SURF

Introducing Supercloud for Education and Research

A federated, unified system to rule them all

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Content

1   Introduction

Summary
Cloud comes in many shapes and sizes (private/public, hybrid, multi, etc.). In Europe the adoption of cloud is around 26%, and it is mainly dominated by Big Tech. The complexity of clouds is increasing, as well as dependency with respect to limited knowledge/expertise, lead time, security, and privacy. The concept of Supercloud emerged that might be a solution to mitigate certain risks and challenges that are encountered. But is this concept feasible?

The cloud is getting bigger and more important as time goes on. It continues to build upon existing technologies. With more need for cloud compute the complexity of working with different cloud providers might skyrocket. Could the concept of Supercloud help mitigate these issues?

The origin of the supercloud concept or its definition is not exactly clear. Around 2021 the term started to catch on within the cloud community. Other terms that are also being used are metacloud, sky computing, spectracloud, likely more terms that describe the same idea.
Before elaborating on the concept of supercloud, let's take a moment to take you along in what cloud is, how it evolved, and why people are now talking about the supercloud.

TLDR[1]; although the Supercloud in its ultimate form is the answer to concerns and challenges faced today, it might be a bit of a stretch to realise it due to governance and interoperability.

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[1] Too long, didn't read

2 What is cloud?

2.1 Public Cloud

Public clouds are computing services offered by third-party providers over the internet, making them available to anyone who wants to use or purchase them. They deliver scalable, flexible, and cost-effective solutions for computing, storage, and networking needs, without the need for users to own and maintain physical servers and data centres. Public clouds are ideal for handling varying demands and workloads, offering a pay-as-you-go model that allows businesses and individuals to access a wide range of resources and services on demand.

Public clouds are frequently linked with Big Tech (major American companies), which currently dominate the market. They are also rapidly gaining popularity because of their managed service offerings. These services allow users to access entire applications as services, freeing them from operational burdens. Such applications span a wide range, including databases, data lakes, high-performance computing (HPC), customer relationship management (CRM), AI suites, video streaming, and more.

2.2 Private Cloud

Private clouds are dedicated cloud computing resources exclusively used by a single organisation, providing enhanced security and control. They are particularly favoured for their ability to meet specific security standards and regulatory compliance requirements. Private clouds offer a highly customisable environment tailored to an organisation's unique needs, from data storage to advanced computing tasks. This setup allows businesses to achieve a balance between the scalability and elasticity of cloud computing while maintaining strict control over their sensitive data and applications. Implementing and managing a private cloud effectively requires skilled in-house professionals, often in significant numbers, along with specialised knowledge. Consequently, if aiming for a properly maintained private cloud, it is not usually considered an economical solution due to these high demands for expertise and resources.

2.3 Hybrid Cloud

Hybrid cloud integrates public and private clouds, allowing sensitive data to be processed and stored on a private cloud server within an organisation. Typically, an organisation's private cloud capacity is fixed, primarily for economic reasons. When additional capacity and scalability are needed for cloud computation, an organisation can expand beyond these limitations through a public cloud, a process known as 'bursting'.

2.4 Multi Cloud

The biggest cloud providers are Amazon (AWS), Google (GCP), and Microsoft (Azure). These three cloud providers combined take up 66% of the total cloud market[2]. These providers offer a range of tools, workflows, features, and specifications. To leverage these cloud services effectively, organisations must integrate and adapt various systems and workflows. Employing multiple cloud providers enhances scalability and mitigates outages by distributing work across different servers, services, and networks.

