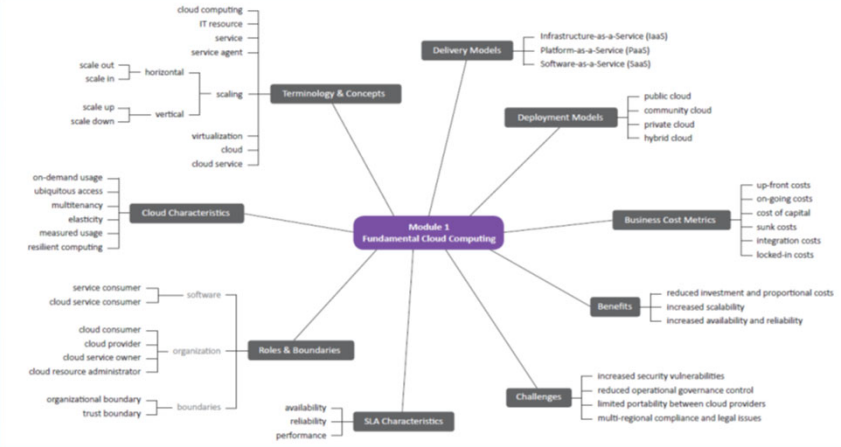
SIT706
Cloud Computing Technologies

Week 2

Class-2 Clouds in Context

Chapter 4
Fundamental Concepts and Models

Fundamental Concepts and Models



Source: Arcitura Education

Chp 4 - Fundamental Concepts and Models

1. Roles and Boundaries
2. Cloud Characteristics
3. Cloud Delivery Models
4. Cloud Deployment Models

Roles and Boundaries

1. Cloud Provider
2. Cloud Consumer
3. Cloud Service Owner
4. Cloud Resource Administrator
5. Cloud Auditor
6. Cloud Broker
7. Cloud Carrier
8. Organisational Boundary
9. Trust Boundary

Roles and Boundaries

1. **Cloud Provider**
   - Organisation providing cloud-based IT resources
   - Responsible for
     - making cloud services available and
     - achieving Service Level Agreement (SLA) guarantees
   - Normally own the IT resources, however can "resell" IT resources leased from other cloud providers

Roles and Boundaries

1. Top 15 Cloud Providers

- Amazon Web Services
- Microsoft Azure
- Google Cloud Platform
- Adobe
- VMware
- IBM Cloud
- Rackspace
- Red Hat
- Salesforce
- Oracle Cloud
- SAP
- Verizon Cloud
- Navisite
- Dropbox
- Egnyte

Source: Softwaretestinghelp.com

Roles and Boundaries

2. Cloud Consumer

– Organisation/persons that have a formal contract or arrangement with a cloud provider to use cloud-based IT resources

Roles and Boundaries

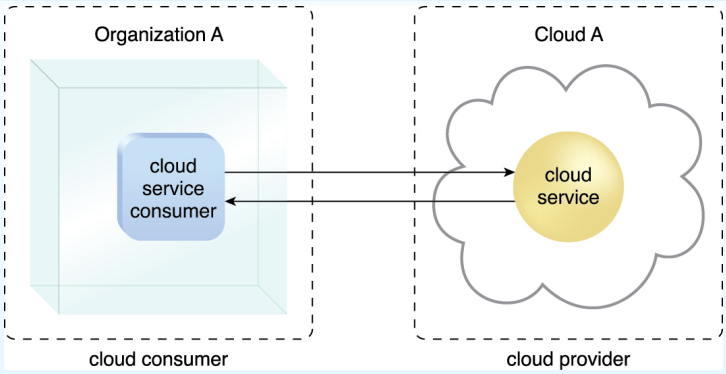


Figure 4.1 A cloud consumer (Organization A) interacts with a cloud service from a cloud provider (that owns Cloud A). Within Organization A, the cloud service consumer is being used to access the cloud service.

