

# Cloud Computing Architecture and Service Management

Testing as a Service

Management/Governance as a Service

Security as a Service	Integration as a Service	Application as a Service	P A A S
		Process as a Service	
		Information as a Service	
		Database as a Service	
		Storage as a Service	
IAAS			

## 1) Storage as a Service

It is a cloud computing service model that enables client to outsource their storage

Advantages :

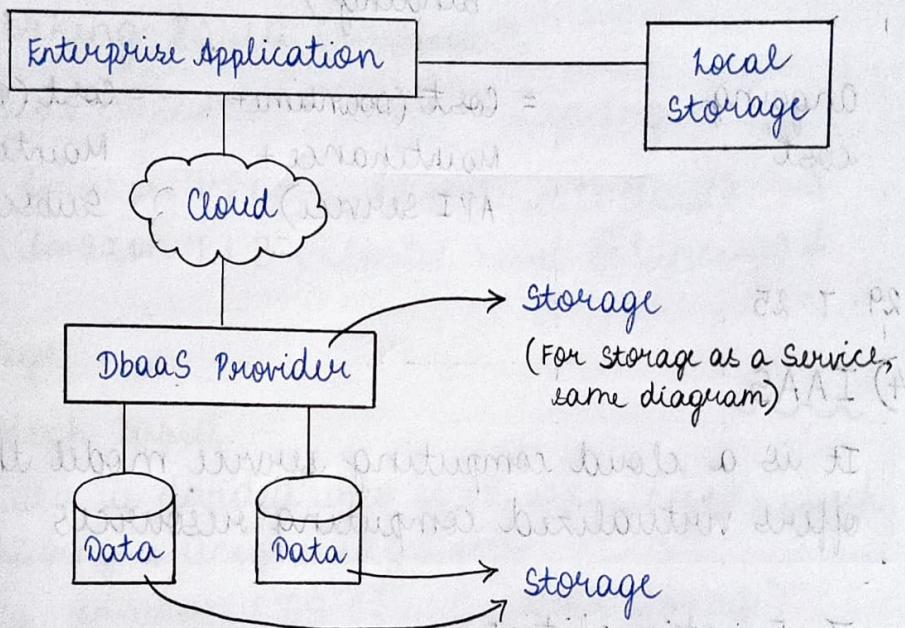
- Capital Expenditure → Operational Expenditure  
CAPEX → OPEX
- Storage Scalability
- Remote Access

Disadvantages :

- Security (Privacy concerns)
- Downloading of large chunks of data
- Dedicated public internet

## 2) Database as a Service (DbaaS)

It is a cloud computing service model that frees a client from purchasing, configuring, installing, backup and regular updates of any database.



### Advantages:

- User can just use, need not worry about:
  1. Cost
  2. Hardware Setup
  3. Configure
  4. Install
  5. Manage
  6. Use
  7. Backup
  8. Regular Updates
- Rapid Application Development
- Cost Effective
- Data Application Security (IAM)

### IBM

- Db2
- MongoDB
- PostgreSQL
- Redis
- Cloudant
- Electric Cloud
- Rabbit MQ
- CockroachDB

### 3) Information as a Service

Eclectic API - collects user data

	Existing API	Own API
one time cost	= cost (Abstraction + Binding)	= Cost (Designing + Building + Testing)
ongoing cost	= Cost (Downtime + Maintenance + API Service)	= Cost (Downtime + Maintenance + Subscription)

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### 4) IAAS

It is a cloud computing service model that offers virtualized computing resources

#### 7 Functionalities :

##### 1. VM Pool Management

(No. of VMs in pool and different configuration in which they are executing)

##### 2. VM Image Repository

(Every VM has an image)

##### 3. Reservation

(Reserving VM for high priority requirement)

##### 4. Monitoring

(If user pays for a resource but doesn't use it, it is given to some other user in demand)

##### 5. Scheduling

(Order of providing resources).

