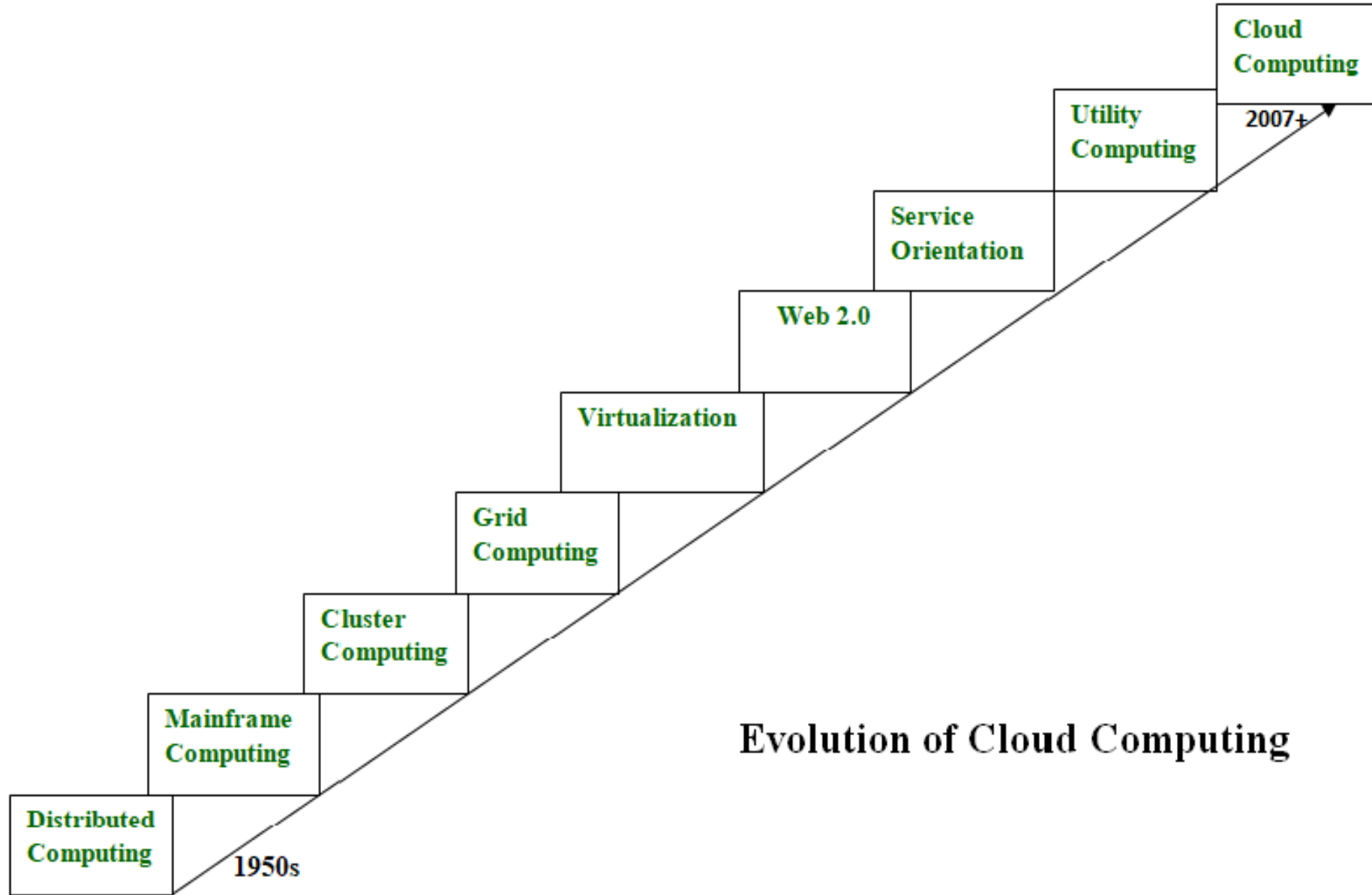# Module I: Introduction to Cloud Computing

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NIT Trichy

Evolution:
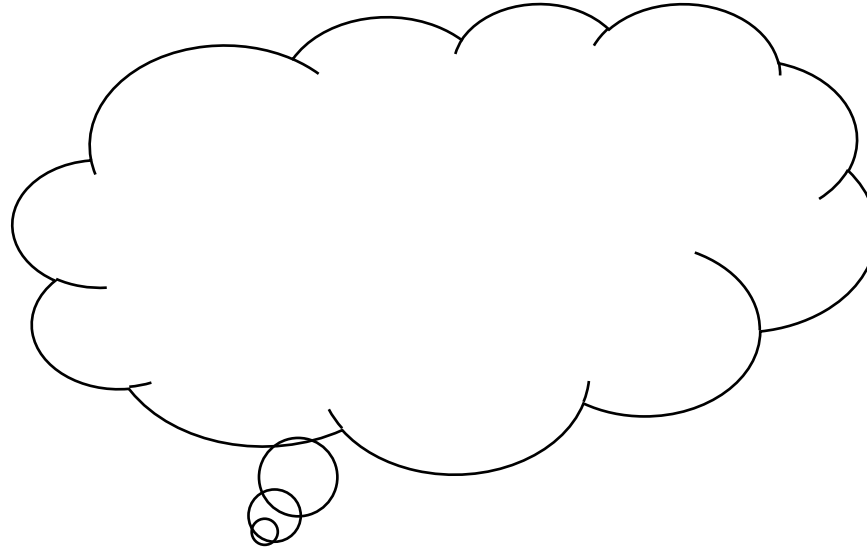

Evolution of Cloud Computing

Definition of Cloud Computing

The term 'cloud' is defined by NIST [10] as follows:

- *"Cloud computing is a model for enabling ubiquitous, convenient, 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. This cloud model is composed of five essential characteristics, three service models, and four deployment models."*
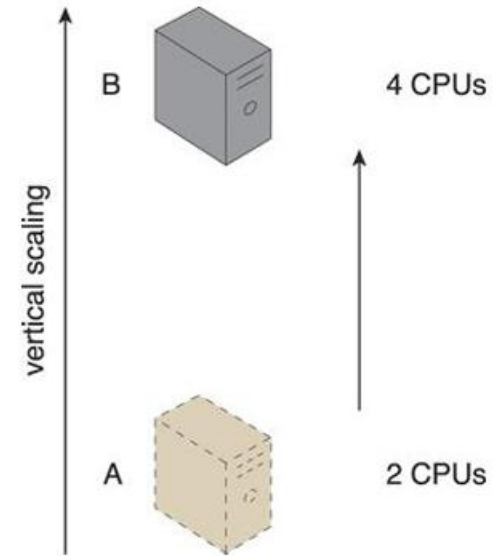
Basic Concepts:

- Cloud

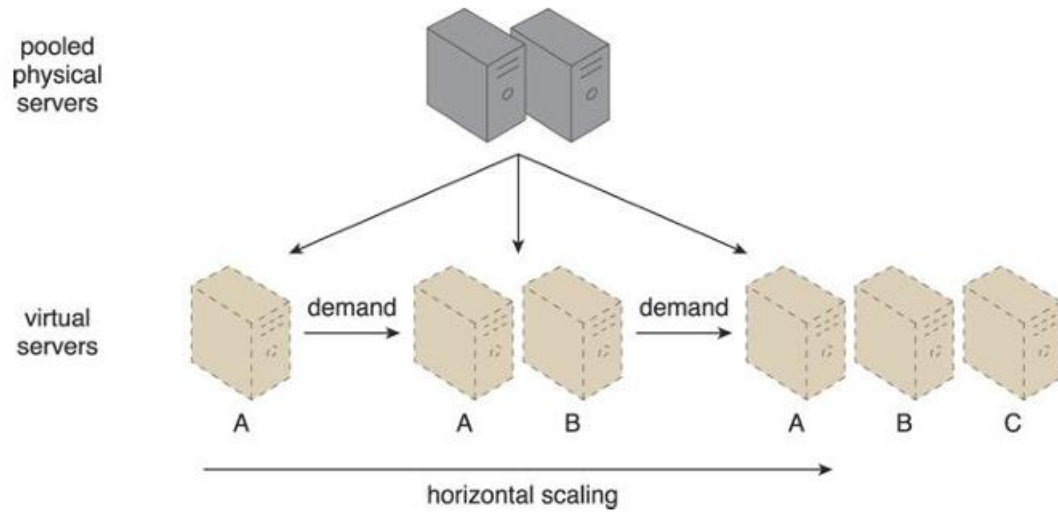- IT Resources

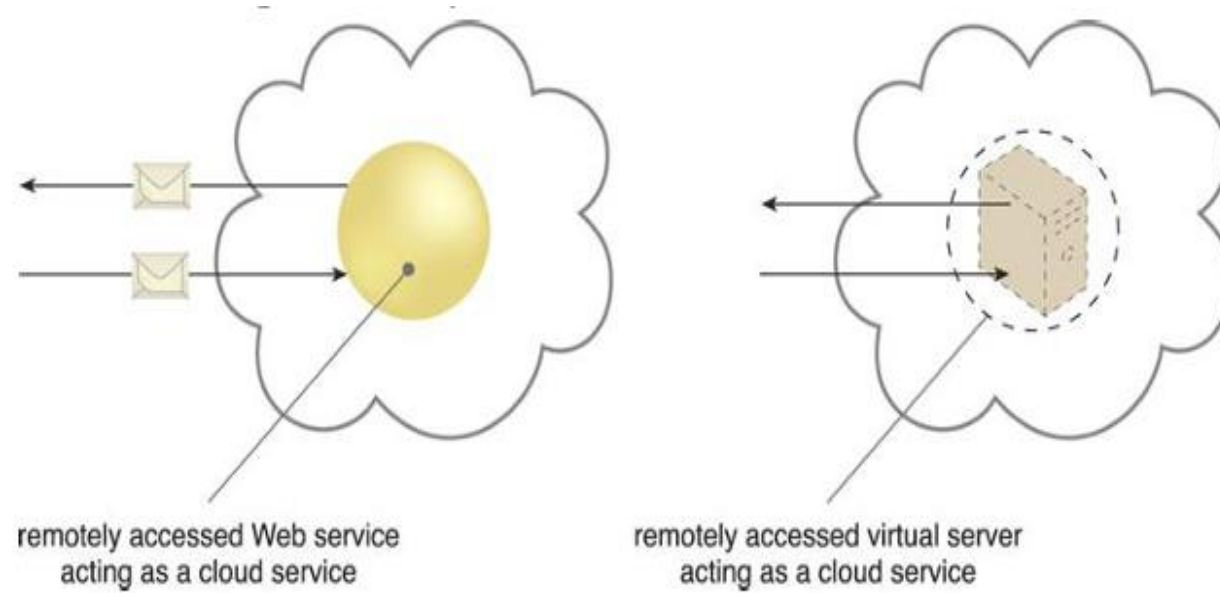| physical server	virtual server	software program	service	storage device	network device
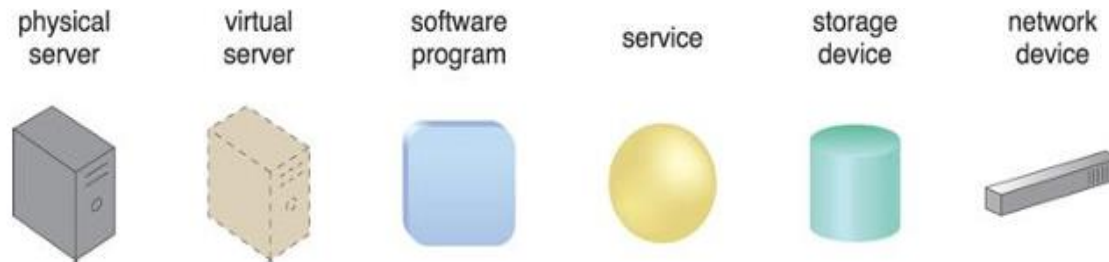
- On-premise: An IT resource that is hosted in a conventional IT enterprise within an organizational boundary