Roles and Boundaries

3. **<u>Cloud Service Owner</u>**
   - Organisation/persons that legally own a cloud service
   - Could be cloud consumer or cloud provider.
   - Not necessarily the consumer of the cloud service

Roles and Boundaries

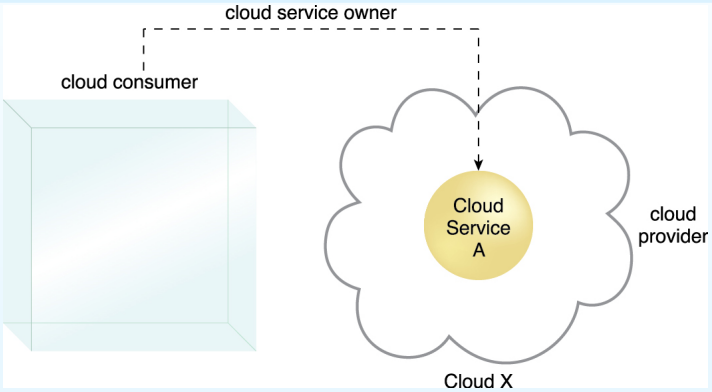


Figure 4.2 A cloud consumer can be a cloud service owner when it deploys its own service in a cloud

Roles and Boundaries

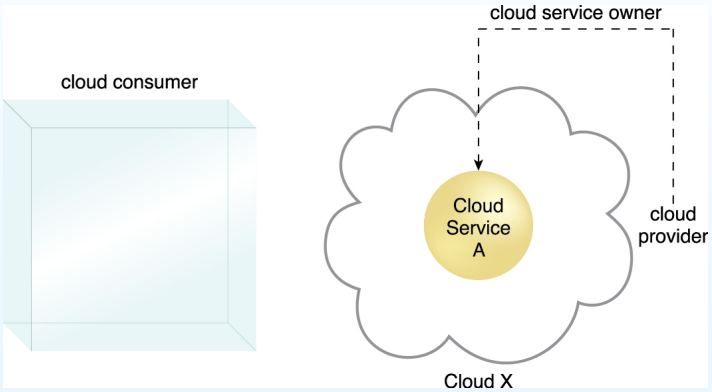


Figure 4.3 A cloud provider becomes a cloud service owner if it deploys its own cloud service, typically for other cloud consumers to use.

Roles and Boundaries

4. **Cloud Resource Administrator**
   - Organisation/persons responsible for the administration of a cloud-based IT resource
     - cloud consumer,
     - cloud provider,
     - or even a third-party

Roles and Boundaries

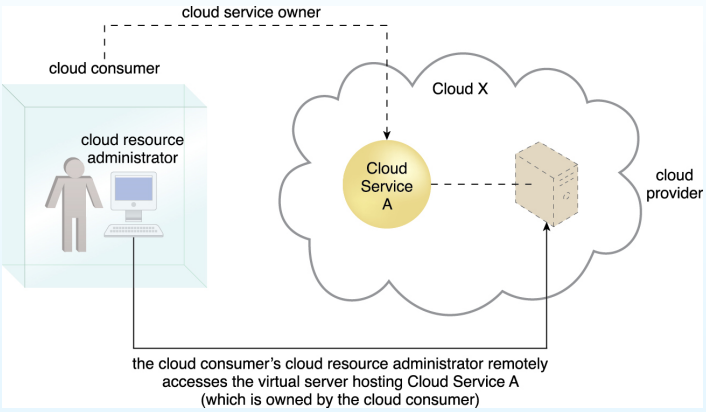


Figure 4.4 A cloud resource administrator can be with a cloud consumer organization and administer remotely accessible IT resources that belong to the cloud consumer.

Roles and Boundaries

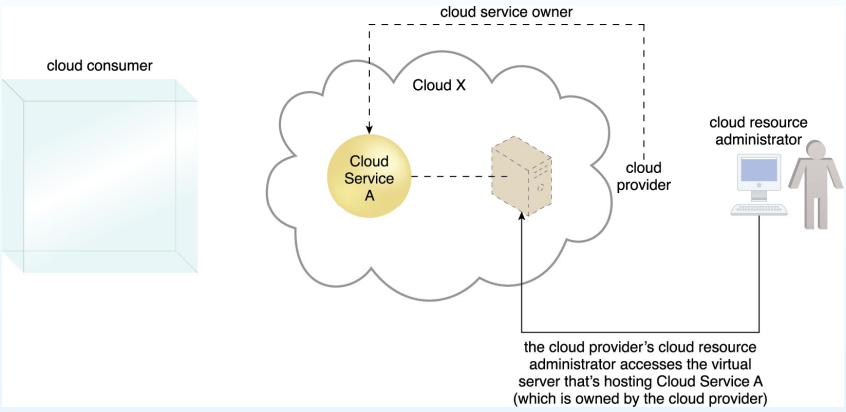


Figure 4.5 A cloud resource administrator can be with a cloud provider organization for which it can administer the cloud provider's internally and externally available IT resources.

