

Chapter 1

Cloud Computing Fundamentals

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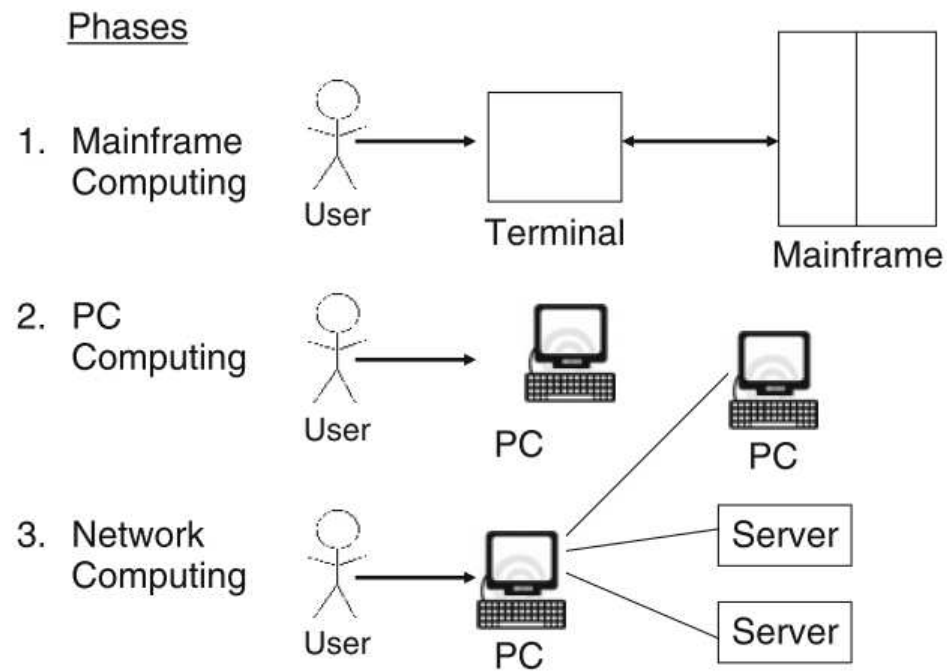
Definition of Cloud Computing

- Cloud computing can be defined as a new style of computing in which dynamically scalable and often virtualized resources are provided as a services over the Internet
- Cloud computing has become a significant technology trend, and many experts expect that cloud computing will reshape information technology (IT) processes and the IT marketplace

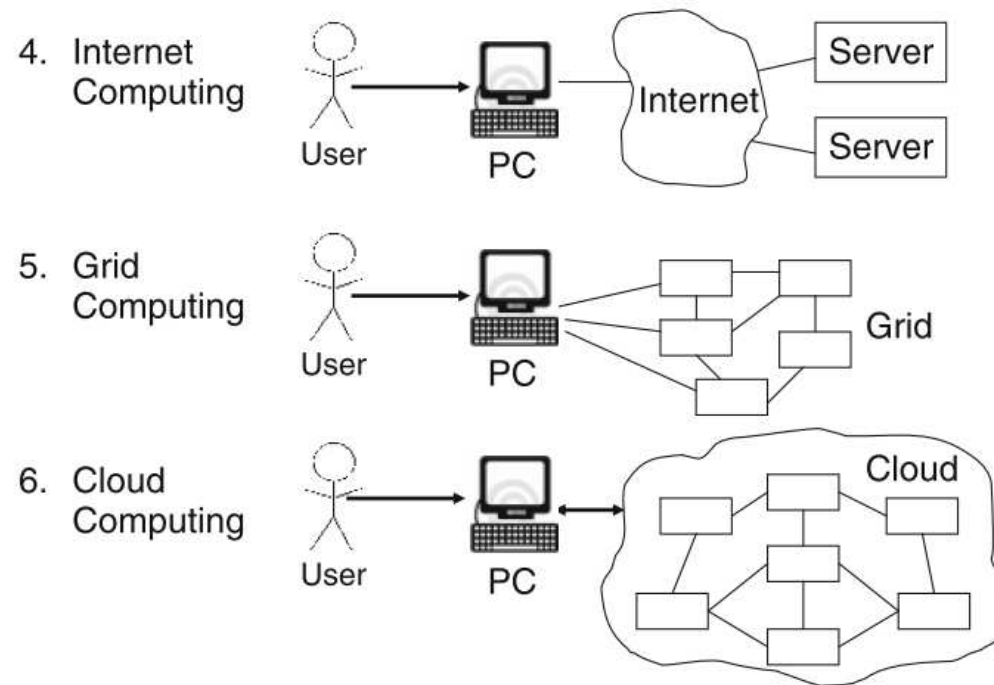
Definition of Cloud Computing

- With the cloud computing technology, users use a variety of devices, including PCs, laptops, smartphones, and PDAs to access programs, storage, and application-development platforms over the Internet, via services offered by cloud computing providers
- Advantages of the cloud computing technology include cost savings, high availability, and easy scalability

six phases of computing paradigms



six phases of computing paradigms (cont.)



six phases of computing paradigms (cont.)

