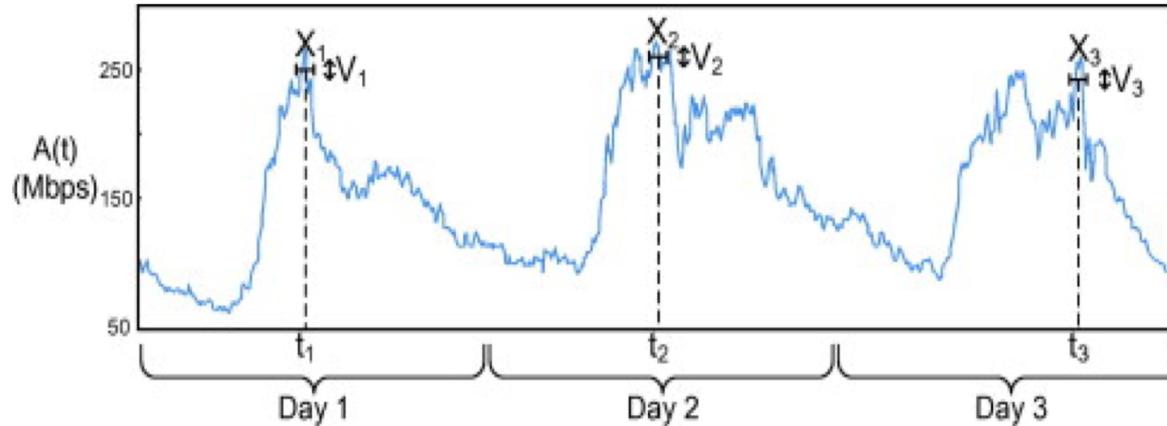


CLOUD & DEPLOYMENT

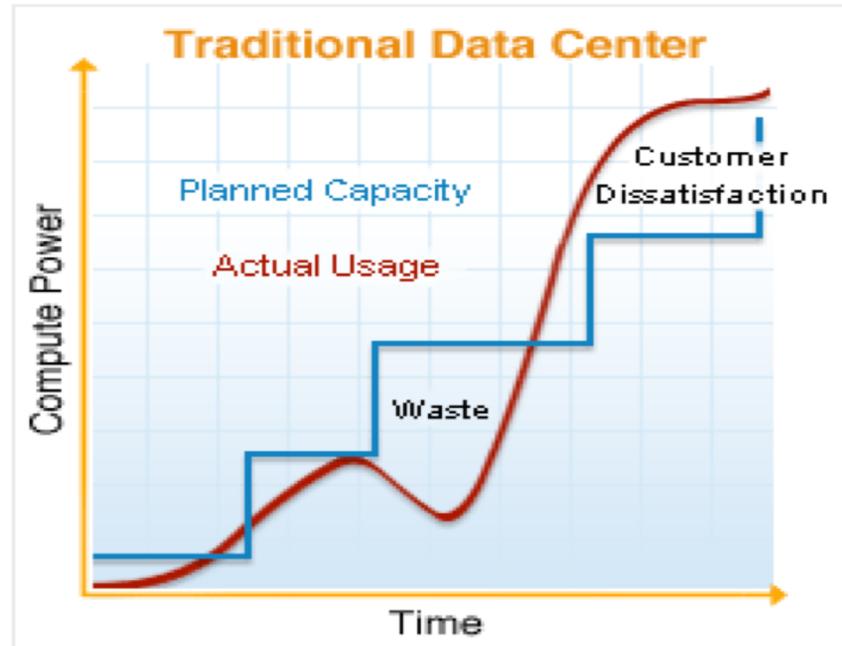
Dr. Assane Wade
2023 – 2024

- Basic Concepts & Motivations
- Definition of Cloud Computing
- Examples
- Criteria for selecting a cloud infrastructure
- Edge computing

Concept of “Busy Hour”



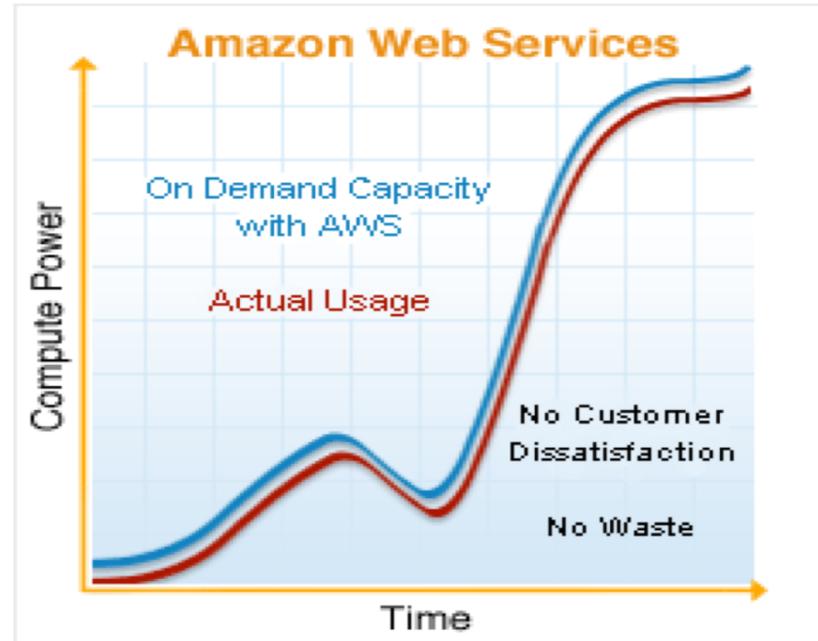
Evolution of business vs evolution of ICT



Source: Amazon

Considerations

In an ideal world ...



Source: Amazon

- Basic Concepts & Motivations
- **Definition of Cloud Computing**
- Examples and Swiss Perspective
- Criteria for selecting a cloud infrastructure
- Edge computing

Definition - Cloud Computing

- *A style of computing* in which massively scalable IT-related capabilities are provided “as a service”, using internet technologies. (**Gartner**)
- Paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual **resources** with self-service provisioning and administration on-demand. (**ITU** - Y3500)
- Cloud computing is on-demand access, via the internet, to computing resources - applications, servers (physical servers and virtual servers), data storage, development tools, networking capabilities, and more - hosted at a remote **data center** managed by a cloud services provider (or CSP). The CSP makes these resources available for a monthly subscription fee or bills them according to usage. (**IBM**)

- These definitions have a common characteristics:
 - They define CC from the perspective of the end users
 - They focus on how it might be experienced by end users
 - The core feature of CC is the provision of IT infrastructure and applications as a **service** in **scalable way**

Assume you are ...



Yasmine. You work on different projects. You need IT applications and resources. You would like to start the applications you need with one click (without any development)



Emna. You develop applications for people within your organisation. You are fighting with new versions of your development environment. You would like to get rid of this burden.



