1.2. NIST Cloud Computing Reference Architecture

Definition

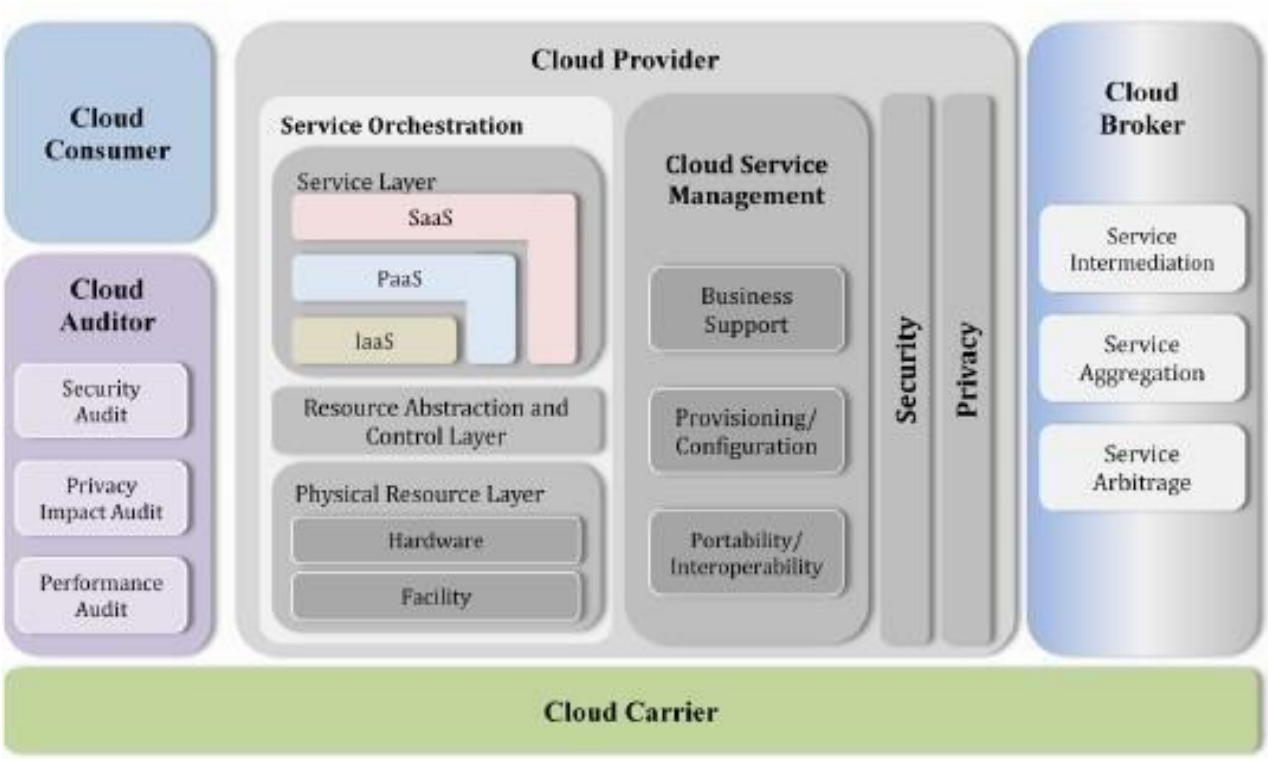
"The National Institute of Standards and Technology (NIST) defines cloud computing as a "pay-per-use model for enabling available, convenient and on- demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

The NIST cloud computing reference architecture defines five major actors:

- Cloud consumer
- Cloud provider
- Cloud carrier
- Cloud auditor
- Cloud broker

Each actor is an entity (a person or an organization) that participates in a transaction or process and/or performs tasks in cloud computing.

