

# What is cloud computing?

SJK005 – Cloud computing

University Master's Degree in Intelligent Systems

University Jaume I

# Competences and learning outcomes

1. To know the definition of cloud computing and its characteristics.
2. To know the four deployment models of cloud computing.
3. To know the three service models of cloud computing .
4. To select the best cloud computing model based on specific requirements.

# Contents

1. Definition of cloud computing.
2. Cloud computing characteristics.
3. Cloud computing deployment models.
4. Cloud computing service models.
5. Cloud Computing Continuum.
6. Summary.

# Definition of cloud computing

## National Institution of Standards and Technology

**Cloud computing** is a model for enabling ubiquitous, 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. This cloud model is composed of **five essential characteristics, three service models, and four deployment models.**

Ref: <https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf>

# Definition of cloud computing

## **Who are the actors in cloud computing and their roles.**

**Cloud providers:** Companies that provide cloud computing solutions (Amazon, Google, Microsoft, IBM, RedHat, Heroku, etc.).

**Cloud consumers:** Those who make use of cloud service providers (companies, institutions, individuals, hobbyist, etc.)

**End consumers:** Those who make use of cloud-based applications (companies, individuals)

# Characteristics of Cloud Computing

1. Fast provisioning.
2. Auto-provisioning.
3. Scalability.
4. Elasticity.
5. Availability.
6. Security.

# Characteristics of Cloud Computing

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## **Exercise**

Compare the following scenarios in the "classic" and "cloud" worlds:

1. To provision new computers.
2. To provision new storage.
3. To provision new software.

# Characteristics of Cloud Computing

How are these characteristics achieved?

1. Modularity.
2. Virtualization.
3. Isolation.



# Characteristics of Cloud Computing

Why is cloud computing so important?

The cloud user concentrates on what is unique to his/her business.

The cloud provider takes care of the rest.

Let's see how this works based on the models and services provided by cloud computing.

# Cloud Computing deployment models

The four basic deployment models of Cloud Computing are:

1. Public Cloud.
2. Private Cloud.
3. Hybrid Cloud.
4. Muti-cloud.

# Cloud Computing deployment models

## Public Cloud

A public cloud is an IT model in which public cloud service providers offer computing services, such as compute and storage, as well as development and deployment environments, and on-demand applications to organisations and individuals **over the Internet**.

Source: Google.

# Cloud Computing deployment models

## **Public Cloud**

1. Fast provisioning.
2. Virtualization.
3. Elasticity.
4. Auto-provisioning.
5. Metering, billing and licensing.
6. Service Level Agreement (SLA) (more in a next slide).

# Cloud Computing deployment models

## **Public Cloud**

Example of public cloud providers: Amazon Web Services, Microsoft Azure, Google Cloud Platform, IBM, Alibaba, and so many big tech companies.

But also: Facebook, Twitter, g-mail, outlook, Tik-tok, Instagram, and the like are cloud computing products (Software as a Service that we will see in the next slides).

# Cloud Computing deployment models

## **Public Cloud**

And more: open social community clouds like Facebook, Twitter, g-mail, outlook, Tik-tok, Instagram, and the like are cloud computing products (Software as a Service that we will see in the next slides).

Concerns on the public cloud use:

1. Privacy.
2. Security.
3. Data property.
4. Strategies when terminating the service.

# Cloud Computing deployment models

## **Public Cloud**

Service Level Agreement (SLA): It establishes the relationship between the company providing the service and the user of the services. It details:

1. Time between failure and recovery.
2. Service availability.
3. Performance and response time.
4. Security.
5. Data protection.
6. Notifications in case the user exceeds the service.
7. Different strategies when the user wants to terminate the service (data recovery, etc.).

# Cloud Computing deployment models

## **Public Cloud**

Pay-as-you-go is another extended characteristic when using the public cloud.

Be always careful with the property of data in the public cloud.



# Cloud Computing deployment models

## **Private Cloud**

The main difference between the public cloud and the private cloud is where it is hosted and who is responsible for managing it. A public cloud uses a shared infrastructure, while a private cloud uses your organisation's dedicated infrastructure.