Roles and Boundaries

Additional Roles

5. Cloud Auditor: third party that conducts independent assessments of cloud environments
6. Cloud Broker: manages and negotiates use of cloud services between cloud consumers and cloud providers
7. Cloud Carrier: responsible for providing connectivity between cloud consumers and cloud providers (wire-level)

Roles and Boundaries

8. **Organisational Boundary**
   - Perimeter surrounding IT resources owned and governed by an organisation
     - Not surrounding the actual organisation, only IT assets/resources

Roles and Boundaries

9. **Trust Boundary**
   - Logical perimeter, typically spanning beyond physical boundaries, representing extent of trusted IT resources
     - Cloud consumer must extend trust boundary beyond physical boundary to include parts of the cloud environment

Roles and Boundaries

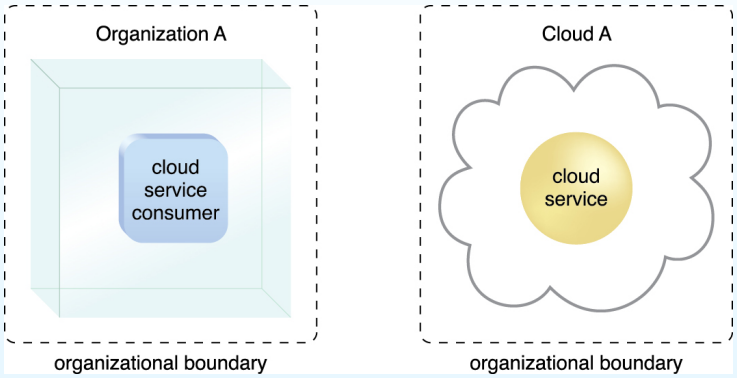
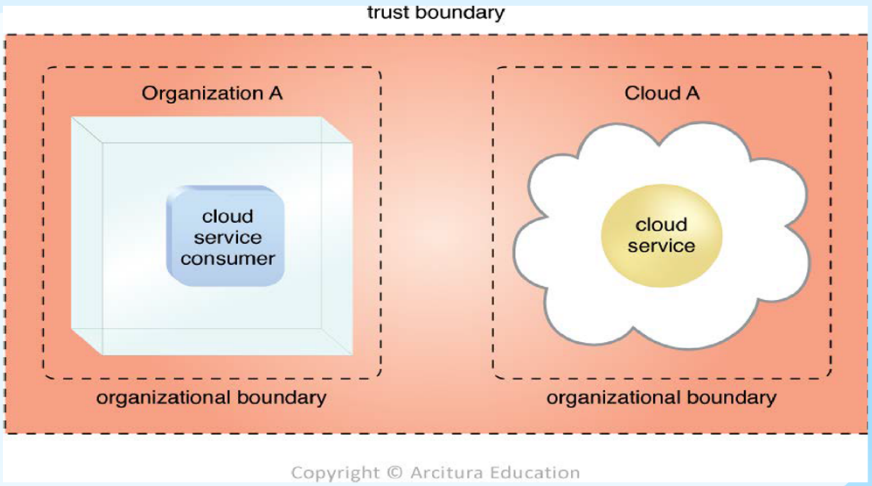


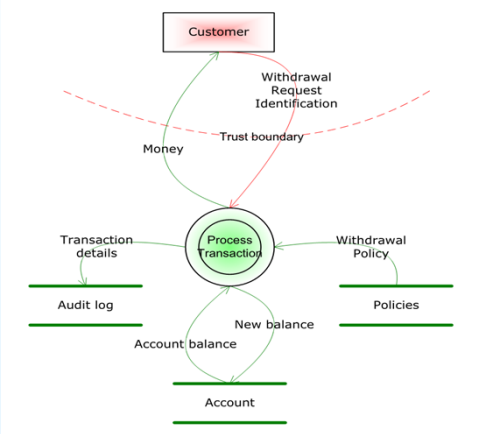
Figure 4.6 Organizational boundaries of a cloud consumer (left), and a cloud provider (right), represented by a broken line notation

Roles and Boundaries



Roles and Boundaries

9. Trust Boundary Example



Source: From Web images

Cloud Characteristics

1. On-demand usage
2. Ubiquitous access
3. Multitenancy
4. Elasticity
5. Measured Usage
6. Resiliency

Cloud Characteristics

1. **On-demand usage**: cloud consumer **configures** cloud-based IT resources and can **then automates usage** without further intervention

2. **Ubiquitous access**: cloud service is **widely accessible**, which requires support for a range of devices, transport protocols, interfaces, security technologies, and so on.

