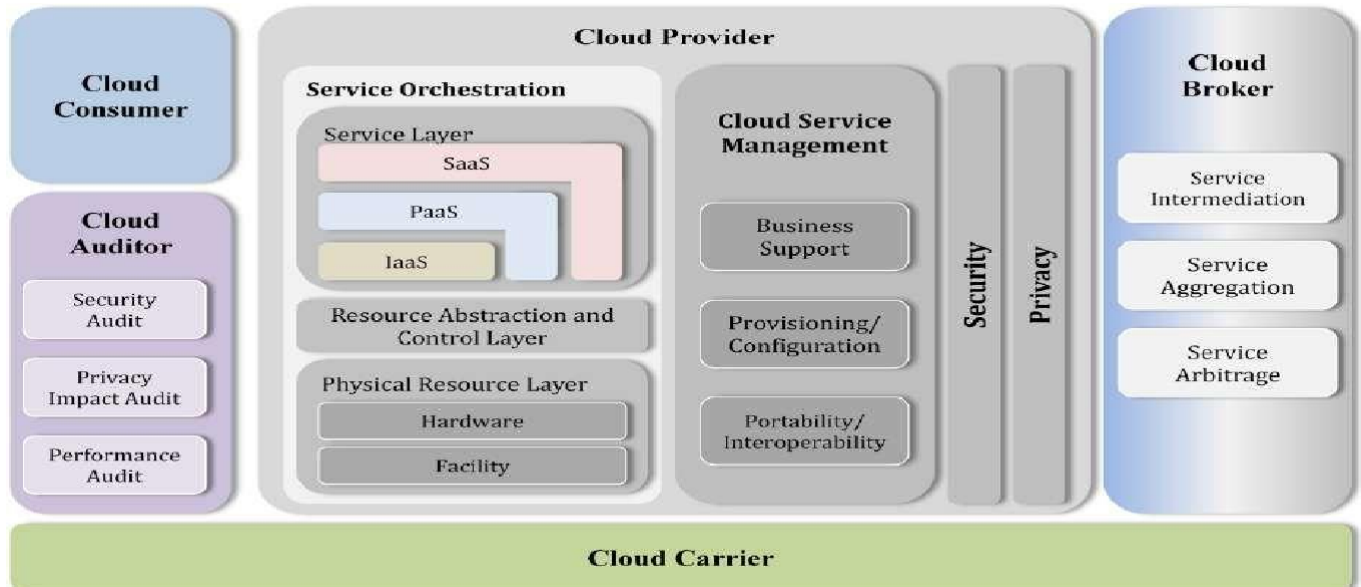**NIST (National Institute of Standards and Technology Background)**
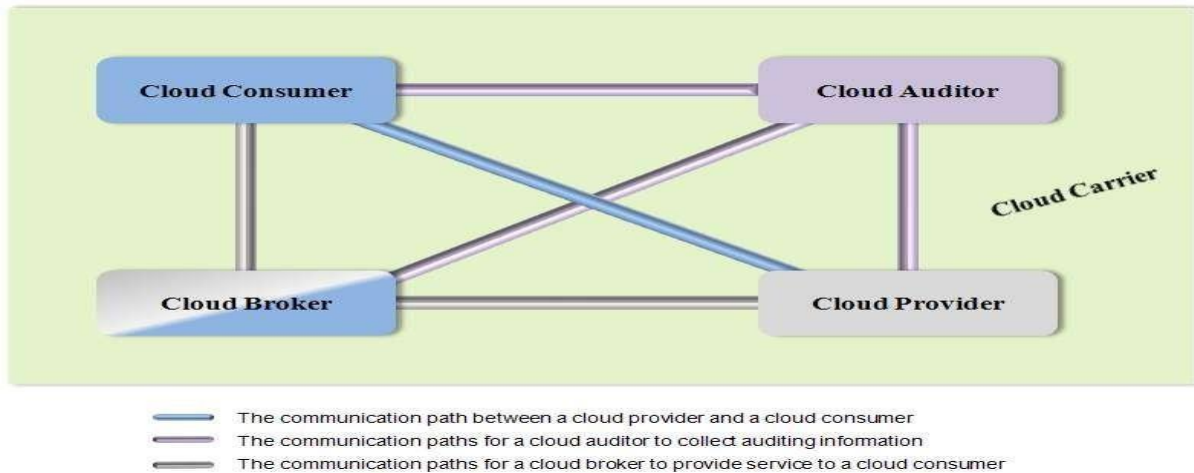
The goal is to accelerate the federal government's adoption of secure and effective cloud computing to reduce costs and improve services.