##### 6. QoS & SLA

(QoS - how resources are given to user (quality))  
(SLA - how resources are used)

##### 7. Billing / Pricing

### 3 Major Components :

#### 1. Compute Resources

- VM<sub>1</sub>, Bare Metal Servers
- Eg. Amazon EC2 → Create VM  
(Elastic Compute Cloud)

#### 2. Networking Based Components

- Virtual Networks, Load Balancing
- Eg. Amazon VPC (Virtual Private Cloud)  
Amazon ELB (Elastic Load Balancing)

#### 3. Storage

##### 3.1. Block Based

- Data is divided into fixed size chunks, each having a unique identifier
- Eg. Amazon EBS (Elastic Block Storage)

##### 3.2. File Based

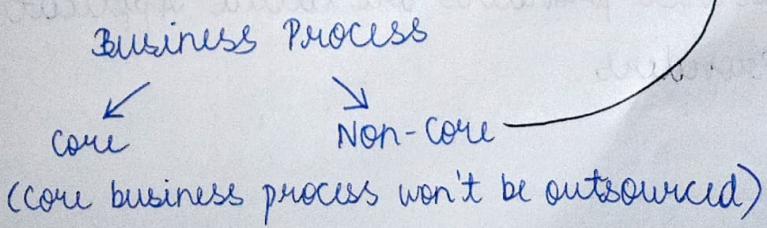
- Files and folders organized in hierarchy
- Eg. Amazon EFS (Elastic File Storage)

##### 3.3. Object Based

- Object based meta data
- Eg. Amazon S3 (Simple Secure Storage)

#### 5) BPAAS (Business Process as a Service)

It is a cloud computing service model that enables any business to outsource their business process to a third-party service provider



Horizontal Business as a Service	Vertical Business as a Service
<ul style="list-style-type: none"> <li>The activities that involve interaction with outside environment</li> </ul>	<ul style="list-style-type: none"> <li>The activities that form a part of the whole system at boundary levels</li> </ul>
<ul style="list-style-type: none"> <li>Example :</li> <li>- CRM - Customer Relationship Management (Order Payment)</li> <li>- Procurement</li> <li>- HR Management (Payroll, customer support)</li> </ul>	<ul style="list-style-type: none"> <li>Example :</li> <li>- Banking and Financial Services (loan Processing)</li> <li>- Inventory (Retail)</li> <li>- Telecommunications (Billing, Revenue)</li> </ul>
<ul style="list-style-type: none"> <li>can focus more on core activities</li> </ul>	<ul style="list-style-type: none"> <li>Helps to reduce HR resources</li> </ul>

### Merits :

- Automated streamlining of non-core activities
- cutting edge at reduced cost  
cutting resources
- Handling fluctuating business demand

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### ⑥ Application as a Service

It is a cloud computing service model that offers access to softwares hosted on cloud. These are called software on demand. These service providers are called Application Service Providers

## • Types

### i) Functional / Specialist ASP

- A single application is offered to the clients
- Eg. Gmail

### ii) Vertical ASP

- Integrated family of applications
- Eg. Oracle

### iii) Enterprise ASP

- Provides integrated services for complex IT needs
- Eg. CRM, SAP, ERP

### iv) Local ASP

- Software will be provided only to people of specific geographic location for local use

- Eg.

Net Magic  
(AWS)

Mumbai

- Cloud Migration
- Disaster Recovery

Sonata Software  
(Azure)

Bangalore

- Cloud Migration

Seance  
(GCP)

Ahmedabad

- Cloud Migration
- Cloud Native Application

## 7) Integration as a Service

It is a cloud computing service model that integrates application data from different sources or different systems

Types	AWS	Azure	GCP
i) Application Integration Integration of different applications along with process automation	Amazon Application Synchronization	Azure logic app	Google Cloud Pub/Sub
ii) Data Integration Integration of data from different sources into a unified view for analyzing and reporting	Amazon glue	Azure Data Factory	Google Cloud Dataflow
iii) API Integration It enables creation, managing and communication between interfaces that enables different systems to be integrated	Amazon API Gateway	Azure API Integration	Apigee
iv) Workflow Automation It refers to set of repetitive tasks that needs to be automated by integrating the system	Amazon Step Function	Azure Automation	Google Cloud Workflow
v) B2B Integration (Business to Business) It offers integration services between business and external agencies	Amazon Transfer Family	Azure Integration	Google Cloud Interconnect

## 8) Testing as a Service

It is a cloud computing service model that offers testing as a service to the clients.