Cloud Characteristics

3. **Multitenancy (and Resource pooling)**: an application is shared with several tenants, but each tenant perceives that they are the only tenant

   -Resource pooling allows cloud providers to pool large-scale IT resources to serve multiple cloud consumers, dynamically assigned and reassigned according to cloud consumer demand

Cloud Characteristics

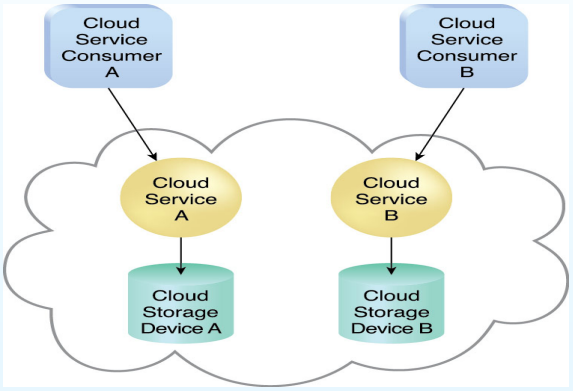


Figure 4.8 In a single-tenant environment, each cloud consumer has a separate IT resource instance.

Cloud Characteristics

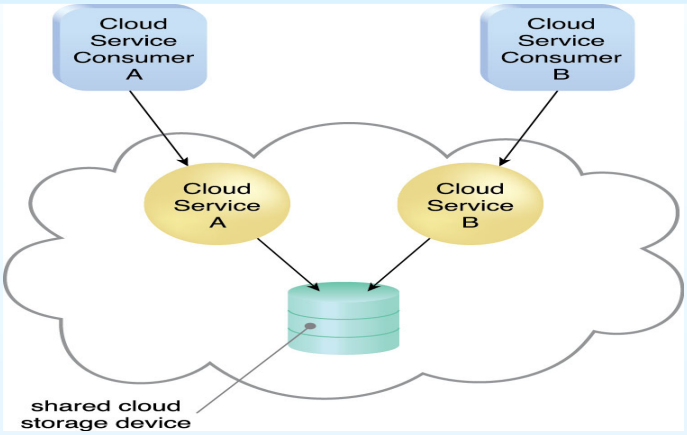


Figure 4.9 In a multitenant environment, a single instance of an IT resource, such as a cloud storage device, serves multiple consumers

Cloud Characteristics

4. Elasticity: ability to automatically and transparently scale IT resources as required responding to runtime conditions or as pre-determined by the cloud consumer/provider

Cloud Characteristics

5. **Measured Usage**: ability to **track IT resource** usage, particularly by cloud consumers (for **charging**, general **monitoring**, and **usage** reporting to provider/consumer)

6. **Resiliency**: distribution of redundant groups of IT resources across physical locations
   - If one group fails, processing is automatically moved to another redundant group

Cloud Characteristics

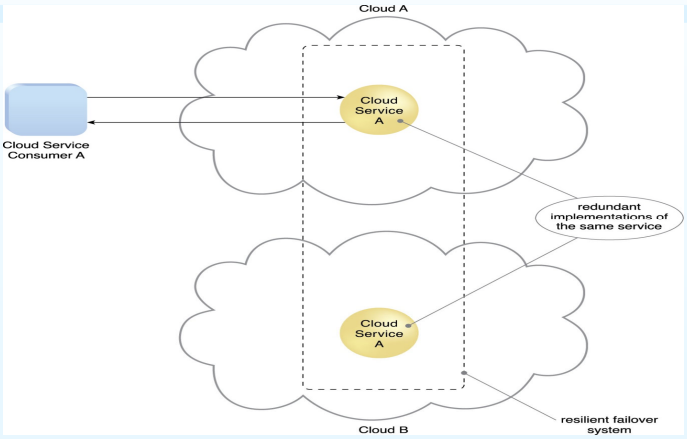


Figure 4.10 A resilient system in which Cloud B hosts a redundant implementation of Cloud Service A to provide failover in case Cloud Service A on Cloud A becomes unavailable.