Ines. You manage using IT resources. You want to optimise and monitor these resources (in terms of capital and operational expenses)

Source: Instagram, @emnas_pencil

Cloud Computing Service Models:

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)



Yasmine

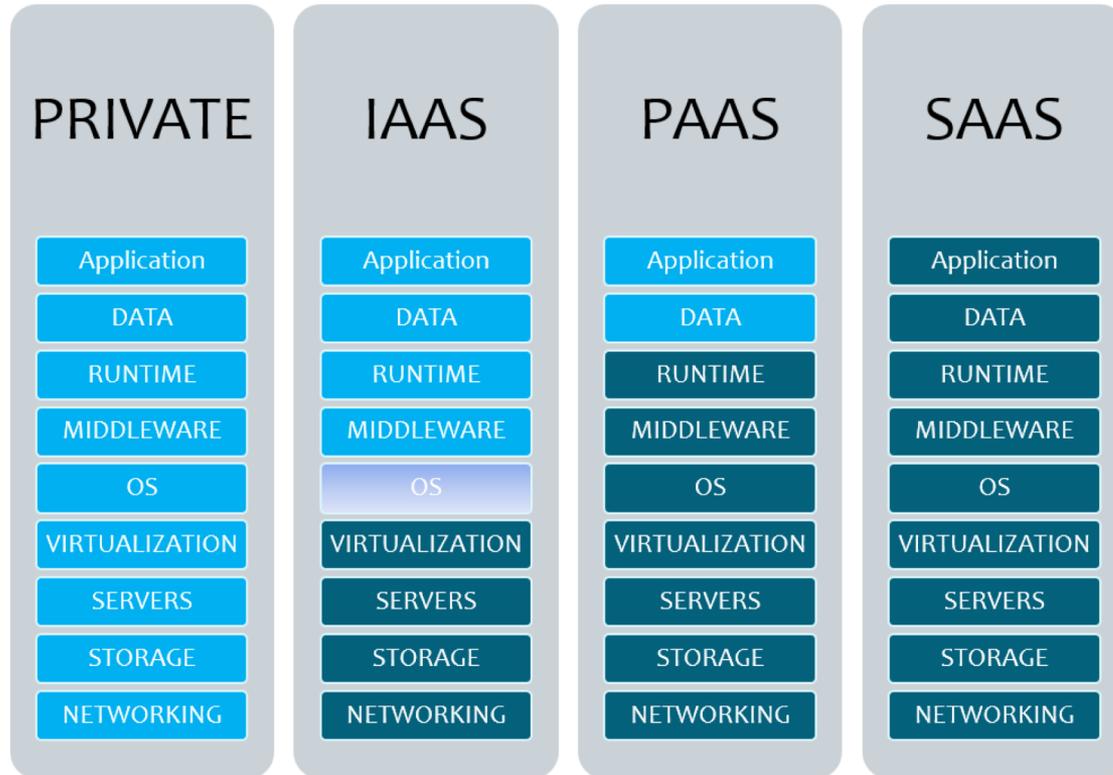


Emna



Ines

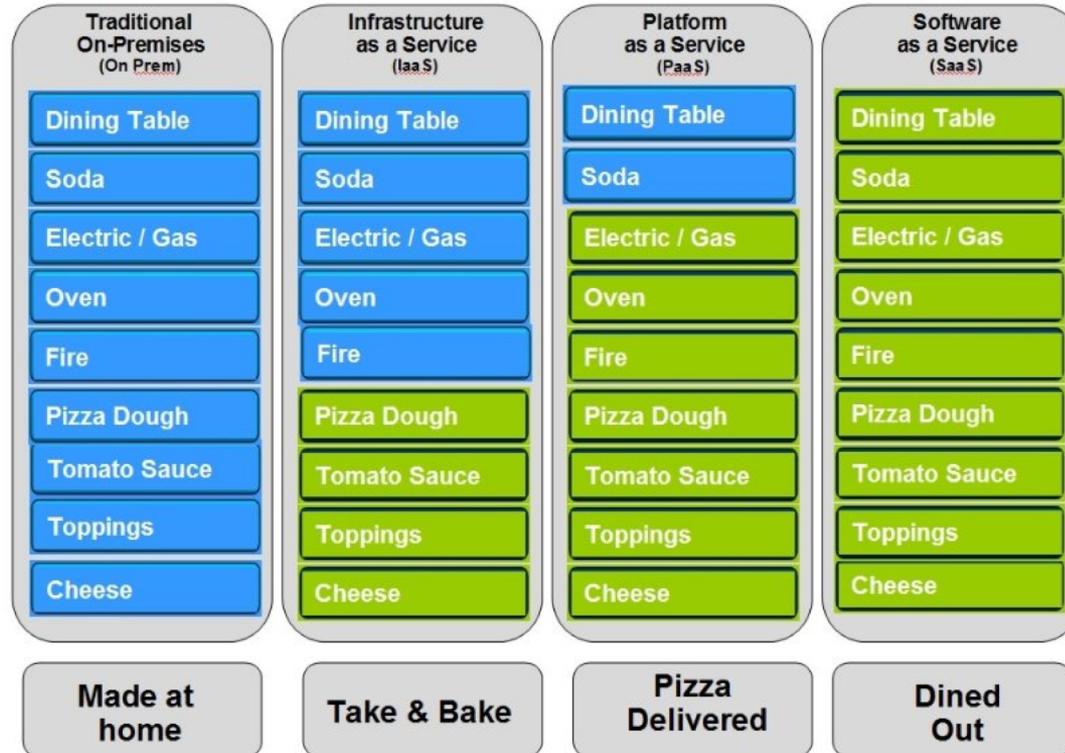
Cloud Service Models



By the User

By the Provider

Pizza as a Service



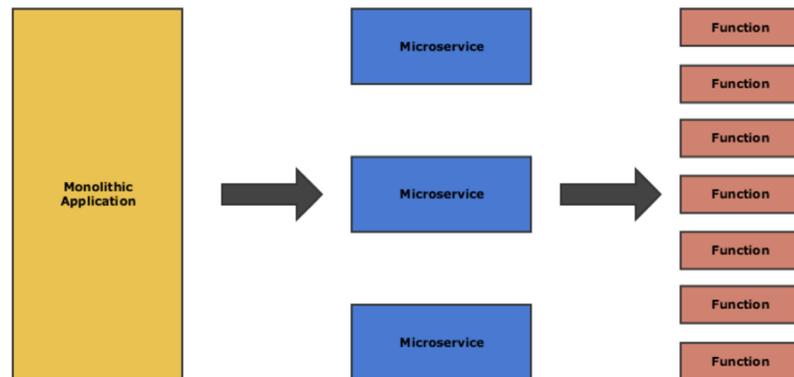
■ You Manage ■ Vendor Manages

- Meanwhile, many additional services appeared
 - Database as a Service, Integration as a Service, Games as a Service, AI as a Service, etc.
- **Function as a Service (FaaS)**
 - Known as **Server-less Computing**
 - FaaS builds/runs applications without caring about provisioning, scaling, and managing any servers.
 - With FaaS, it may not be running at all until the function needs to be executed. It starts the function within the needed time and then shuts it down.
 - A new business model
 - A new (?) programming paradigm: a high level of abstraction
 - **Providers: AWS Lambda, Azure Functions, Cloud Functions, Manta, etc.**

