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"Cloud Platforms and Cloud Applications"

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SYLLABUS

- **Amazon Web Services (AWS):** Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB).

- **Microsoft Cloud Services:** Azure core concepts, SQL Azure, Windows Azure Platform Appliance.

- **Cloud Computing Applications:** Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Google Cloud Application: Google App Engine. Overview of OpenStack architecture.

AWS Introduction

Amazon Web Services(AWS)

AWS stands for Amazon Web Services.

The AWS service is provided by the Amazon that uses distributed IT infrastructure to provide different IT resources available on demand. It provides different services such as infrastructure as a service (IaaS), platform as a service (PaaS) and packaged software as a service (SaaS).

Amazon launched AWS, a cloud computing platform to allow the different organizations to take advantage of reliable IT infrastructure.

Amazon Web Services(AWS)

Uses of AWS

Simple Storage Service

Simple Email Service

CloudFront

Website Hosting

File Sharing System

Amazon Web Services(AWS)

Uses of AWS :

- A small manufacturing organization uses their expertise to expand their business by leaving their IT management to the AWS.

- A large enterprise spread across the globe can utilize the AWS to deliver the training to the distributed workforce.

- An architecture consulting company can use AWS to get the high-compute rendering of construction prototype.

- A media company can use the AWS to provide different types of content such as ebox or audio files to the worldwide files.

Amazon Web Services(AWS)

Pay-As-You-Go :

Based on the concept of Pay-As-You-Go, AWS provides the services to the customers.

AWS provides services to customers when required without any prior commitment or upfront investment. Pay-As-You-Go enables the customers to procure services from AWS.

- Computing

- Programming models

- Database storage

- Networking

Amazon Web Services(AWS)

Advantages of AWS :

1) Flexibility

- We can get more time for core business tasks due to the instant availability of new features and services in AWS.

- It provides effortless hosting of legacy applications. AWS does not require learning new technologies and migration of applications to the AWS provides the advanced computing and efficient storage.

- AWS also offers a choice that whether we want to run the applications and services together or not. We can also choose to run a part of the IT infrastructure in AWS and the remaining part in data centres.

2) Cost-effectiveness

AWS requires no upfront investment, long-term commitment, and minimum expense when compared to traditional IT infrastructure that requires a huge investment.

Amazon Web Services(AWS)

Advantages of AWS :

3) Scalability/Elasticity

Through AWS, autoscaling and elastic load balancing techniques are automatically scaled up or down, when demand increases or decreases respectively. AWS techniques are ideal for handling unpredictable or very high loads. Due to this reason, organizations enjoy the benefits of reduced cost and increased user satisfaction.

4) Security

AWS provides end-to-end security and privacy to customers.

AWS has a virtual infrastructure that offers optimum availability while managing full privacy and isolation of their operations.

Customers can expect high-level of physical security because of Amazon's several years of experience in designing, developing and maintaining large-scale IT operation centers.

AWS ensures the three aspects of security, i.e., Confidentiality, integrity, and availability of user's data.

History of Amazon Web Services(AWS)