Cloud Delivery Models

1. Infrastructure-as-a-Service (IaaS)
2. Platform-as-a-Service (PaaS)
3. Software-as-a-Service (SaaS)
4. Combinations

Cloud Delivery Models

1. Infrastructure-as-a-Service (IaaS):

- Infrastructure-centric *IT resources* that can be *accessed and managed* via *cloud service-based interfaces and tools*
  -Includes hardware, network, connectivity, operating systems, and other "raw" IT resources
- Provides cloud consumers with a high level of control and responsibility over its configuration and utilization
  -Generally not pre-configured
  -Administrative responsibility sits with the cloud consumer
- Typically leased as (virtual) hardware requirements, e.g., processor capacity, memory, local storage, etc.

Cloud Delivery Models

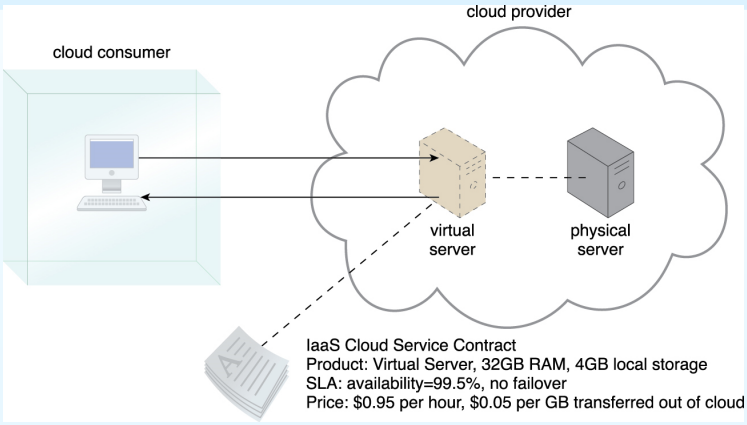


Figure 4.11 A cloud consumer is using a virtual server within an IaaS environment. Cloud consumers are provided with a range of contractual guarantees by the cloud provider, pertaining to characteristics such as capacity, performance, and availability

Cloud Delivery Models

2. Platform-as-a-Service (PaaS)

Pre-defined "ready-to-use" environment typically comprised of **already deployed and configured** IT resources, e.g., Google App Engine offers a Java and Python-based environment

Cloud Delivery Models

2. Platform-as-a-Service (PaaS)

Common reasons to use PaaS:

- **Extending on-premise environment** into the cloud for scalability and economy
- **Uses ready-made environment** as substitute for on-premise environment
- **Cloud consumer becomes a cloud provider** by making its own cloud services available to other cloud consumers

Cloud Delivery Models

2. Platform-as-a-Service (PaaS)

Cloud consumer is **spared setting up and maintaining the infrastructure** IT resources (IaaS) **but** has a **lower level of control** over the underlying IT resources

Cloud Delivery Models

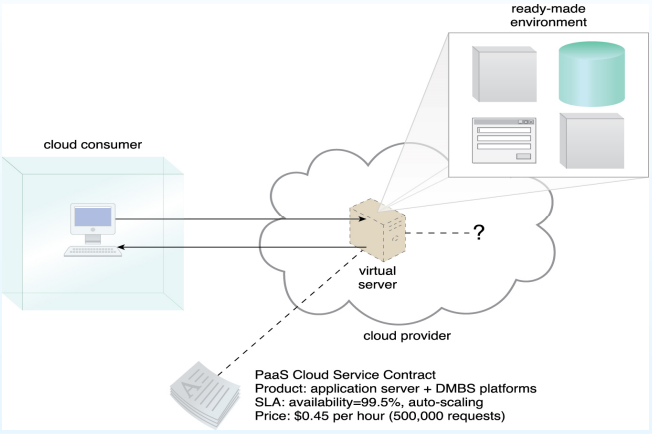


Figure 4.12 A cloud consumer is accessing a ready-made PaaS environment. The question mark indicates that the cloud consumer is intentionally shielded from the implementation details of the platform.