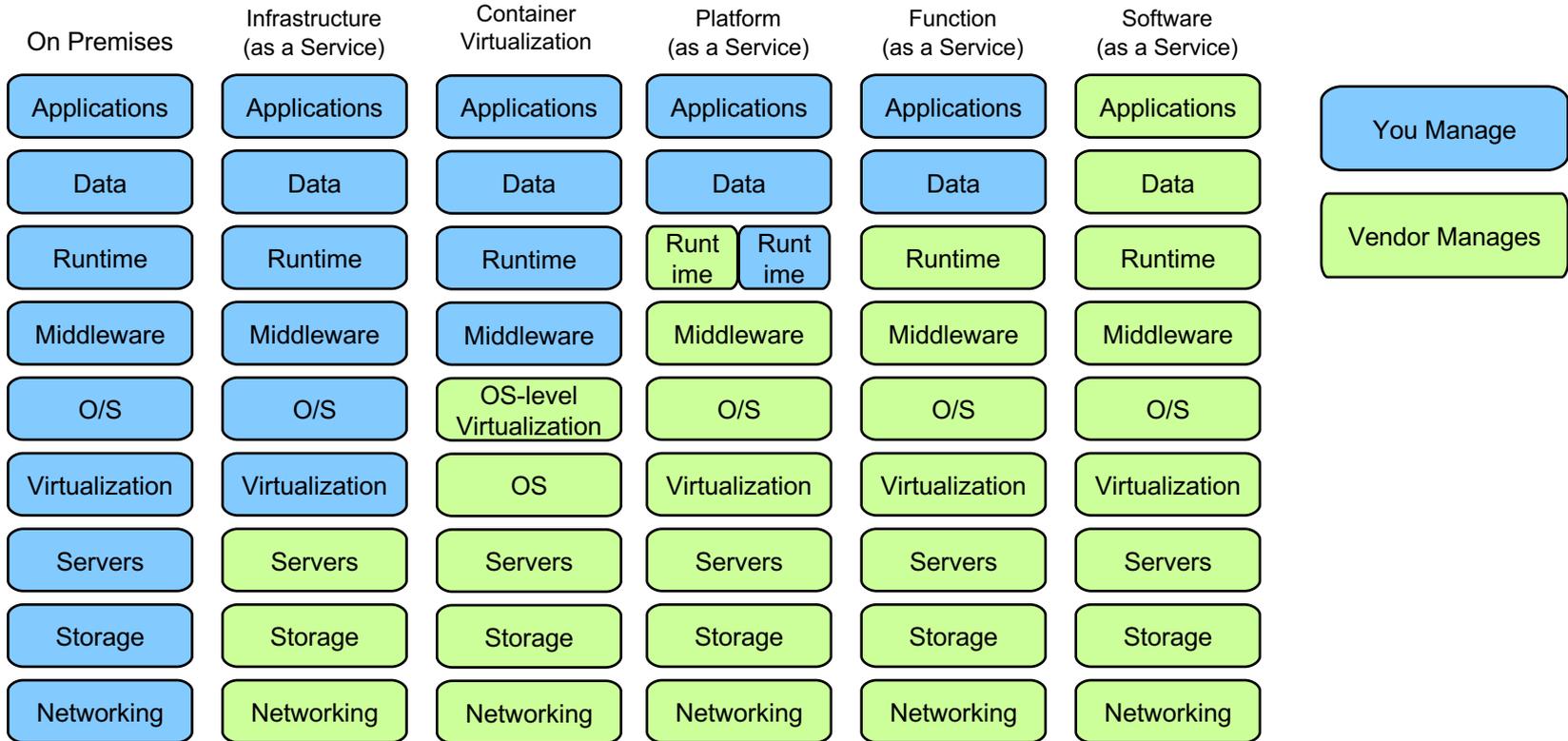
Function as a Service in a nutshell

- Run your code without supplying or administrating servers.
- No charge is applicable when your code is not running
- Scalability: Scaling up the IaaS infrastructure according to the needs
- Stateless functions: use external resources to manage the state of the application so that the state can be shared.