- Cloud consumers and providers

- Scaling

pooled physical servers

virtual servers

A → demand → A B → demand → A B C

horizontal scaling

vertical scaling

B — 4 CPUs

A — 2 CPUs

- Cloud services

remotely accessed Web service
acting as a cloud service

remotely accessed virtual server
acting as a cloud service

- Cloud service consumers

software program

service

workstation

laptop

mobile device

Terminology used in Cloud Computing

Cloud consumer	An individual person or organization that sustains a business relationship with cloud providers and avails the services offered by the provider
Cloud provider	An individual person or organization who offers a service and is liable for the services of cloud computing to the parties that demand it
Cloud auditor	A party that conducts evaluation of cloud services, such as performance, operation on various systems, and security, among others
Cloud broker	The management between cloud providers and cloud consumers, like presentation and delivery of various services
Cloud carrier	The mediator responsible for connectivity and transport of cloud services from service providers to cloud consumers

Benefits:

- ## Reduced Investments and Proportional Costs

  - On-demand access to pay-as-you-go computing resources on a short-term basis (such as processors by the hour), and the ability to release these computing resources when they are no longer needed.

  - The perception of having unlimited computing resources that are available on demand, thereby reducing the need to prepare for provisioning.

  - The ability to add or remove IT resources at a fine-grained level, such as modifying available storage disk space by single gigabyte increments.

  - Abstraction of the infrastructure so applications are not locked into devices or locations and can be easily moved if needed.
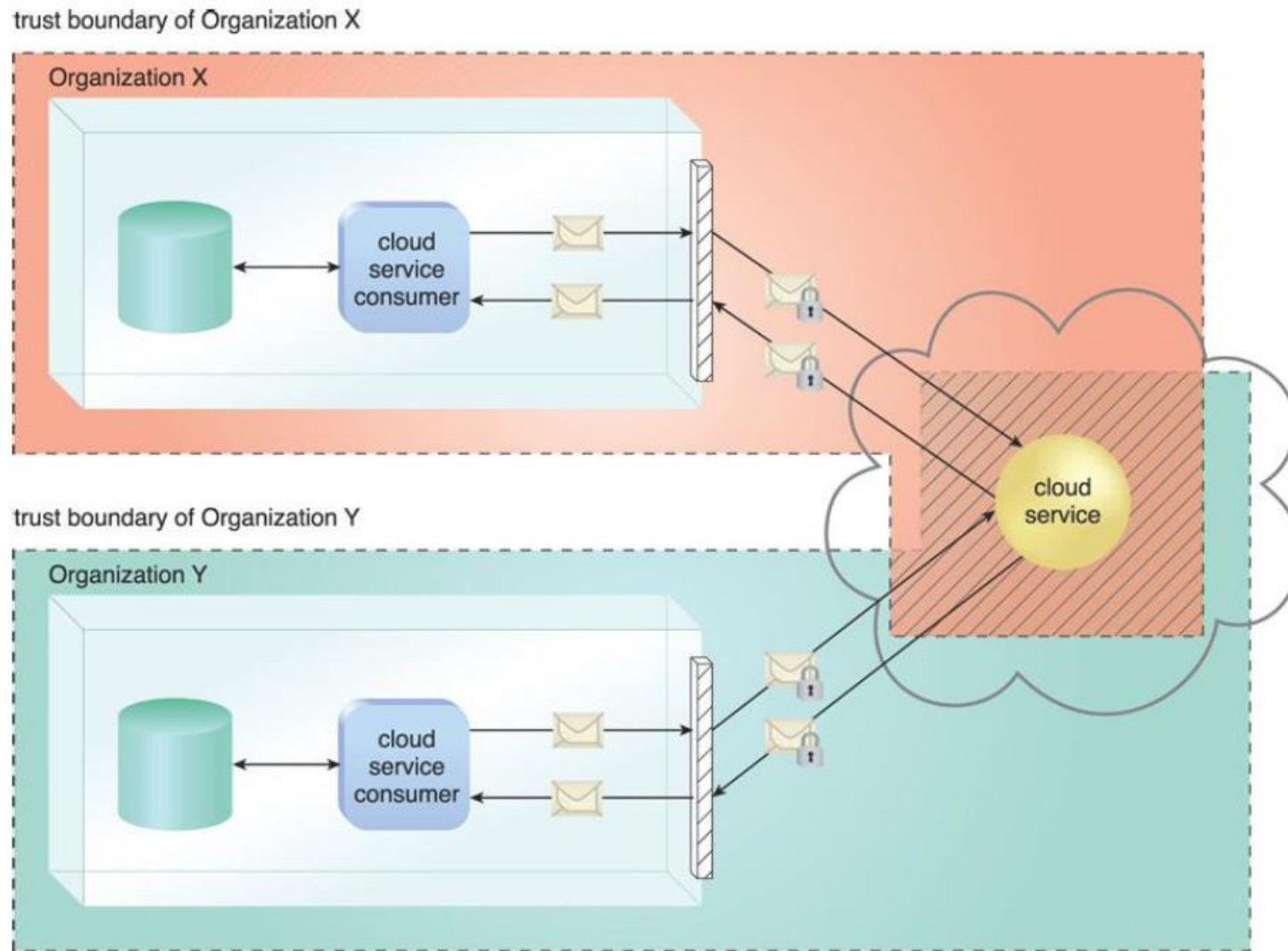
- ## Increased Scalability
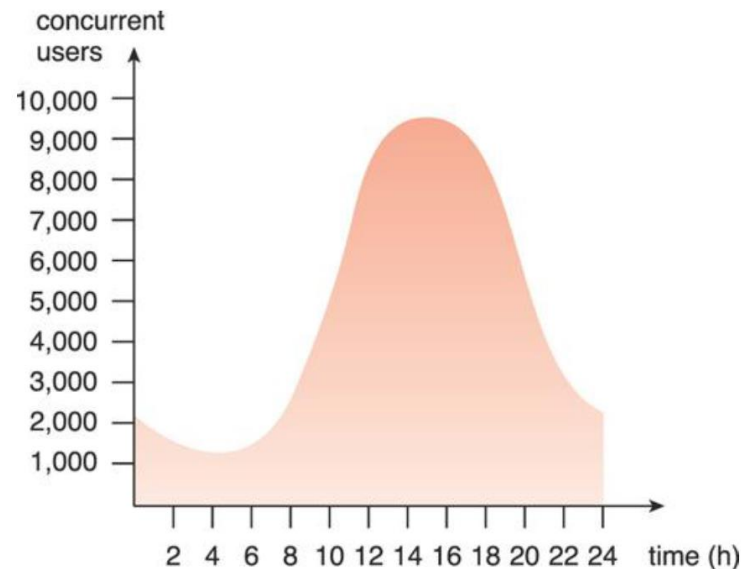
• Increased Availability and Reliability

