Openstack Administration 101

General introduction to the course
&
Introduction to Cloud Comuting

openstack
CLOUD SOFTWARE

«OpenStack Administration 101» , 30 Nov. – 3 Dec. 2021

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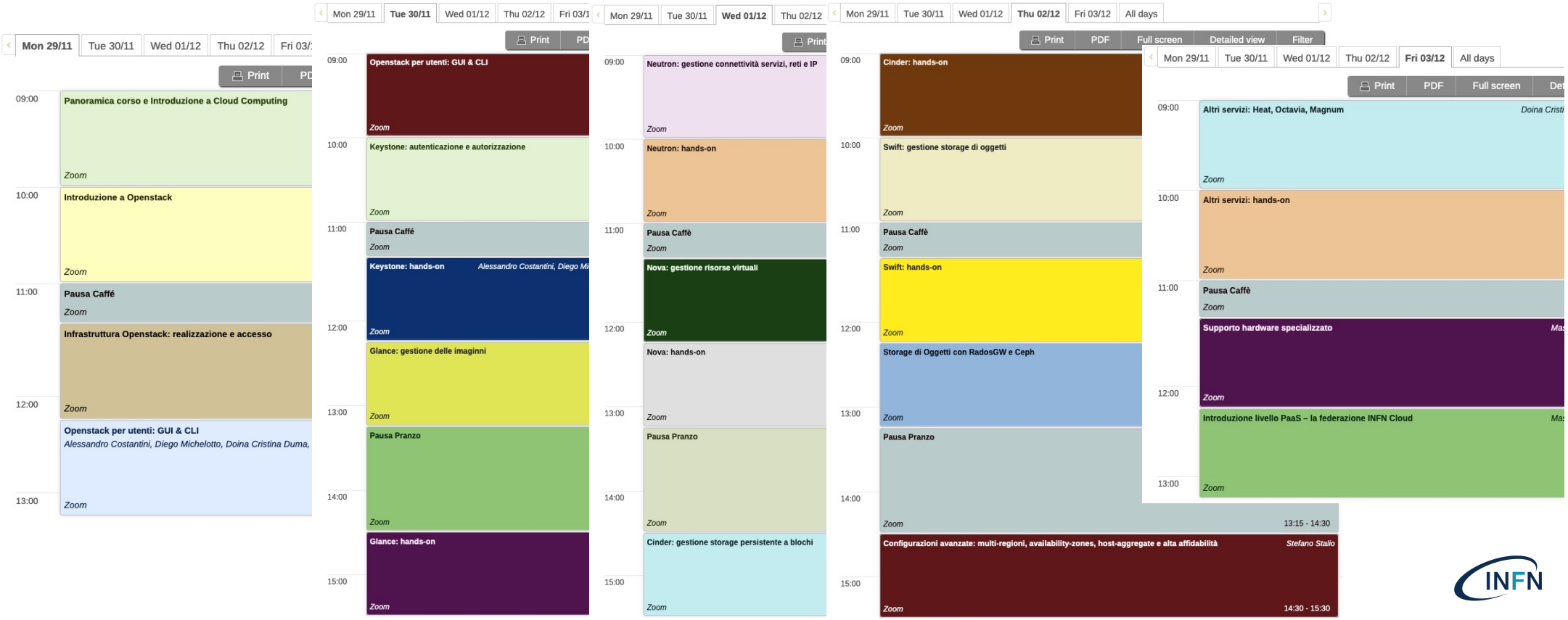
29/11/2021

Introduction to the course
<<101>>

"101"

"topic for beginners in any area."

has all the basic principles and concepts that are expected in a particular field



Introduction to the course (2)

- Logistics
  - All the week will be online, no recording
  - Presentations in agenda, https://agenda.infn.it/e/oa101, at least before each session
  - Hands-on in baltig, https://corso_oa101.baltig-pages.infn.it/hands-on/
  - Communication:
    - mailing-list - corso_oa101@lists.infn.it
    - zoom-chat - https://l.infn.it/zoomoa101

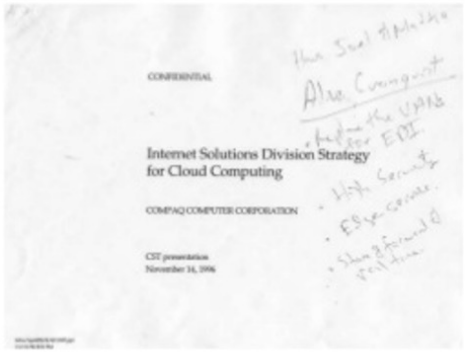
Cloud Computing

Overview

- Introduction to cloud
  - Definition, service models, characteristics, deployment, federation
- Openstack & Cloud Computing

Some History

- 1996 George Favaloro a Compaq marketing executive and Sean O'Sullivan were writing a business plan for "internet business" and they called it **"cloud computing"**



- 1997 professor Ramnath Chellappa from University of Texas uses the term **"cloud computing"** for the first time in a scientific paper, in his presentation *"Intermediaries in Cloud-Computing: A New Computing Paradigm"*

