open-standard-based chip technology to rival proprietary technologies from Intel and ARM. The RISC-V standard is also beginning to be used in GPU applications and custom accelerators, which could trigger new waves of innovation, unfettered by legacy conflict.

Strategy&

Strategy& is a global strategy consulting business uniquely positioned to help deliver your best future: one that is built on differentiation from the inside out and tailored exactly to you. As part of PwC, every day we're building the winning systems that are at the heart of growth. We combine our powerful foresight with this tangible know-how, technology, and scale to help you create a better, more transformative strategy from day one.

As the only at-scale strategy business that's part of a global professional services network, we embed our strategy capabilities with frontline teams across PwC to show you where you need to go, the choices you'll need to make to get there, and how to get it right.

The result is an authentic strategy process powerful enough to capture possibility, while pragmatic enough to ensure effective delivery. It's the strategy that gets an organization through the changes of today and drives results that redefine tomorrow. It's the strategy that turns vision into reality. It's strategy, made real.

strategy&
Part of the PwC network

www.strategyand.pwc.com