

# Introduction Cloud Computing

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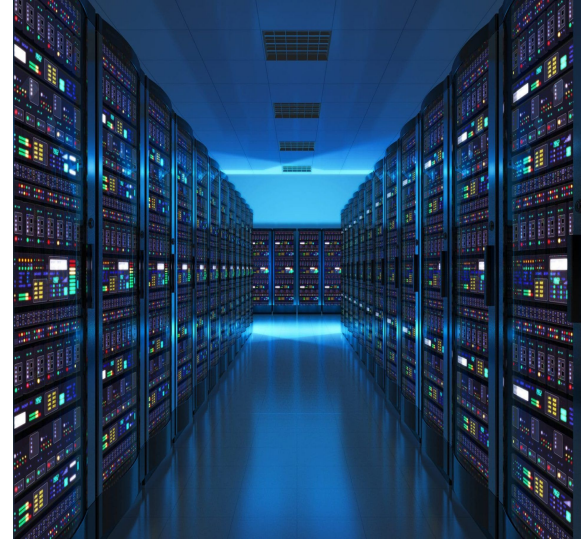
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# Goals

1. General introduction
2. Types of Cloud
3. Types of Cloud services
4. Some Cloud providers

# Cloud computing the idea

- **Amazon, 2002**
  - Rent to external users a part part of his facilities during period of low use
  - Creation of Amazon Web Services (AWS) initially for data storage then for compute



# Cloud computing the idea

The idea basic idea, **mutualization**

- **My Car**

- Rent to people not having a car
- Reduce the Cost of ownership



- **Harvester**

- Cost a Lot of Money
- Reduce the cost when shared



# Cloud Computing Definition

***Set of Resources/applications/services which execute in a distributed environment (hosting center), accessible through Web standard protocols, which globally provide a service with the following characteristics:***

- Pays as you Go
- Illusion of infinity of ressources
- Abstraction of the hardware infrastructure
- Mutualization between many users

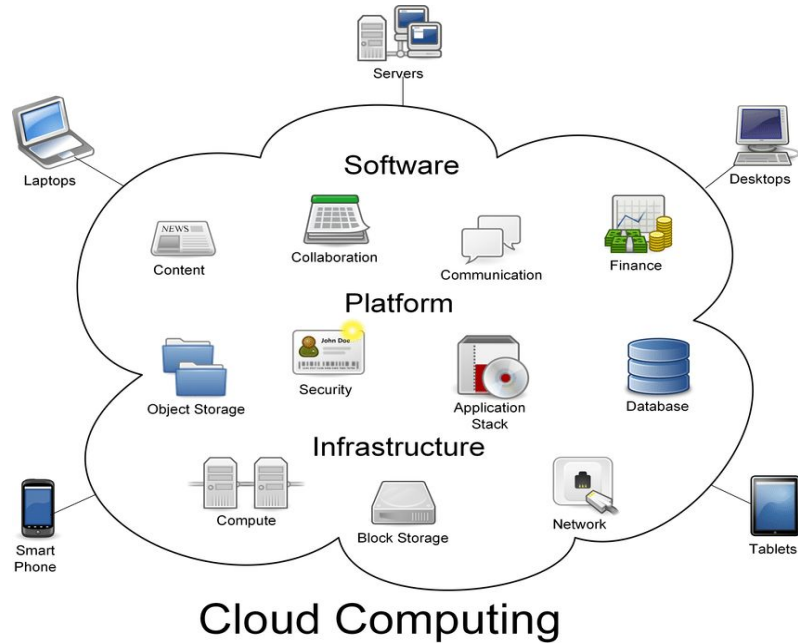
# Cloud Computing Definition

## NIST Definition of Cloud Computing

*"Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."*

# Cloud Computing Definition

General scheme is externalization of resources



# Cloud computing

- Enormous **Computer data-centers (DC)** containing Commodity hardwares
- Achieve economies of scale.
  - Reduce costs of electricity, bandwidth, hardware, software and use low-cost locations
  - Lower-cost than provisioning own hardware



# Cloud computing

- Cloud computing is **Utility Computing**
  - Cloud services are controlled and monitored by the cloud provider through a **pay-per-use business model**.
- An ideal cloud computing platform is:
  - Efficient in its use of resources
  - Scalable
  - Elastic
  - Self-managing
  - Highly available and accessible
  - Inter-operable and portable

**Utility computing** is a service provisioning model in which a service provider makes computing resources and infrastructure management available to the customer as needed, and charges them for specific usage rather than a flat rate.