• An IT resource with increased availability is accessible for longer periods of time (for example, 22 hours out of a 24 hour day). Cloud providers generally offer "resilient" IT resources for which they are able to guarantee high levels of availability.
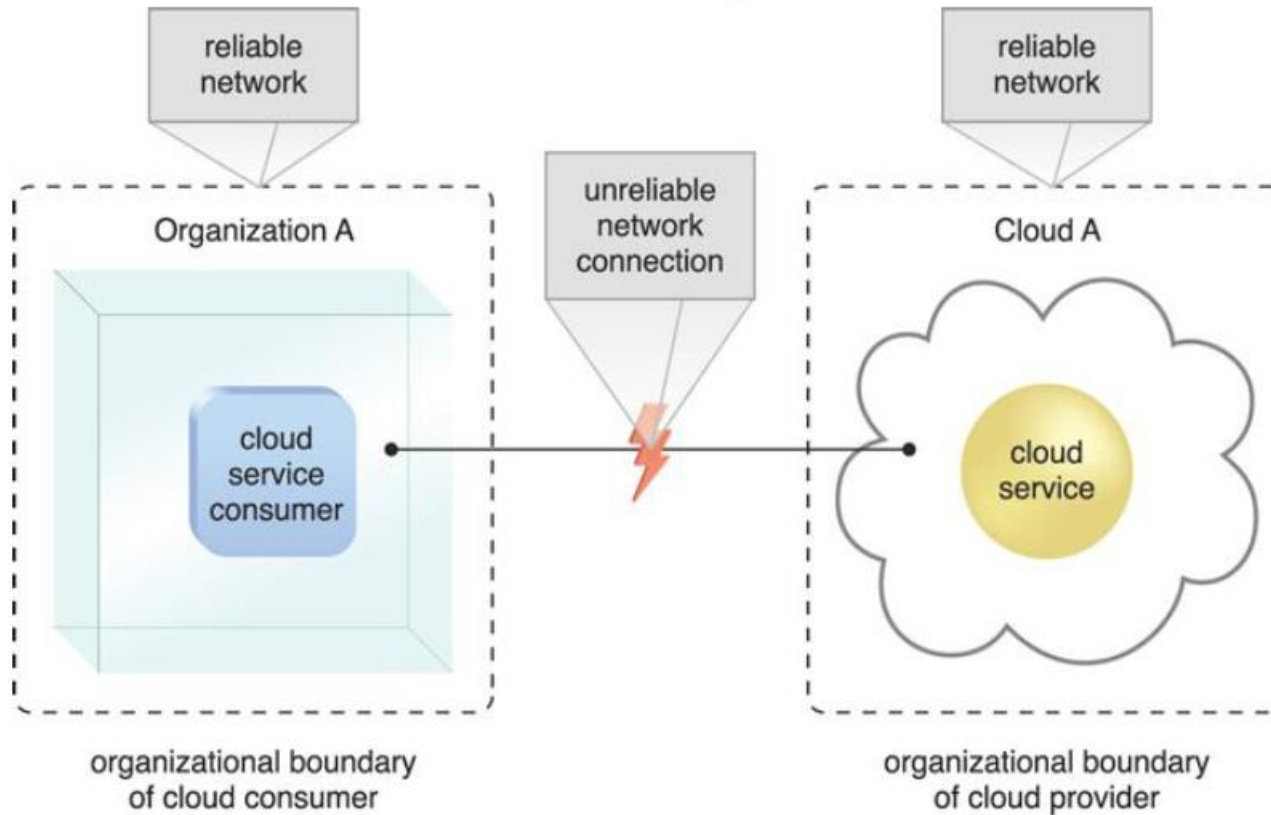
• An IT resource with increased reliability is able to better avoid and recover from exception conditions. The modular architecture of cloud environments provides extensive failover support that increases reliability.
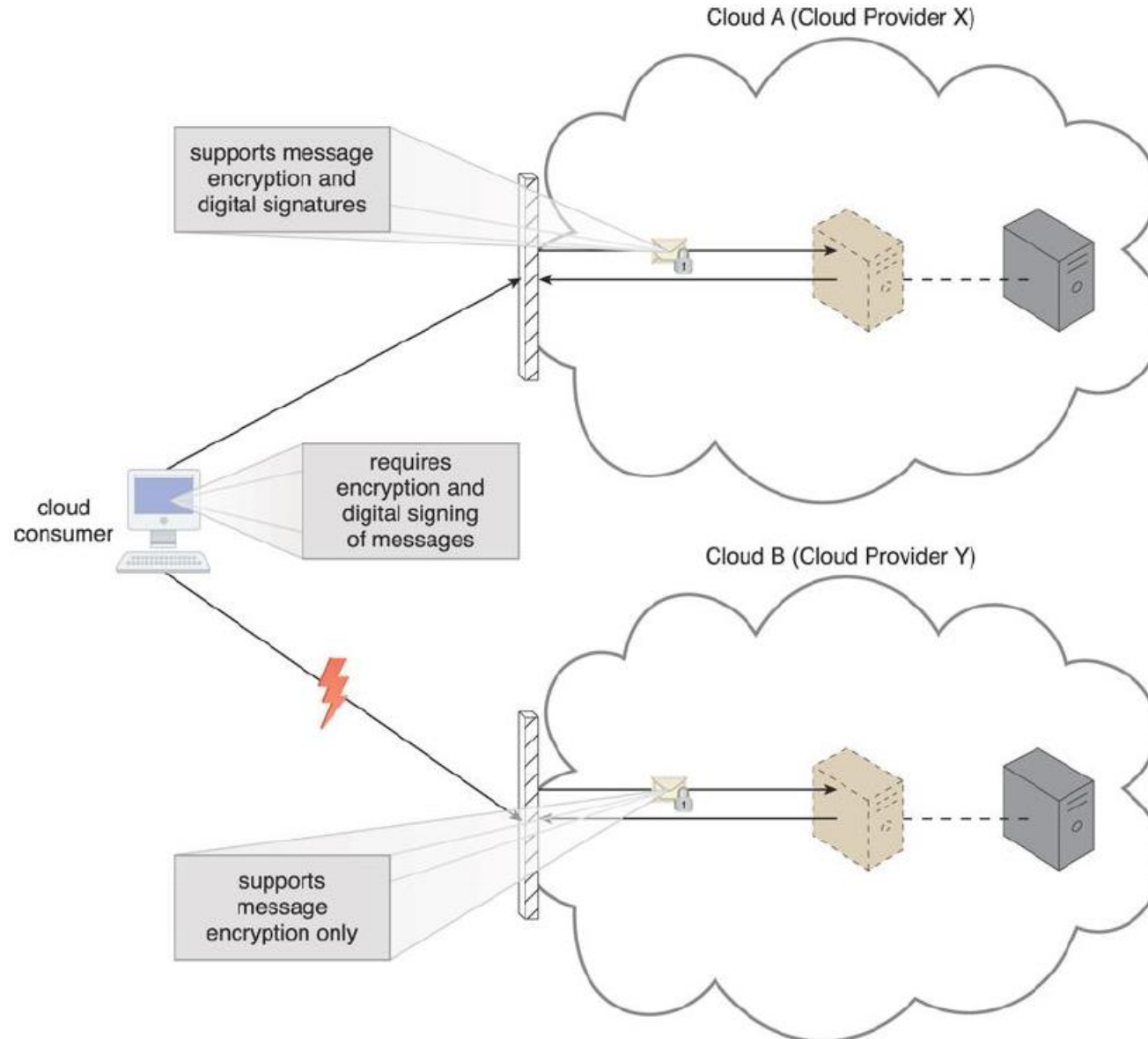
Risks and Challenges:

- Increased Security Vulnerabilities
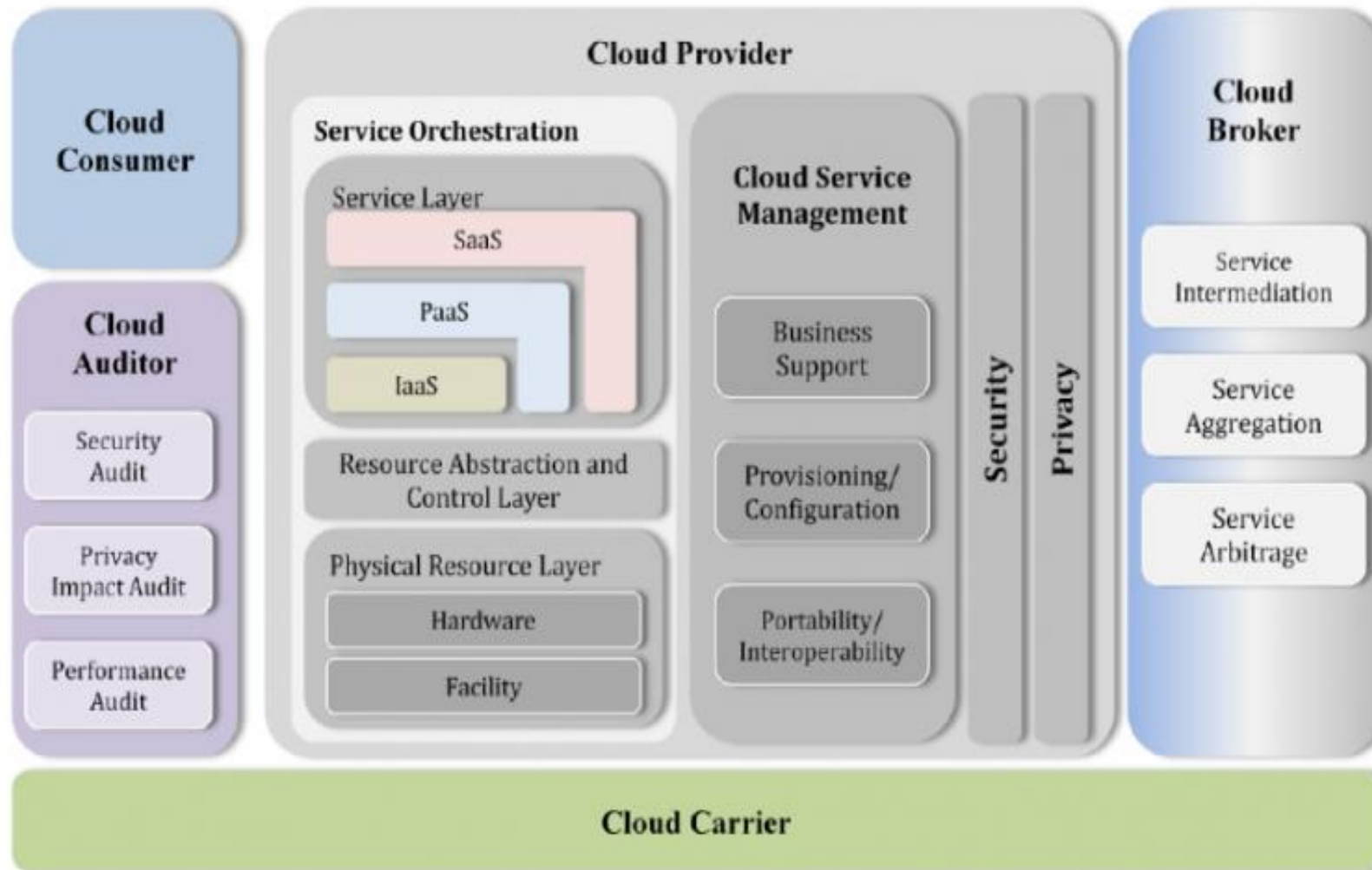
- Reduced Operational Governance Control

Limited Portability Between Cloud Providers

Cloud A (Cloud Provider X)

supports message encryption and digital signatures

cloud consumer

requires encryption and digital signing of messages

Cloud B (Cloud Provider Y)

supports message encryption only

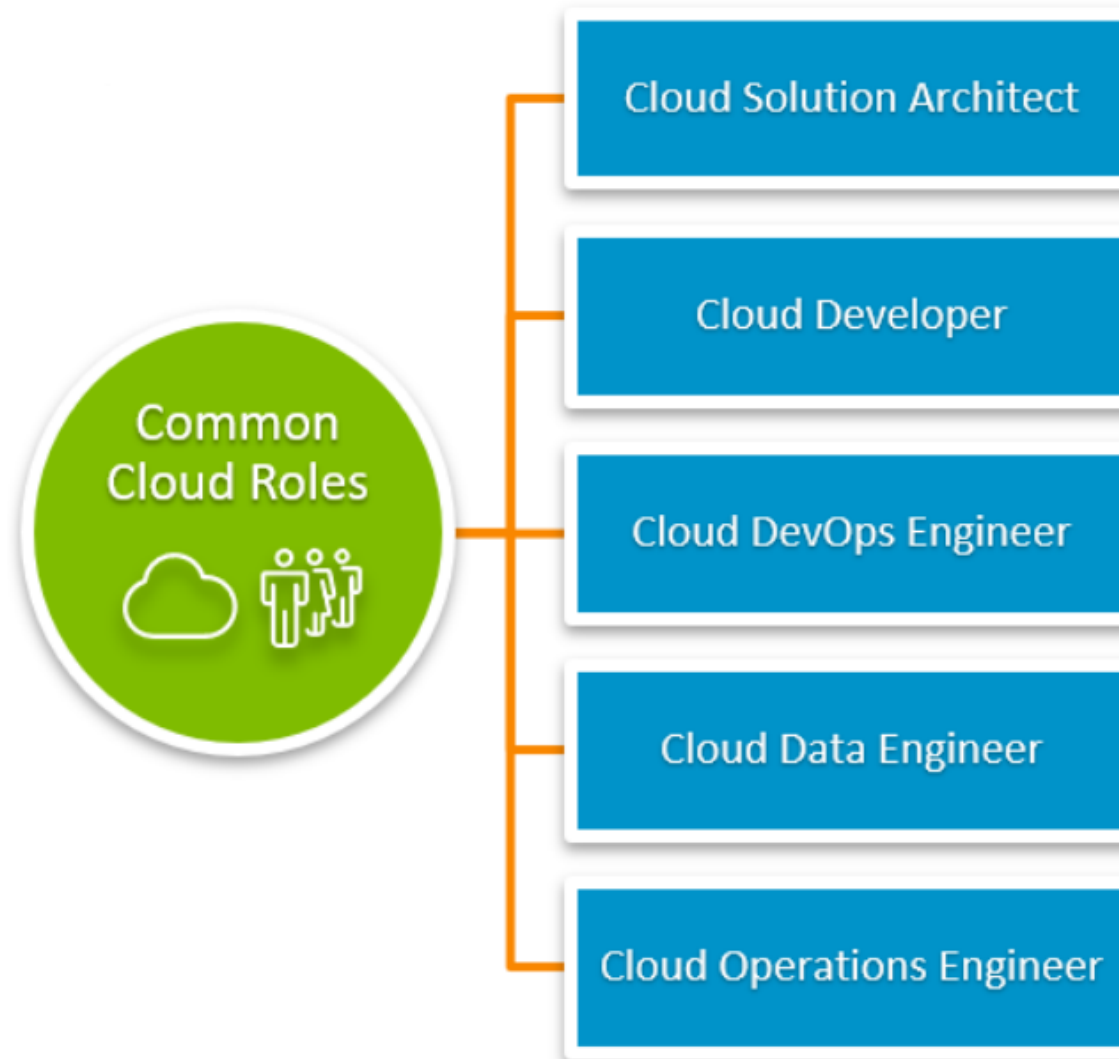- Multi-Regional Compliance and Legal Issues

- Serious legal concerns pertaining to industry or government regulations that specify data privacy and storage policies.

