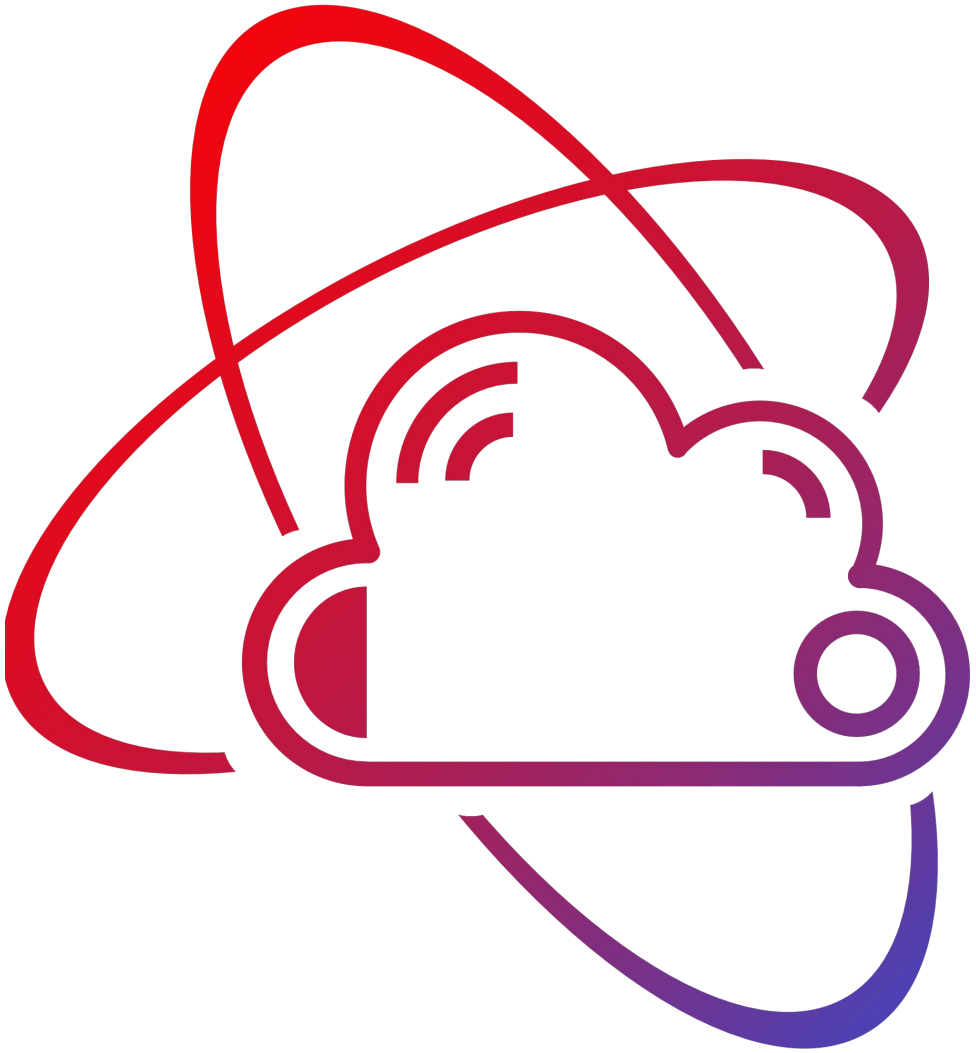
Cloud Computing Architecture

Introduction to Cloud Computing



SWINBURNE UNIVERSITY OF TECHNOLOGY

Acknowledgement of Country

We respectfully acknowledge the Wurundjeri People of the Kulin Nation, who are the Traditional Owners of the land on which Swinburne's Australian campuses are located in Melbourne's east and outer-east, and pay our respect to their Elders past, present and emerging.

We are honoured to recognise our connection to Wurundjeri Country, history, culture, and spirituality through these locations, and strive to ensure that we operate in a manner that respects and honours the Elders and Ancestors of these lands.

We also respectfully acknowledge Swinburne's Aboriginal and Torres Strait Islander staff, students, alumni, partners and visitors.

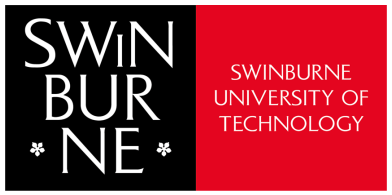
We also acknowledge and respect the Traditional Owners of lands across Australia, their Elders, Ancestors, cultures, and heritage, and recognise the continuing sovereignties of all Aboriginal and Torres Strait Islander Nations.