Cloud Computing Reference Architecture:

Actor	Definition
Cloud Consumer	A person or organization that maintains a business relationship with, and uses service from, *Cloud Providers*.
Cloud Provider	A person, organization, or entity responsible for making a service available to interested parties.
Cloud Auditor	A party that can conduct independent assessment of cloud services, information system operations, performance and security of the cloud implementation.
Cloud Broker	An entity that manages the use, performance and delivery of cloud services, and negotiates relationships between *Cloud Providers* and *Cloud Consumers*.
Cloud Carrier	An intermediary that provides connectivity and transport of cloud services from *Cloud Providers* to *Cloud Consumers*.

Interactions between the Actors in Cloud Computing

- ▬ The communication path between a cloud provider and a cloud consumer
- ▬ The communication paths for a cloud auditor to collect auditing information
- ▬ The communication paths for a cloud broker to provide service to a cloud consumer
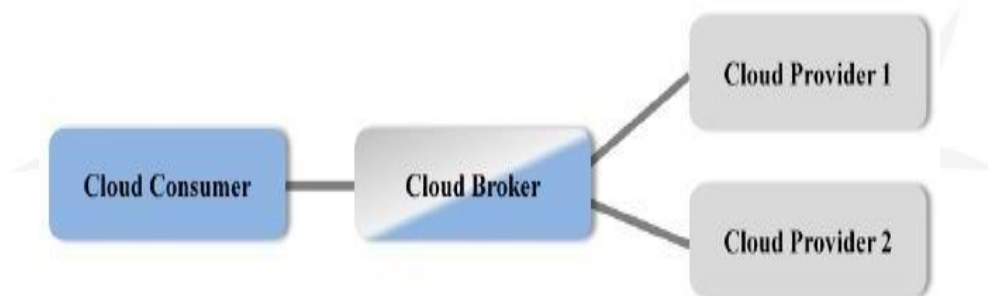
Example Usage Scenario 1:

- ☐ A cloud consumer may request service from a cloud broker instead of contacting a cloud provider directly.
- ☐ The cloud broker may create a new service by combining multiple services or by enhancing an existing service.

Usage Scenario- Cloud Brokers

- ☐ In this example, the actual cloud providers are invisible to the cloud consumer.
- ☐ The cloud consumer interacts directly with the cloud broker.

Example Usage Scenario 2

- ☐ Cloud carriers provide the connectivity and transport of cloud services from cloud providers to cloud consumers.
- ☐ A cloud provider participates in and arranges for two unique service level agreements (SLAs), one with a cloud carrier (e.g. SLA2) and one with a cloud consumer (e.g. SLA1).

Usage Scenario for Cloud Carriers

- ➢ A cloud provider arranges service level agreements (SLAs) with a cloud carrier.
- ➢ Request dedicated and encrypted connections to ensure the cloud services.

—— SLA between cloud consumer and cloud provider
—— SLA between cloud provider and cloud carrier
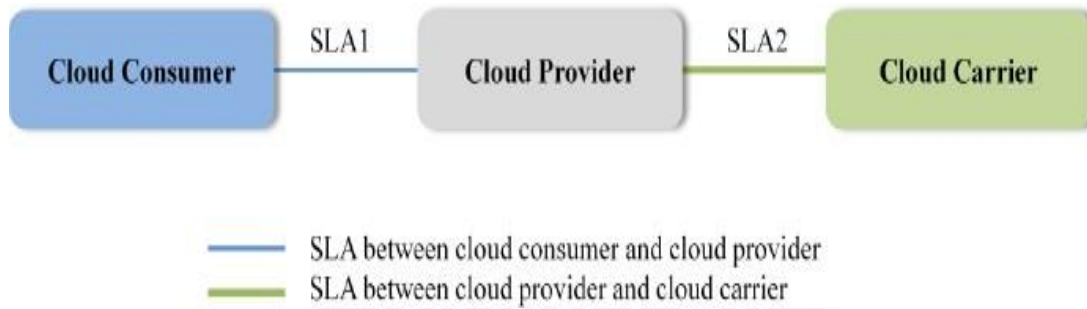
Example Usage Scenario 3

- For a cloud service, a cloud auditor conducts independent assessments of the operation and security of the cloud service implementation.

