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WHITEPAPER

Beyond Cloud – A Glimpse into the Future in Nine Hypotheses

The cloud will not disappear in its current form. However, it will evolve, grow and become more permeable. At some point, it will be as easy to access the cloud as it is today to switch to a foreign mobile network.

What is the cloud?

It is a term that has moved far beyond the IT industry and is now taking over the planet. If your aim is to take a holistic view and consider all of its individual aspects, then it is becoming increasingly difficult to formulate a general definition of the cloud. Possible definitions are often simply the interpretation of the person who is asked:

- **The cloud provides a shared pool of on-demand, retrievable services or computing resources**
- **The cloud is an IT model that is primarily characterized by the outsourcing of IT services to an external service provider[1]**
- **The cloud is an operating model and therefore a special kind of sourcing**

Regardless of how you define the cloud, you will inevitably touch on one of the aspects mentioned above. You will also seek out the cloud solution that best meets your needs because, regardless of whether you are a cloud expert or a technical layperson: the cloud has long since become a part of our everyday lives.

Companies tend to be ahead of private users when it comes to understanding the significance and future relevance of the cloud. Within the practically unlimited possibilities of the cloud, they recognize the intrinsic potential that the cloud offers their business model now and in the near future, which in turn will contribute to their future success. The cloud is ubiquitous and is gaining acceptance – or is it?

At MHP, we are pleased that our clients and the readers of this whitepaper hold a wide range of views, because no matter how you define the cloud, for us at MHP, two things are clear:

- **The cloud is a growth driver, a competitive advantage, and a guarantee of future success for any current and future business activities**
- **Regardless of where a company is right now in terms of their current technological transformation process, we are all still at the start of this journey**

The question of future competitiveness will not be, "What do I use the cloud for?", but rather "How deeply is the cloud integrated into my company and its value-adding activities?".

Here at MHP, we are addressing this question and taking it one step further. In this whitepaper, we ask the question: "What comes next after the cloud?".

[1] See the Fraunhofer Cloud Computing Alliance (in German): https://www.cloud.fraunhofer.de/de/faq/cloud.html, accessed on 5/5/2022

Objective of this whitepaper

Without being able to predict the future, this whitepaper is intended to encourage reflection, inspire lively conversations and discussions, and encourage innovation.

In **nine Hypotheses**, which should be understood more as open intellectual exercises rather than formal postulates, we will take a look at the world in 2035 and describe how we think the cloud will evolve from today's perspective. We analyze and connect current technological trends and offer recommended next steps for companies, decision-makers, and everyone who is as passionate about technology as we are.

Overarching we ask ourselves:

"Can future companies only exist as "cloud-native enterprises"?

The evolution of the cloud

To understand what lies ahead, it makes sense to start by taking a look at the past.

The foundations for the internet were already laid by the end of the 1970s. The internet was preceded by an experimental predecessor called ARPANET, which was created as part of an American research project. ARPANET was the first project to enable cable-based machine communication via an enclosed network for geographically separated systems. At that time, due to a lack of infrastructure and the prohibitively high costs of private computers, commercial applications for this technology were inconceivable.

In 1991, the World Wide Web was first made available to the public, and many companies began using it for commercial purposes. Companies and private individuals began to develop their own websites in order to attract clients and establish an online presence. For the general public, the internet was essentially a notice board sprinkled with early online services, such as e-mail, message boards, and some simple online platforms. Many companies would soon join in. The **era of the dot-com bubble** at the turn of the millennium heralded the birth of cloud computing, as companies like GoDaddy or BlueHost offered their services around the world.

In these early days, the **desktop computing model** was the prevailing one for the internet. Computers were not universally connected, therefore making them enclosed systems that were only locally accessible for select individuals.

As the **internet continued to expand** and computer hardware costs fell, **client-server architecture** – a standard concept for orchestrating tasks across distributed systems within a single shared network – **became increasingly important**. Computing resources such as memory, network, and processing power continued to rest primarily in the hands of private individuals or various companies. This trend remained in place even as the internet expanded, and interconnectivity increased. Companies relied on self-managed, decentrally organized infrastructures, such as internal company networks, internal servers, and company computing centers for the provision of relevant services.