Introduction to Cloud Computing

In this Presentation:

- Virtualisation and Cloud Computing
- 3 Service Models for Cloud Computing
- Advantages of Cloud Computing
- Cloud Providers

Virtualisation and Cloud Computing



What is Cloud Computing?

Definitions:

- "…the *on-demand* delivery of compute power, database storage, applications, and other IT resources through a cloud services platform *via the internet* with *pay-as-you-go* pricing."
- "*Computing as a Service* delivered over the internet."
- "…the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet ("the cloud") to offer *faster innovation, flexible resources, and economies of scale*."
- "…a paradigm shift away from the traditional model of purchasing, provisioning and maintaining expensive IT infrastructure, to one in which the *infrastructure is owned and maintained by a third party and delivered to the customer on demand over the internet*."

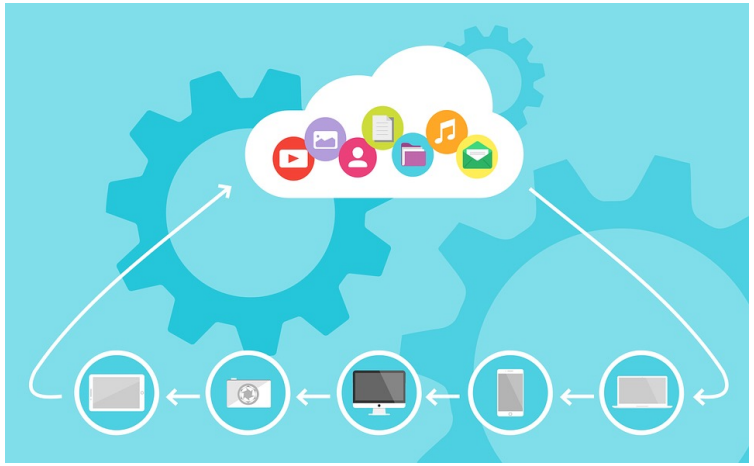


Image from: https://upload.wikimedia.org/wikipedia/commons/d/dc/Cloud-Computing_services.png

Why do we use the term “Cloud”?

History of Cloud Computing timeline:

- 1960s: Computer scientists at MIT begin experimenting with ways to share resources among multiple users.
- 1970s and 1980s: Advances in virtualization technology make it possible to create virtual machines that can run multiple operating systems on a single physical server.
- Late 1990s: The term "cloud computing" is coined as companies like Salesforce.com and Amazon begin offering web-based services that allow customers to access software and data over the internet.
- Early 2000s: Companies like Google and Microsoft begin offering cloud-based services like email and storage.
- Today: Cloud computing is a major force in the technology industry, with companies of all sizes using cloud services to run their applications and store their data.

Image from: https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQ-D207CPLJUwNUr2n6agG3nzNhhvd4tfo9ug&usqp=CAU

Cloud Computing: Before and After

Before Cloud Computing

- Hardware solutions are physical. This means they require:
  - Space
  - Staff
  - Physical security
  - Planning
  - Capital expenditure
  - Guessing at theoretical maximum peaks
- Is there enough resource capacity?
- Do we have sufficient storage? What if your needs change?

Before

After

After Cloud Computing

- Hardware solutions are virtual, eliminating the need for physical space, staff, and physical security
- Scalability allows for easy adjustments to meet changing resource and storage needs
- No capital expenditure required for purchasing and maintaining physical hardware
- Pay-as-you-go pricing model allows for cost savings by only paying for resources used
- Easy access to a vast pool of resources and storage capacity
- Automatic updates and maintenance of hardware and software.

What is Virtualisation in Cloud Computing?

Virtualisation in Cloud Computing Definition:

'...the process of creating a virtual version of a physical resource, such as a server, storage device, or network. This virtual resource can then be used in place of the physical resource, allowing for efficient use of resources and increased flexibility in managing them.

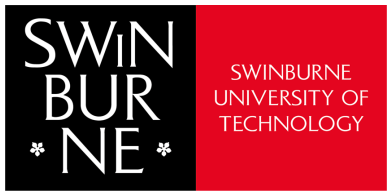
Virtualization enables the abstraction of logical and physical resources, which allows multiple workloads to share the same underlying physical resources. This is a key technology that enables cloud computing and allows for the dynamic allocation of resources on-demand.'