# Roles in the Cloud

- **Cloud provider**
  - Provides hardware infrastructures and a set of services on top
- **Cloud Clients**
  - Use resources of the Cloud
- **Cloud resellers**
  - Build and Sells a Service that rely on the Cloud.
- **Cloud developers**
  - Produce tools for the Cloud

# Types of Cloud

- There are **four primary cloud deployment models** :
  - Public Cloud
  - Private Cloud
  - Community Cloud
  - Hybrid Cloud

# Public Cloud

- Public clouds are owned by cloud service providers who charge for the use of cloud resources.
- Basic characteristics:
  - Shared resources and multi-tenancy
  - Leased or rented infrastructure
  - Economies of scale



# Private Cloud

- The cloud infrastructure belongs to and is operated by only one organization.
- Basic characteristics :
  - Heterogeneous infrastructure
  - Customized policies
  - Dedicated resources
  - In-house infrastructure
  - End-to-end control

 EUCALYPTUS



# Community Cloud

- The cloud is built to be shared by several organizations for their usage



# Hybrid Cloud

- The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability.

# Service Classifications

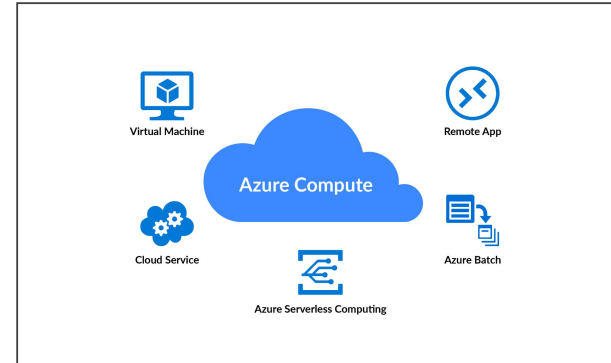
- **Infrastructure as a Service (IaaS)**
- **Platform as a Service (PaaS)**
- **Software as a Service (SaaS)**





# Infrastructure as a Service (IaaS)

- A type of cloud computing service that offers essential compute, storage, and networking resources on demand, on a pay-as-you-go basis
  - **Virtualization**
  - **Bare metal**



# Platform as a Service (PaaS)

- A computing platform that abstracts the infrastructure, OS, and middleware to drive developer productivity



# Software as a Service (SaaS)

- Run applications on a provider's on a cloud infrastructure. Applications are accessible from various client devices through a thin client interface such as a web browser.



Google Docs

# Serverless, Function as a Service (More later)

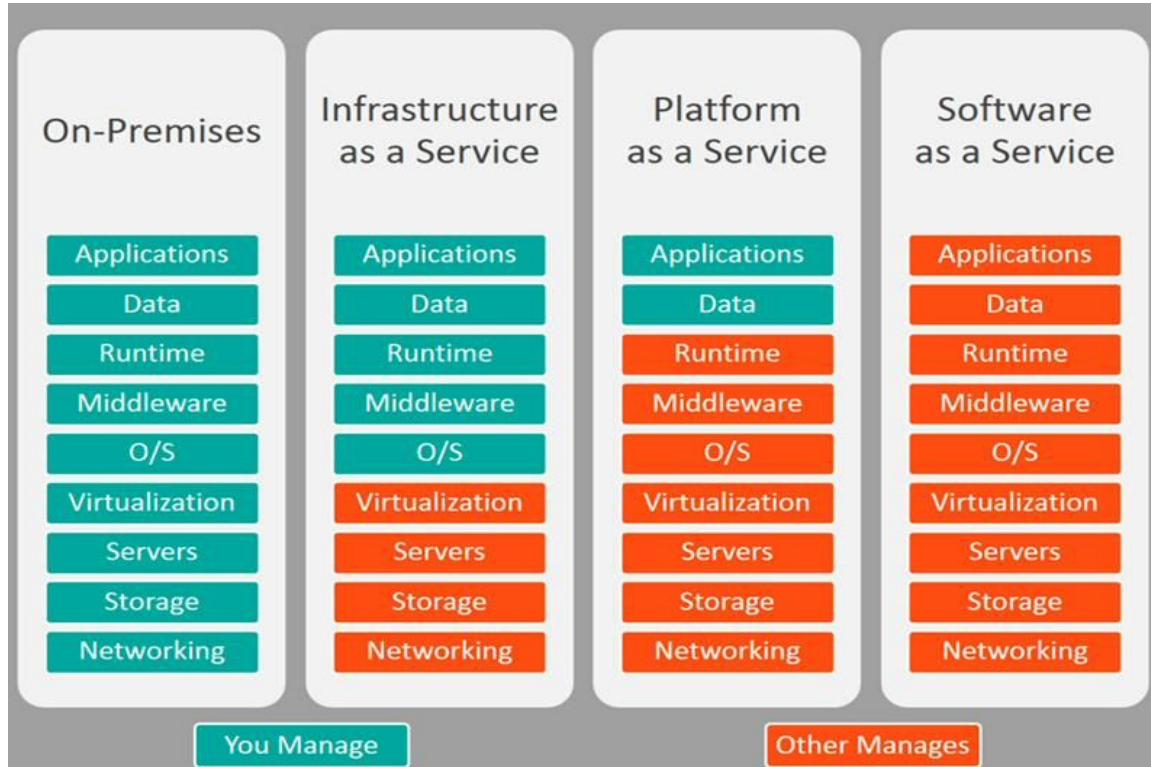
- Serverless is an event-driven or code execution where underlying infrastructure is abstracted. Applications consists of stateless functions that are spawned based on the triggering of events.