As computer hardware became increasingly powerful and software was used more intelligently, the topic of virtualization began to gain momentum. The first providers began offering virtual servers (vServer) or virtual private servers (VPS), including dedicated storage solutions on internal company servers, including for external clients. However, with the foundation of well-financed, innovative, and extremely horizontally and vertically scalable tech companies in the form of **cloud service providers** (**also referred to as hyperscalers**) such as Amazon, Microsoft, and Google, the world experienced an eruptive moment: with their scalable, comprehensive service offers, cloud providers could now centralize resources to a degree that was previously unthinkable. Privately organized IT infrastructures, like the ones belonging to these companies, are now being replaced by compatible cloud services, which are being centrally consolidated into ever-larger, externally managed computing centers. The processing or consumption of the ever-growing mountains of data no longer takes place on-site in a company's own internal computing center, but rather far away at the service provider or hyperscaler of their choice. Decentralized structures are giving way to centralized ones; capacity and procurement planning are being replaced by on-demand availability. New job profiles, such as cloud architects or cloud platform engineers, are entering the market.

HYPOTHESIS 1

The shift towards centralization will reverse itself. In the future, the capacity of the cloud will no longer be limited solely by hyperscalers' dedicated resources, but rather will be expanded and supplemented in its current form by a symbiosis of independent IoT devices. The field of market participants will (once again) grow.

The reason for this is the increasing penetration of smart devices on the market. A growing number of devices – from thermostats to CNC machines and even cars – now have considerable performance resources. Most of the potential of these resources remains untapped. Anyone familiar with the amount of processing power at the disposal of a modern vehicle will understand the volume of resources standing around unused at the employee parking lot of the VW factory in Wolfsburg, Germany, during a single day shift, for example. At the same time, this lack of resource utilization goes hand in hand with the wasting of potential and opportunities, which are becoming increasingly important to exploit.

My refrigerator, the node

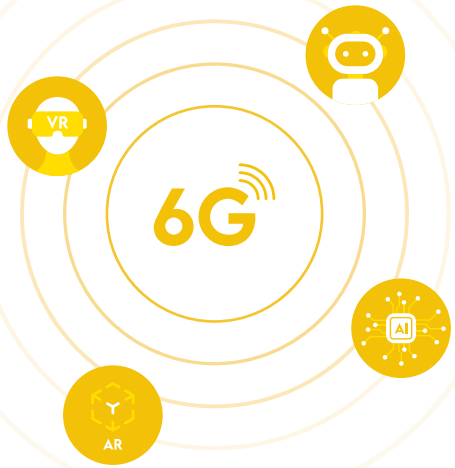
What drives us here at MHP is the idea of 'anything-to-cloud', i.e., the ability to offer and provide local computing and storage resources in order to merge them into a uniform, homogeneous, and tightly integrated package that allows these resources to be utilized, especially in the context of smart devices.

A look at our regional distribution and low-voltage networks can provide a point of comparison here. The central provision of electrical power through large power plants is increasingly giving way to decentralized provision through renewable energy sources or mobile storage units in the form of electric vehicles[2]. Connecting private CHP units in order to simulate a standardized thermal power plant, which is actually decentrally distributed across the basements of various homes and provides resources there in the form of heat energy, is nothing new. In the future, the '**anything-to-cloud**' model allows for the provision of local resources and resources organized by third parties, e.g., through the integration of local vehicles or other smart devices in the cloud.

The basic idea of distributed ledger technologies is becoming increasingly technologically mature and gaining **acceptance** even outside of the politically controversial Bitcoin protocol. Within the context of distributed ledger technologies, less powerful systems like refrigerators or smart meters could become increasingly important, for example, for storing transaction histories. This effect could be further enhanced by the growing trend of moving away from the proof-of-work concept and towards the proof-of-stake consensus process. In the future, why would we need a cell phone contract when communication increasingly takes place via the internet and a growing number of vehicles or smart devices are equipped with their own SIM cards? Why should companies pay for external CPU usage when there are plenty of machines that are standing around unused on their own shop floors?