- The audit may involve interactions with both the Cloud Consumer and the Cloud Provider.
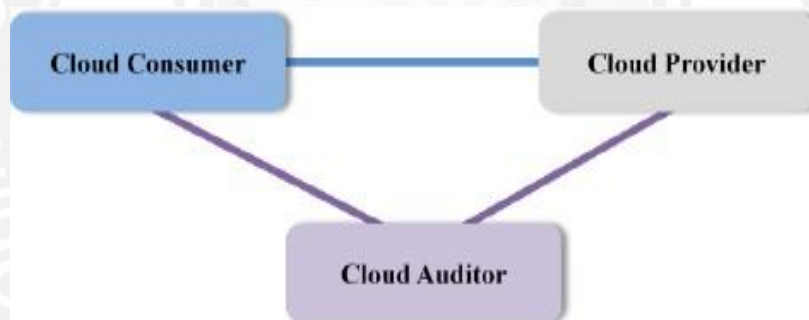

Cloud Consumer

- The cloud consumer is the principal stakeholder 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.

The cloud consumer may be billed for the service provisioned, and needs to arrange payments accordingly.

Example Services Available to a Cloud Consumer

 The consumers of SaaS can be organizations that provide their members with access
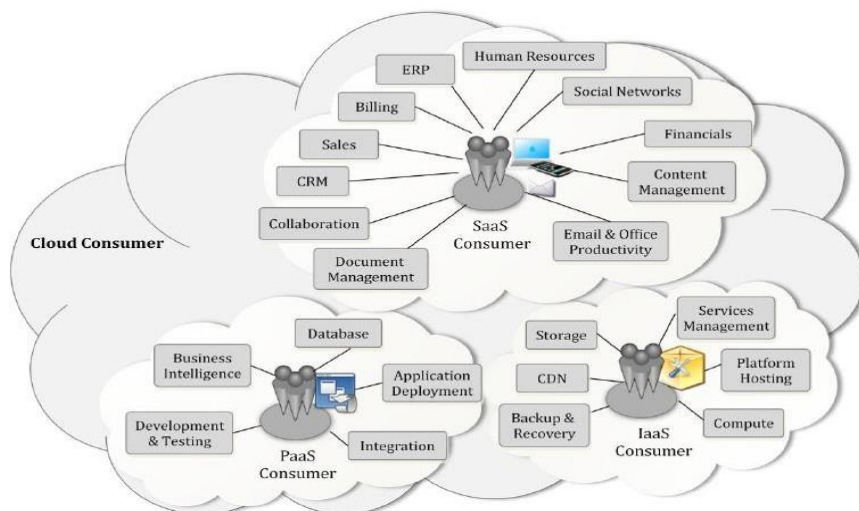
to software applications, end users or software application administrators.

 SaaS consumers can be billed based on the number of end users, the time of use, the network bandwidth consumed, the amount of data stored or duration of stored data.Cloud consumers of PaaScan employ the tools and execution resources provided by cloud providers to develop, test, deploy and manage the applications.

 PaaS consumers can be application developers or application testers who run and test applications in cloud-based environments,.

 PaaS consumers can be billed according to, processing, database storage and network resources consumed.

 Consumers of IaaS have access to virtual computers, network-accessible storage & network infrastructure components.

  The consumers of IaaS can be system developers, system administrators and IT managers.

 IaaS consumers are billed according to the amount or duration of the resources consumed, such as CPU hours used by virtual computers, volume and duration of data stored.

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.

Makes arrangement to deliver the cloud services to the Cloud Consumers through network access.