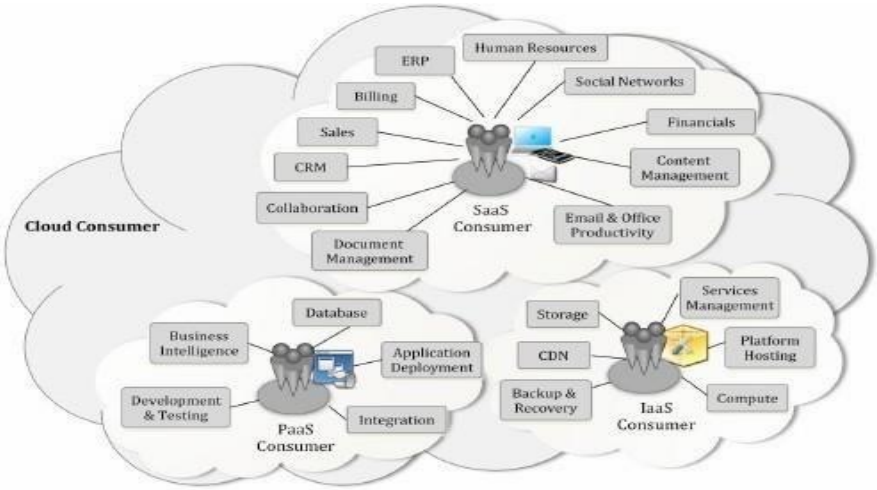
NIST Cloud Reference Model



Cloud Consumer

- The cloud consumer is the principal stake holder for the cloud computing service.

- A cloud consumer represents a person or organization that maintains a business relationship with, and uses the service from a cloud provider.
- Cloud consumers need SLAs to specify the technical performance requirements fulfilled by a cloud provider.
- SLAs can cover terms regarding the quality of service, security, remedies for performance failures.



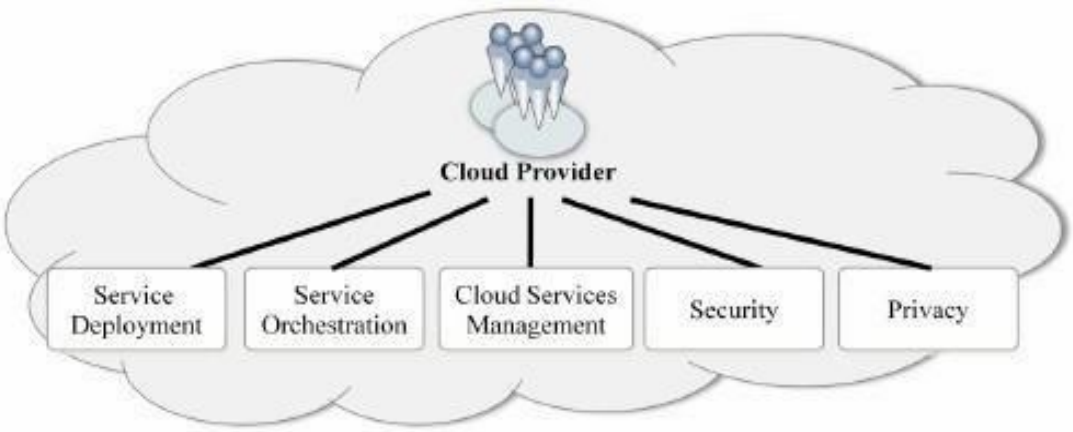
Example Services Available to a Cloud Consumer

Cloud Services on Cloud Consumer

- The consumers of SaaS can be organizations that provide their members with access to software applications, end users who directly use software applications, or software application administrators who configure applications for end users.
- Cloud consumers of PaaS can employ the tools and execution resources provided by cloud providers to develop, test, deploy and manage the applications hosted in a cloud environment.
- Consumers of IaaS have access to virtual computers, network-accessible storage, network infrastructure components, and other fundamental computing resources on which they can deploy and run arbitrary software.

Cloud Provider

- A cloud provider is a person, an organization; it is the entity responsible for making a service available to interested parties.
- A Cloud Provider acquires and manages the computing infrastructure required for providing the services, runs the cloud software that provides the services, and makes arrangement to deliver the cloud services to the Cloud Consumers through network access.



5 Major Activities of Cloud Provider Cloud

Service on Cloud Provider

- For Software as a Service, the cloud provider deploys, configures, maintains and updates the operation of the software applications on a cloud infrastructure so that the services are provisioned at the expected service levels to cloud consumers.
- The provider of SaaS assumes most of the responsibilities in managing and controlling the applications and the infrastructure, while the cloud consumer shave limited administrative control of the applications.
- For PaaS, the Cloud Provider manages the computing infrastructure for the platform and runs the cloud software that provides the components of the platform, such as runtime software execution stack, databases, and other middleware components.
- For IaaS, the Cloud Provider acquires the physical computing resources underlying the service, including the servers, networks, storage and hosting infrastructure

Cloud Auditor

- A cloud auditor is a party that can perform an independent examination of cloud service controls with the intent to express an opinion thereon.
- A cloud auditor can evaluate the services provided by a cloud provider in terms of security controls, privacy impact, performance, etc.