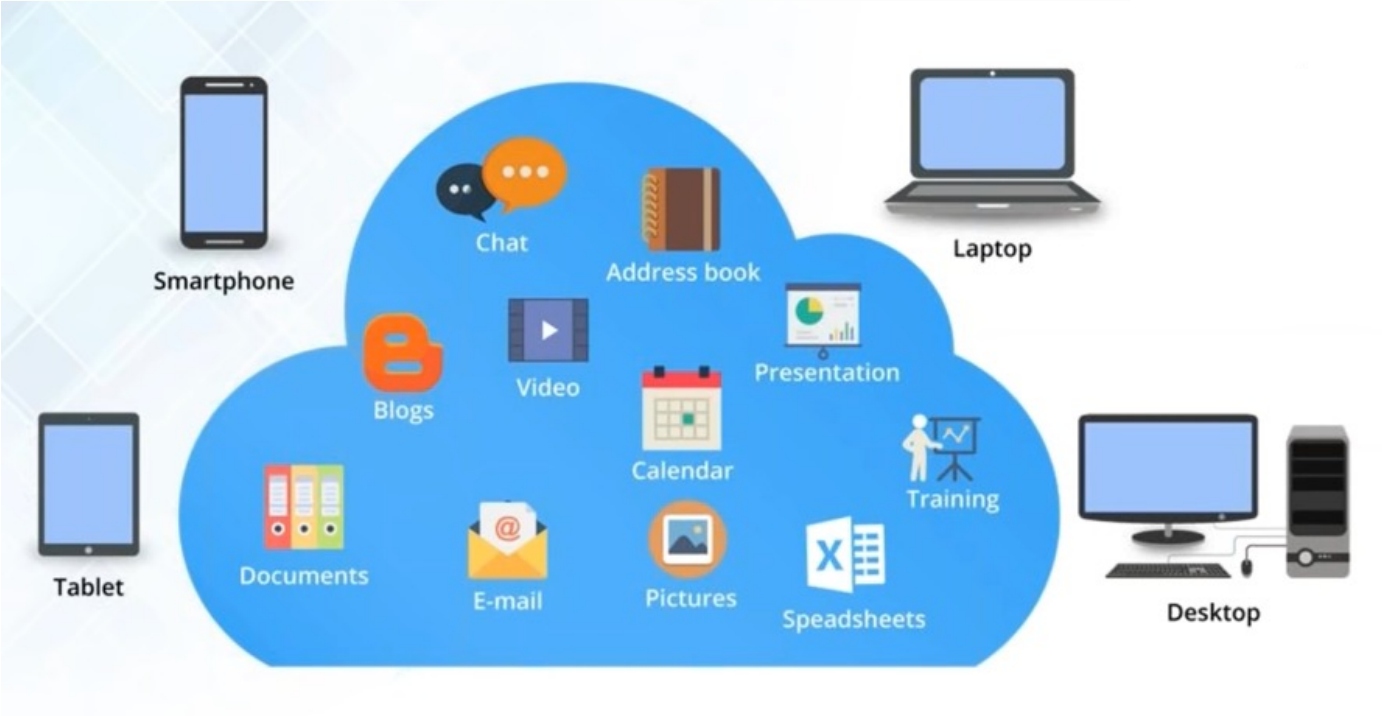
Some History

- **1999**
  - **Salesforces.com** was founded – first cloud-based solution, it revolutionized entreprise software by delivering it via a website, and not on a physical medium
  - **Google -** American multinational technology company that specializes in Internet-related services and products,
- **2002 – Amazon Web Services** was launched
- **2006 – Amazon Elastic Compute Cloud (**EC2) allowed pay-per-use for computing power.
- **2007 – Apple** introduces iPhone
- **2009 – Google Apps** suite was launched (Gdrive – **2012**)
- **2010 – Microsoft Azure**
- **2010 – birth of OpenStack – the beginning of the cloud opensource**
- **2011 – Apple** presents iCloud

Cloud Computing

Why Cloud? What changed?

Everything for some, little for others, eventually, everything will change for most.



Cloud Computing (NIST)

NIST Cloud Computing Program - NCCP

DESCRIPTION

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. This cloud model promotes availability and is composed of five essential characteristics (On-demand self-service, Broad network access, Resource pooling, Rapid elasticity, Measured Service); three service models (Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS)); and, four deployment models (Private cloud, Community cloud, Public cloud, Hybrid cloud). Key enabling technologies include: (1) fast wide-area networks, (2) powerful, inexpensive server computers, and (3) high-performance virtualization for commodity hardware.

Created November 15, 2010, Updated October 12, 2021

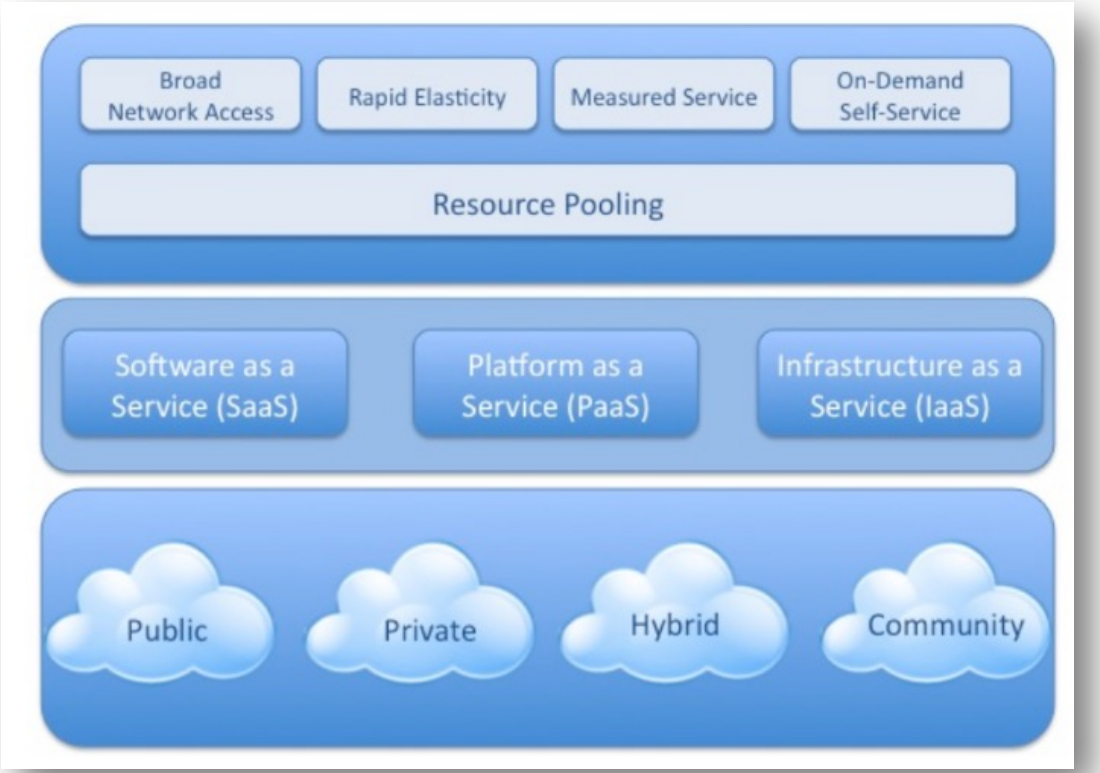
Cloud Computing

Main publications/results of NCCP

- NIST-SP 500-291, NIST Cloud Computing Standards Roadmap
- The NIST Definition of Cloud Computing
- NIST Cloud Computing Reference Architecture
- Evaluation of Cloud Computing Services Based on NIST SP 800-145
- The NIST Cloud Federation Reference Architecture

Cloud Computing

"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."