Cloud Delivery Models

3. Software-as-a-Service (SaaS)

Typically a **software program** positioned as a shared cloud service and made available as a "product" or generic utility

Cloud Delivery Models

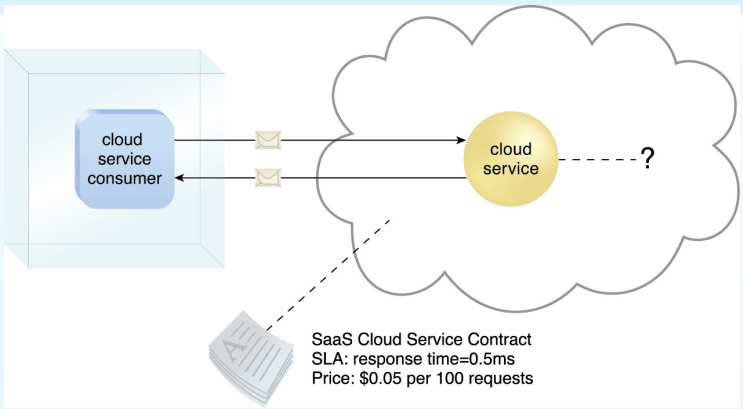


Figure 4.13 The cloud service consumer is given access the cloud service contract, but not to any underlying IT resources or implementation details.

Cloud Delivery 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 infrastructure-related IT resources and, possibly, to underlying physical IT resources

Cloud Delivery Models

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 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 Delivery Models

4. **<u>These delivery models can also be combined</u>**

IaaS + PaaS

- Cloud provider delivers PaaS environment using IaaS environment either on its own on-premise cloud or from another cloud provider

IaaS + PaaS + SaaS

- Same as above, but also using the same PaaS environment to build SaaS cloud services that are then sold to cloud consumers

Cloud Delivery Models

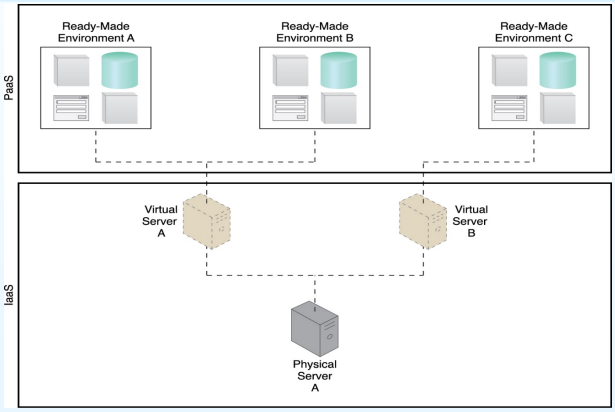


Figure 4.14 A PaaS environment based on the IT resources provided by an underlying IaaS environment

Cloud Delivery Models

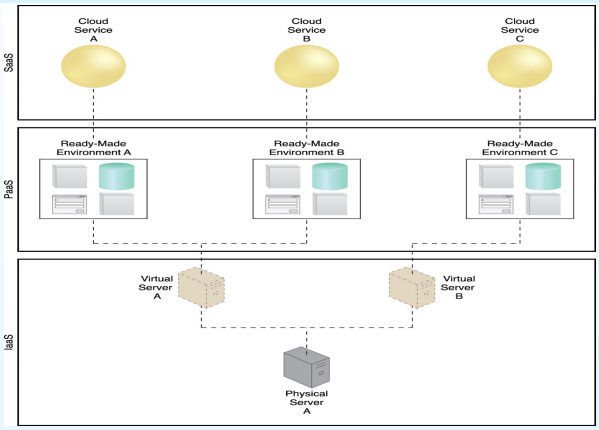


Figure 4.16 A simple layered view of an architecture comprised of IaaS and PaaS environments hosting three SaaS cloud service implementations.

Cloud Delivery Models

5. Specialized variations of the tree based cloud delivery models:

- Storage-as-a Service
- Database-as-a Service
- Security-as-a-Service
- Communication-as-a-Service
- Integration-as-a-Service
- Testing-as-a-Service
- Process-as-a-Service