**AWS Lambda**



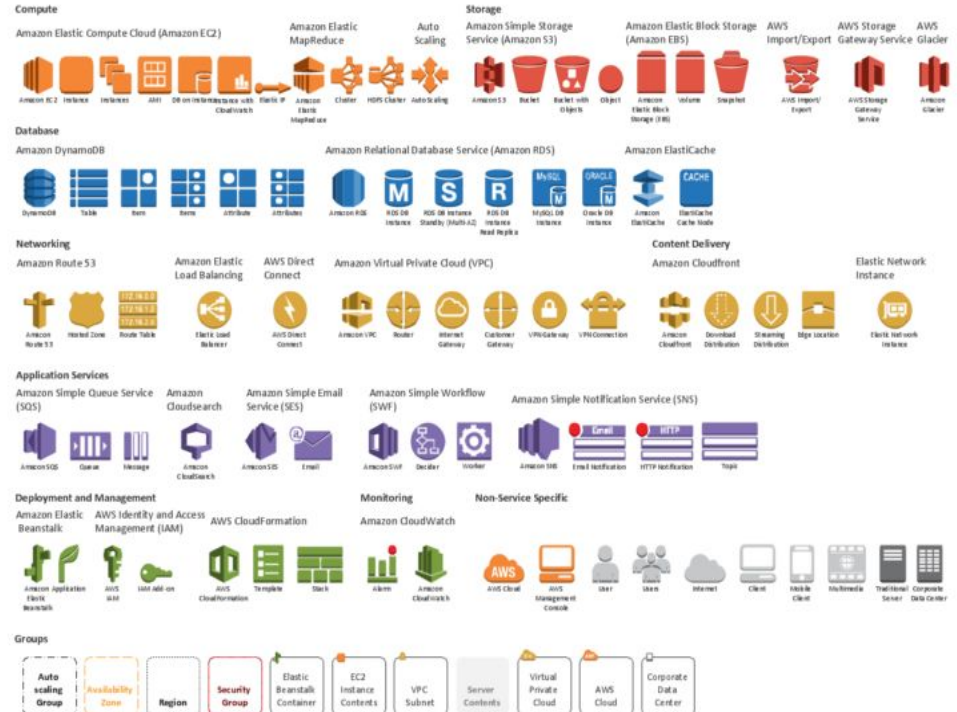
# Cloud Services



## Some Cloud providers

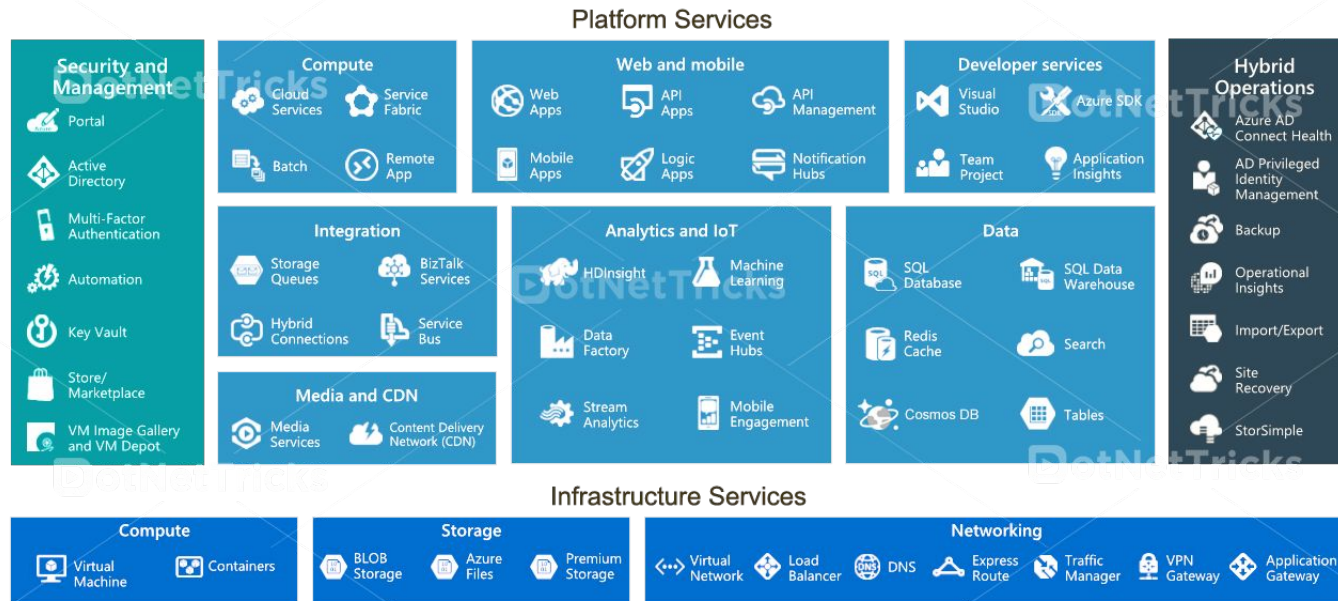
- **Amazon AWS**

- Public Cloud
- Most popular cloud provider



# Some Cloud providers

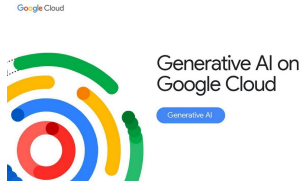
- **Microsoft Azure**
  - Public Cloud
  - Provides several services



# Cloud Use Cases

Why Companies Adopt Cloud Computing **Content:**

- Access to on-demand computing resources
- Reduced infrastructure costs
- Flexibility and scalability
- Faster innovation and global deployment:



- Example: A small business can launch a global website without owning a datacenter



# Data Storage and Backup

## Storage and Backup:

- Cloud services: Dropbox, Google Drive, OneDrive, AWS S3
- Automatic backup and fast recovery in case of failure
- Real-time collaboration on files:
- Example: a team shares documents in Google Drive without a local server



# Artificial Intelligence and Machine Learning

## AI and Machine Learning in the Cloud:

- ML and AI models accessible via Cloud: AWS SageMaker, Azure ML, Google AI Platform
- Benefits: massive computing power, centralized data
- Examples: chatbots, image recognition, sales forecasting
- Example: voice recognition apps (Siri, Google Assistant)

# Examples of Companies Migrating to the Cloud

## Companies and Cloud Migration:

- Netflix: global streaming based on AWS
- Airbnb: scalable infrastructure on AWS
- Spotify: data storage and processing on Google Cloud
- Schneider Electric: modernization of internal systems via Azure

# Data-centers (DC)

- Scaled-up/out version of machine rooms for enterprise computing
- A **large collection** of commodity components
  - PC-based servers (CPUs, DRAM, disks),
  - Ethernet networking
  - Commodity OS and software stack
  - 10s to 100s of thousands of nodes
- High-bandwidth networking (10Gbps 40Gbps 100Gbps)
- Power delivery, cooling, UPS (50 – 200MW)
- System software for DC management (centralized or distributed)
- Software that implements internet services