[2] See: https://newsroom.porsche.com/de/2022/produkte/porsche-taycan-pufferspeicher-stromnetz-vehicle-to-grid-anwendungen-27527.html

On communication, networks, and latencies



Admittedly, the technical hurdles are currently high – and not only present in terms of security concerns. The basic prerequisite for any network is the rapid, smooth flow of data. Data needs to flow – and quickly. At the end of 2021 in the Chinese metropolis of Wuxi, the car manufacturer Audi of Ingolstadt, Germany, presented the world's first V2X (vehicle-to-everything) demonstration of fully automated Level 4 driving on public roads using 5G technology.[3] The demands placed on data traffic in this context are enormous, and 5G will not be able to keep up with the necessary requirements as data volumes grow.

Thanks to ITS higher frequencies and lower latencies, 6G enables significantly higher data throughput and better data rates. 6G is needed to manage the continually growing flow of data. As the designated successor to 5G mobile technology, 6G will deliver on the promises of 5G.[4] Technologies like mobile edge computing or hyperscale edge computing stand to significantly benefit from this development and achieve their first comprehensive breakthrough as a result. Smart devices like vehicles will be affected by this development, which has led us at MHP to derive the following additional Hypotheses from Hypothesis 1:

HYPOTHESIS 2

In the future, data evaluation will no longer be centralized at the major hyperscalers' computing centers, but rather will take place decentrally, directly where the data is created, and be supported by the provision of computing power from smart IoT devices and rapid communications technology. Edge computing will be supplemented in the future by additional AI algorithms in order to spice up an otherwise bland data stew.

As a result, the shop floor will gain a great deal of significance, especially with regard to derivative topics, such as data fabric.

[3] See: https://www.audi-mediacenter.com/en/audi-in-china-5583/profile-of-audi-in-china-5585, accessed on 4/20/2022

[4] See: https://www.innovations-report.com/information-technology/6g-is-coming-to-make-good-on-the-promises-of-5g/, accessed on 4/20/2022

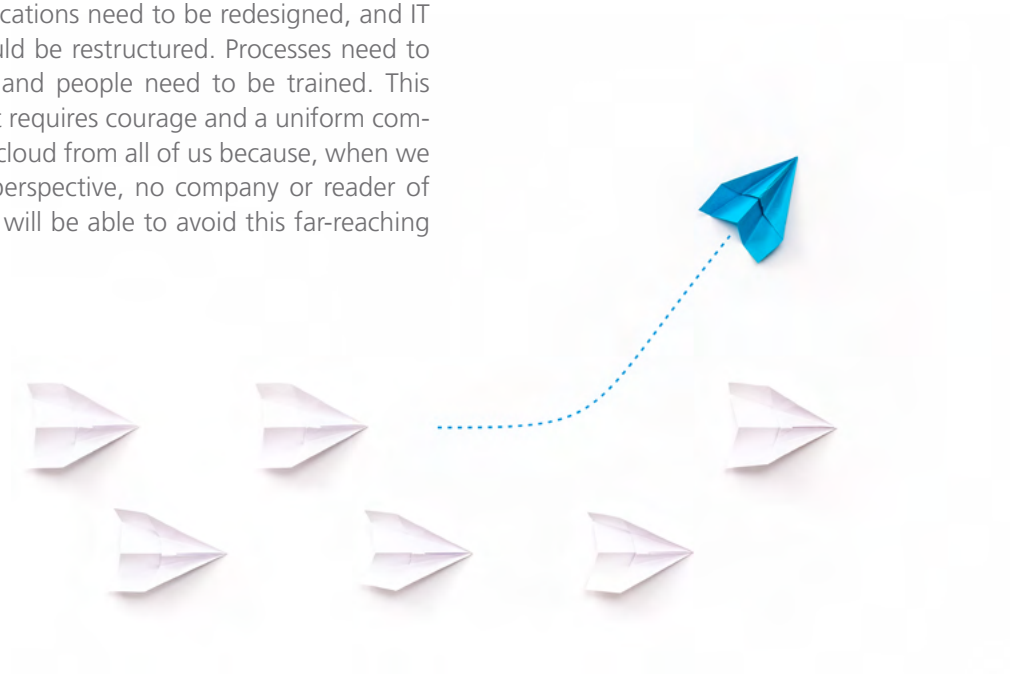
The evolution of cloud applications

The aforementioned considerations will produce the following after-effects:

HYPOTHESIS 3

Today, applications of all kinds must be designed to be cloud-agnostic. Lift and shift is dead – the future belongs to the use of cloud-specific services and mobile applications.

MHP has a wide range of expertise in the field of the future-proof design of cloud applications, strategic development planning, and the strategic shift away from traditional companies to modern 'cloud-native enterprises. We believe that many applications will be able to run anywhere on-demand using distributed computing resources. Many companies are wasting time and resources on challenging, protracted lift-and-shift projects. In this context, lift and shift means the moving of traditional applications, software systems, and, in some cases, entire IT landscapes to the virtual service offerings of hyperscalers. Unfortunately, this process often occurs without first conducting an architectural analysis of the technological characteristics of the system in question. These investments are wasteful and are not future-proof, as they do not benefit profoundly enough from the cloud-specific and the sometimes, but not always, immediately obvious advantages of the cloud. Applications need to be redesigned, and IT landscapes should be restructured. Processes need to be overhauled, and people need to be trained. This enormous effort requires courage and a uniform commitment to the cloud from all of us because, when we take a holistic perspective, no company or reader of this whitepaper will be able to avoid this far-reaching shift.



A revolution from below

HYPOTHESIS 4

Access to the cloud will become increasingly simple, and at some point it will be as easy as the current process of connecting to a foreign mobile network.

Technical hurdles as far as the eye can see. Endless security concerns. Legal and compliance requirements that can only be partially realized at best. What may sound unrealistic or even naive at first in terms of the moats created by the established hyperscalers is what is entailed by the observations described above. Too many resources remain unutilized, too much potential is unexplored. Related business models and new possibilities for monetization are too valuable to leave this potential untapped. Changing customer needs and political corrective measures allow for new strategic partnerships and will result in technological progress.

Politically motivated or self-managed initiatives, such as the Gaia-X project, which was launched under the former Federal Minister for Economic Affairs and Energy Peter Altmaier at the Digital Summit 2019, encourage precisely this shift towards the barrier-free use of the cloud. Even if the original objective was the establishment of a uniform data infrastructure to preserve digital data sovereignty, it promotes the connection of additional – and, importantly, smaller – market participants, the blurring of rigid platform boundaries, and the creation of common data spaces.

Admittedly, despite massive efforts on the parts of various participants, the development of open standards, like the sovereign cloud stack (SCS) using open-source software under the responsibility of the Open Source Business Alliance (OSB), and generous state funding, at this time, Gaia-X has not made it past the conceptual phase. The success of the program must be evaluated critically, not least due to the fact that the initial funding was cut once the coalition government came into power. What remains is the will and growing interest in restructuring projects in terms of general participation opportunities in the cloud environment.

If applications can be executed anywhere at any time via decentralized resources, two additional factors are required for companies specifically:

Autonomic computing (AC)

Autonomic computing describes the adaptive abilities of an IT system to react independently and invisibly for the user to the external stimuli in its surroundings and to autonomously interact with these stimuli. While this may sound innovative, it is actually a well-established concept. The initial ideas have been around since the early 2000s. In its Autonomic Computing Initiative (ACI), IBM first defined the four areas of autonomic computing:

- **Self-configuration** – the ability of a system to autonomously adjust to external changes in its environment through reconfiguration, component adaptation, or shedding defective components
- **Self-healing** – the ability of a system to detect, isolate, and repair defective components
- **Self-optimization** – the ability of a system to continually optimize itself and to ensure that system processes have the best possible performance
- **Self-protection** – the ability of a system to detect a wide variety of external system attacks, to track suspicious behavior, and therefore through adaptation to ensure the overall security and system integrity completely and at all times

Autonomic computing is currently undergoing a renaissance because, ultimately, the idea of reducing the total cost of ownership (TCO) is a key consideration.

