

## 1.2 Definition

- “The National Institute of Standards and Technology (NIST) defines cloud computing as a "pay-per-use model for enabling available, convenient and 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 Architecture

- Architecture consists of 3 tiers
  - Cloud Deployment Model
  - Cloud Service Model
  - Essential Characteristics of Cloud Computing

### Essential Characteristics 1

- On-demand self-service.
  - A consumer can unilaterally provision computing capabilities such as server time and network storage as needed automatically, without requiring human interaction with a service provider.

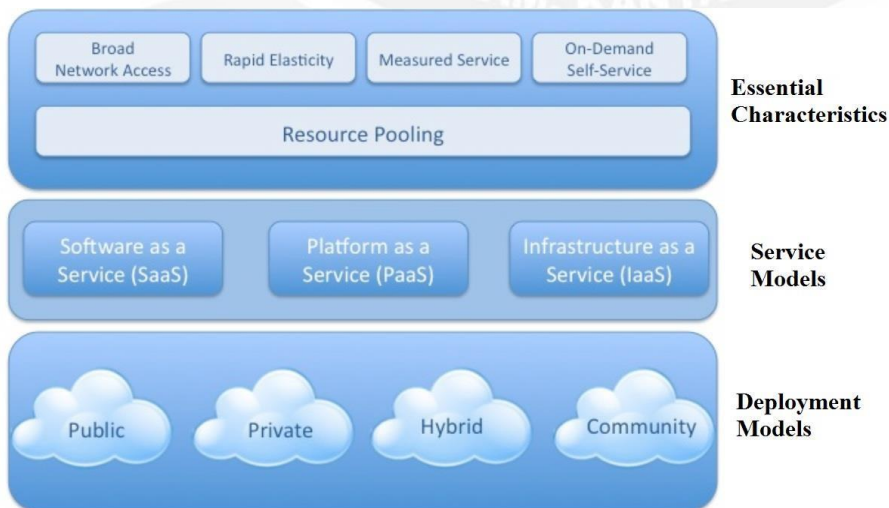


Figure 1.5 Cloud Computing Architecture

**Essential Characteristics 2**

- Broad network access.
  - Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs) as well as other traditional or cloudbased software services.

**Essential Characteristics 3**

- Resource pooling.
  - The provider's computing resources are pooled to serve multiple consumers using a **multi-tenant model**, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.

**Essential Characteristics 4**

- **Rapid elasticity.**
  - Capabilities can be rapidly and elastically provisioned - in some cases automatically - to quickly scale out; and rapidly released to quickly scale in.
  - To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

**Essential Characteristics 5**

- **Measured service.**
  - Cloud systems automatically control and optimize resource usage by leveraging a metering capability at some level of abstraction appropriate to the type of service.
  - Resource usage can be monitored, controlled, and reported - providing transparency for both the provider and consumer of the service.

**Cloud Service Models**

- Cloud **S**oftware as a Service (**SaaS**)
- Cloud **P**latform as a Service (**PaaS**)
- Cloud **I**nfrastructure as a Service (**IaaS**)

**SaaS**

- SaaS is a licensed software offering on the cloud and pay per use
- SaaS is a software delivery methodology that provides licensed multi-tenant access to software and its functions remotely as a Web-based service. Usually