# Data-centers (DC)

- ~500 Datacenters (w/ >10k servers)
- ~ \$30 billion Workloads for AWS 2018
- Microsoft and Google > 2,000,000 servers
- ~3% of US Power consumption



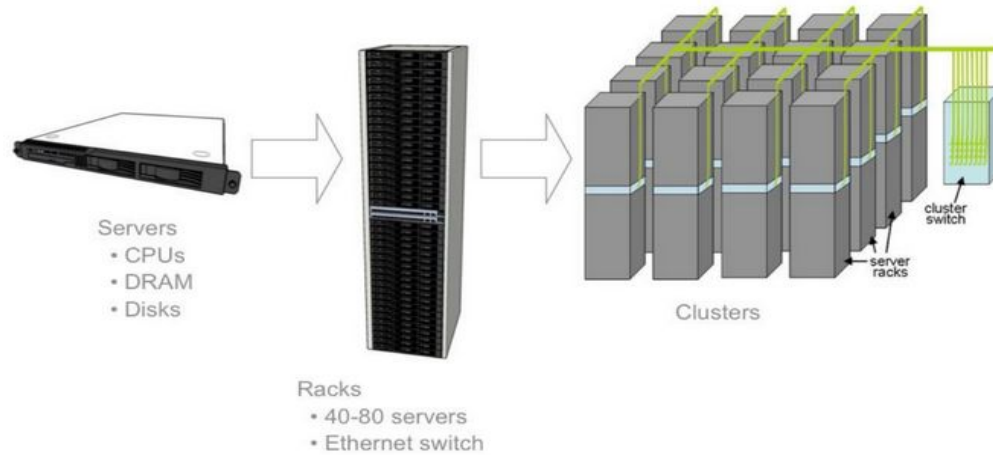
Ouvert en 2009, le data center [Azure](#) de Microsoft à Dublin représente pour l'heure une capacité de 39 000 mètres carrés de salles informatiques. L'équivalent de presque huit terrains de football. 80 salariés de [Microsoft](#) travaillent sur le site, aux côtés de quelques prestataires triés sur le volet.

# Data-centers (DC)



Pour la première fois, [Google](#) lève le voile sur l'un de ses secrets les mieux gardés : ses centres de données. Ici, le datacenter de Council Bluffs, dans l'Iowa, qui s'étend sur plus de 10 000 mètres carrés. Il est notamment utilisé pour héberger le moteur recherche de Google ainsi que YouTube.

# Data-centers (DC)



# DataCenters

- **Compute and Memory**
  - A PC-based server (most of them x86)
  - Custom Linux OS (optimized for latency)
  - 1U, 2U, or blade form factors are popular
- **Networking**
  - 10Gbps ethernet links to rack switch
  - A few 10Gbps links to cluster level switches
- **Storage**
  - Distributed file system using disks on servers (GFS)
  - Network attached storage (NAS) devices



# Data-centers (DC)

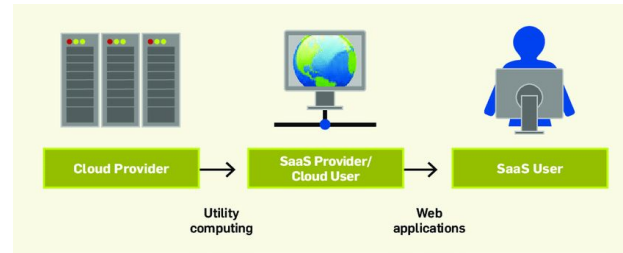
## AWS Regions



# Cloud Security

## Key Concepts in Cloud Security Content:

- Data encryption in transit and at rest
- Identity and access management (IAM)
- Multi-factor authentication (MFA)
- Regular security audits and compliance standards (ISO 27001, SOC 2, GDPR)
- Shared responsibility model between provider and user



- Example: Using IAM policies to restrict access to sensitive data

# Cloud Security

## Understanding the CLOUD Act

- The Clarifying Lawful Overseas Use of Data Act (CLOUD Act) allows US authorities to access data stored by US-based cloud providers, even if stored overseas
- Implications for privacy and cross-border data
- Importance of knowing provider policies and local regulations
- Impact on businesses: compliance and legal considerations

# Some Cloud providers

- French Cloud providers
  - OVHCloud
  - Eolas
  - OutScale
  - ScaleWay