Cloud Provider - Major Activities
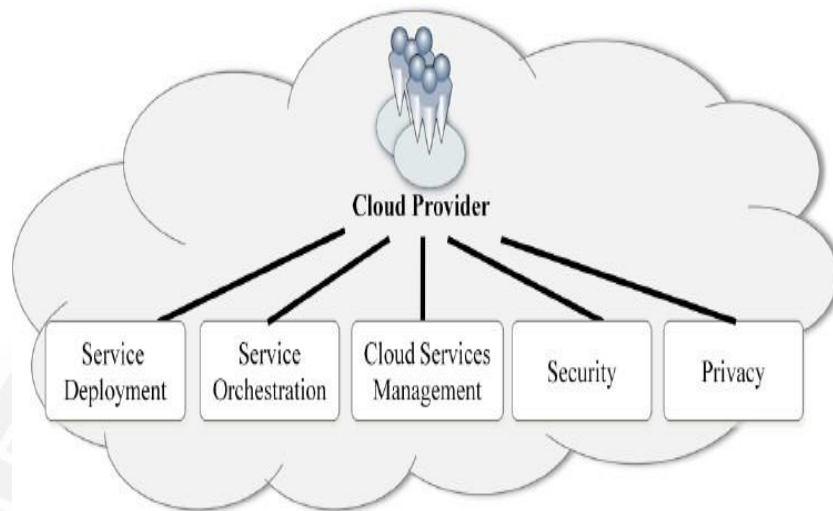
Cloud Auditor

- A cloud auditor is a party that can perform an independent examination of cloud service controls.
- Audits are performed to verify conformance to standards through review of objective evidence.
- A cloud auditor can evaluate the services provided by a cloud provider in terms of security controls, privacy impact, performance, etc.

Cloud Broker

- 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. Negotiates relationships between cloud providers and cloud consumers.

Services of cloud broker

Service Intermediation:

- A cloud broker enhances a given service by improving some specific capability and providing value-added services to cloud consumers.

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.

Services of cloud broker

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.

Eg: The cloud broker 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.

 The distribution of cloud services is normally provided by network and telecommunication carriers or a *transport agent*

 A transport agent refers to a business organization that provides physical transport of storage media such as high-capacity hard drives and other access devices.

Scope of Control between Provider and Consumer

The Cloud Provider and Cloud Consumer share the control of resources in a cloud system
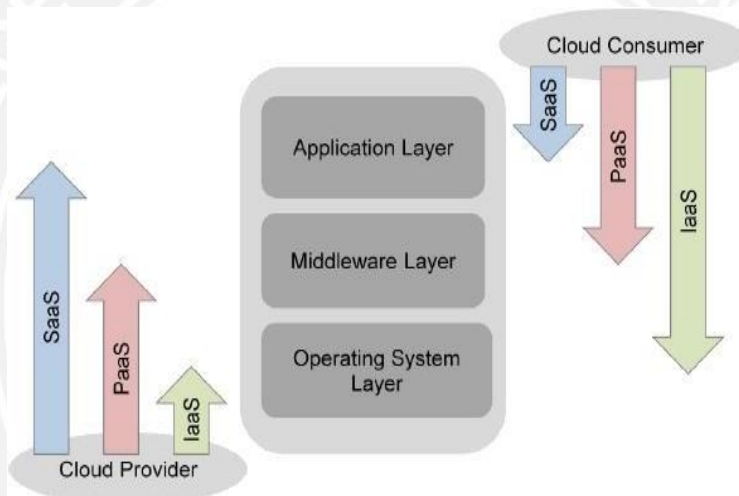
 The application layer includes software applications targeted at end users or programs.

The applications are used by SaaS consumers, or installed/managed/maintained by PaaS consumers, IaaS consumers and SaaS providers.

 The middleware layer provides software building blocks (e.g., libraries, database, and Java virtual machine) for developing application software in the cloud.

 Used by PaaS consumers, installed/ managed/ maintained by IaaS consumers or PaaS providers, and hidden from SaaS consumers.

 The OS layer includes operating system and drivers, and is hidden from SaaS consumers and PaaS consumers.

 An IaaS cloud allows one or multiple guest OS to run virtualized on a single physical host.

The IaaS consumers should assume full responsibility for the guest OS, while the IaaS provider controls the host OS.