Source: Google.

# Cloud Computing deployment models

## **Private Cloud**

Three different models in this case:

1. Owned and managed by a company for the benefit of its customers and employees.
2. Owned by a company but managed by a provider (behind a firewall).
3. Owned and managed by a public cloud provider but as a private cloud for a client.

# Cloud Computing deployment models

## **Hybrid Cloud**

Customers use different services provided by different private and public providers, but no services is duplicated.

Ex: GMail as mail provider, but Microsoft 365 as office suite provider.

# Cloud Computing deployment models

## **Multi-Cloud**

Customers use services provided by different private and public providers. These services could be duplicated.

Ex: GCloud office suite for internal use, but Microsoft 365 office suite for collaborating with other institutions.

# Cloud Computing deployment models

Eventually: use the public/private model that best fits your (company) requirements.

**Exercise:** Think about the case of a software development company, the company needs: version control system, synchronous communications (on-line meetings) and asynchronous (messaging), document creation and management, payroll, customer relationship, and a long etcetera. Propose a possible solution and justify your choice of cloud for each of the services.

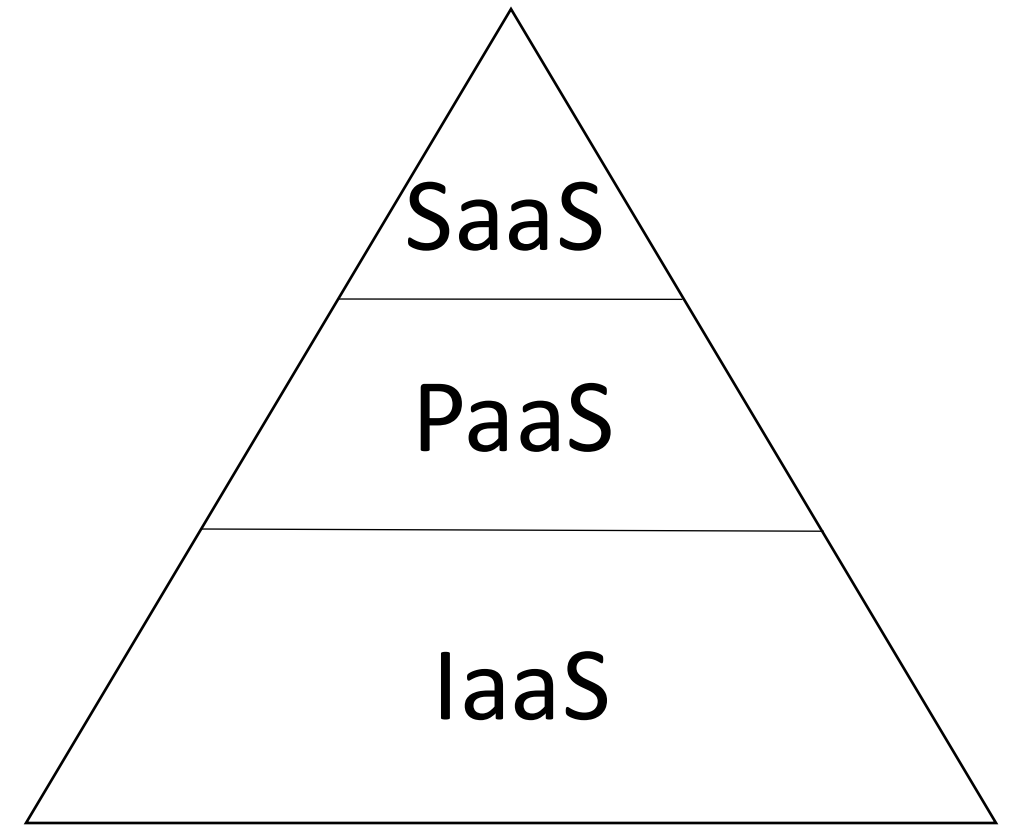
# Cloud Computing deployment models

**Exercise:** Compare the results of the previous exercise with a "traditional" approach to provision the same infrastructure.