Cloud Broker

- As cloud computing evolves, the integration of cloud services can be too complex for cloud consumers to manage.
- A cloud consumer may request cloud services from a cloud broker, instead of contacting a cloud provider directly.
- A cloud broker is an entity that manages the use, performance and delivery of cloud services and negotiates relationships between cloud providers and cloud consumers.

Categories of Cloud Broker

- A cloud broker can provide services in three categories

  - **Service Intermediation:** A cloud broker enhances a given service by improving some specific capability and providing value-added services to cloud consumers. The improvement can be managing access to cloud services, identity management, performance reporting, enhanced security, etc.
  - **Service Aggregation:** A cloud broker combines and integrates multiple services into one or more new services. The broker provides data integration and ensures the secure data movement between the cloud consumer and multiple cloud providers.
  - **Service Arbitrage:** Service arbitrage is similar to service aggregation except that the services being aggregated are not fixed. Service arbitrage means a broker has the flexibility to choose services from multiple agencies. The cloud broker, for example, can use a credit-scoring service to measure and select an agency with the best score.

Cloud Carrier

- A cloud carrier acts as an intermediary that provides connectivity and transport of cloud services between cloud consumers and cloud providers. Cloud carriers provide access to consumers through network, telecommunication and other access devices.
- For example, cloud consumers can obtain cloud services through network access devices, such as computers, laptops, mobile phones, mobile Internet devices (MIDs), etc.

Cloud Computing Architecture

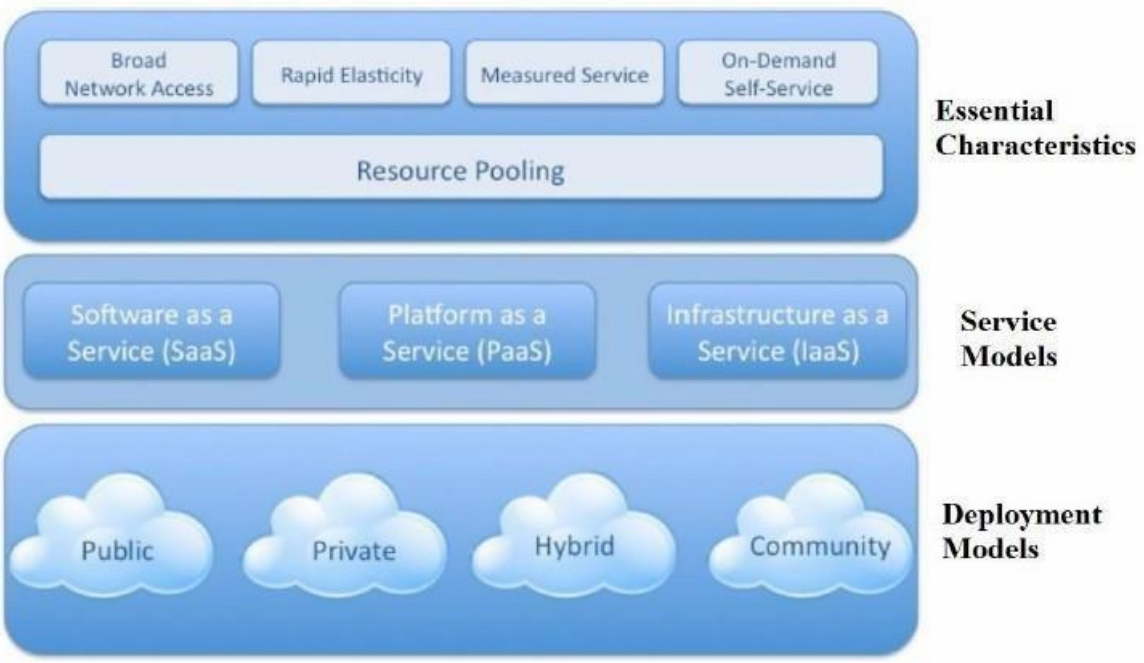
Architecture consists of 3 tiers

- Cloud Deployment Model
- Cloud Service Model
- Essential Characteristics of Cloud Computing

Essential Characteristics of Cloud Computing

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.



Cloud Computing Architecture

1. **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 cloud-based software services.

2. **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.

3. **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.

4. **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.