### ◆ Types : (FURPS)

#### 1. Functionality Testing

- The intention is to check whether the functionalities are implemented according to the specified requirements
- Eg. AWS Cloud Build

#### 2. Performance Testing

- The intention is to check the non-functional requirements with respect to external environment.
- Eg. AWS Cloud Watch

#### 3. Usability Testing

- The intention is to check whether it is user friendly and convenient.
- Eg. AWS Cloud Watch

#### 4. Security Testing

- The intention is to identify the security vulnerabilities
- Eg. Azure Penetration Testing Services

#### 5. Regression Testing

- The intention is to retest to ensure that there is no impact because of recent changes
- Eg. Azure Pipelines

	Management as a Service	Governance as a Service
Definition	Manage and monitor IT resources and operations	Whether IT resources are aligned with business objectives
Focus	Management of IT resources	compliance, Governance
Objective	<ul style="list-style-type: none"> <li>Infrastructure</li> <li>db - s/w - n/w</li> <li>Security</li> </ul>	<ul style="list-style-type: none"> <li>Audit Management</li> <li>Compliance Management</li> <li>Risk Management</li> <li>Policy Management</li> <li>Data Governance Management</li> </ul>
Example	Azure, AWS cloud management services	Data Governance (Informatica) Compliance (logic Gate)

## 10) Security as a Service

Threat Intelligence:

- Proactive - Preventive Mechanism
- Reactive - After threat has occurred, measures that were taken

### • Major Security Mechanism / Services

#### 1. IAM (Identity Access Management)

- Assigning and reassigning privileges for user
- Eg. Microsoft Azure Active Directory

#### 2. DLP (Data Loss Prevention)

- If data is not lost, stole, misused, then it's called DLP
- Eg. Symantec DLP

### 3. Email Security

- only for internal services
- single system security
- Eg. Proof Point

### 4. Web Security

- multiple systems, security
- Eg. CISCO Umbrella

### 5. Network Security

- Multiple network security
- Eg. Fortinet, Forti Gate

### 6. IDPS

- Intrusion Detection and Prevention System
- Eg. logic Gate

### 7. Vulnerability Scanning

- checking for security breaches
- Ensures how far security breaches are affecting the work
- Eg. Rapid 7

### 8. Cloud Security

- Covers entire cloud projects (multiple resources & clients)
- Eg. AWS Security Hub