- Another potential legal issue pertains to the accessibility and disclosure of data.

- Most regulatory frameworks recognize that cloud consumer organizations are ultimately responsible for the security, integrity, and storage of their own data, even when it is held by an external cloud provider.
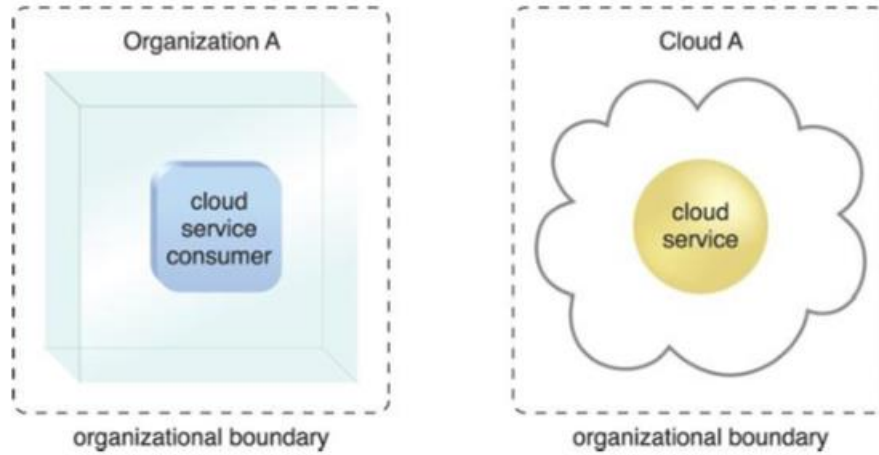
Roles

NIST cloud computing reference model

Job Roles in Cloud Computing

Common Cloud Roles

Cloud Solution Architect

Cloud Developer

Cloud DevOps Engineer

Cloud Data Engineer
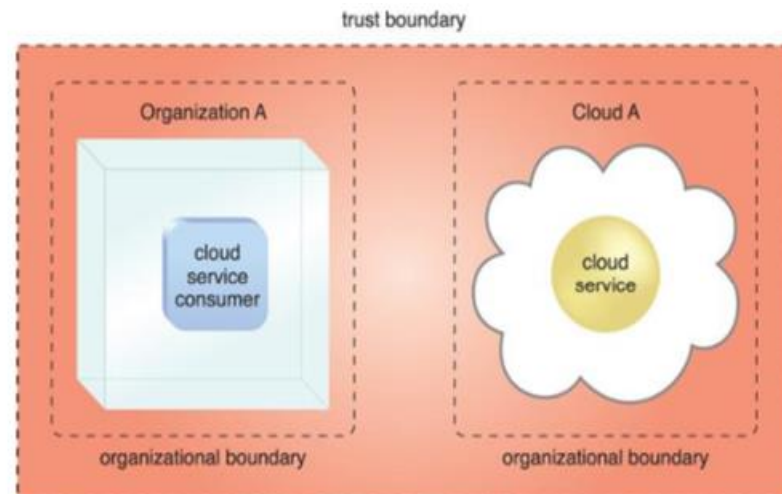
Cloud Operations Engineer

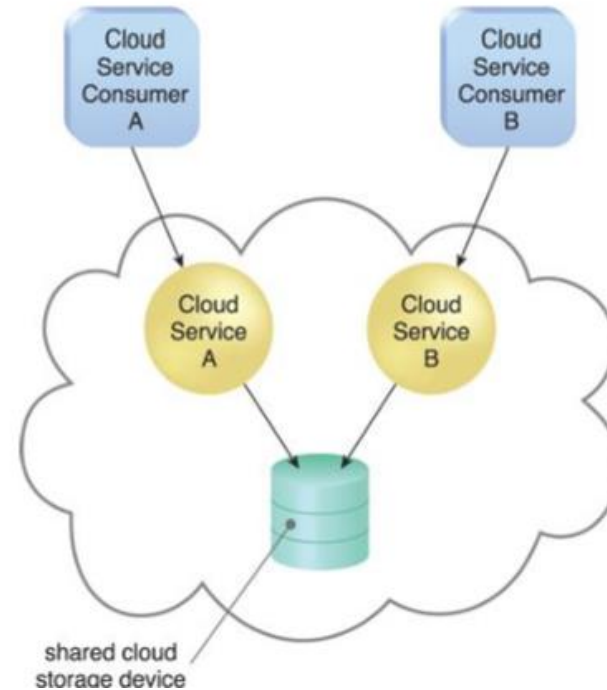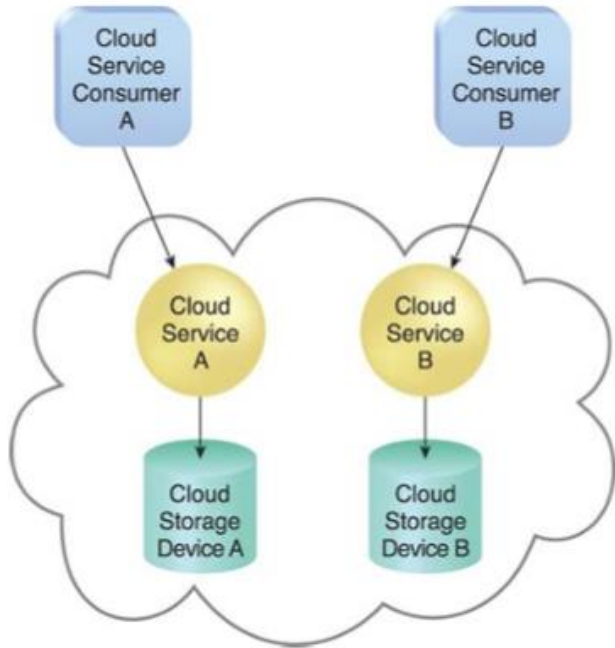# Boundaries:

- Organizational boundary:

- Trust boundary:

Characteristics

- On-demand usage
- Ubiquitous access (widely accessible)
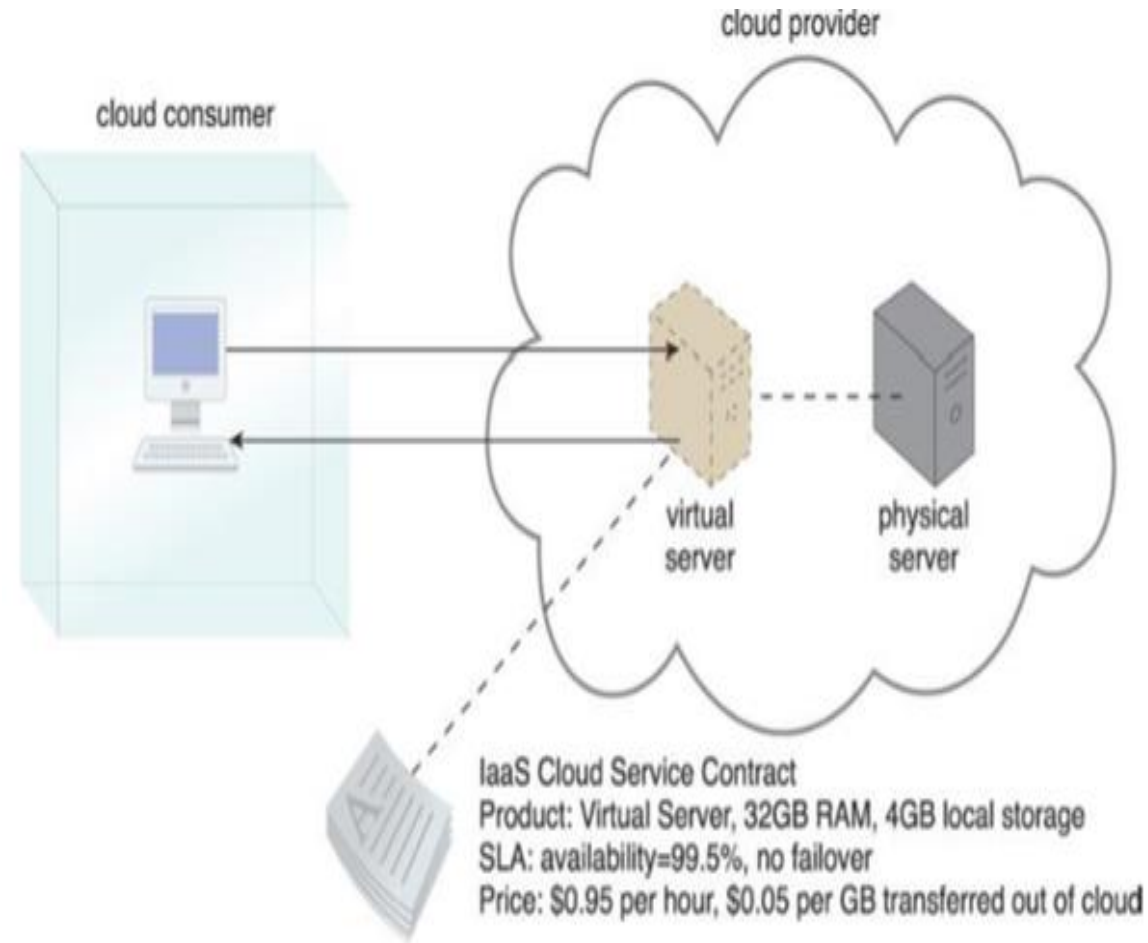- Multitenancy (and resource pooling)

- Elasticity (Scaling of IT resources in run-time)

- Measured usage (ability of a cloud platform to keep track of the usage of its IT resources, primarily by cloud consumers)