Cloud Deployment Models

1. Public cloud
2. Community cloud
3. Private cloud
4. Hybrid cloud

Cloud Deployment Models

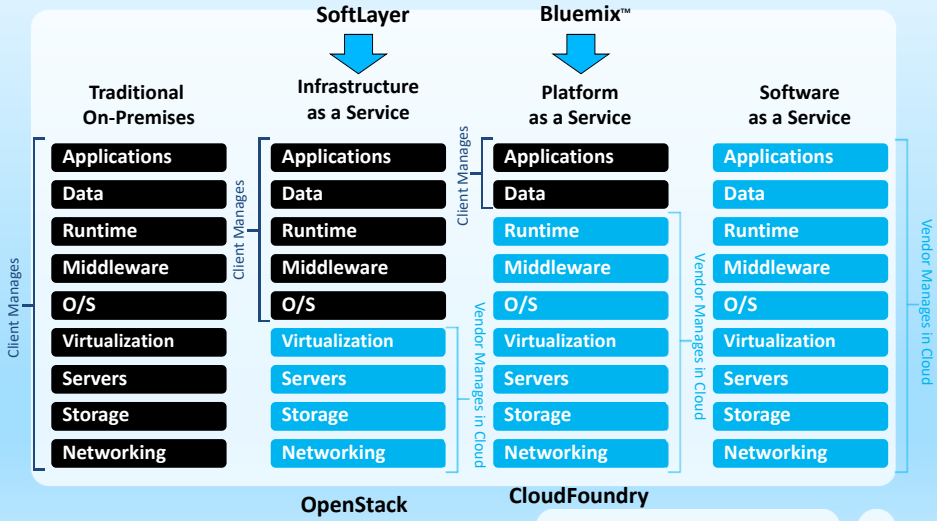
1. **<u>Public cloud</u>**
   - owned by a third-party provider
   - generally offered to cloud consumers at a cost
   - usually provisioned via previously described delivery models

Cloud Deployment Models

1. Public cloud Services

- To gain insight into Cloud computing, we take a closer look at the services of IBM Cloud-
- http://www.ibm.com/cloud-computing/bluemix/

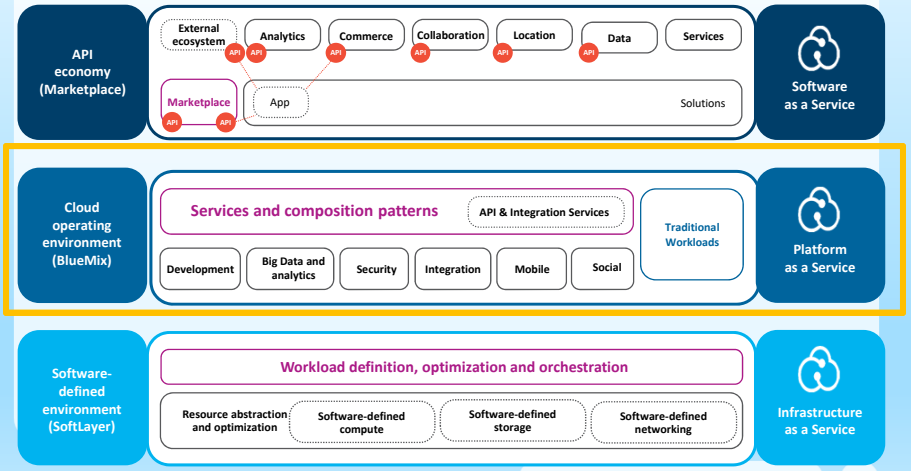
1. Public Cloud – IBM Bluemix services



Source: This slide is adapted from IBM Bluemix slides available in their website

1. Public Cloud – IBM Bluemix services

From Software Defined Environments to Cloud Operating Environment to an API Economy



Source: This slide is adapted from IBM Bluemix slides available in their website

Public Cloud Services – IBM Bluemix services

Web and Application	Mobile	DevOps
Reduce costs, deliver and scale engaging web applications and services •Session Cache •Data Cache •Application Auto-Scaling •Workflow •RapidApps •Rules •Elastic MQ	**Rapidly build on-device mobile applications or host mobile web applications** •Mobile Application Security •Push •Mobile Data •Mobile Quality Assurance •Location	**Open, integrated rapid development that scales.** •Monitoring and Analytics •Continuous Integration •Git Hosting •Web IDE •Delivery Pipeline •Agile Planning and Tracking
Integration	**Database**	**Security**
Securely connect cloud applications to on-premise data and infrastructure. •Cloud Integration	**Choose your own database-as-a-service.** •SQL Database •Cloudant JSON Database	**Build security into your application by design.** •SSO •Appscan Mobile Analyzer
Big data	**Watson**	**Internet of Things (IoT)**
Harness the power of Big Data. •BLU Analytics Acceleration •Time Series Database •Reporting •Map Reduce •Streams	**Analytics based on natural language questions.** •Watson Analytics Services	**Consume, analyze and act on streaming data from physical sensors.** •Internet of Things Cloud

Sources: This slide is adapted from IBM Bluemix slides available in the Week 2

Cloud Deployment Models

2. Community cloud

- similar to public except access is limited to a specific community of cloud consumers
- might be:
  - jointly owned by a third-party
  - owned by the community members
  - Example: Chatter, Salesforce product.
  - A company can also use Chatter to create an internal social network across their organization.