Monolithic vs Microservice vs FaaS

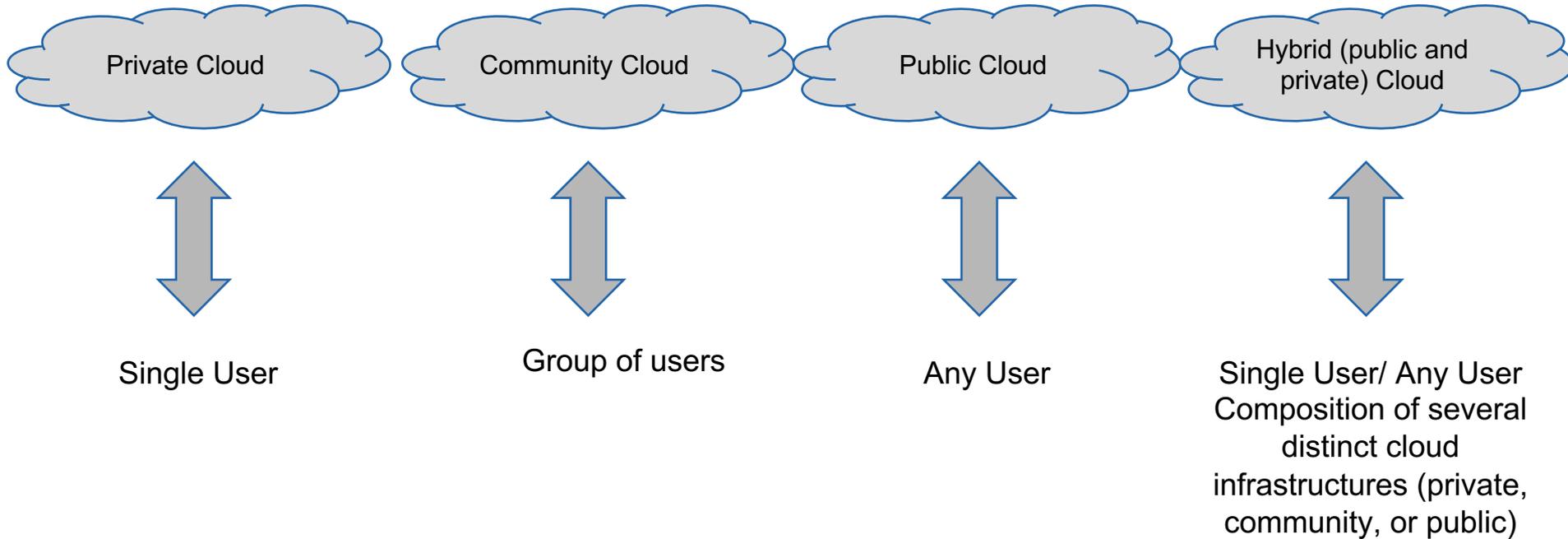


Cloud Service Models



Cloud Deployment models

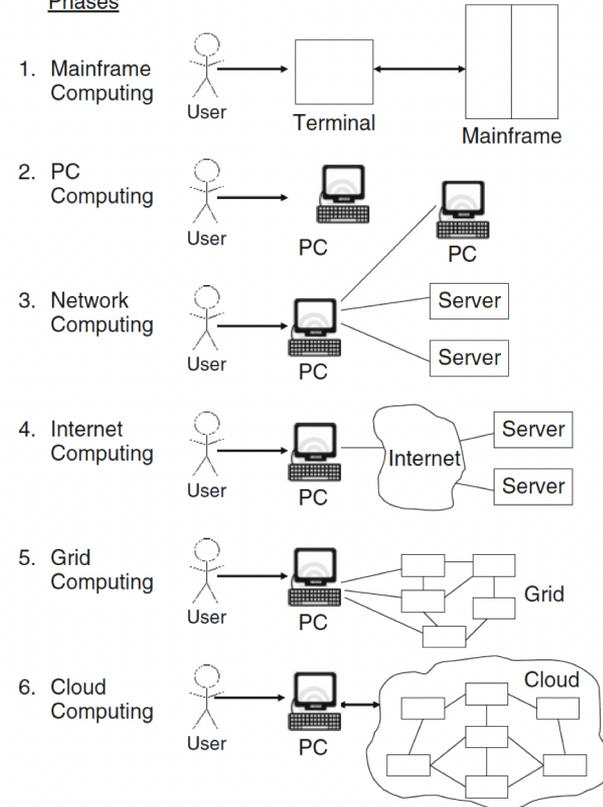
Cloud Computing Deployment Models:



Is cloud computing a new technology?

- Nothing new beneath the sun.

Phases



To summarize ... from a non technical perspective

- Cloud computing is not the savior of IT.
- It is nothing but **a way to deploy your enterprise architecture** in a way that has the potential to be **more productive** and **cost effective**.
- In essence, **it is a tool, not a way of life**. It is not magic, it is not even new, but if approached correctly, it could be a path towards efficiency.

*Cloud Computing and SOA
Convergence in Your Enterprise
2009*

To summarize ... from a technical perspective

- CC is based on pay-per-use business models
- Main features of CC are based on **virtualization** and **dynamic scalability on demand**
- Cloud services are consumed either via web browser or defined API
- CC is massively scalable (elastic)
- Self-provisioning of resources

- Basic Concepts & Motivations
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Amazon Web Services are currently available in 32 regions, 102 availability zones. 12 planned Availability zones and 4 new regions (Canada, Malaysia, New Zealand, and Thailand.)



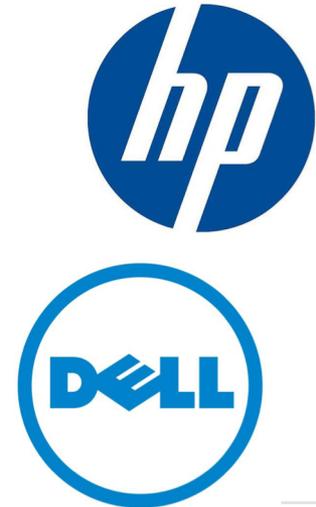
Families of services

- Compute
- Storage
- Database
- Migration & transfer
- Networking & Content Delivery
- Developer Tools
- Management & Gouvernance
- Media Service
- Machine Learning
- Analytics
- Security, Identity & Compliance
- AWS Cost Management
- Mobile
- AR & VR
- Application Integration
- Customer Engagement
- Business Applications
- End User Computing
- Internet of Things
- Game Development
- ...

- Free and open-source cloud-computing software platform.
- Provides services for managing a Cloud environment on the fly.
- Consists of a group of interrelated projects that control pools of processing, storage, networking resources, authentication, storage, etc.
- Initially designed to provide services for an IaaS
- Today, OpenStack provides “high level” services



- OpenStack is trusted to manage 40 Million+ cores around the world, across dozens of industries.
- With more than 60 availability zones across more than 20 countries,
- OpenInfra foundation serves more than 60,000 Individual Members from over 180 countries around the world.
- Many supporters



- Launched in 2008.
- Provides infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) to organizations worldwide.
- 9% of the cloud market in 2023 (Third biggest cloud provider worldwide)

38 regions - 115 zones - 187 network edge locations - 200+ countries and territories

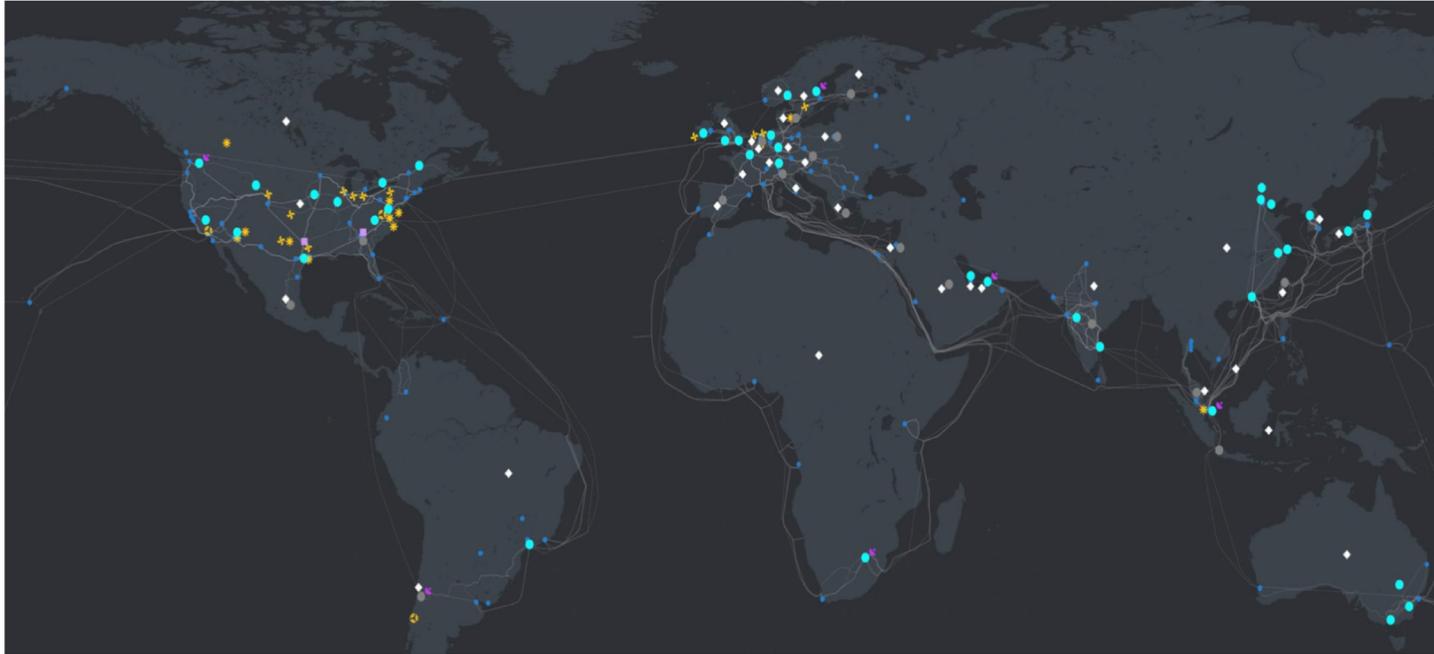
Coming soon regions: Dammam (kingdom of Saudi Arabia, Querétáo (Mexico), Malaysia, Thailand, New Zealand, Greece, Norway, South Africa, Austria and Sweden