- Resiliency (can refer to redundant IT resources within the same cloud (but in different physical locations) or across multiple clouds)
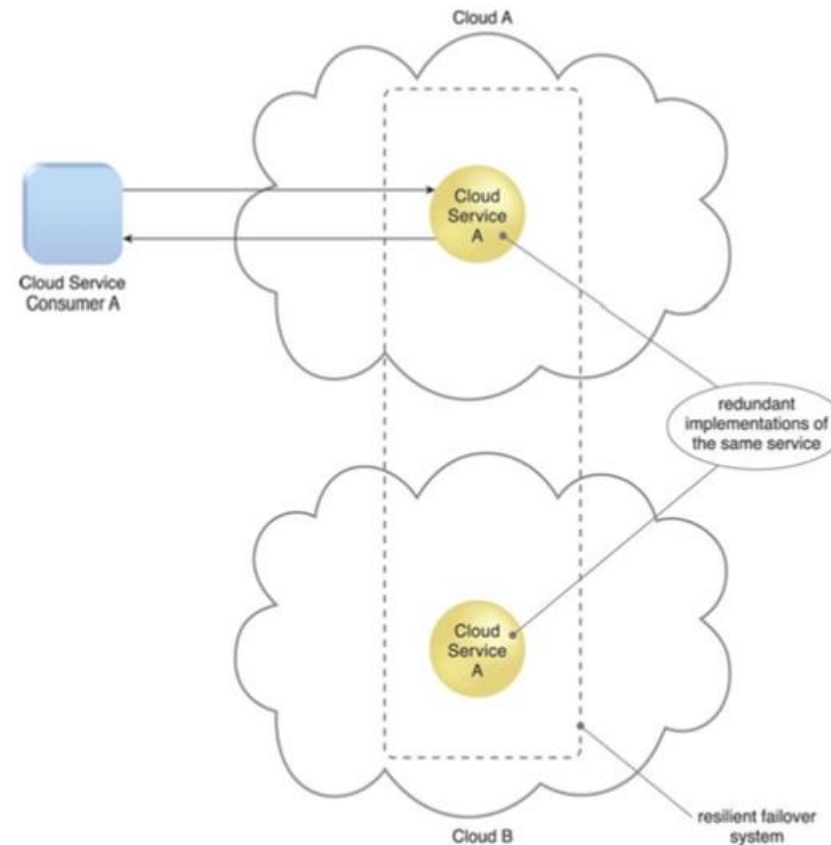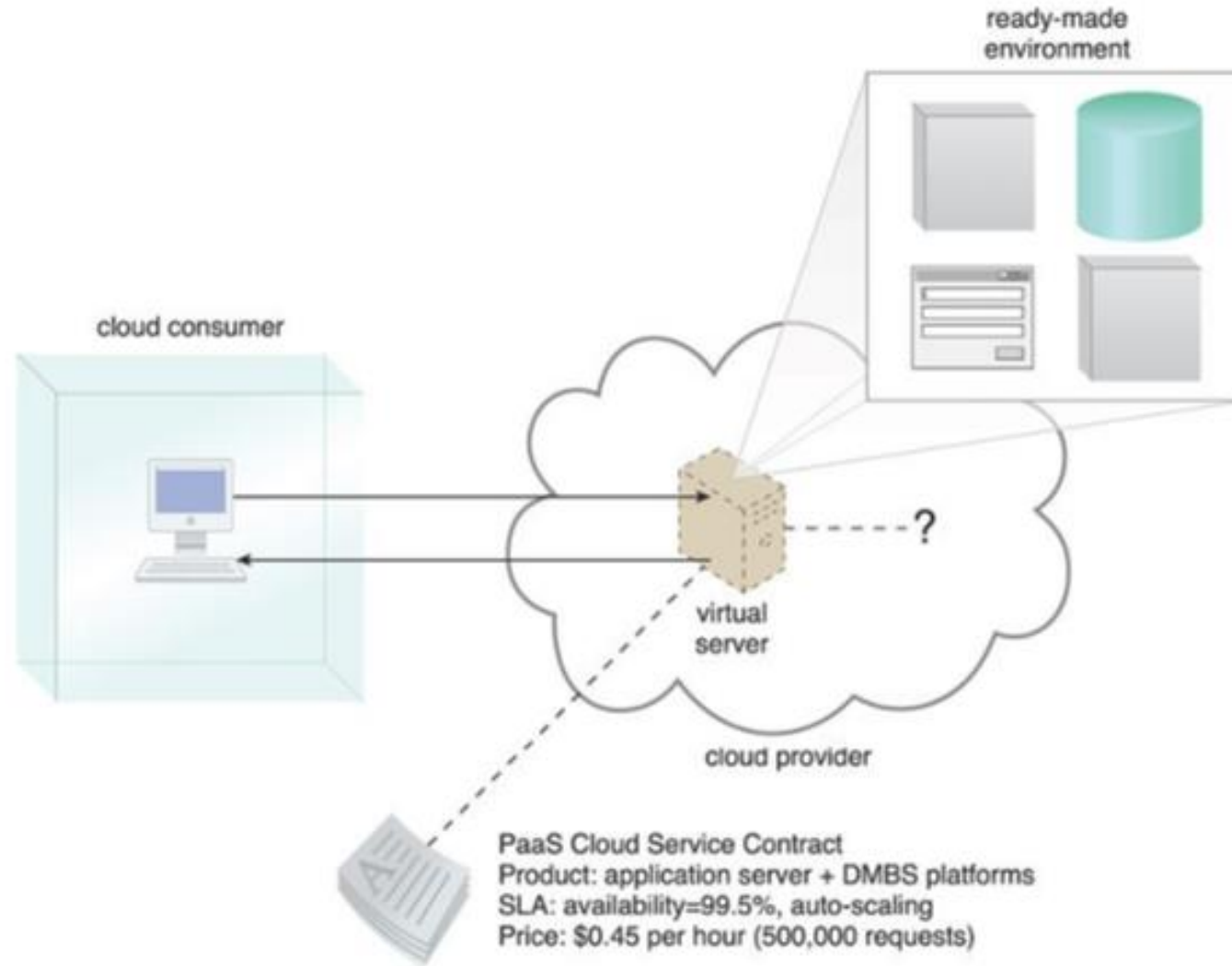
Cloud Delivery Models

- Infrastructure-as-a-Service (Iaas)

- Example: Google Apps, Microsoft Office 365, Salesforce

- Platform-as-a-Service (PaaS)

ready-made environment

cloud consumer

virtual server

cloud provider

PaaS Cloud Service Contract
Product: application server + DMBS platforms
SLA: availability=99.5%, auto-scaling
Price: $0.45 per hour (500,000 requests)

- Example: Google App Engine, Amazon Web Services(AWS), Elastic Beanstalk

- Software-as-a-Service (SaaS)

SaaS Cloud Service Contract
SLA: response time=0.5ms
Price: $0.05 per 100 requests
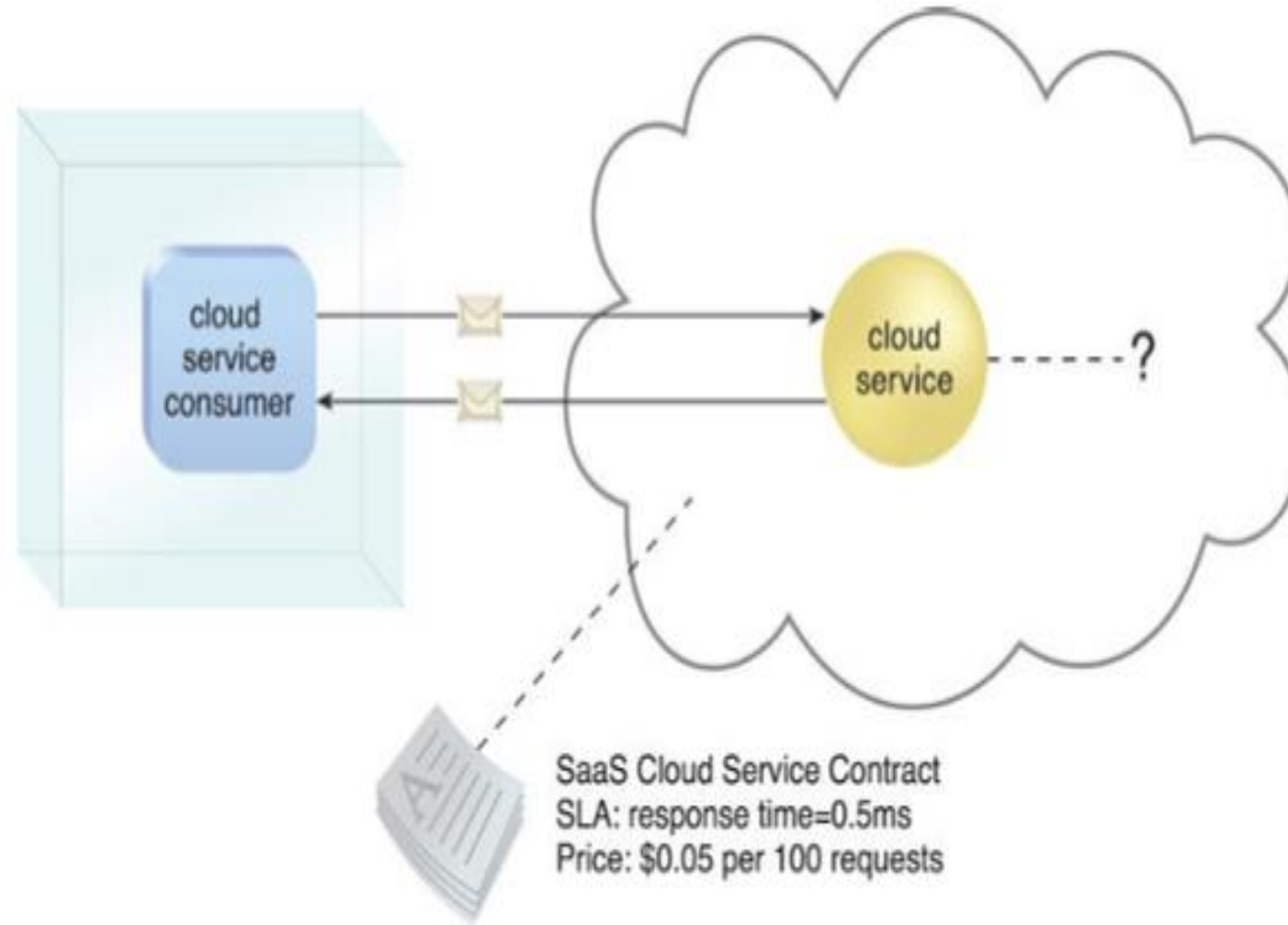
- Example: Google Compute Engine, Microsoft Azure, AWS Elastic Compute Cloud