Cloud Deployment Models

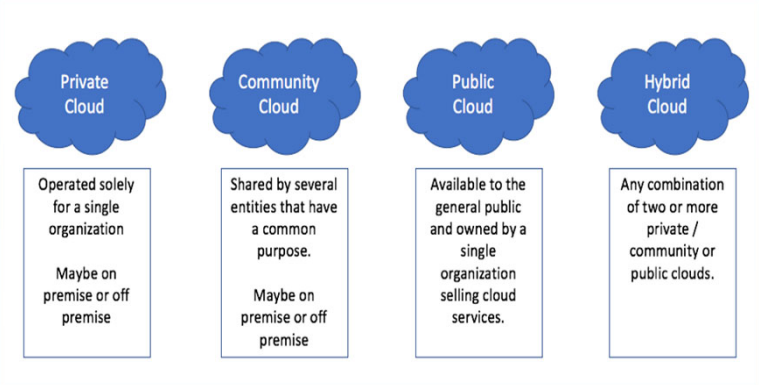
2. Community cloud Cost

- Salesforce charge by log-in
  - 200 "unique" partner log-ins per month then bill will be $30,000
  - If the number of log-ins increases, then price will increase. Say 5,000 log-ins per month, the price is **$420,000** per year.

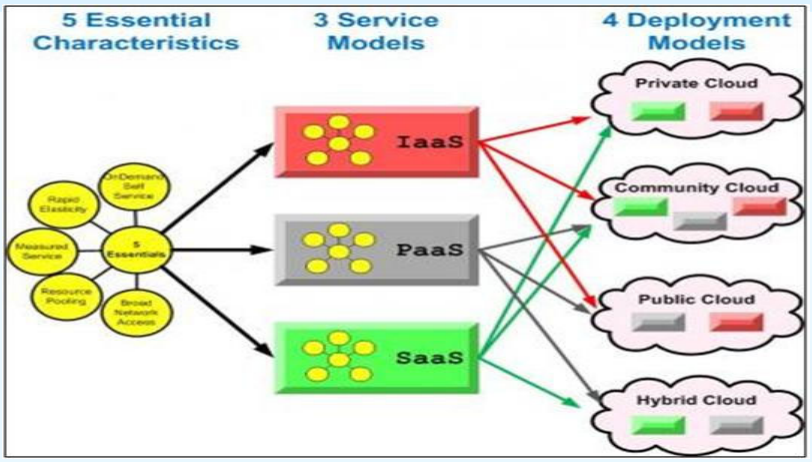
Cloud Deployment Models

3. **Private cloud**
   - owned by a single organisation
   - used to centralise access to IT resources
4. **Hybrid cloud**
   - composed of two or more of the above
   - e.g., applications using private cloud can expand to use public cloud during peak times

Summary Cloud Deployment Models



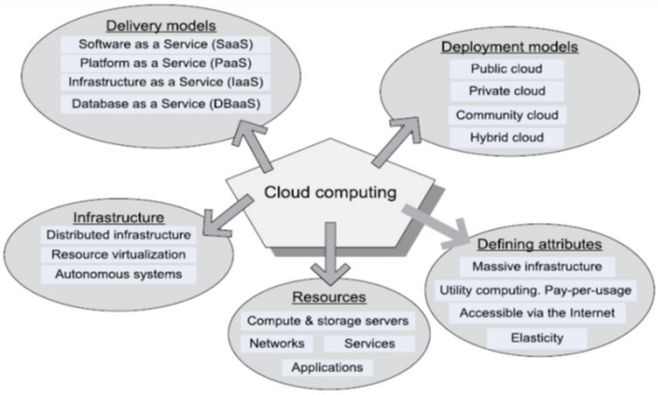
Cloud Delivery & Deployment Models



Cloud Delivery & Delivery Models and Attributes

Cloud computing: delivery models, deployment models, defining attributes, resources, and organization of the infrastructure

Source:
Dan C. Marinescu



Week 2 Summary

- Clouds in Context
  - Roles and Boundaries
  - Cloud Characteristics
  - Cloud Delivery Models
  - Cloud Deployment Models

End of Week-2 Lecture