Source: <https://cloud.google.com/about/locations>

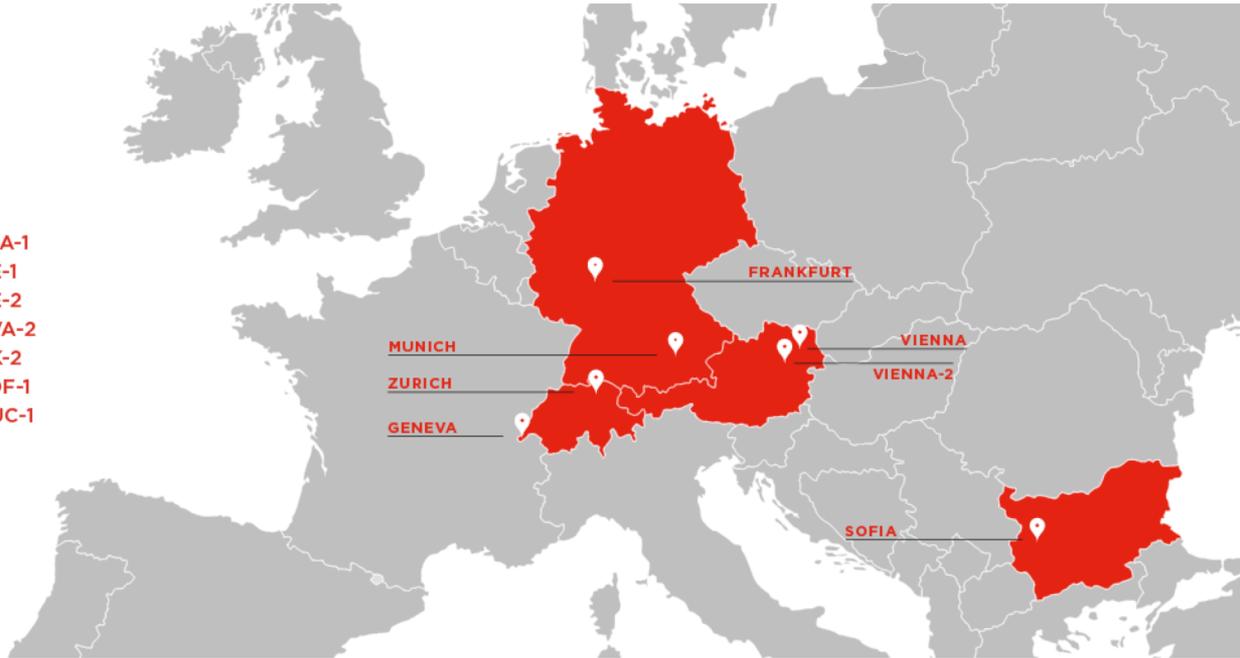
- Introduced in October 2008 under the codename "Project Red Dog".
- It was officially launched as Windows Azure in February 2010 and Microsoft Azure on March 25, 2014
- 26% of the cloud Market in 2023 (second biggest cloud provider worldwide)

- 60 datacenter regions
- 200 datacenters
- 190 points of presence
- 175,000 miles of terrestrial and subsea fiber worldwide



- Exoscale is a trademark of Akenes SA, a private company founded in 2011 and headquartered in Switzerland.
- Provides a complete portfolio, from standard VMs over Managed Kubernetes to DBaaS.
- Compute Instances - Object Storage - DNS - Database-as-a-Service (DBaaS) - Managed Kubernetes (SKS) - GPU Servers are the services

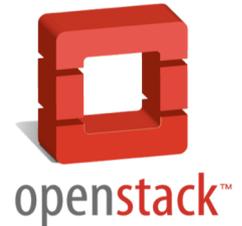
- FRANKFURT DE-FRA-1
- VIENNA AT-VIE-1
- VIENNA-2 AT-VIE-2
- GENEVA CH-GVA-2
- ZURICH CH-DK-2
- SOFIA BG-SOF-1
- MUNICH* DE-MUC-1

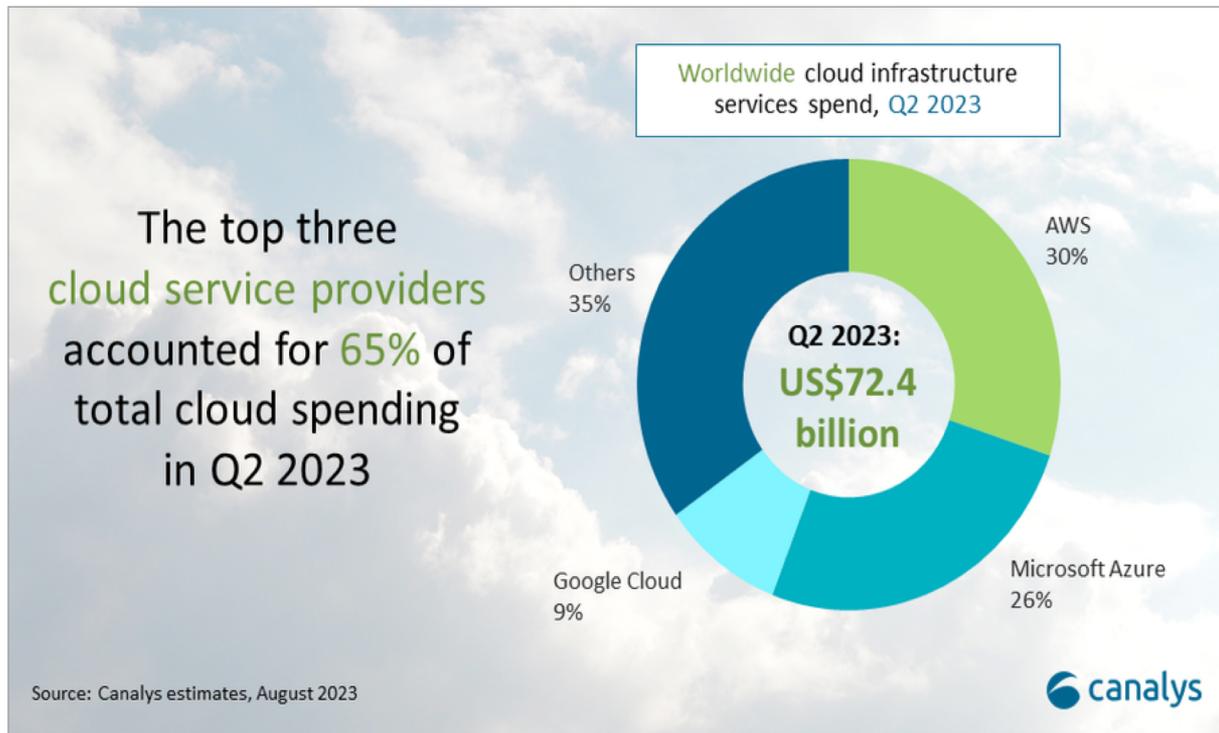


*Restricted Zone

- Apache CloudStack is open source software
- Deploy and Manage large networks of virtual machines, as a highly available, highly scalable Infrastructure as a Service (IaaS) cloud computing platform.
- CloudStack is used by a number of service providers to offer public cloud services, and by many companies to provide an on-premises (private) cloud offering, or as part of a hybrid cloud solution.