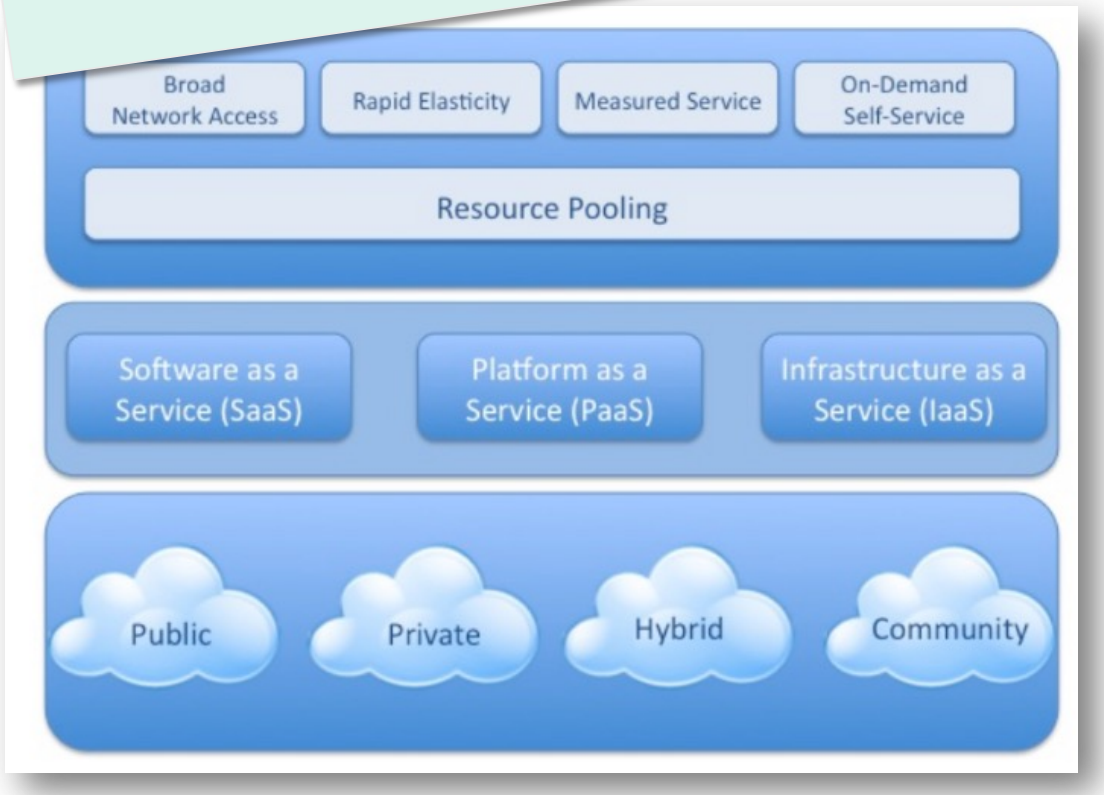
Essential characteristics

Service Models

Deployment Models

Cloud Computing

1 Supplying
2 information and communication technologies
3 as a service



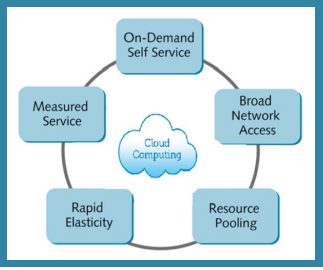
Essential characteristics

Service Models

Deployment Models

Cloud Computing

Essential Caractheristics



Self-service, on-demand

- A consumer can unilaterally provision computing capabilities as needed automatically without requiring human interaction with each service provider.
  - **Benefits:** "As needed" access to computing capabilities

Broad network-based access

- Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms
  - **Benefits**: Anytime anyplace access to computing resources from any machine within policy and security constraints.

Resource pooling

- The customer has no control or knowledge over the details of the provided resources, that are managed by the Cloud provider
  - **Benefits**: Lowers costs by sharing resources.

Rapid Elasticity

- Capabilities can be elastically provisioned and released to scale rapidly commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited
  - **Benefits**: Ability to quickly grow and shrink computing capability – and associated costs – dynamically according to need.

Measured service

- Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service
  - **Benefits**: Pay-per-use/charge-per-use

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Service Models

- In the standard Cloud definition ("Supplying information and communication technologies **as a service**"), the ***service toward the Cloud users is the essential part*** – e.g. for usability, flexibility, reliability, etc.

- Cloud computing is indeed typically modeled around ***service models*** primarily linked to:
  - Infrastructure (**IaaS** → Infrastructure as a **Service**)
  - Platform (**PaaS** → Platform as a **Service**)
  - Software (**SaaS** → Software as a **Service**)

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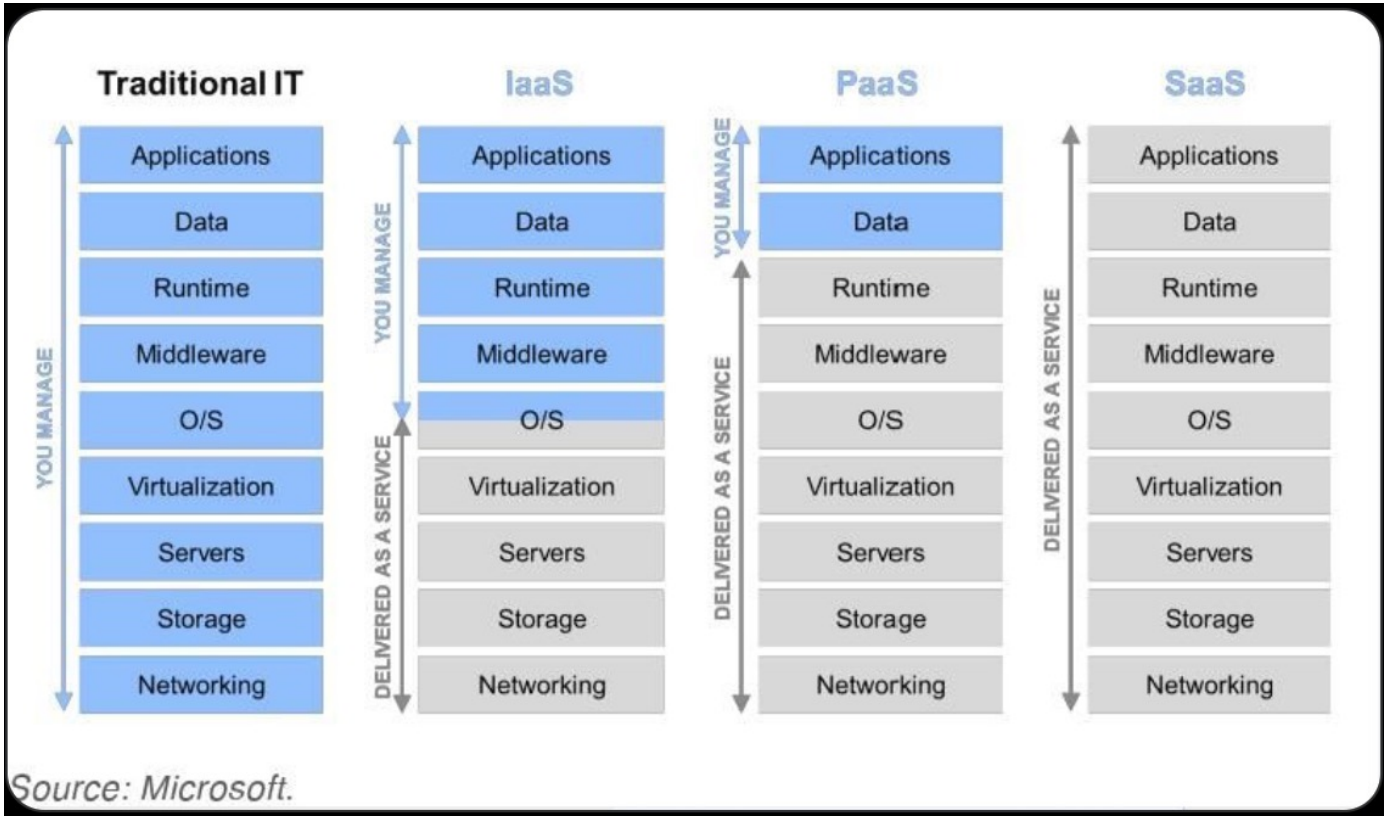
Service Models