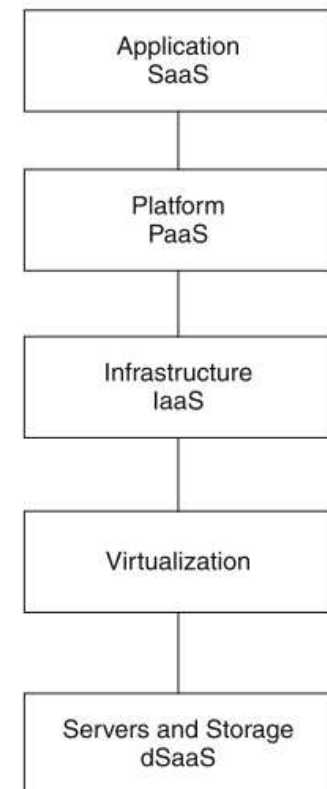
- In phase 1, many users shared powerful mainframes using dummy terminals
- In phase 2, stand-alone PCs became powerful enough to meet the majority of users' need
- In phase 3, PCs, laptops, and servers were connected together through local networks to share resources and increase performance

six phases of computing paradigms (cont.)

- In phase 4, local networks were connected to other local networks forming a global network such as the Internet to utilize remote applications and resources
- In phase 5, grid computing provided shared computing power and storage through a distributed computing system
- In phase 6, cloud computing further provides shared resources on the Internet in a scalable and simple way

Layers of Cloud Computing

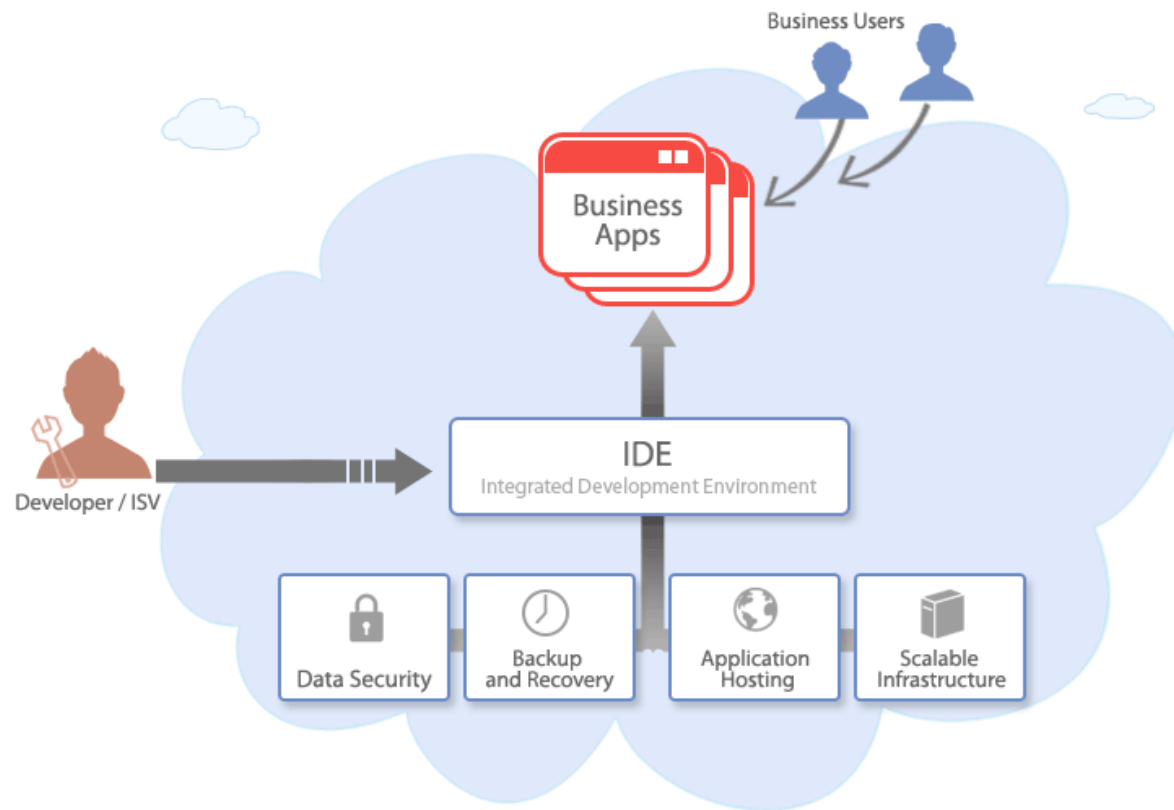
- Cloud computing can be viewed as a collection of services, which can be presented as a layered cloud computing architecture
- services offered through cloud computing usually include IT services referred as to SaaS (Software-as-a-Service), which is shown on top of the stack
- SaaS allows users to run applications remotely from the cloud