- Free and open-source cloud-computing software platform.
- Provides services for managing a Cloud environment on the fly.
- Consists of a group of interrelated projects that control pools of processing, storage, networking resources, authentication, storage, etc.
- Initially designed to provide services for an IaaS
- Today, OpenStack provides “high level” services





source: <https://www.canalys.com/newsroom/global-cloud-services-q2-2023>

Gartner Magic Quadrant for IaaS

2021



2022



- Basic Concepts & Motivations
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- Examples
- **Criteria for selecting a cloud infrastructure**
- Edge computing

Three types of cloud selection criteria

- Prerequisites criteria (constraints)
- Application requirements (characteristics) criteria
- Cost criteria



- Data require a certain level of privacy/security
- SLA
- Geographical location

App requirements criteria

- Service/OS/Application support
- VM characteristics and performance



- Total cost of running an application on a specific cloud



Instances types (AWS)

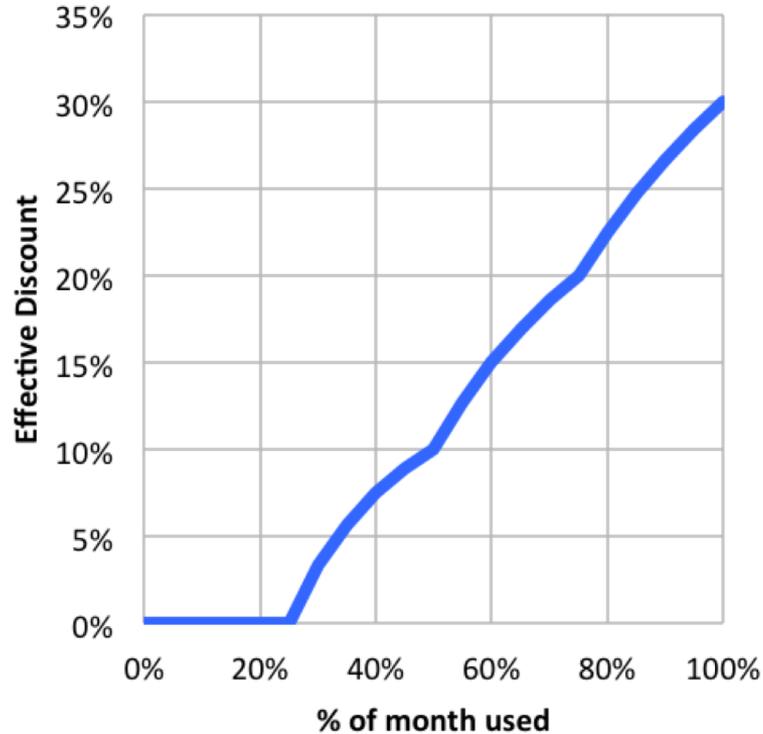
To maximise utilization of their infrastructure cloud providers offer different pricing models.

Example AWS: It offers instance models that differ in their availability and their pricing structure

- **On-Demand Instances**
 - Pay-by-the hour
 - Start and stop as you wish
- **Reserved Instances**
 - Pay a yearly upfront fee and receive a discount on the hourly charge
 - Amazon EC2 Reserved Instances (RI) provide a significant discount (up to 72%) compared to On-Demand pricing and provide a capacity reservation when used in a specific Availability Zone
- **Savings Plans**
 - Savings Plans is a flexible pricing model that can help you reduce your bill by up to 72% compared to On-Demand prices, in exchange for a one- or three-year hourly spend commitment
- **Spot Instances**
 - Bid for unused EC2 capacity
 - Mention your Spot Price and if the market rate is less than your Bid, you get your instance
 - Instance automatically terminates if your Spot Price becomes less than the current market rate