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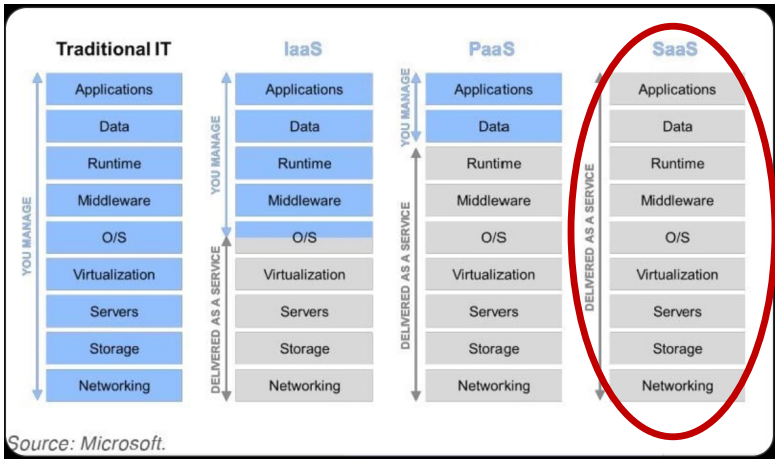
Service Models

SaaS



Source: Microsoft.

Software as a Service (SaaS)

- The capability provided to the CSC is to use the CSP's **applications running on a cloud infrastructure (*)**.
  - accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface
- The service that is provisioned is a **software application**, described as computer programs designed to permit the user to perform a group of coordinated functions, tasks, or activities
- The **SaaS provider** is typically responsible for all aspects of making the software service available - **deploying, configuring, maintaining, and updating** the operation of the software applications on a cloud infrastructure.

(*) A cloud infrastructure is the collection of hardware and software that enables the five essential characteristics of cloud computing.

- physical layer = hardware resources (server, storage and network components)
- abstraction layer = software deployed across the physical layer, which manifests the essential cloud characteristics.

Cloud Computing

Service Models

SaaS - examples

salesforce.com
Success On Demand.

NETSUITE
ONE SYSTEM. NO LIMITS.

postini

facebook

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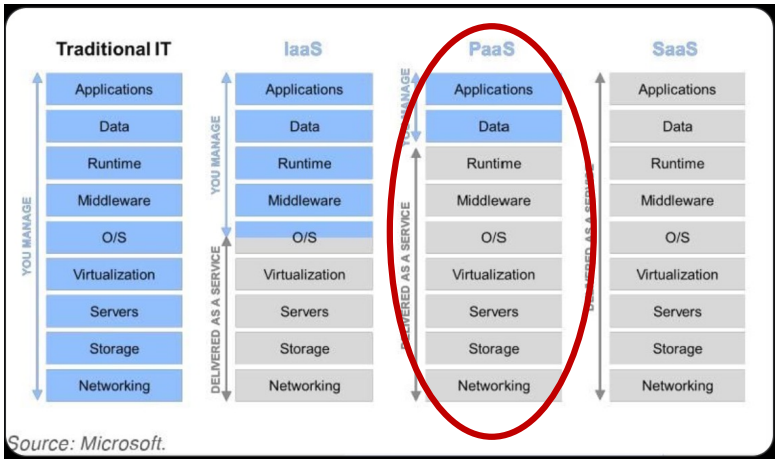
Cloud Computing

Service Models

PaaS



Source: Microsoft.

Platform as a Service (PaaS)

- The capability provided to the CSC is to deploy onto the cloud infrastructure CSC-created or acquired **applications** created using programming languages, libraries, services, and tools supported by the provider
  - **CSC has control over the deployed applications** and possibly configuration settings for the application-hosting environment
- The service that is provisioned is a **software development and/or deployment platform**, described as the capability to [develop and/or] deploy applications without the complexities of managing underlying infrastructure services.
- PaaS is distinguished from an extensible SaaS or web application by its **primary CSCs: developers and deployers versus end users.**

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Service Models

PaaS - examples

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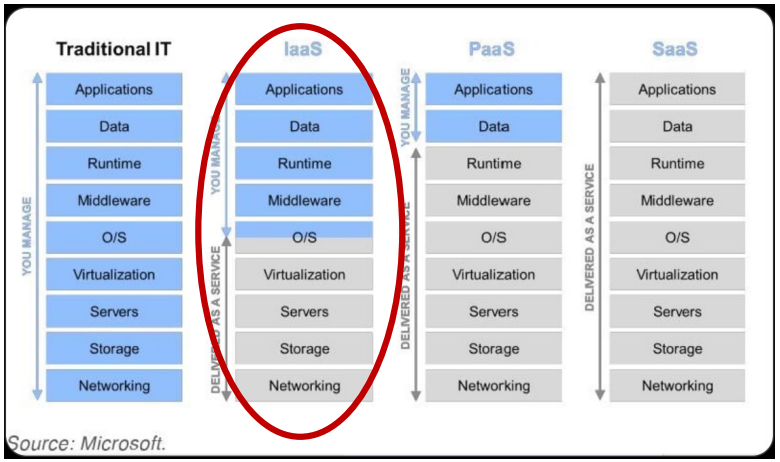
Service Models

IaaS



Infrastructure as a Service (PaaS)

- The capability provided to the CSC to **provision processing, storage, networks**, and other fundamental **computing resources** where the CSC can deploy and run arbitrary software, which can include operating systems and applications.
  - CSC has control over operating systems, storage, and deployed applications, and possibly limited control of select networking components (e.g., host firewalls).
- The service that is provisioned is **infrastructure**, typically **software-defined**
- The primary CSCs are an **IT Operations** role creating, installing, monitoring, and managing services and applications deployed in an IaaS cloud