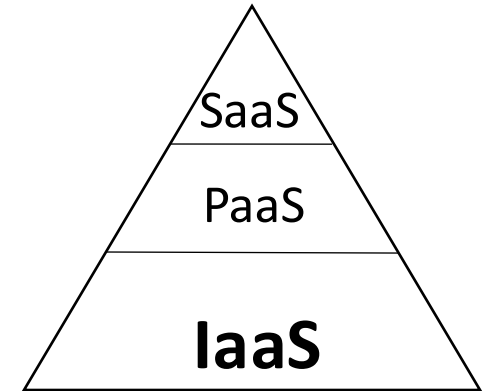
# Cloud Computing services models

1. Infrastructure as a Service (IaaS).
2. Platform as a Service (PaaS).
3. Software as a Service (SaaS).

This is the hierarchy of \*aaS.



# Cloud Computing services models



## **Infrastructure as a Service (IaaS)**

It is the foundational part of cloud computing.

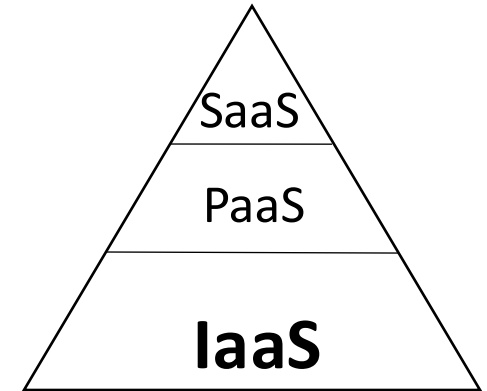
It provides computing, storage and networking.

Key idea: instead of buying physical machines (computers, HD, routers) you pay for its "virtual" version.

The user self-provision of the computing, storage and networking needed.



# Cloud Computing services models

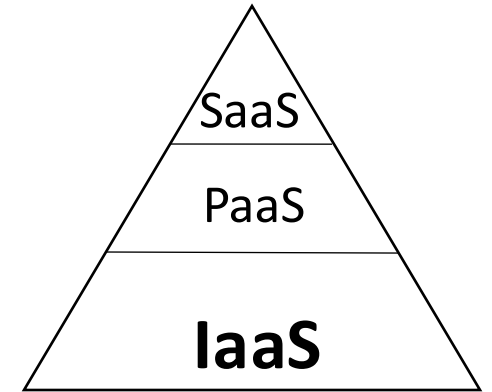


## Infrastructure as a Service (IaaS)

### Characteristics:

- The user is self-provisioning of the computing, storage and networking needed.
- The user can scale the services on demand: more computing, storage or networking.
- Optionally, the services can auto-scale: they are elastic, when more is needed, they automatically scale.
- The user knows, at all time, how much the service is costing him/her.

# Cloud Computing services models



## **Infrastructure as a Service (IaaS)**

The user is in charge of:

Computing: Selecting the operative system, install all packages needed.

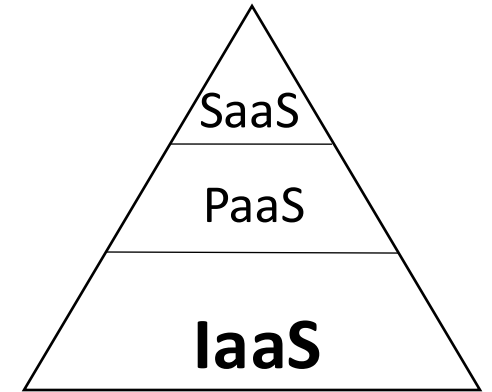
Storage: Selecting HD size and king.

Networking: Define networking characteristics.

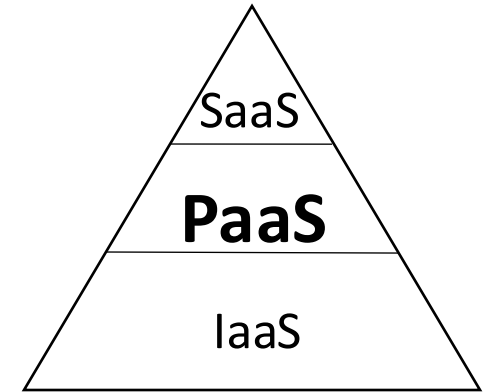
# Cloud Computing services models

## **Infrastructure as a Service (IaaS)**

All this is possible thanks to Virtualization!!!