Layers of Cloud Computing (cont.)

- Infrastructure-as-a-service (IaaS) refers to computing resources as a service which includes virtualized computers with guaranteed processing power and reserved bandwidth for storage and Internet access
- Platform-as-a-Service (PaaS) is similar to IaaS, but also includes operating systems and required services for a particular application. In other words, PaaS is IaaS with a custom software stack for the given application
- The data-Storage-as-a-Service (dSaaS) provides storage that the consumer is used including bandwidth requirements for the storage

The concept of Platform-as-a-Service

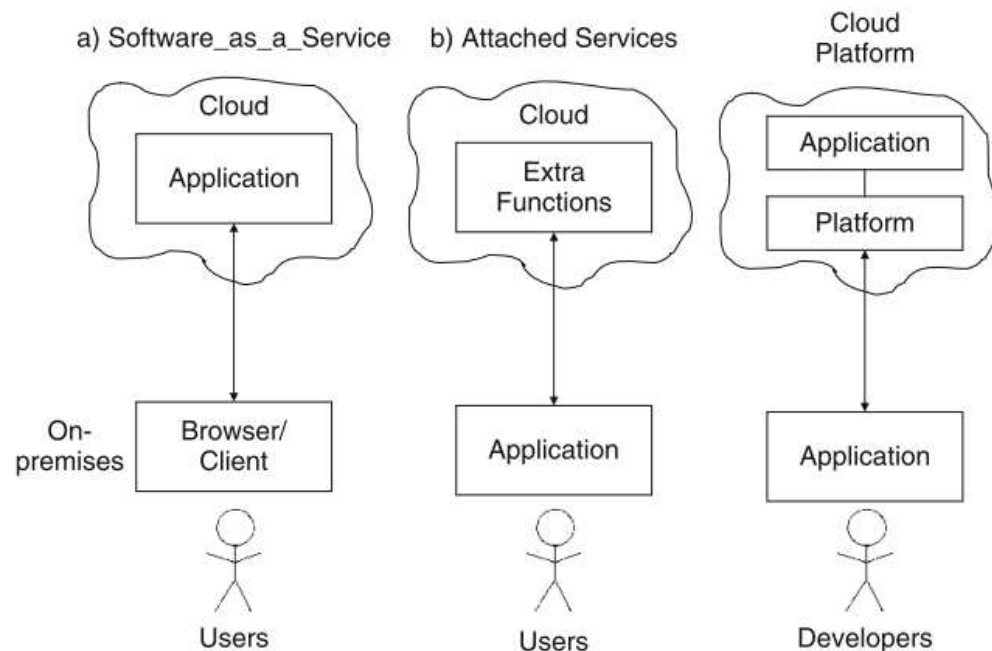


Platform-as-a-Service

- Platform as a Service (PaaS) is a delivery of a computing platform over the web
- PaaS enables you to create web applications quickly, without the cost and complexity of buying and managing the underlying software/hardware
- PaaS provides all the facilities required to support the complete life cycle of building and delivering web applications entirely on the web
- As Platform-as-a-Service (PaaS) is available as a service, the developer and ISV's get full control of the application development and deployment

Three categories of cloud services

- According to Chappell (2008) there are three categories of cloud services



Three categories of cloud services (cont.)