Cloud Computing

Service Models

IaaS - examples

Google Cloud Platform

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Cloud Computing

Deployment models

- **Private Cloud:**
  - The infrastructure is **procured for exclusive *use*** by a single organization. Management, operation, ownership, location of the private cloud, however, can be independent by the organization using it.
    - Private car
- **Community Cloud:**
  - The infrastructure is **available to a community** of organizations sharing a common goal (for instance: mission, security requirements, adherence to common regulatory rules, etc.)
    - Car-sharing
- **Public Cloud:**
  - The infrastructure is **available to the public** at large. Management can be either public or private. The location is at some service supplier premises.
    - Bus, accessible to everyone
- **Hybrid Cloud:**
  - The infrastructure is a **combination of two or more Cloud infrastructures** (private, public, community Cloud), connected so that there is some form of portability of e.g. data or applications.
    - Rent a trailer

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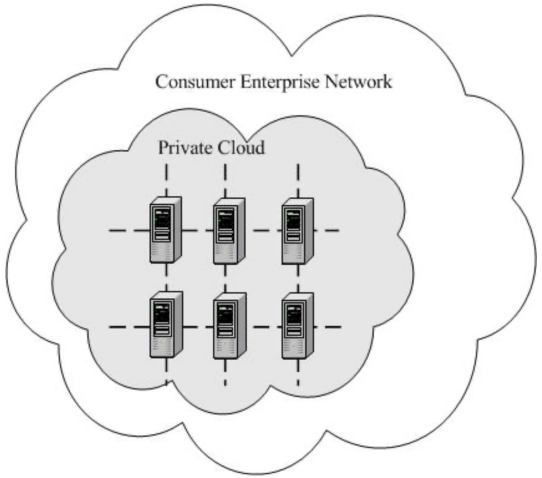
Cloud Computing

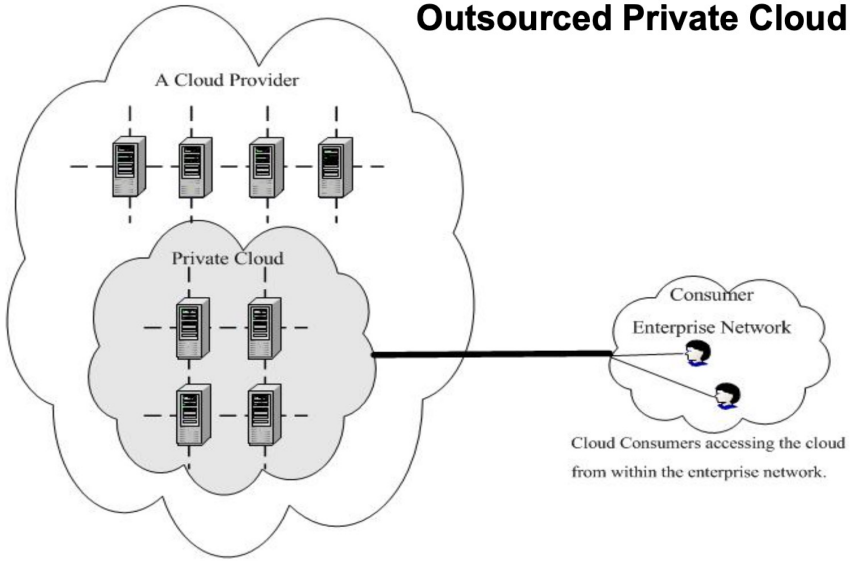
Deployment models

Private cloud

On-site Private Cloud



Outsourced Private Cloud



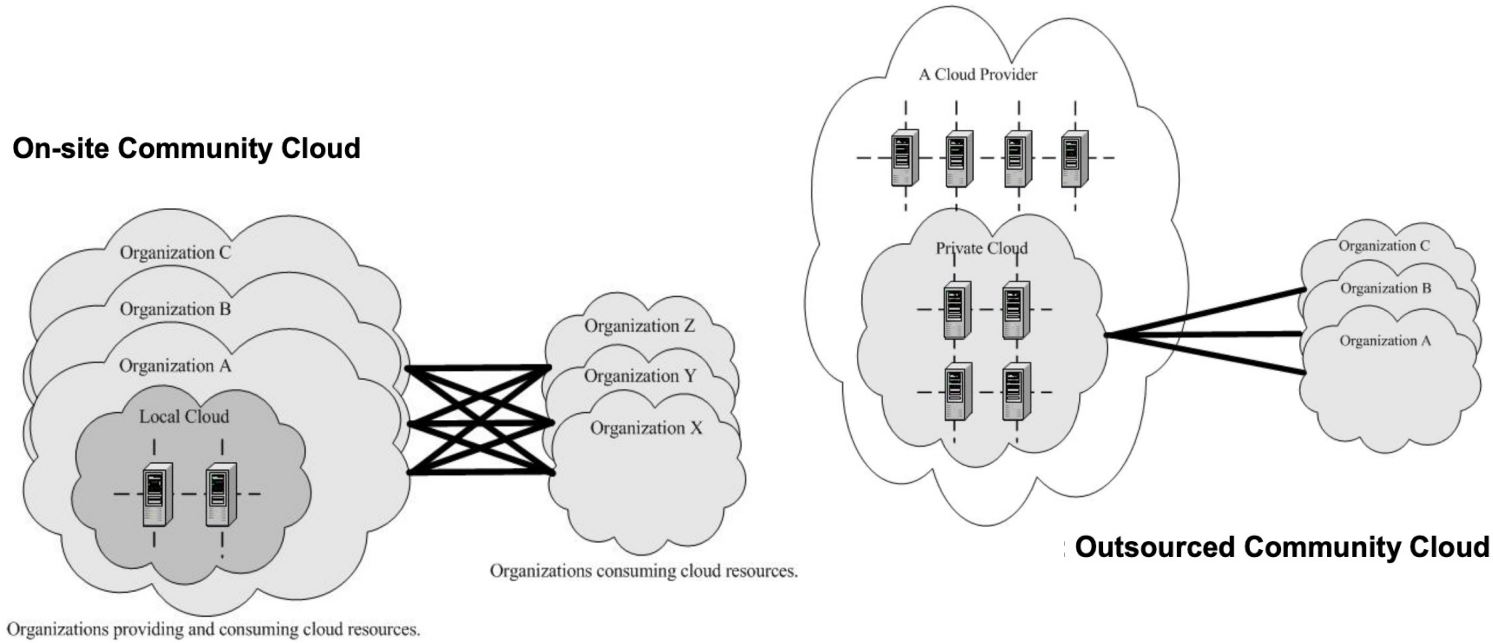
Private Cloud Service Deployment

- Only **one organization** can use the cloud service and the underlying resources.
- Private cloud may be **on premises or off premises** and provides much greater control over data, underlying systems, and applications.
- Private cloud model provides an organization **greater control over security, assurance over data location**
- Organization's cloud resources may be **owned, managed, and operated** by organization, a third party or a combination.