# Cloud Computing services models



## **Platform as a Service (PaaS)**

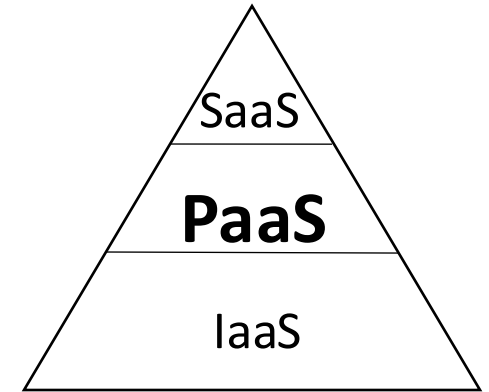
PaaS lays on top of IaaS.

Instead, first provisioning and later developing software, you concentrate on developing software and deploying it in a PaaS provider.

The user does not need to select the operative system, formatting HD, nor configuring networking, this is already provisioned in PaaS.

Examples: AWS lambda, Heroku, OpenShift.

# Cloud Computing services models



## Platform as a Service (PaaS)

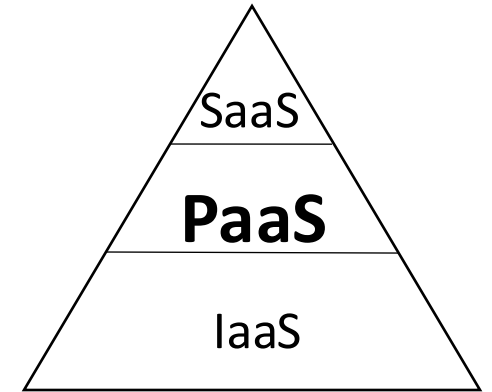
Characteristics:

- The user can use different computer languages.
- The user can choose between different databases, queue frameworks, version control systems, and so on.
- Deployments can be automatised.

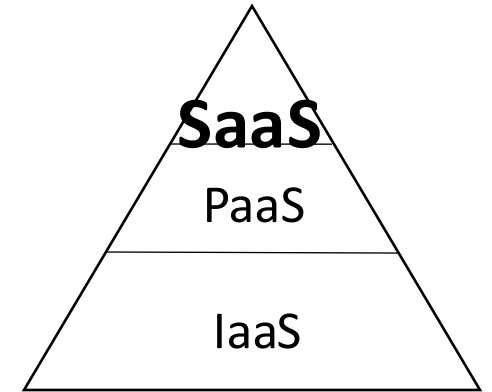
# Cloud Computing services models

## **Platform as a Service (PaaS)**

This is possible thanks to containerization!!!



# Cloud Computing services models

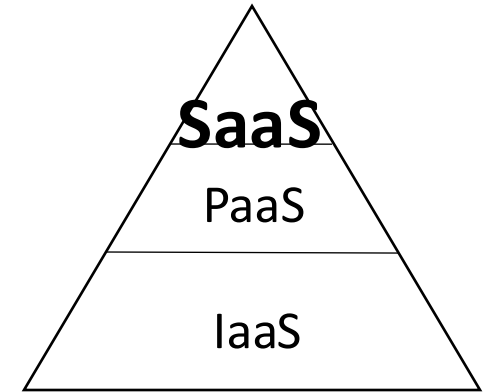


## **Software as a Service (SaaS)**

Easily speaking, software is accessed by a network connection, no installation is required.

Commonly this is achieved by means of a web browser.

# Cloud Computing services models



## **Software as a Service (SaaS)**

Characteristics:

Multi-tenancy: many users pay and have access to the same software deployed in the cloud.

Availability: shortages are uncommon.