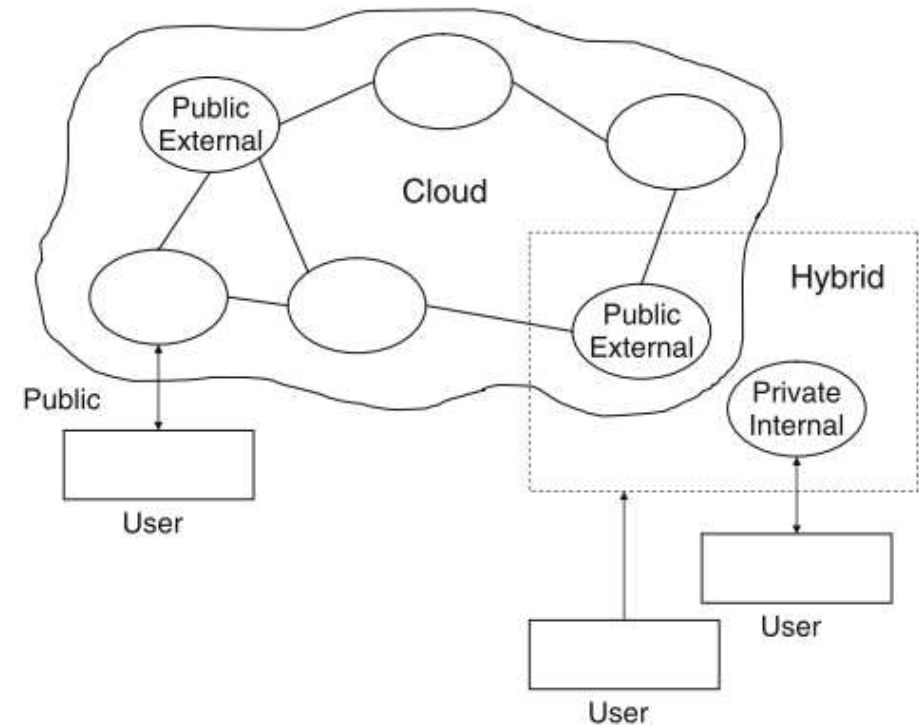
- 1. **SaaS:** The entire application is running in the cloud
 - The client contains a simple browser to access the application
 - A well-known example of SaaS is www.salesforce.com
- 2. The application runs on the client
 - It accesses useful functions and services provided in the cloud
 - An example of this type of cloud services on the desktop is Apple's iTunes
 - The desktop application plays music, while the cloud service is used to purchase a new audio and video content

Three categories of cloud services (cont.)

- 3. A cloud platform for creating applications, which is used by developers
 - The application developers create a new SaaS application using the cloud platform

Types of Cloud Computing

- There are three types of cloud computing
 - Public cloud
 - Private cloud
 - Hybrid cloud



Public Cloud

- In the public cloud (or external cloud) computing resources are dynamically provisioned over the Internet via Web applications or Web services from an off-site third-party provider
- Public clouds are run by third parties, and applications from different customers are likely to be mixed together on the cloud's servers, storage systems, and networks

Private Cloud

- Private cloud (or internal cloud) refers to cloud computing on private networks
- Private clouds are built for the exclusive use of one client, providing full control over data, security, and quality of service
- Private clouds can be built and managed by a company's own IT organization or by a cloud provider

Hybrid Cloud

- A hybrid cloud environment combines multiple public and private cloud models
- Hybrid clouds introduce the complexity of determining how to distribute applications across both a public and private cloud