- Anything-as-a-Service (Xaas) : https://kinsta.com/blog/xaas/
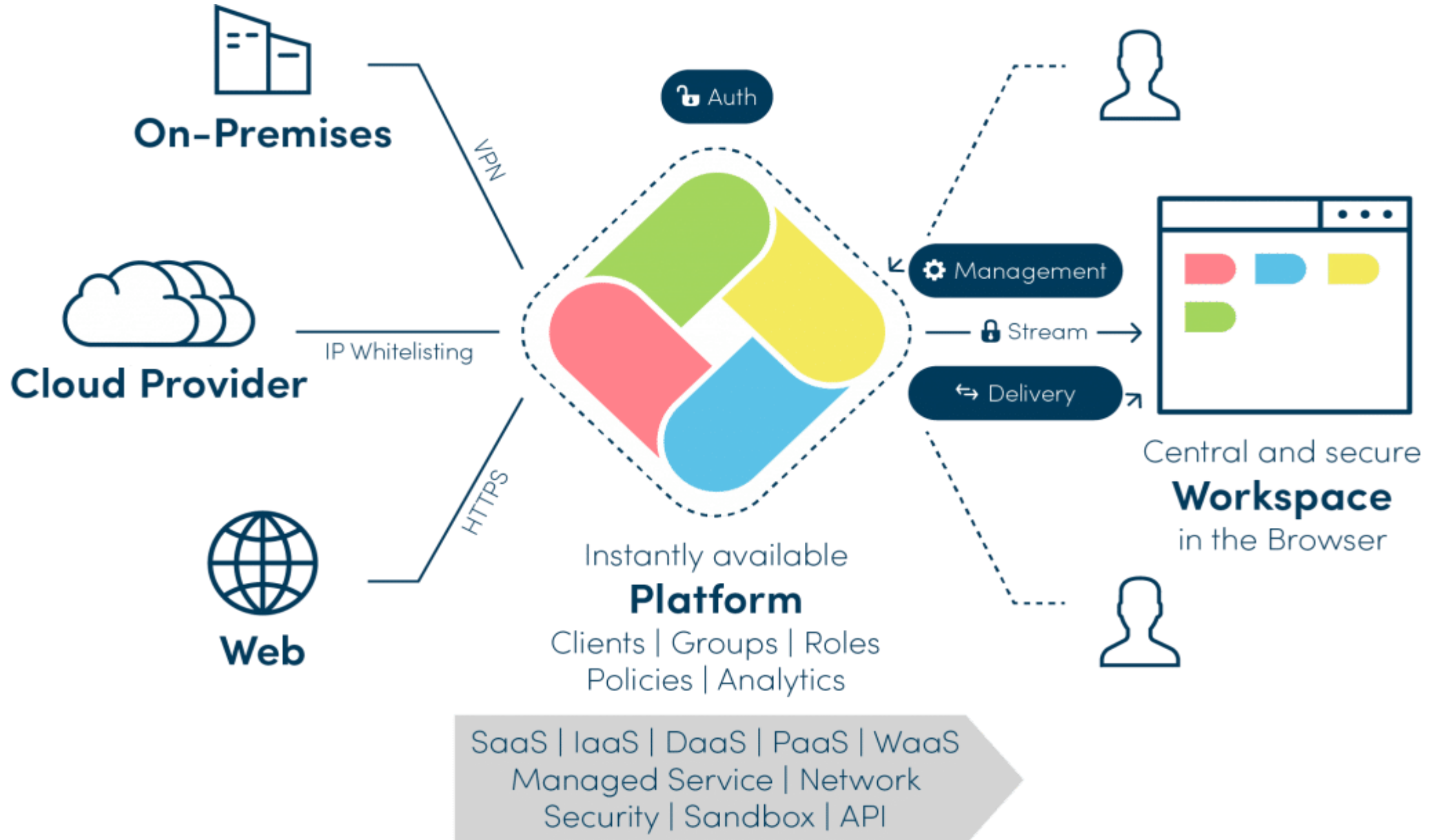
XaaS Examples:

- Authentication as a Service (AaaS)
- Containers as a Service (CaaS)
- Database as a Service (DBaaS)
- Device as a Service (DaaS)
- Disaster Recovery as a Service (DRaaS)
- Function as a Service (FaaS)
- Malware as a Service (MaaS)
- Network as a service (NaaS)
- Storage as a Service (STaaS)
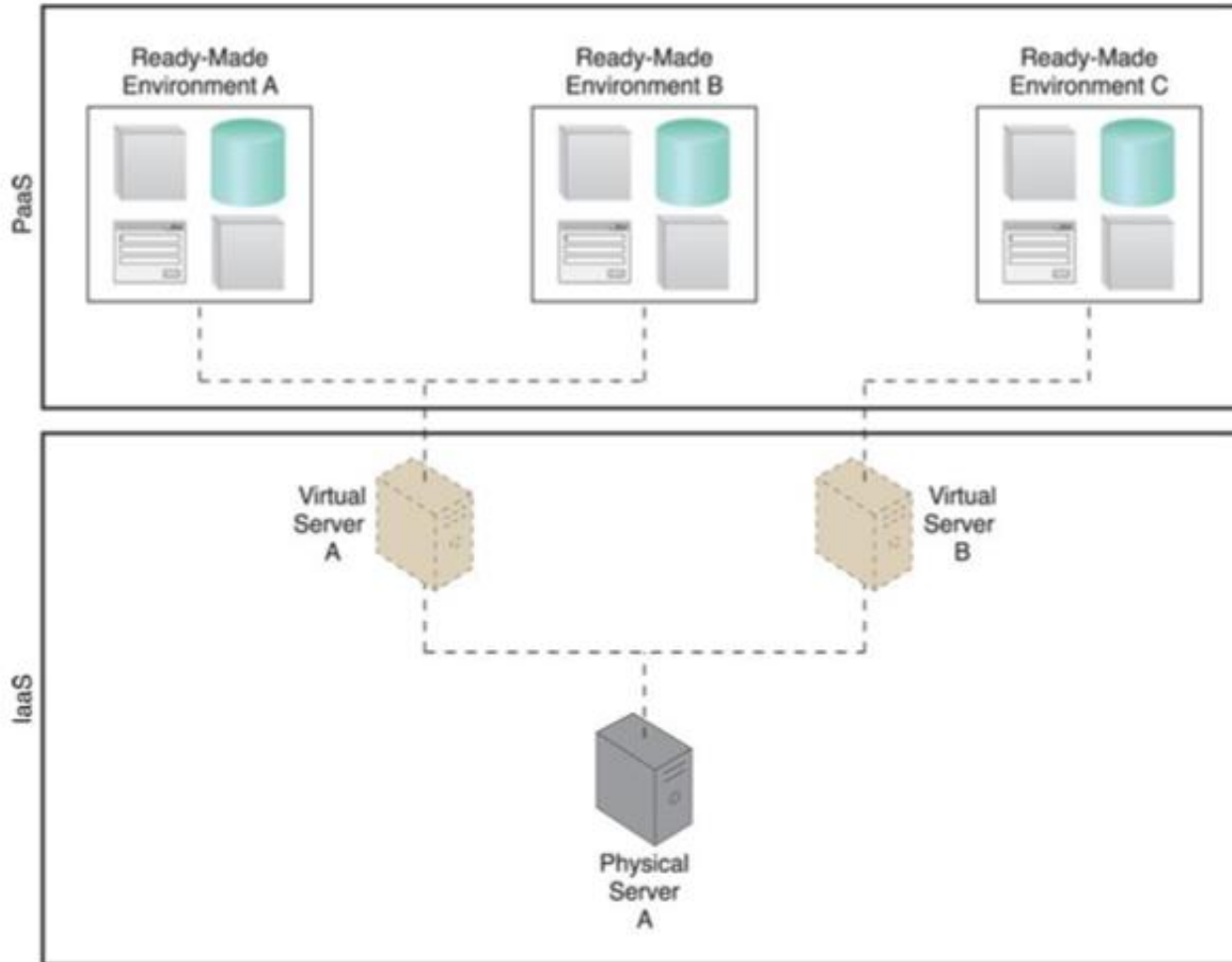- Unified Communications as a Service (UCaaS)