It's also possible to integrate multi-cloud and hybrid cloud strategies to develop a multi-hybrid cloud architecture. To illustrate the usage of multi-cloud and hybrid-cloud configurations: in 2023, 87% of technology companies adopted a multi-cloud approach for their cloud computing needs, and within this group, 72% implemented a hybrid cloud setup[3].
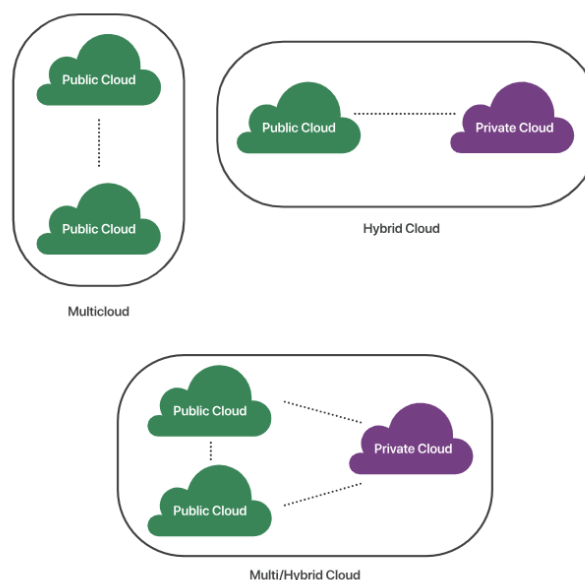
2.5 Edge and Cloud continuum

Edge and cloud computing form a seamless continuum of technologies that enhance data processing capabilities across the spectrum of environments. Edge computing processes data near its source, such as Internet of Things (IoT) devices, to minimise latency and reduce bandwidth demands, facilitating real-time analytics and decisions. Conversely, cloud computing harnesses the power of centralised data centres to provide scalable and flexible computing resources, storage, and applications via the internet. This integrated model offers a continuum that optimises performance, efficiency, and scalability, allowing organisations to harness localised processing at the edge and extensive computing power in the cloud, thus ensuring a comprehensive approach to data management and application deployment.

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[2] The Latest Cloud Computing Statistics (updated October 2023) | AAG IT Support (aag-it.com)

[3] Message from Flexera

3   The concept of Supercloud

3.1   Current challenges
There are notable challenges for organisations in utilising public cloud solutions, particularly with the adoption of multi-cloud setups. This complexity arises because each cloud provider offers unique tools and workflows, making integration and management more difficult. Additionally, the push towards multi-cloud and hybrid-cloud architectures is increasingly driven by regulatory compliance, the desire for greater autonomy, and the need for effective exit strategies. Regulatory mandates often require data to be stored in specific geographical locations or handled in certain ways, prompting organisations to distribute their assets across multiple clouds. Furthermore, leveraging a combination of cloud environments allows organisations to avoid vendor lock-in, ensuring they have the flexibility to shift providers as needs or market conditions change, thereby enhancing their negotiation leverage and operational resilience.

Knowledge and expertise
Multi cloud setups require certain knowledge and expertise. Hiring (new) talent, training existing employees, or outsourcing a part of the (development) process are some of the consequences. Using multi cloud is therefore not easily and equally accessible to all.

Lead time
When it comes to provisioning and maintenance, the workflow for each cloud provider is also different which makes it more complex and time-consuming to make changes throughout the whole multi cloud setup.

Security
Roll-out changes to security protocols are more complex when using multiple providers. The changes must be done for each and individual system, taking up a lot of time and leaving more room for error.

Privacy
Next to the issue of required expertise per provider, security and privacy are always a top priority concern. All providers have their own solutions for this, making working with multiple providers at once a hard task. Next to this, not all sensitive data can be used on the public cloud, so there is even more complexity when dealing with sensitive data[4].

3.2   One system to rule them all?
The idea behind the concept of supercloud is that it could abstract different cloud providers to form a federated and unified infrastructure. A supercloud provider could aggregate available cloud technologies to make computing, storage, and networks more scalable, more secure, more transparent, and even reduce development costs.
The concept of supercloud would enable users to deploy workloads to a preferred server or to assign the best server based on performance, latency, or cost. Data could be seamlessly transferred or moved across the cloud providers by the users (while a rather quite complex orchestration might happen under the hood of the supercloud).