Cloud Computing

Deployment models

Community cloud



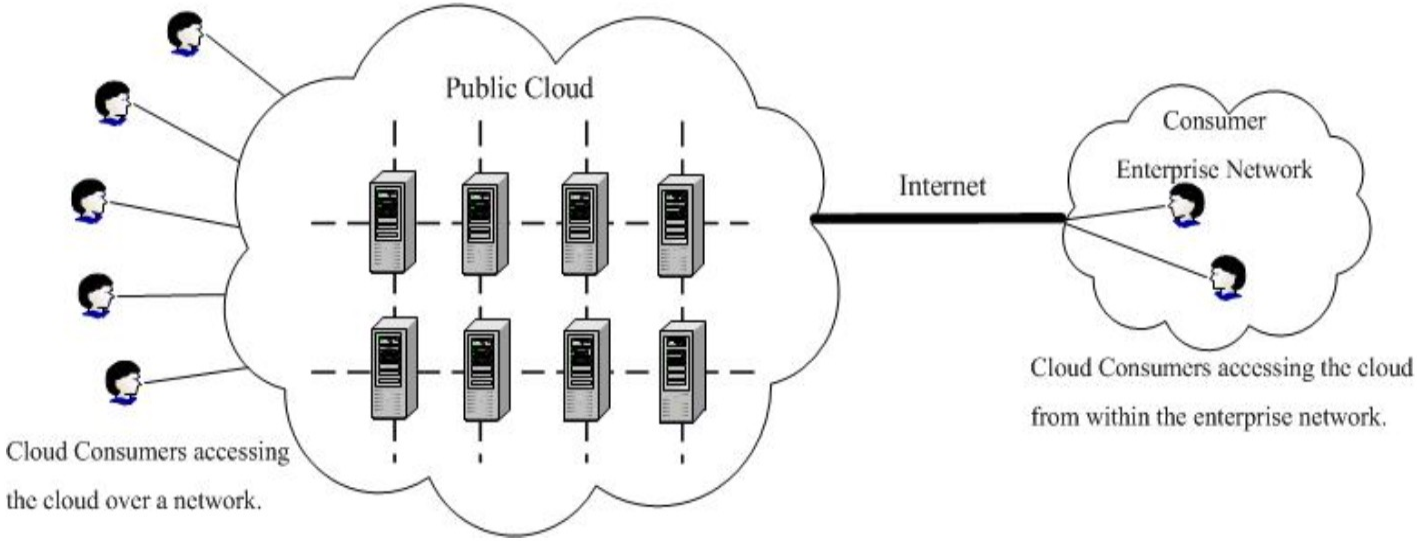
Community Cloud Service Deployment

- A specific community of CSCs from organizations that have shared concerns have exclusive use of the cloud service and the underlying resources .
- Organization's cloud resources may be operated by one or more of the organizations in the community or a third party.
- A cloud service auditor can conduct independent assessment of cloud services to confirm the scope of the group and confirm that the service and underlying infrastructure are exclusive to the group.

Cloud Computing

Deployment models

Public cloud



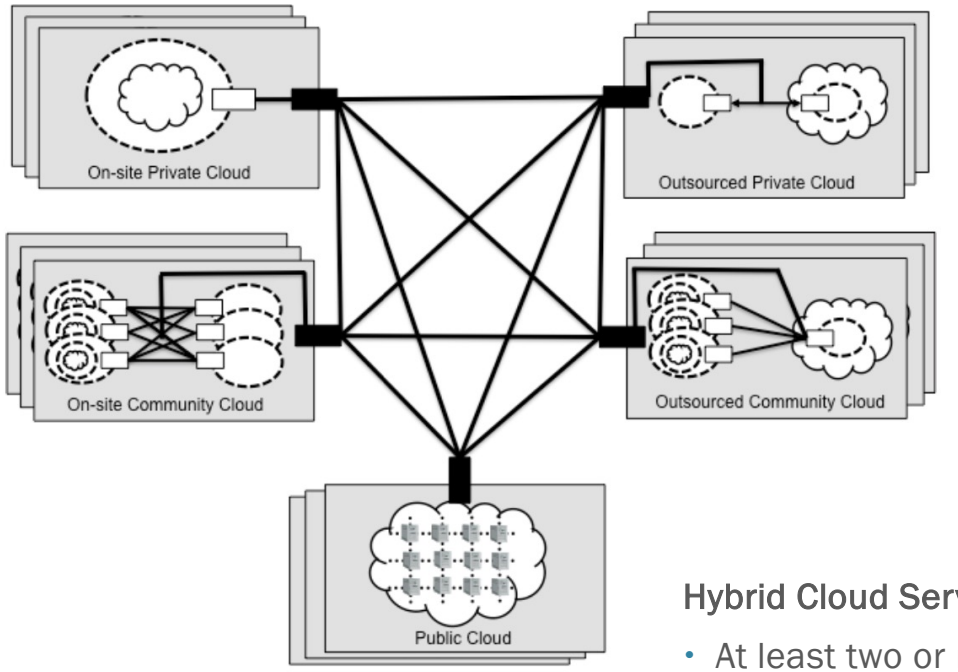
Public Cloud Service Deployment

- Unrelated CSCs use the shared cloud service and the underlying resources..
- While the CSP may limit access to a service, the CSC has no control over the set of users accessing the service.