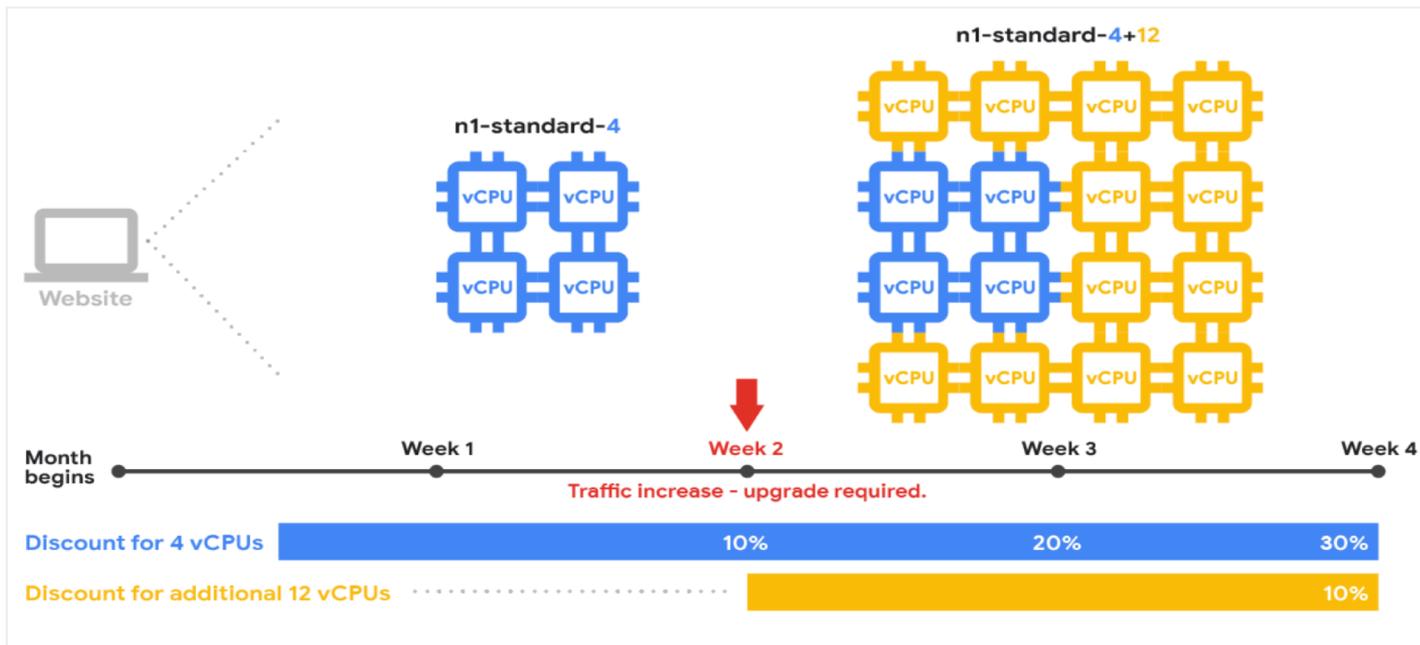
Sustained use discounts (SUD) - GCE

<https://cloud.google.com/compute/docs/sustained-use-discounts>



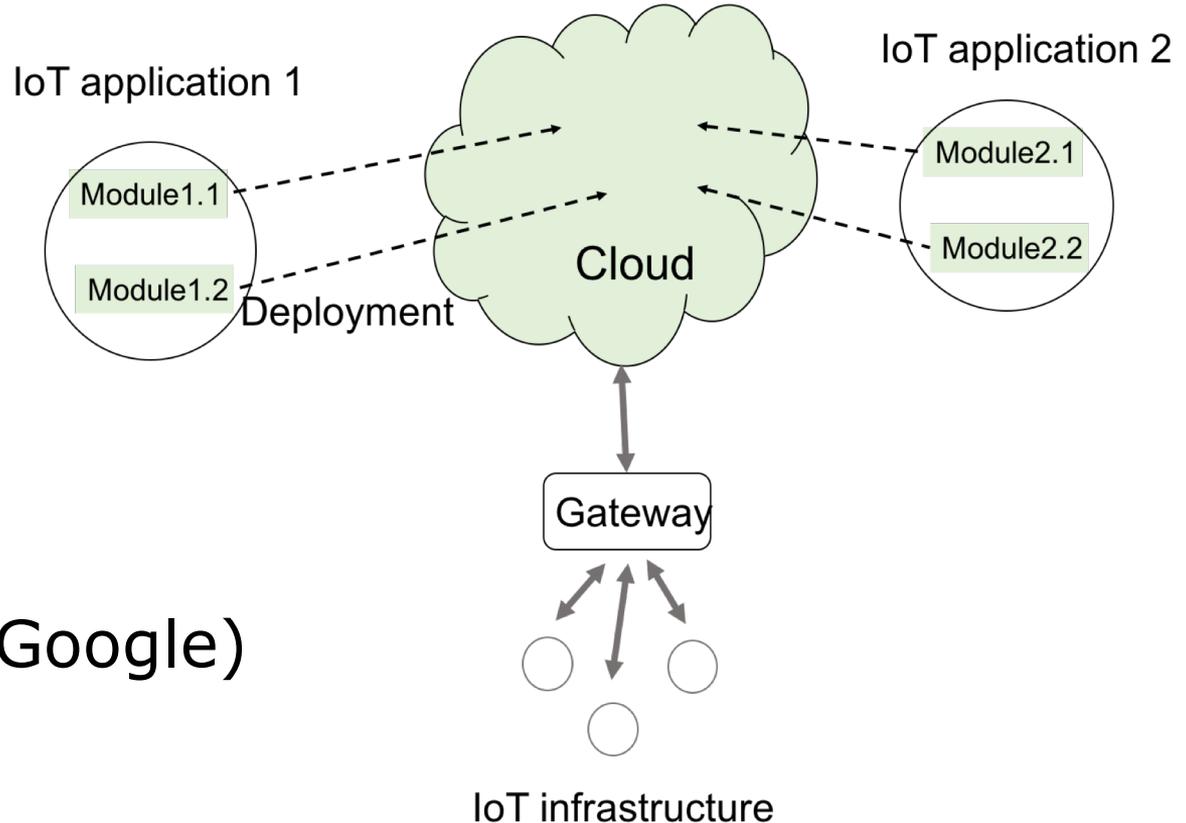
Sustained use discounts (SUD) - GCE

To take advantage of the full discount, create your VM instances on the first day of the month. Discounts reset at the beginning of each month.



- Basic Concepts & Motivations
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- Examples and Swiss Perspective
- Criteria for selecting a cloud infrastructure
- **Edge computing**

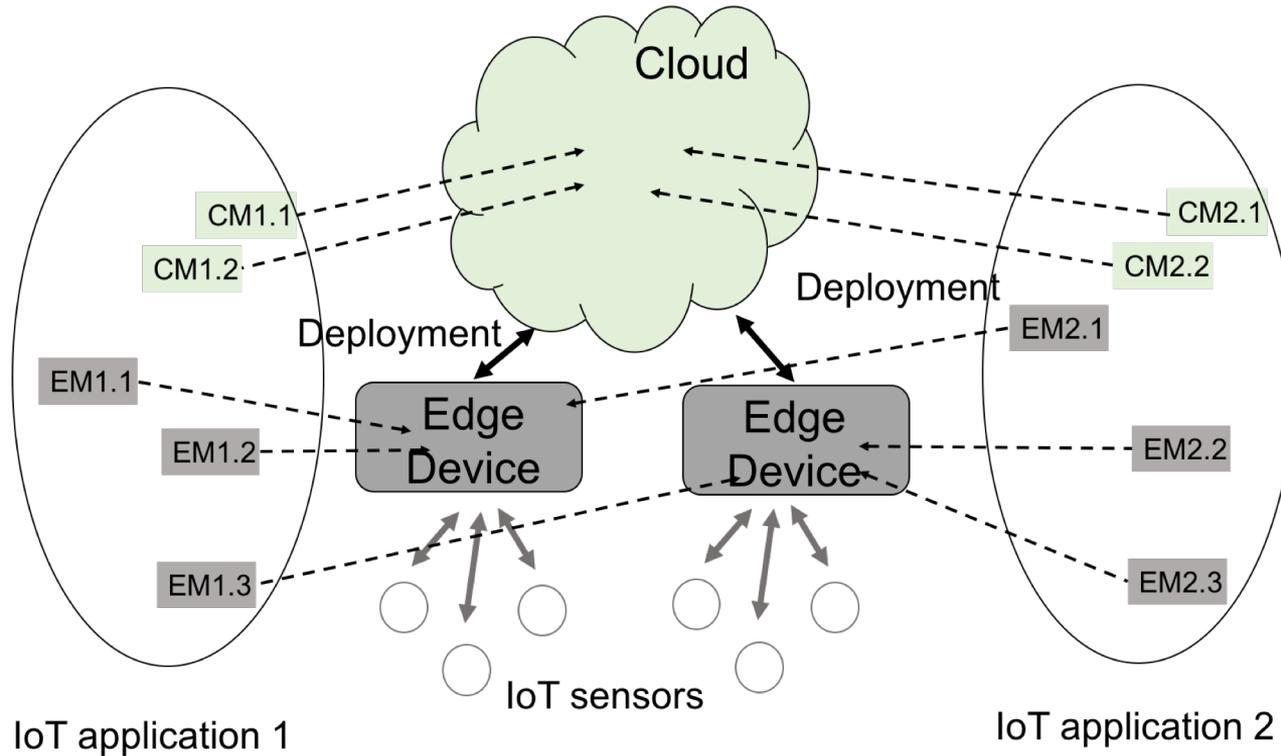
The context: Centralised Cloud platforms