Enabling Technologies

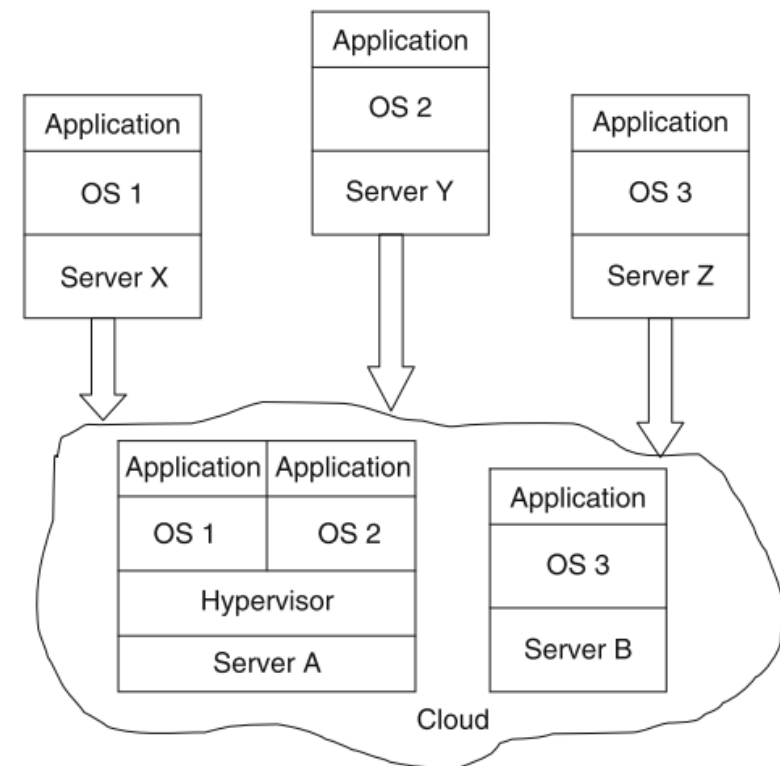
- Key technologies that enabled cloud computing are as follows
 - Virtualization
 - Web service and service-oriented architecture (SOA)
 - Service flows and workflows
 - Web 2.0 and mashup

Virtualization

- The advantage of cloud computing is the ability to virtualize and share resources among different applications with the objective for better server utilization
- **Example**
 - In non-cloud computing three independent platforms exist for three different applications running on its own server
 - In the cloud, servers can be shared, or virtualized, for operating systems and applications resulting in fewer servers (in specific example two servers)

Virtualization (cont.)

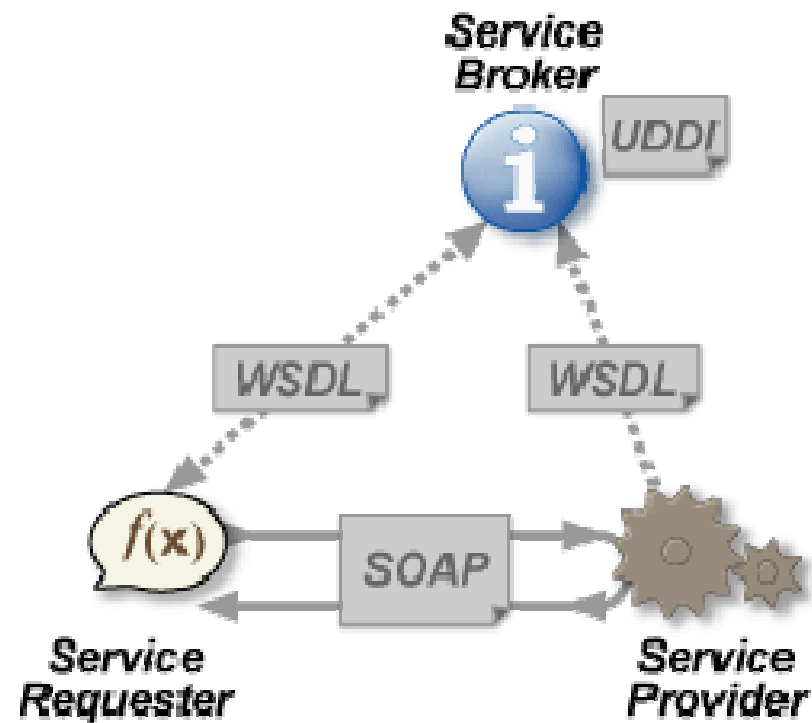
- Virtualization technologies include virtual machine techniques such as VMware and Xen, and virtual networks, such as VPN
- Virtual machines provide virtualized IT-infrastructures on-demand, while virtual networks support users with a customized network environment to access cloud resources



Web Service and Service Oriented Architecture

- Cloud services are typically designed as Web services, which follow industry standards including WSDL, SOAP, and UDDI
- A Service Oriented Architecture organizes and manages Web services inside clouds
- A SOA also includes a set of cloud services, which are available on various distributed platforms

Web Service and Service Oriented Architecture (cont.)



Service Flow and Workflows

- The concept of service flow and workflow refers to an integrated view of service-based activities provided in clouds
- Workflows have become one of the important areas of research in the field of database and information systems

Web 2.0 and Mashup

- Web 2.0 is a new concept that refers to the use of Web technology and Web design to enhance creativity, information sharing, and collaboration among users
- On the other hand, Mashup is a web application that combines data from more than one source into a single integrated storage tool. Both technologies are very beneficial for cloud computing