Benefits of XaaS

- Cost saving

- Scalability

- Accessibility

- Faster Implementation

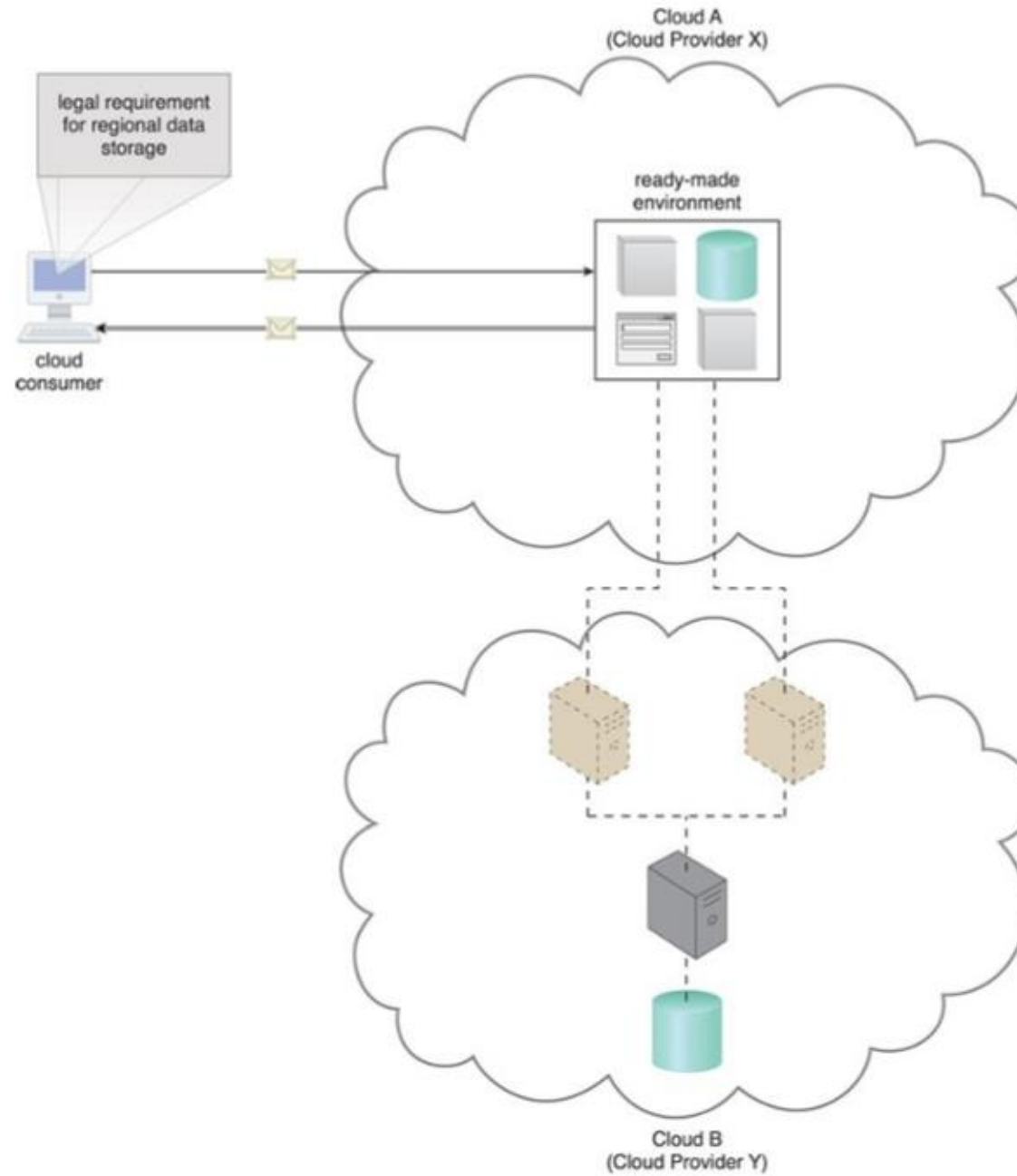- Quick modification

- Better security
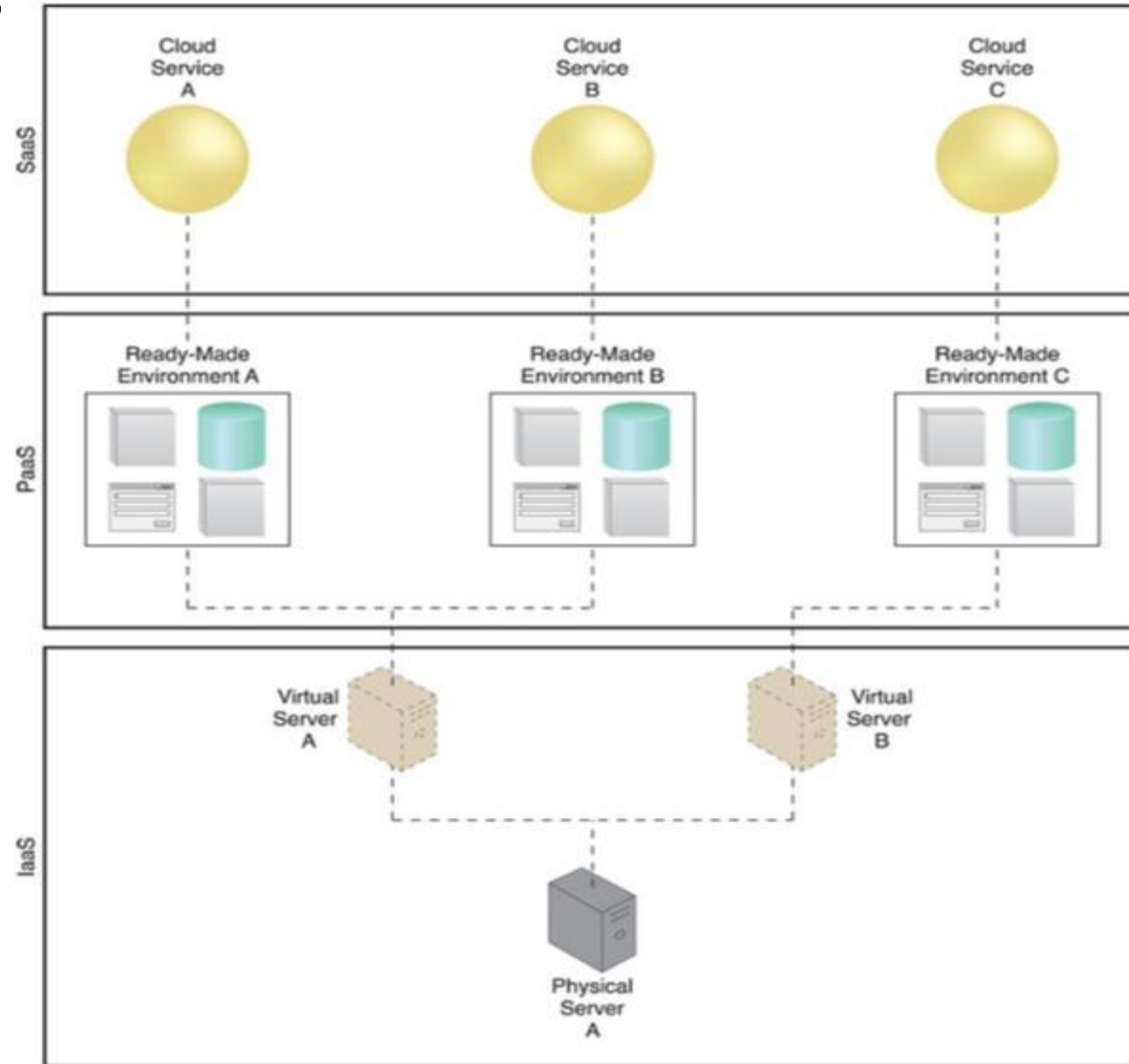
- Flexibility

Combination of Cloud delivery models

- IaaS+PaaS

- Example:

- IaaS+PaaS+SaaS
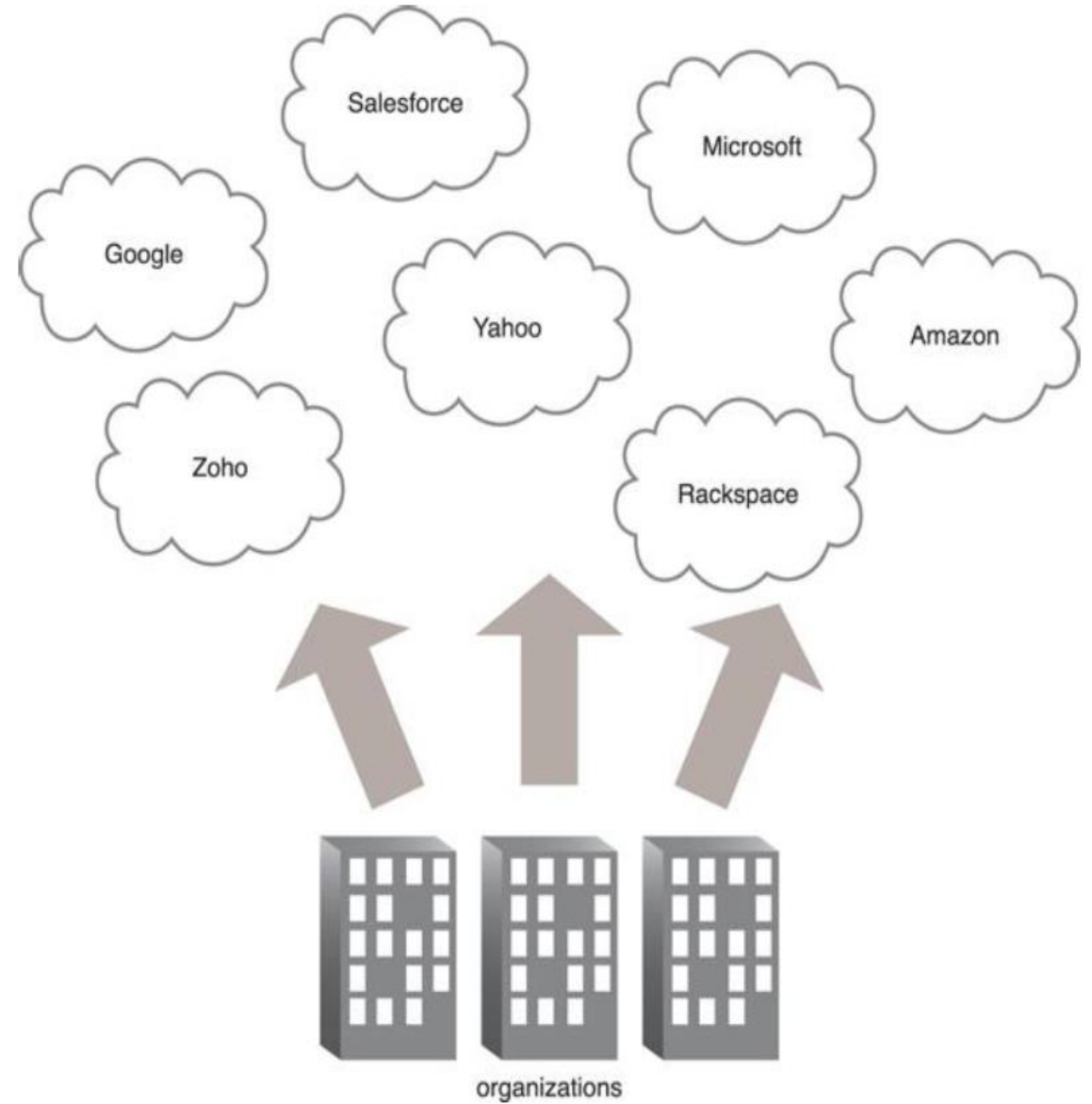
Comparison of Cloud Deployment Models

Cloud Delivery Model	Typical Level of Control Granted to Cloud Consumer	Typical Functionality Made Available to Cloud Consumer
SaaS	usage and usage-related configuration	access to front-end user-interface
PaaS	limited administrative	moderate level of administrative control over IT resources relevant to cloud consumer's usage of platform
IaaS	full administrative	full access to virtualized infra-structure-related IT resources and, possibly, to underlying physical IT resources

Activities carried out by Cloud Consumer and Provider

| Cloud Delivery Model	Common Cloud Consumer Activities	Common Cloud Provider Activities
SaaS	uses and configures cloud service	implements, manages, and maintains cloud service monitors usage by cloud consumers
PaaS	develops, tests, deploys, and manages cloud services and cloud-based solutions	pre-configures platform and provisions underlying infrastructure, middleware, and other needed IT resources, as necessary monitors usage by cloud consumers
IaaS	sets up and configures bare infrastructure, and installs, manages, and monitors any needed software	provisions and manages the physical processing, storage, networking, and hosting required monitors usage by cloud consumers