billed based on usage

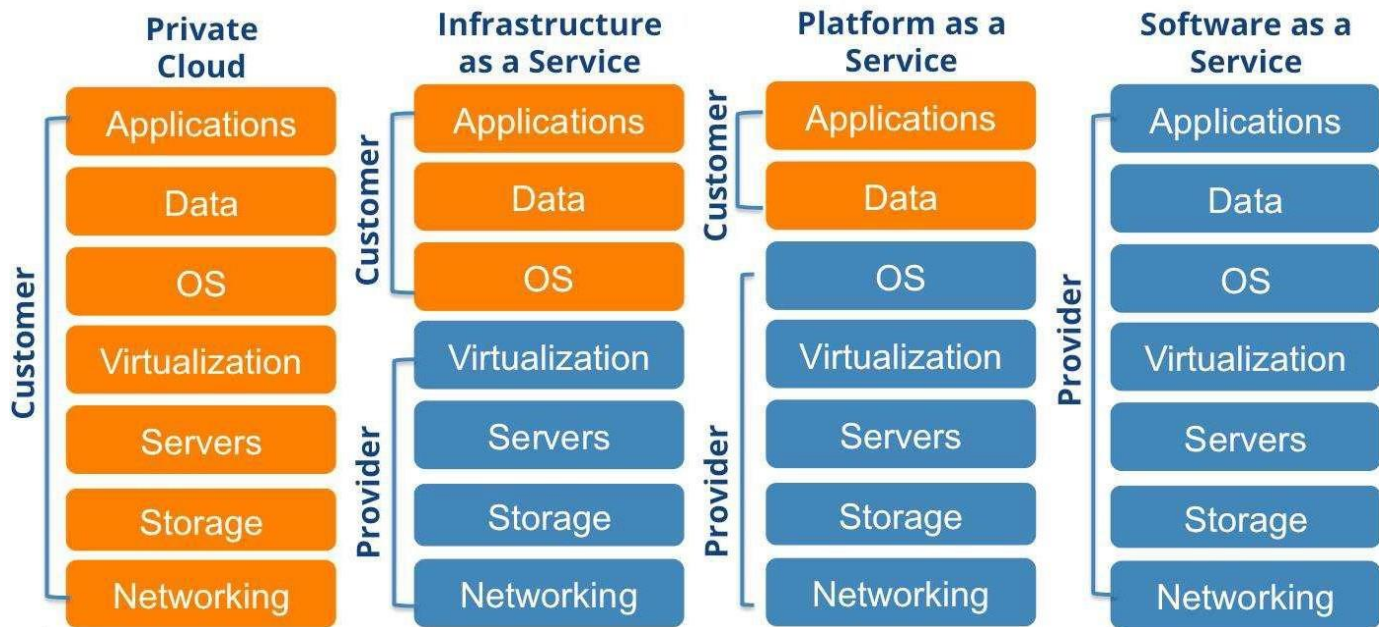
- Usually multi tenant environment
- Highly scalable architecture
- ☐ Customers do not invest on software application programs
- ☐ The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure.
- ☐ The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email).
- ☐ The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, data or even individual application capabilities, with the possible exception of limited user specific application configuration settings.

#### SaaS providers

- ☐ Google's Gmail, Docs, Talk etc
- ☐ Microsoft's Hotmail, Sharepoint
- ☐ Salesforce,
- ☐ Yahoo, Facebook

#### Infrastructure as a Service (IaaS)

- ☐ IaaS is the delivery of technology infrastructure ( mostly hardware) as an on demand, scalable service
  - Usually billed based on usage
  - Usually multi tenant virtualized environment
  - Can be coupled with Managed Services for **OS** and application support
  - User can choose his OS, storage, deployed app, networking components



**Figure 1.6 Cloud Service Model**

- The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources.
- Consumer is able to deploy and run arbitrary software, which may include operating systems and applications.
- The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

#### **IaaS providers**

- Amazon Elastic Compute Cloud (EC2)
  - Each instance provides 1-20 processors, upto 16 GB RAM, 1.69TB storage
- RackSpace Hosting
  - Each instance provides 4 core CPU, upto 8 GB RAM, 480 GB storage
- Joyent Cloud
  - Each instance provides 8 CPUs, upto 32 GB RAM, 48 GB storage
- Go Grid
  - Each instance provides 1-6 processors, upto 15 GB RAM, 1.69TB storage

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

- PaaS provides all of the facilities required to support the complete life cycle of building, delivering and deploying web applications and services entirely from the Internet.

Typically, applications must be developed with a particular platform in mind

- Multi-tenant environments
  - Highly scalable multi-tier architecture
- The capability provided to the consumer is to deploy onto the cloud infrastructure consumer created or acquired applications created using programming languages and tools supported by the provider.
  - The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

### **PaaS providers**

- Google App Engine
  - Python, Java, Eclipse
- Microsoft Azure
  - .Net, Visual Studio
- Sales Force
  - Apex, Web wizard
- TIBCO,
- VMware,
- Zoho

### **Cloud Computing - Opportunities and Challenges**

- It enables services to be used without any understanding of their infrastructure.
- Cloud computing works using economies of scale
- It potentially lowers the outlay expense for startup companies, as they would no longer need to buy their own software or servers.
- Cost would be by on-demand pricing.
- Vendors and Service providers claim costs by establishing an ongoing revenue stream.
- Data and services are stored remotely but accessible from “anywhere”

### **Cloud Computing – Pros**

- Lower computer costs
- Instant software updates:
  - When the application is web-based, updates happen automatically

- Improved document format compatibility
- e capacity:
  - Cloud computing offers virtually limitless storage
  - • Increased data reliability:

### Cloud Computing – Cons

- Need of Internet:
  - A dead Internet connection means no work and in areas where Internet connections are few or inherently unreliable, this could be a deal-breaker.
  - Requires a constant Internet connection
- Can be slow:
  - Even with a fast connection, web-based applications can sometimes be slower than accessing a similar software program on your desktop PC.
- Disparate Protocols:
  - Each cloud systems uses different protocols and different APIs – Standards yet to evolve.