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[4] Issues in Cloud Computing - GeeksforGeeks

Interoperability

One of the major concerns related to the supercloud concept is the development and integration of commercial clouds. Commercial public cloud providers are typically focused on maximising their profits, which they achieve by using highly efficient tools to simplify and accelerate their development processes. Each cloud provider has its own unique set of tools and workflows, leading developers to become dependent on one or just a few providers for all their needs. The supercloud concept aims to abstract these processes to a degree where specific tools and workflows become generalised and/or interoperable across different cloud providers. This would make it easier for users to connect with a single platform – effectively acting as a 'neutral cloud'. The scope of this neutral cloud would be to integrate and orchestrate the existing cloud services, whether they are private, public, or commercial.

Governance

The supercloud concept success is probably dependent on a single platform responsible for building and maintaining this emerging infrastructure and for its strategic commercial but impartial posture.

If the organisations developing the supercloud infrastructure are biased, or driven by profits and politics, it could erode trust among cloud providers and infrastructure developers. A deficit of trust may create friction and frustration during the development process, potentially leading to the collapse of the supercloud infrastructure.

4 Alternative supercloud futures

The supercloud concept represents a sophisticated technological endeavour that may not be immediately apparent or accessible to all, it might never happen.
Given the intricacies and possible obstacles, it's challenging to predict its fruition. However, to give an idea of its potential, we imagined several scenarios that envision the (successful) establishment of a federated cloud infrastructure in Europe, maybe not a utopian supercloud, but a close one.

4.1 Scenario a: United cloud (federated Europe, federated infrastructure)

Some countries have decided to join forces to tackle the development of a European cloud and it is there: Gaia-X. Gaia-X isn't just about cloud services; it's about an environment where data and services are shared and used securely across various industries, promoting new business models and innovation.[5]

4.2 Scenario b: Regulated supercloud (federated Europe, commercial cloud)

European countries decided to collaborate closely to harness the benefits of cloud computing technologies while leveraging commercial cloud services instead of developing their infrastructure, like the Gaia-X initiative. There is a strategic partnership between European governments and major commercial cloud service providers (CSPs) such as Amazon Web Services (AWS), Google Cloud, and Microsoft Azure. A EU-level body is established to oversee the implementation, ensuring that CSPs comply with European standards and regulations. This body also facilitates the resolution of any disputes and monitors the overall health and innovation of the European cloud ecosystem.

4.3 Scenario c: Cloud nation (fragmented Europe, federated cloud)

Despite political fragmentation, European nations still choose to collaborate on a technical level for cloud infrastructure. Europe is politically fragmented, with countries prioritising national agendas and exhibiting varying degrees of commitment to EU principles. However, recognising the benefits of technological cooperation, they maintain a federated approach to cloud infrastructure. A multinational committee ensures governance of the federated cloud, coordinating compliance across varying national regulations related to data protection and cybersecurity.

4.4 Scenario d: Cloud as usual (fragmented Europe, commercial infrastructure)

Yet of political fragmentation, companies and countries consider commercial alternatives like IBM's Satellite or Google's Distributed Cloud to build a fragmented yet functional cloud infrastructure. This approach represents an organic evolution towards a conglomeration of services from different providers, giving rise to an interconnected cloud ecosystem without centralised governance or a singular economic framework.

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[5] Home ▌ Gaia-X Hub the Netherlands

5   Conclusion

The idea of a Supercloud has gotten a lot of tech enthusiasts, educators, and researchers curious. It's like imagining a world where all your favourite gadgets work together seamlessly, except it is for cloud services. But to keep it real: the Supercloud in its ultimate form might be a bit of a stretch.

That said, just because we might not reach the Supercloud dream in its purest form doesn't mean the journey's not worth pursuing. The "buzz" around the concept of Supercloud isn't just hype; it's highlighting a shared desire for simplicity in our increasingly complex cloud world. Researchers, developers and Cloud users in general are dealing with its increasing complexity.

So, where does that leave us? Well, we're making tracks towards a future where we might not have one ring to rule them all, but we're looking for ways to at least get them on the same finger. The Supercloud has laid out the welcome mat for discussions on better integration and smarter governance.

To be continued…

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