- AWS IoT Core
- Azure IoT hub
- Cloud IoT Core (Google)

- For many IoT applications, submitted to constraints the centralised vision is not sustainable.
- Data production is exploding, making Cloud based centralised IoT platforms, ill-equipped to cope with the huge quantity of collected data.
 - The Centralised model is doomed to fail.
 - The need to make the edge smarter is inescapable.
 - **A new model, combining edge and cloud, is required**

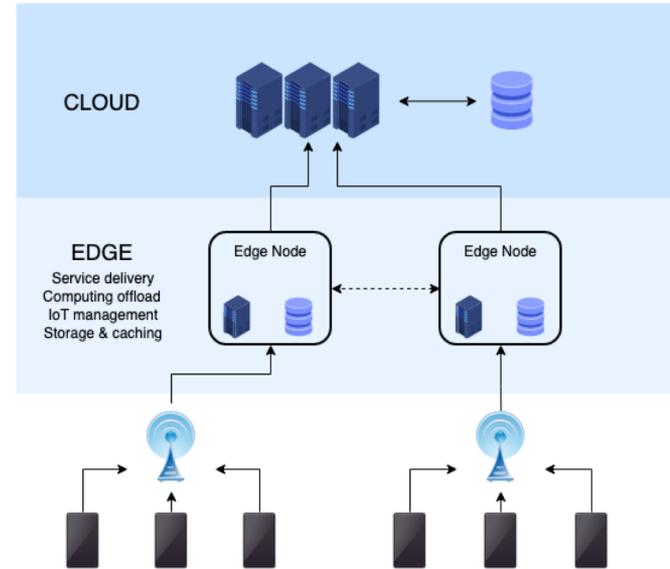
The context: A Hybrid Edge-Cloud platform



What is Edge Computing ?

Edge computing is:

- a method of optimising applications by taking some “portions” away from central nodes to the other extreme (the "edge").
- a practice of processing data near the edge of the network, where the data is being generated, instead of processing in a centralised data-processing warehouse.



Why Edge Computing ?

- Four objectives are behind Edge computing:
 - Unload the cloud.
 - Limit the traffic between IoT devices and the cloud
 - Keep decision as close as possible to the IoT devices
 - Enhance security

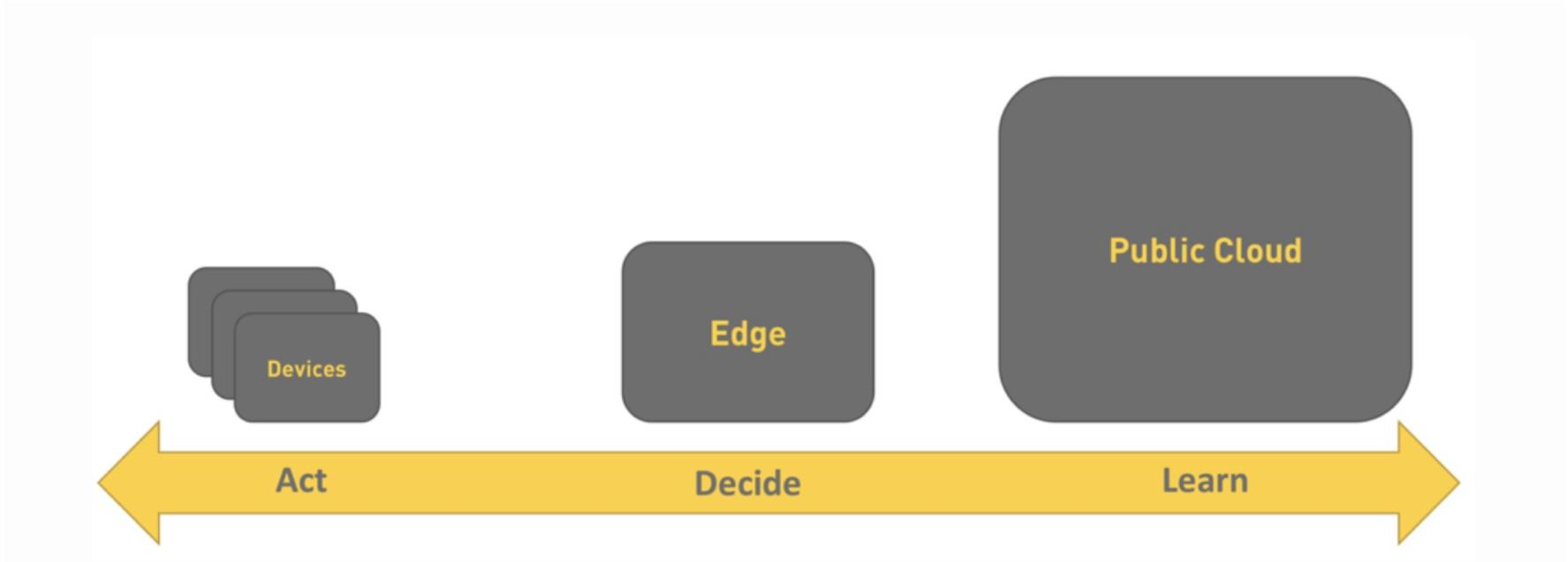
What are the Cons of Edge computing ?

Strike the balance between:

- “keeping data at the edge” and “bringing it into a central cloud”
- “sophisticated algorithms in the cloud” and “lightweight analytical processes” in the edge?



Edge-Cloud concept



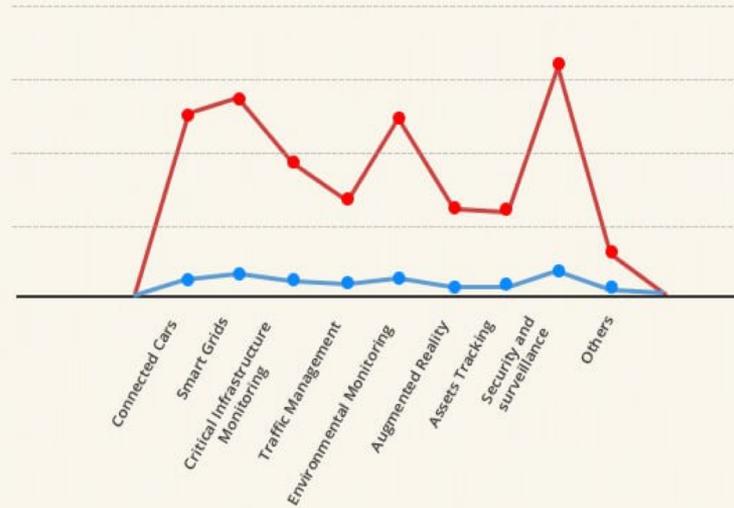
<https://thenewstack.io/azure-iot-edge-a-technology-primer/>

GLOBAL EDGE COMPUTING MARKET

BY APPLICATION

■ 2017

■ 2025



CONNECTED CARS is projected as one of the most lucrative segments and it would exhibit the highest **CAGR of 35.9%** during 2018-2025.

<https://www.alliedmarketresearch.com/edge-computing-market>