Image from: https://www.educba.com/what-is-virtualization-in-cloud-computing/

Types of Virtualisation in Cloud Computing

- Memory virtualisation
  - Virtual memory
- Storage virtualisation
  - Logical disks and file systems
  - Networked attached storage
  - Cloud storage
- Network virtualisation
  - VLANs (segmentation), VPNs (tunneling), VPCs
- Operating System virtualisation (virtual desktop)
  - Multiple OS on the one computer (host-guest)
- Machine virtualisation
  - Hyper-visors (e.g. Hyper-V, VMWare) allow multiple servers (virtual machines) to be run on a single “metal” computer.

3 Service Models for Cloud Computing



What are the main Cloud Service Models?

Infrastructure as a service (IaaS):

Services in this category are the basic building blocks for cloud IT and typically provide you with access to networking features, computers (virtual or on dedicated hardware), and data storage space. It is the most similar to existing IT resources that many IT departments and developers are familiar with today.

Platform as a service (PaaS):

Services in this category reduce the need for you to manage the underlying infrastructure (usually hardware and operating systems) and enable you to focus on the deployment and management of your applications.

Software as a service (SaaS):

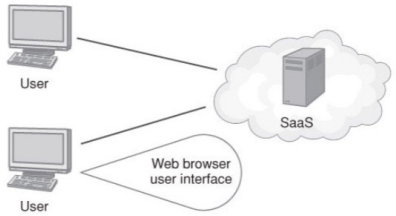
Services in this category provide you with a completed product that the service provider runs and manages. A common example of a SaaS application is web-based email, where you can send and receive email without managing feature additions to the email product or maintaining the servers and operating systems that the email program runs on.

Image from: https://cloudcomputinggate.com/saas-paas-iaas-examples/

How does Software as a Service work?

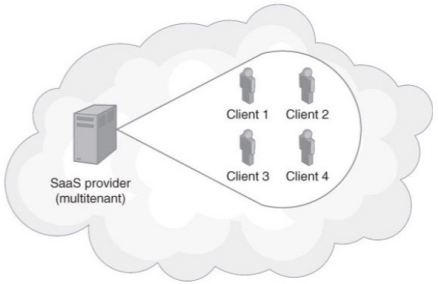
What are Multitenant SaaS Solutions?

- '...cloud-based software applications that are designed to be shared by multiple customers, or tenants. In a multitenant architecture, all tenants share the same instance of the software, but each tenant's data is isolated and kept separate from other tenants' data.'



SaaS applications are often multitenant solutions.

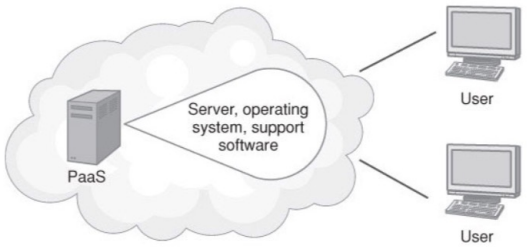
- Within the single SaaS application, two or more tenant companies share the same server resources.
- Each tenant can customize their own version of the software for their clients.



How does Platform as a Service work?

PaaS definition:

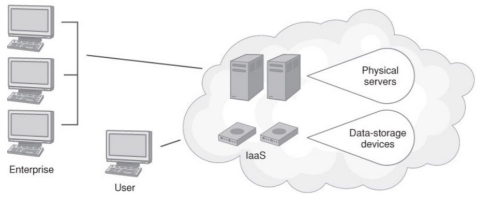
- PaaS provides the underlying hardware technology, such as one or more servers (or virtual servers), operating systems, database solutions, developer tools, and network support, for developers to deploy their own solutions.
- The hardware and software within a PaaS solution is managed by the platform provider.
- Developers need not worry about performing hardware or operating system upgrades. Instead, developers can focus on their own applications.
- Provide a collection of hardware and software resources that developers can use to build and deploy applications within the cloud.
- Depending on their needs, developers may use a Windows-based PaaS solution or a Linux-based PaaS.



How does Infrastructure as a Service work?