Cloud Computing

Deployment models

Hybrid cloud



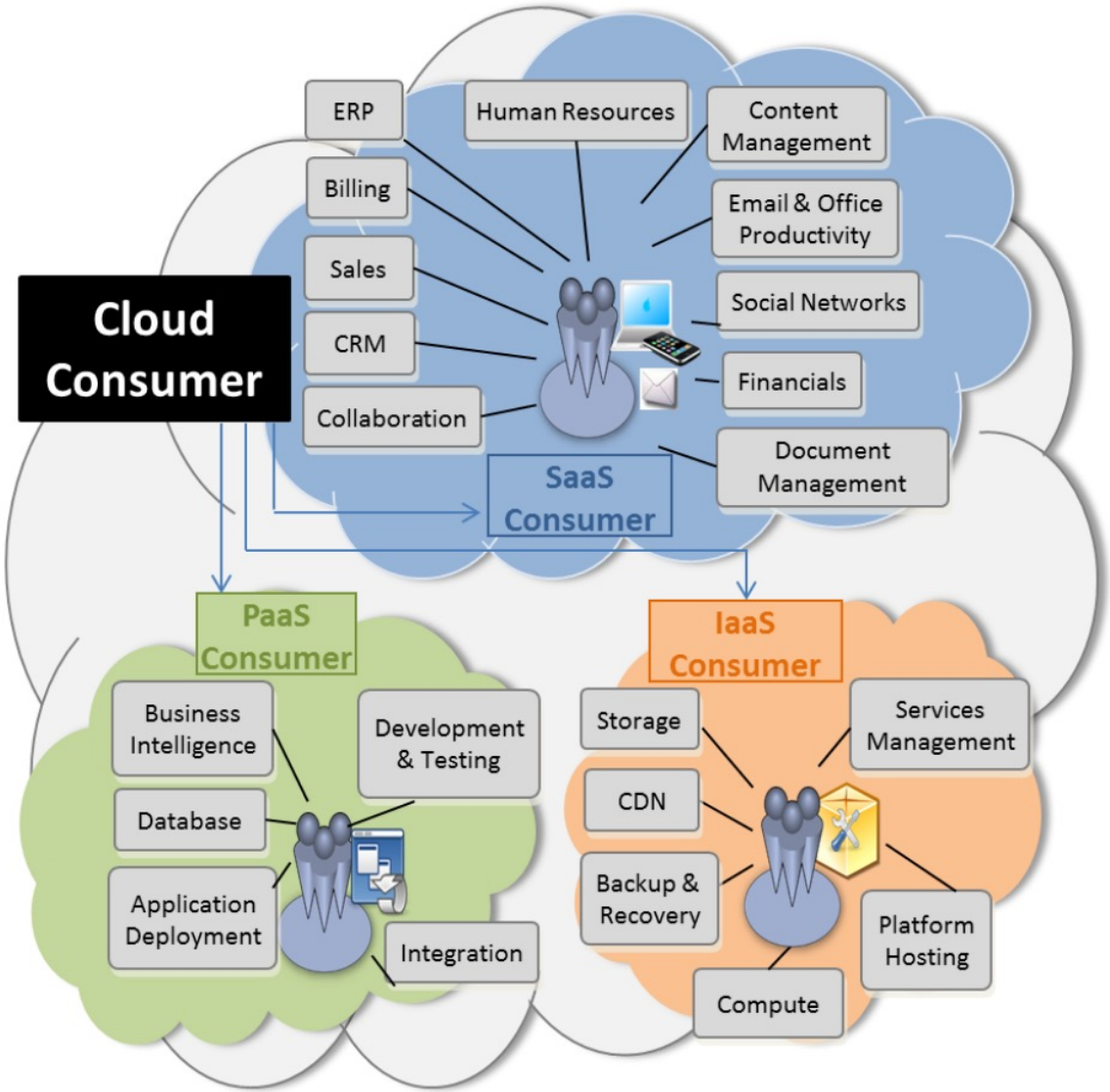
Hybrid Cloud Service Deployment

- At least two or more distinct cloud infrastructures are connected together to facilitate hosted data and application portability.
- The cloud service infrastructure for each set of CSCs is virtually separated from the other sets of CSCs

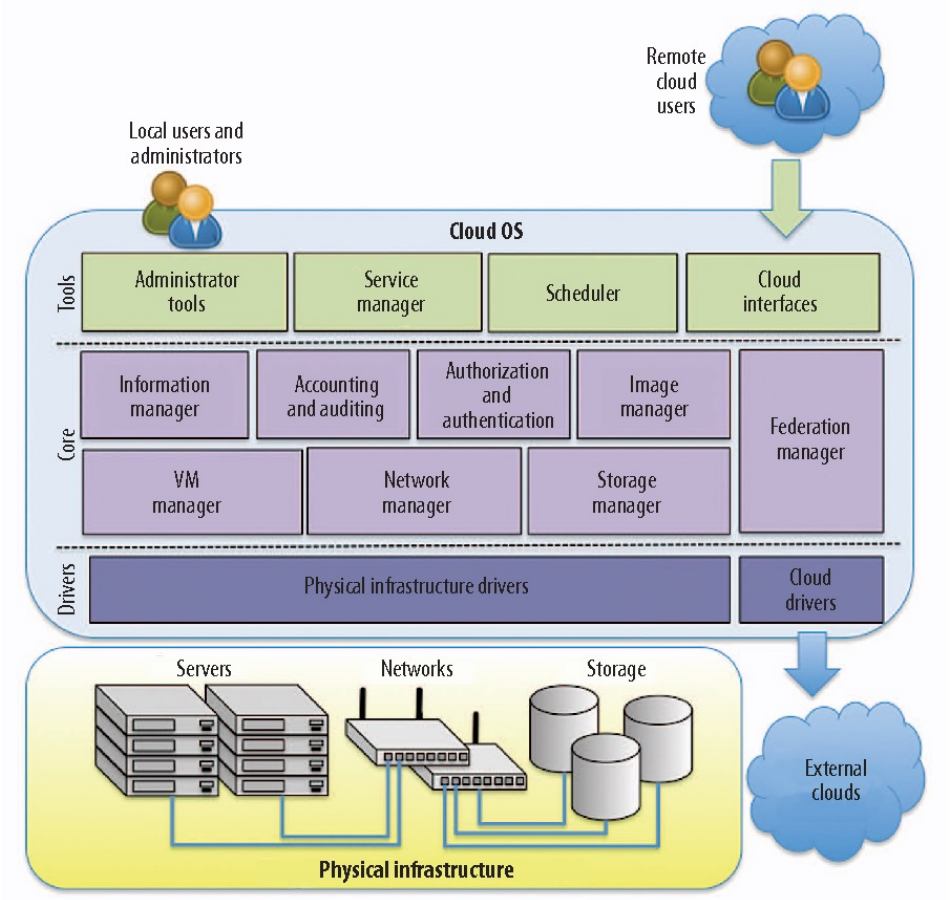
Activities & Usage scenarious (1)

Type	Consumer Activities	Provider Activities
SaaS	Uses application/service for business process operations.	Installs, manages, maintains, and supports the software application on a cloud infrastructure.
PaaS	Develops, tests, deploys, and manages applications hosted in a cloud environment.	Provisions and manages cloud infrastructure and middleware for the platform consumers; provides development, deployment, and administration tools to platform consumers.
IaaS	Creates/installs, manages, and monitors services for IT infrastructure operations.	Provisions and manages the physical processing, storage, networking, and the hosting environment and cloud infrastructure for IaaS consumers.

Activities & Usage scenarious (2)



Cloud Federation



- An open challenge in cloud computing is **cloud federation**, which involves different architectures and levels of coupling among federated cloud instances.
- The key component of an IaaS cloud architecture is the **cloud OS**, which manages the physical and virtual infrastructures and controls the provisioning of virtual resources according to the needs of the user services

Cloud Federation

- **Cloud federation**, which enables cloud providers and IT companies to collaborate and share their resources, is associated with many **portability and interoperability issues.**
- Cloud developers and researchers have proposed or implemented numerous federation architectures, including **cloud bursting, brokering, aggregation, and multitier.**
- These architectures can be **classified** according to the level of coupling or interoperation among the cloud instances involved, ranging from **loosely coupled** (with no or little interoperability among cloud instances) to **tightly coupled** (with full interoperability among cloud instances).