A certain degree of artificial intelligence (AI) is required for the adaptive interaction of systems. Because we are currently witnessing AI algorithms improve in quality, the possibilities of autonomic computing are becoming increasingly relevant in terms of the future development of the cloud and the applications that can be implemented in the cloud environment. The cloud of the future will demand particular awareness of this topic, especially on the part of decision-makers at large and medium-sized companies.

Cybersecurity mesh

If applications can be executed from anywhere at any time using decentralized resources within the context of 'anything-to-cloud', the demands on IT security will take on an unprecedented dimension. Simple 'zero-trust' approaches are not sufficient for meeting the requirements of the future. Current security concepts (if there are even any in place) will need to be expanded to include important key activities and comprehensive defense measures. In the future, no company will be able to do without cybersecurity mesh.

Cybersecurity mesh is an architectural approach that guarantees scalable, reliable protection of decentralized, generally uncontrolled devices within a company's overall ecosystem. In October 2021, Gartner predicted that by 2024, organizations adopting a cybersecurity mesh architecture will reduce the financial impact of security incidents by an average of 90%.[5]

In combination with emerging security technologies, such as security service edge (SSE), security posture management (SSPM), or cloud native application protection (CNAPP), cybersecurity mesh will pose major challenges to company developers and architects.

Comprehensive protection can never be achieved using technical means alone; companies can only talk about achieving serious protection when their security teams have the power to comprehensively monitor and implement security guidelines.

[5] See: https://www.gartner.com/en/articles/the-top-8-cybersecurity-predictions-for-2021-2022, accessed on 2/23/2022

"The deployment is in progress" – interim conclusion

From where we stand today, the cloud is not going anywhere. Today, there is no question of "What comes next after the cloud?", or rather this question cannot yet be effectively answered. What is certain, however, is that the cloud in its current form and with its current range of services will change and evolve over time. This evolution will need to take account of considerations of efficiency, technological developments, changing customer requirements, and new business models.

Those seeking what is 'beyond the cloud' are looking for the next generation, or rather the next big breakthrough.

New roles – the future of the hyperscalers

As the cloud evolves on the basis of changing customer requirements, the role of the traditional hyperscaler will also change. The problem: costly investments are unavoidable when it comes to establishing your own cloud infrastructure.

According to Synergy Research Group, in 2021, providers of cloud solutions – primarily AWS, Azure, and Google as the top industry players in their class – invested around USD 180 billion to expand their infrastructure.[6] European providers lag far behind in last place even in their home markets, and the gap between these providers and US concerns continues to widen.

HYPOTHESIS 5

On the basis of their investment power and willingness to invest, the cloud and therefore also traditional hyperscalers will be the first point of contact for the wide-scale provision of future technologies and technological innovations.

The starting point for this Hypotheses is the consideration of the fact that the development, operation, and maintenance of future technologies will be extremely costly and require a great deal of resources, especially in the early stages. Resources in the form of financial and human capital will be required for the development and operation of state-of-the-art high-performance computing or HPC clusters for performing operations that require a great deal of computing power, the development of application-related quantum algorithms as part of the operation of a quantum computer, or the development and testing of innovative AI systems. Only companies with strong financials, sound expertise, and a large customer base will be able to raise this level of financial and human capital in order to offer these services to wide swaths of the market.

Hyperscalers have these resources and benefit from the scaling effects of their large customer bases, making them able to roll out these technologies profitably and extensively.

Innovative future technologies will be introduced and offered to the general public or a company's own customer base, not primarily for the company itself, but rather always in pursuit of entrepreneurial aims. Cloud providers will be faced with and forced to overcome the complexity to be expected in terms of the operation and use of these future technologies.

HYPOTHESIS 6

Cloud providers will react to the growing complexity of the operation and application of future technologies by expanding the area of managed services and further simplifying use.