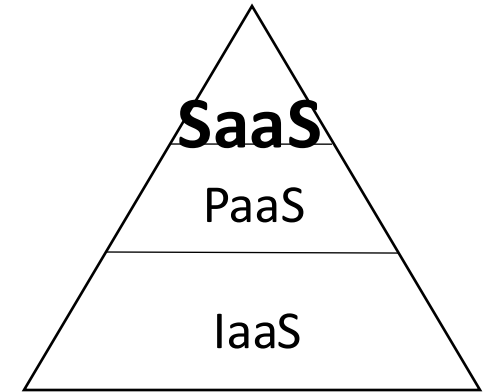
Versioning: new software versions are deployed transparently to the user.



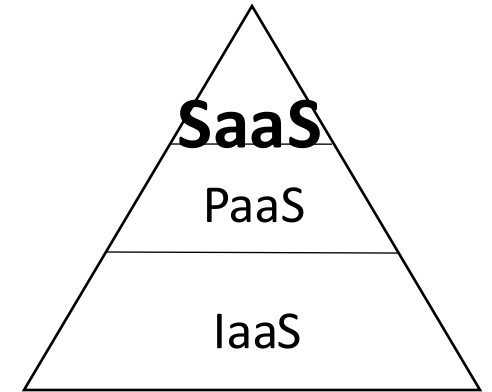
# Cloud Computing services models

## **Software as a Service (SaaS)**

This is possible thanks to microservices!!!



# Cloud Computing services models



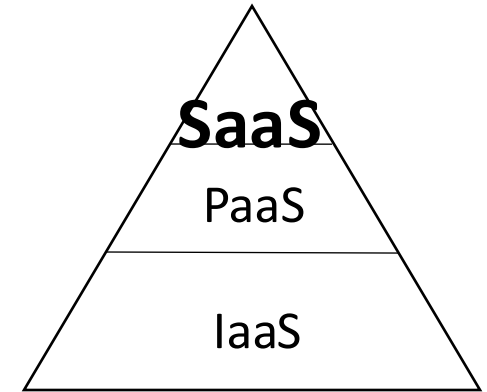
## **Software as a Service (SaaS)**

SaaS as PaaS: third parties can develop software that makes use of SaaS APIs to extend original SaaS capabilities.

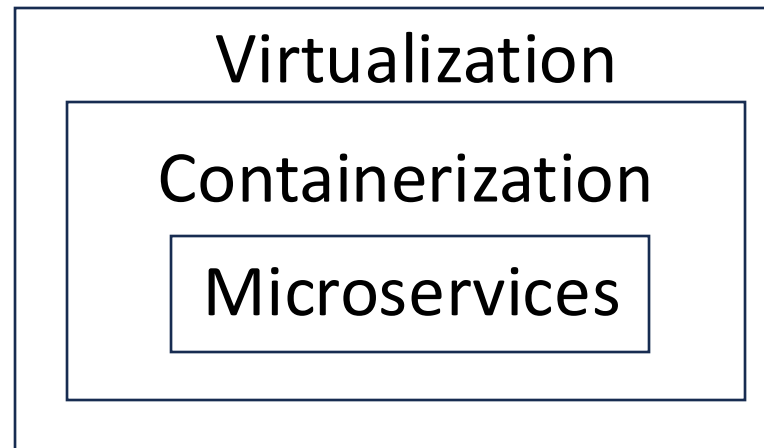
Ex: Based on Microsoft 365 third parties can develop new "complements" that make use of Microsoft 365 APIs (GSuite, github, Facebook, Instagram, etc.)

# Cloud Computing services models

## Putting it all together



## Cloud Native Applications



# Cloud Computing continuum

Users make use of different services models regardless of which model they belong to.

From the user point of view, the procedure for computing provisioning is indistinguishable from using a cloud application.

# Cloud Computing continuum

## **Summary:**

- Cloud Computing (CC) provides computing resources (computing, storage, networking,...) through a network (Internet).
- CC deployment models can be public, private, hybrid or Multi-cloud.
- CC service models can be IaaS, PaaS or SaaS.
- Virtualization, containerization and microservices are the key tools to develop CC applications.