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Cloud Federation

Coupling levels

Loosely coupled federation

- formed by **independent cloud instances**—for example, a private cloud complementing its infrastructure with resources from an external commercial cloud—with limited inter-operation between them.
- Usually, a cloud instance has **little or no control over remote resources** (for example, decisions about VM placement are not allowed), monitoring information is limited (for example, only CPU, memory, or disk consumption of each VM is reported), and there is no support for advanced features such as cross-site networks or VM migration.

Partially coupled federation

- various partner clouds that establish a **contract or framework agreement** stating the terms and conditions under which one partner cloud can use resources from another.
- It can enable a certain **level of control over remote resources** (for example, allowing the definition of **affinity rules** to force two or more remote VMs to be placed in the same physical cluster);
- can agree to the **interchange of more detailed monitoring information** (for example, providing information about the host where the VM is located, energy consumption, and so on); and can enable some advanced networking features among part-ner clouds (for example, the creation of virtual networks across site boundaries).

Tightly coupled federation

- includes **clouds belonging to the same organization** and is normally governed by **the same cloud OS** type.
- a cloud instance can have advanced control over remote resources—for example, allowing decisions about the exact placement of a remote VM and can access all **the monitoring information** available about remote resources.
- advanced features, including the **creation of cross-site networks, cross-site migration of VMs,** implementation of high- availability techniques among remote cloud instances, and creation of virtual storage systems across site boundaries

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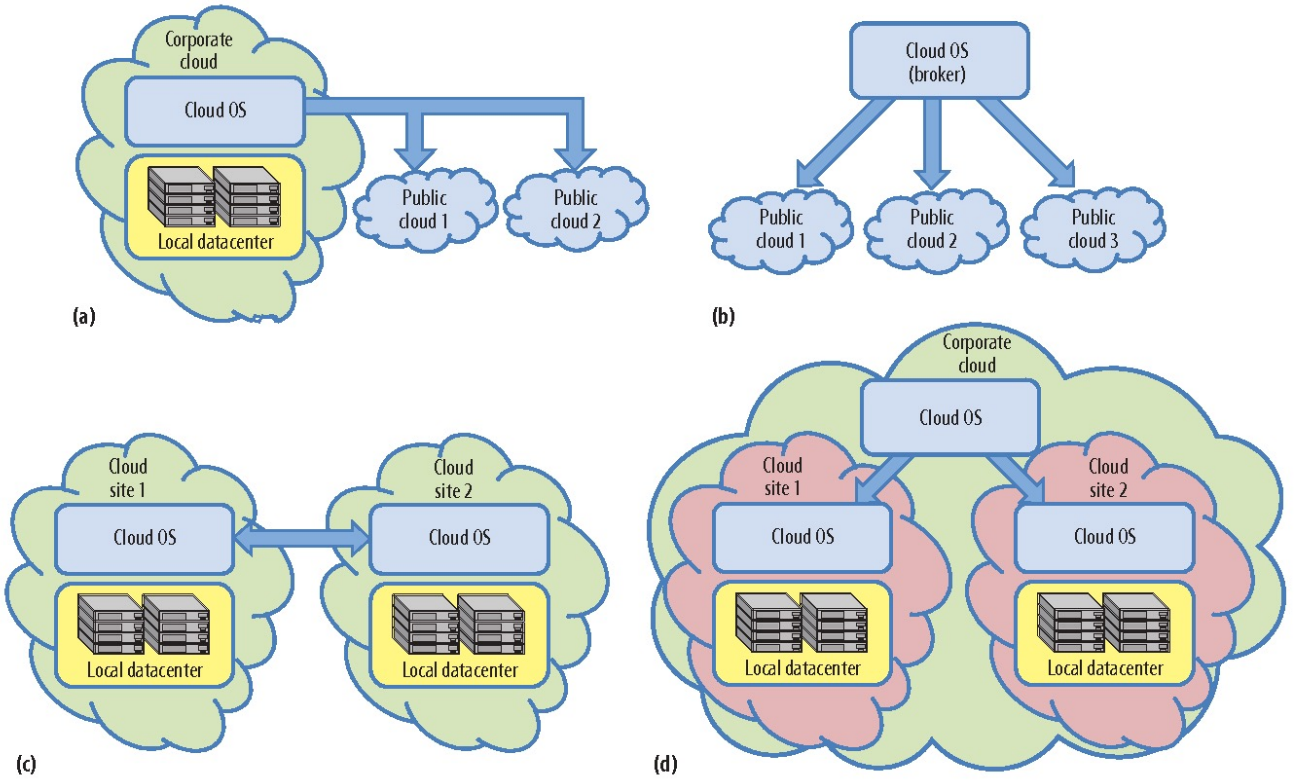
Cloud Federation

Architectures

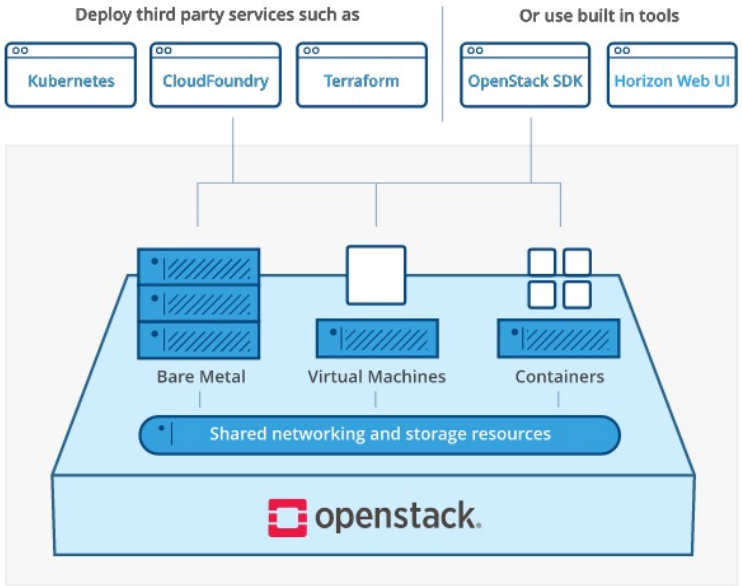


Cloud federation architectures: (a) bursting (hybrid), (b) broker, (c) aggregated, and (d) multitier.

Openstack e Cloud Computing

What is OpenStack?

- OpenStack is a **cloud operating system** that controls **large pools of compute, storage, and networking resources** throughout a data center, all **managed and provisioned through APIs** with **common authentication mechanisms**.
- A **dashboard** is also available, giving administrators control while empowering their users to provision resources through a web interface.
- Beyond standard infrastructure-as-a-service functionality, additional components provide **orchestration**, **fault management** and **service management** amongst other services to ensure high availability of user applications.



And now....
OpenStack