IaaS definition:

- An IaaS provider makes all of the computing hardware resources available, and the customers, in turn, are responsible for installing and managing the systems, which they can normally do, for the most part, over the Internet.
- IaaS provides a virtual data center within the cloud.
- IaaS provides servers (physical and virtualized), cloud-based data storage, and more.
- Developers must install their own operating system, database management software, and support software.
- Then the developers (or the company's system administrators) must manage both the hardware and the software.



What are the three Cloud Deployment Models?

"All-In" Public Cloud:

- A cloud-based application is fully deployed in the cloud, and all parts of the application run in the cloud. Applications in the cloud have either been created in the cloud or have been migrated from an existing infrastructure.

Hybrid:

- A hybrid deployment is a way to connect infrastructure and applications between cloud-based resources and existing resources that are not located in the cloud. The most common method of hybrid deployment is between the cloud and existing on-premises infrastructure (sometimes called on-prem).

Private Cloud (On-premises):

- When you run a cloud infrastructure from your own data center, that's called on-premises or private cloud. While this kind of deployment lacks many of the benefits of cloud computing, it does provide dedicated resources and is a popular choice for organizations who need to meet certain compliance standards.

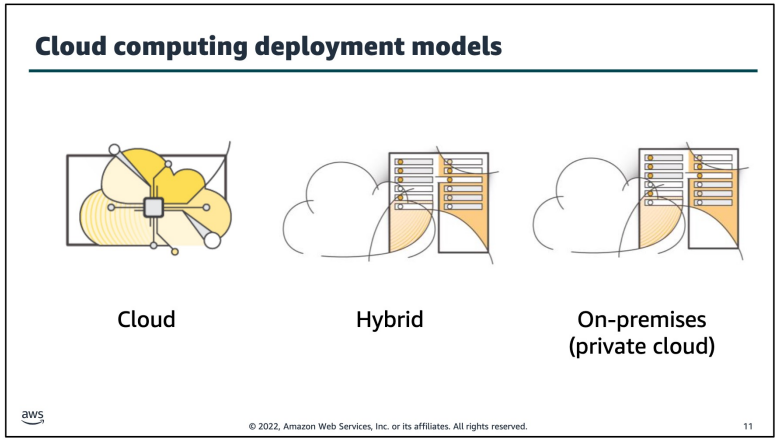


Image from: AWS Academy - ACF Module 1

Advantages of Cloud Computing

What are the advantages of cloud computing? (AWS)

Advantage #1—Trade capital expense for variable expense:

Capital expenses (capex) are funds that a company uses to acquire, upgrade, and maintain physical assets such as property, industrial buildings, or equipment.

Advantage #2—Benefit from massive economies of scale:

By using cloud computing, you can achieve a lower variable cost than you can get on your own.

Advantage #3—Stop guessing capacity:

Eliminate guessing about your infrastructure capacity needs.

Advantage #4—Increase speed and agility:

In a cloud computing environment, new IT resources are only a click away, which means that you reduce the time it takes to make those resources available to your developers from weeks to just minutes.

Advantage #5—Stop spending money on running and maintaining data centers:

Focus on projects that differentiate your business instead of focusing on the infrastructure.

Advantage #6—Go global in minutes:

You can deploy your application around the world with just a few clicks

What are the benefits of cloud-based platforms?

- Scalability.

On demand resource scaling.

- Redundancy.

Servers, storage, and networks.

- Cost benefits from resource pooling.

Shares IT resources across a very large number of companies, which provides cost savings to each.

- Outsourced server management.

Provides an IT staff who maintain operating systems and underlying support software.

- Low cost of entry.

Companies do not need to invest in their own IT data center.

Cloud Providers

Who are some major Cloud Providers?

Amazon Web Services (AWS):

- AWS is a collection of remote computing services (also called web services) that make up a cloud computing platform, offered by Amazon.com. These services operate from 31 geographical regions across the world.

Microsoft Azure:

- Azure is a cloud computing service created by Microsoft for building, testing, deploying, and managing applications and services through a global network of Microsoft-managed data centers. It has over 60 regions around the world.

Google Cloud Platform (GCP):

- GCP is a collection of remote computing services that make up a cloud computing platform, offered by Google. These services operate from over 35 geographical regions across the world.

Oracle Cloud:

- Oracle Cloud is a collection of managed services from Oracle Corporation, including data storage, application development, and business analytics services. It offers a range of services including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It operates from 41 public cloud regions around the world.

Image from: https://blog.clinked.com/top-cloud-providers