As we have identified up to now, it is not access to and the performance of the cloud that will change, but rather the role of the provider. At the end of the day, these developments will also impact all of the applications on the application layer that add value to companies and that we human beings will need to learn to work with.

[6] See: https://www.handelsblatt.com/technik/it-internet/amazon-microsoft-und-google-cloud-konzerne-sichern-sich-mit-gigantischen-investitionen-den-zukunftsmarkt/28094548.html, (in German), accessed on 2/28/2022

On the human aspects of the shift

With the shift or evolution of the cloud, more attention is being paid to the human side of the practical application of cloud-based technology.

As we discussed above, we are currently observing increased quality in terms of the maturity of AI models and their algorithms. The scope of application for AI grows as the fundamental models and the corresponding infrastructure become increasingly powerful. We can assume that, in the future, the processing of data and data models will become significantly more efficient and be increasingly automated. Simply feeding AI models with training data is a thing of the past.

HYPOTHESIS 7

Generative AI will allow us to develop innovative cloud-based business segments that are currently unforeseeable.

Generative AI is able to learn a representation of artifacts from data and use it to generate new derivative artifacts with the same characteristics of the original data. This means that generative AI is the first technology that can offer autonomous creative results – a property that has previously only been attributed to human beings.

The volume of findings and data produced by generative AI will grow rapidly. Gartner has predicted that it will make up 10% of all data produced by 2025.[7] Even though we cannot fully grasp the potential of this technology right now, we can assume that not only will companies profit from the results of generative AI in particular when it comes to customer support, but that their employees will benefit from it as well.

[7] See: https://www.gartner.com/en/documents/4006921, accessed on 2/23/2022

No action without reaction

These upcoming possibilities bring with them a range of home-grown problems. In terms of responsible AI, decision-makers of all stripes will need to remain vigilant:

HYPOTHESIS 8

In the future, decisions will no longer be made without support from AI models. As a result, the overall decision-making process will change fundamentally for managers and top executives.

On the whole, the underlying decision-making process for decision-makers will change. In the future, the quality of decisions will increasingly depend on the quality of the AI models used and the data fed into these models; the abilities of the human decision-makers themselves will be of less importance. Companies and decision-makers therefore need to gain awareness of how to work with artificial intelligence in order to be able to counter these AI models and the resulting decision-making templates, in particular in terms of explainability, justifiability and human-centeredness. The topic of decision intelligence – meaning the current trend of creating **decision-making templates**, mostly cloud-based, using artificial intelligence in combination with analytic tools – is one that will endure.

The possibilities are currently beyond the limits of our imaginations, however, we cannot afford to lose our sovereignty over AI models and data.

Conclusion

On the basis of current technical factors or partial interests, many ideas and concepts seem unlikely today. However, it is clear that the current status quo will not be maintained. Technical hurdles will disappear, new cooperation's will emerge, technology will continue to evolve, and humans will be forced to learn how to cope with the new technological reality. This applies in particular to decision-makers at large and medium-sized companies, who shoulder a unique societal responsibility.

The cloud in its current form will not disappear. However, it will continue to evolve, grow, and become more available to additional market participants. One day, accessing the cloud will be as easy as it is currently to connect to a foreign mobile network. Not only does technology need to be flexible, but so too do companies when it comes to designing this technology.

Artificial intelligence will continue to generate rapidly growing volumes of data. The growing flood of information will flow through continuously accelerating communication channels. In just a few years, we will feel as if the world is spinning even faster than it does today. Companies and their decision-makers must be prepared for this change. But what does that mean for the company itself?

HYPOTHESIS 9

The perfect company – and therefore the only company capable of surviving – will be the 'cloud-native enterprise'.

We define a cloud-native enterprise as a company that:

- **is fully integrated into the cloud in terms of its processes and its products.**
- **uses as many emerging technologies as possible, e.g., the ones specified in this whitepaper, to its advantage.**
- **optimizes its resources.**
- **is free of all legacy burdens, such as outdated systems and outdated worldviews.**
- **can react with maximum flexibility to the changes of a world that is moving 'beyond the cloud'.**

"Is the cloud-native enterprise an utopia?"

Contact

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