Cloud Deployment Models:
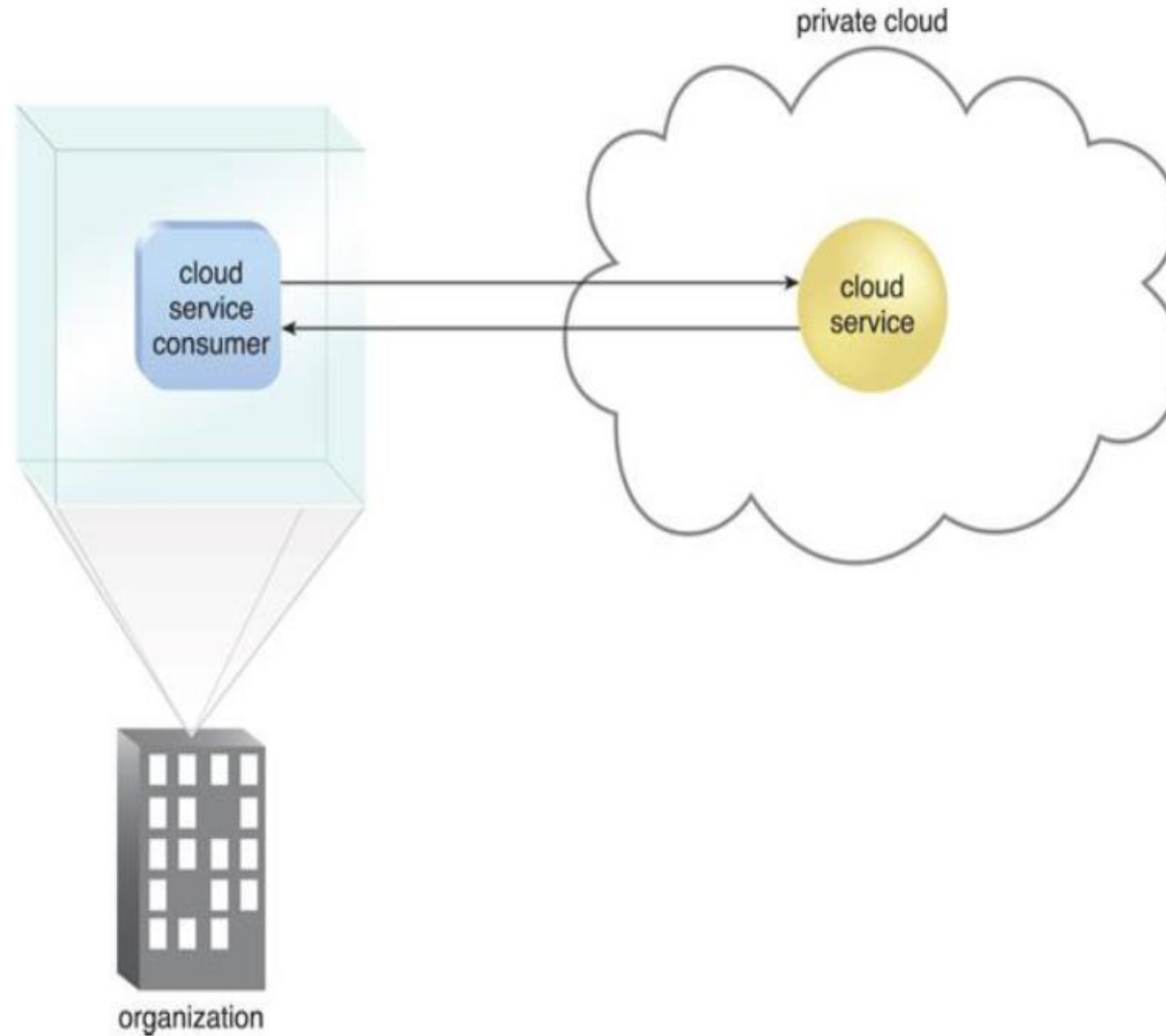
- Public Cloud

- Example: AWS, Azure, IBM, Oracle

- Community Cloud
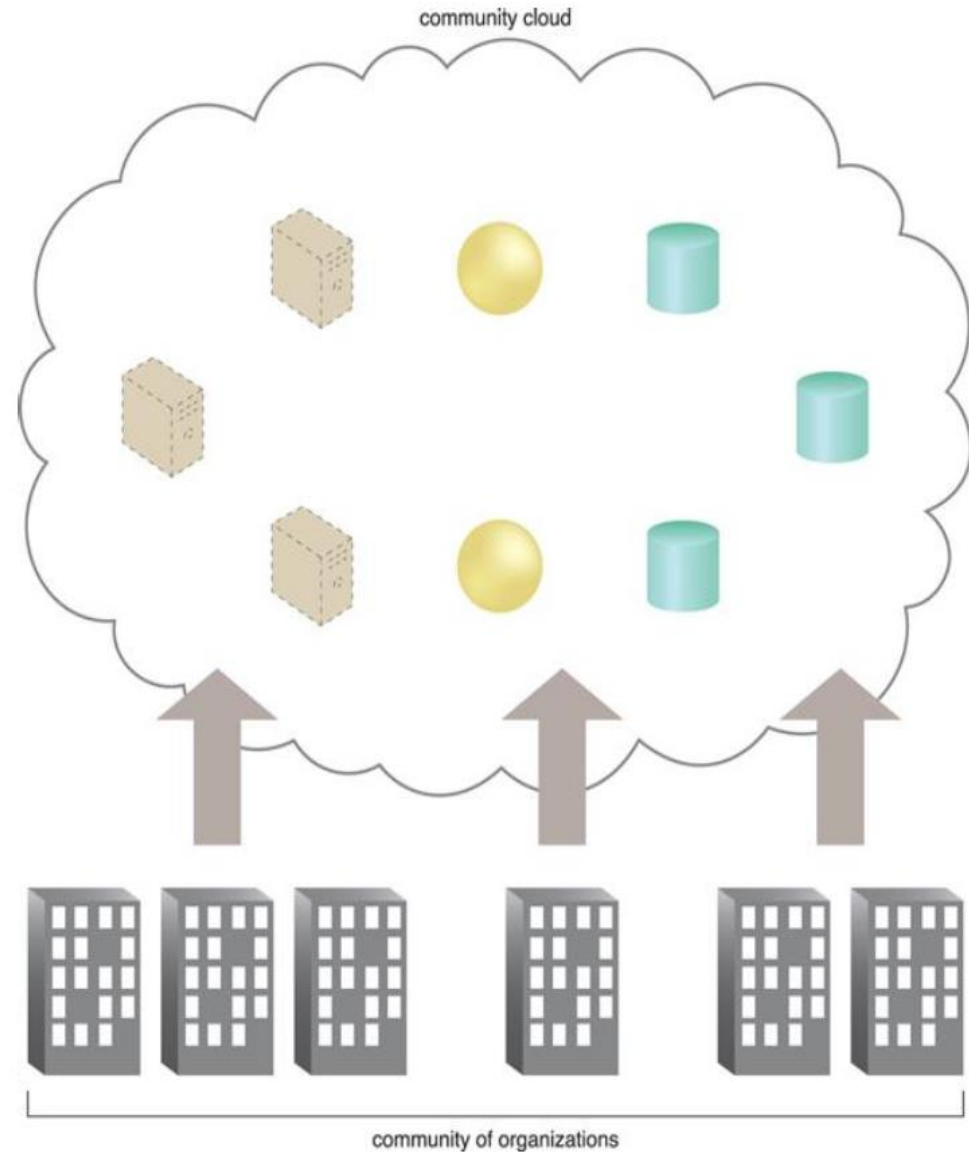
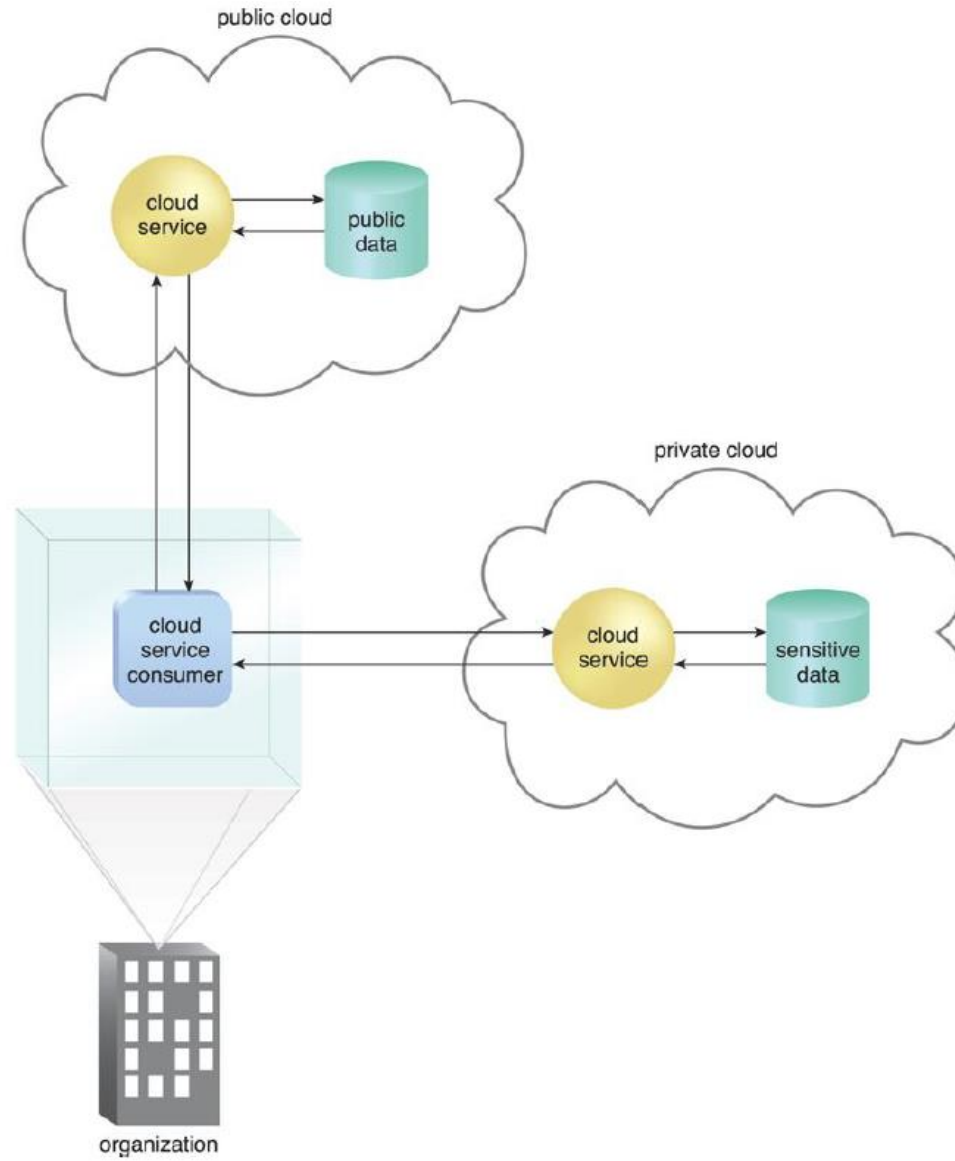- Example: Banks, Insurance companies, Enterprises

- Private Cloud

- Example: DELL, OpenStack, VMWare

- Hybrid Cloud

- Example: Rackspace, VMWare, Cisco, IBM

Other Cloud Deployment Models:

- *Virtual Private Cloud* – Also known as a "dedicated cloud" or "hosted cloud," this model results in a self-contained cloud environment hosted and managed by a public cloud provider, and made available to a cloud consumer.

- *Inter-Cloud* – This model is based on an architecture comprised of two or more inter-connected clouds.

Test Your Understandings

a) What type of computing technology refers to services and applications that typically run on a distributed network through virtualized resources?

1. Distributed Computing

2. Cloud Computing

3. Soft Computing

4. Parallel Computing

b) Which one of the following options can be considered as the Cloud?

1. Hadoop

2. Intranet

3. Web Applications

4. All of the mentioned

c) Which of the following has many features of that is now known as cloud computing?

1. Web Service

2. Softwares

3. All of the mentioned

4. Internet

d) How many types of services are there those are offered by the Cloud Computing to the users?

1. 2

2. 4

3. 3

4. 5

e) The Foce.com and windows Azure are examples of which of the following?

1. IaaS

2. PaaS

3. SaaS

4. Both A and B

f) Which one of the following a technology works behind the cloud computing platform?

1. Virtualization

2. SOA

3. Grid Computing

4. All of the above