### 9. Threat Intelligence

- Eg. Fire Eye Threat Intelligence

### 10. End point Detection

- Eg. Symmantic Endpoint

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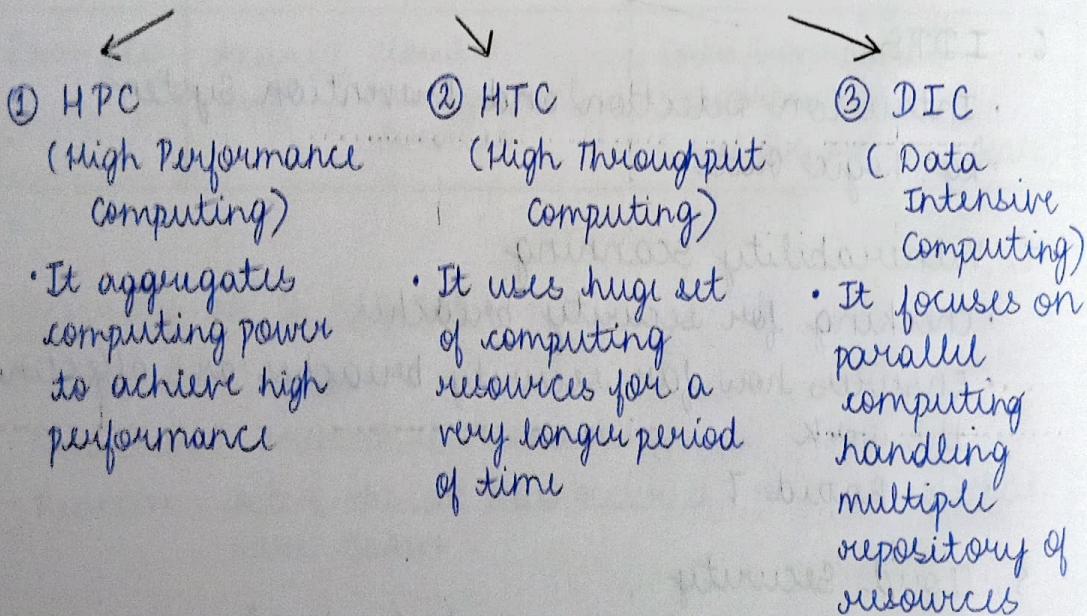
## Cloud Applications

### ♦ Features of Cloud

[★ Q) Mention the major features of cloud that dragged the popularity across diversified applications]

- 1) Availability of large Scale of Computing Resources
- 2) Storage at sustainable cost
- 3) Rapid delivery of services at minimal cost

### ♦ Scientific Applications



### ♦ Healthcare Applications

- ECG - Electro Cardiogram
- It is the electronic manifestation of myocardium
- Arrhythmias - Irregular or abnormal heartbeat

Steps	① ECG Analysis on Cloud		② Gene Expression - cancer diagnosis	
	Focus	Example	Focus	Example
1. Data acquisition	Data is collected from the patients with the help of sensors on wearable device.	AWS S3		
2. Data uploading	upload the data into cloud	AWS IOT Core		• AWS Database • Azure Datafactory
3. Data Preprocessing	Normalization of data, removal of noise	AWS Lambda	" and filter low quality images	
4. Feature Extraction	Diagnose arrhythmias from waveform	Google Cloud ML	Gene expressions are extracted to find its deviation with normal gene expression	• AWS ML Studio • Google cloud • AI Platform
5. Classification	To classify if the waveform has arrhythmias or not	Sage maker/ Tensorflow on cloud	To classify if patient has cancer or not	
6. Visualization	The predicted results can be visualized using cloud services	Power BI (Business Intelligence)		• Gene Expression Tools • Heatmap • Dendrogram
7. Storage	The results are stored for future purpose	AWS RDS (Relational Database Service)		
8. Alerts & Notification		AWS SNS (Simple Notification Service)		
Collaboration			Discussion on different formulas for future research	Azure Devops

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## ♦ Geoscience Applications

- Earthquake Prediction
- Weather Forecasting
- Climate Modeling
- Satellite Imaging
- GIS - Geographic Information System

\* Storage happens as object  
A unit is called bucket

\* Time series and spatial data → 2 types of data

↓  
used for  
forecasting

↓  
Eg. GIS

Steps	Focus	Example
1) Data Collection	Sensor Data, Satellite Data, Climate Data, Seismic Data	GCP Public Datasets
2) Data Storage	Spatial + Time Series	AWS S3
3) Data Preprocessing	Raw Data → Usable Format	AWS Lambda, GCP Data Proc
4) Data Integration	Merge data from multiple sources	GCP Big Query
5) Simulation or Modeling	climate models, seismic models	GCP Compute Engine
6) Visualization	Analyze patterns	Power BI, Tableau, GCP, AI Platform
7) Results Storage	Future Use	AWS S3
8) Collaboration and sharing	Share data / models with researchers	Azure sharepoint, GCP firebase

- \* Modeling → Having a prototype and verified its working  
\* Simulation → Just a prediction