2002- AWS services launched

2006- Launched its cloud products

2012- Holds first customer event

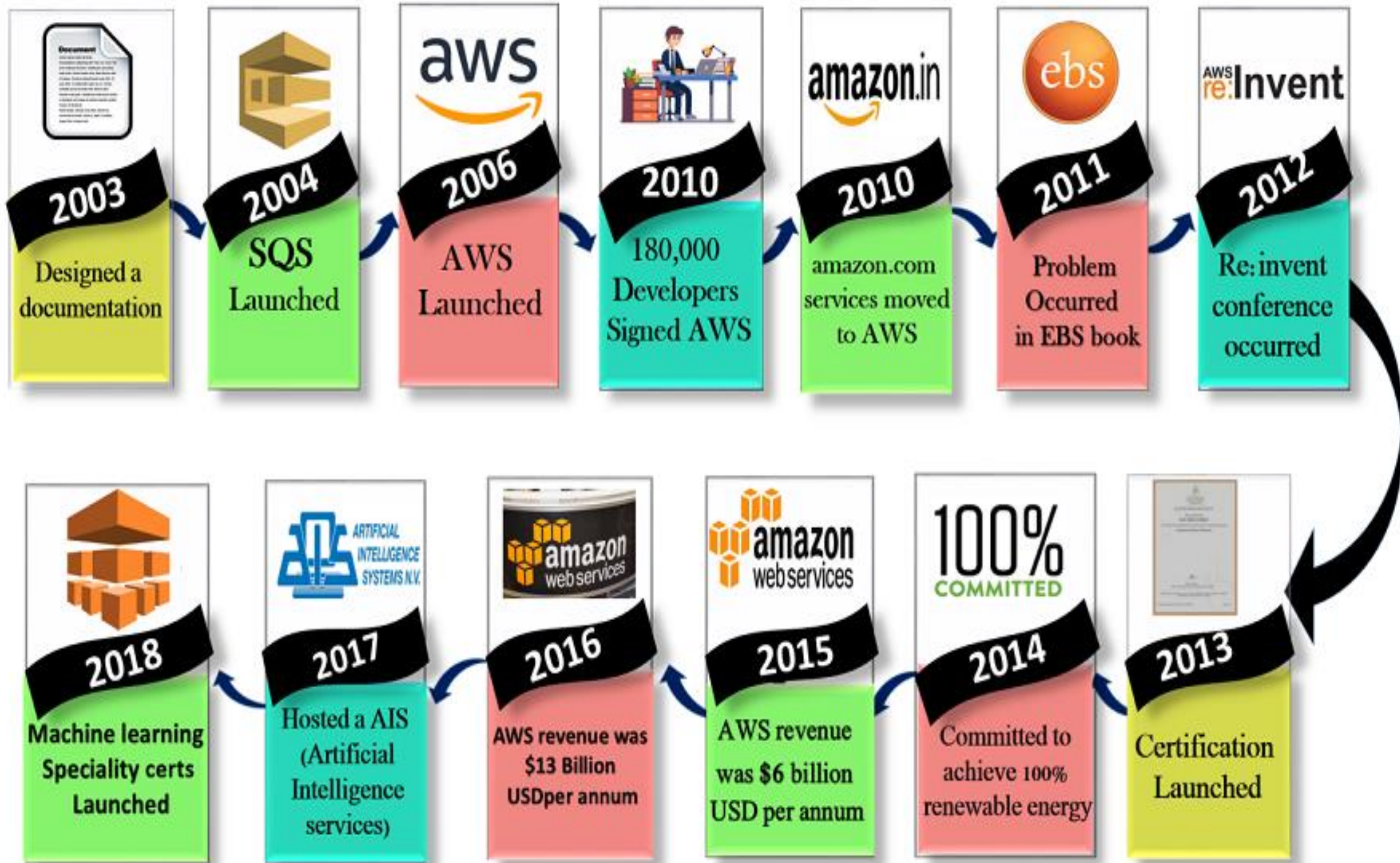**2015-** Reveals revenues achieved of $4.6 billion

2016- Surpassed $10 billon revenue target

2016- Release snowball and snowmobile

2019- Offers nearly 100 cloud services

2021- AWS comprises over 200 products and services

History of Amazon Web Services(AWS)

2003 — Designed a documentation

2004 — SQS Launched

2006 — AWS Launched

2010 — 180,000 Developers Signed AWS

2010 — amazon.com services moved to AWS

2011 — Problem Occurred in EBS book

2012 — Re:invent conference occurred

2018 — Machine learning Speciality certs Launched

2017 — Hosted a AIS (Artificial Intelligence services)

2016 — AWS revenue was $13 Billion USDper annum

2015 — AWS revenue was $6 billion USD per annum

2014 — Committed to achieve 100% renewable energy

2013 — Certification Launched

Features of Amazon Web Services(AWS)

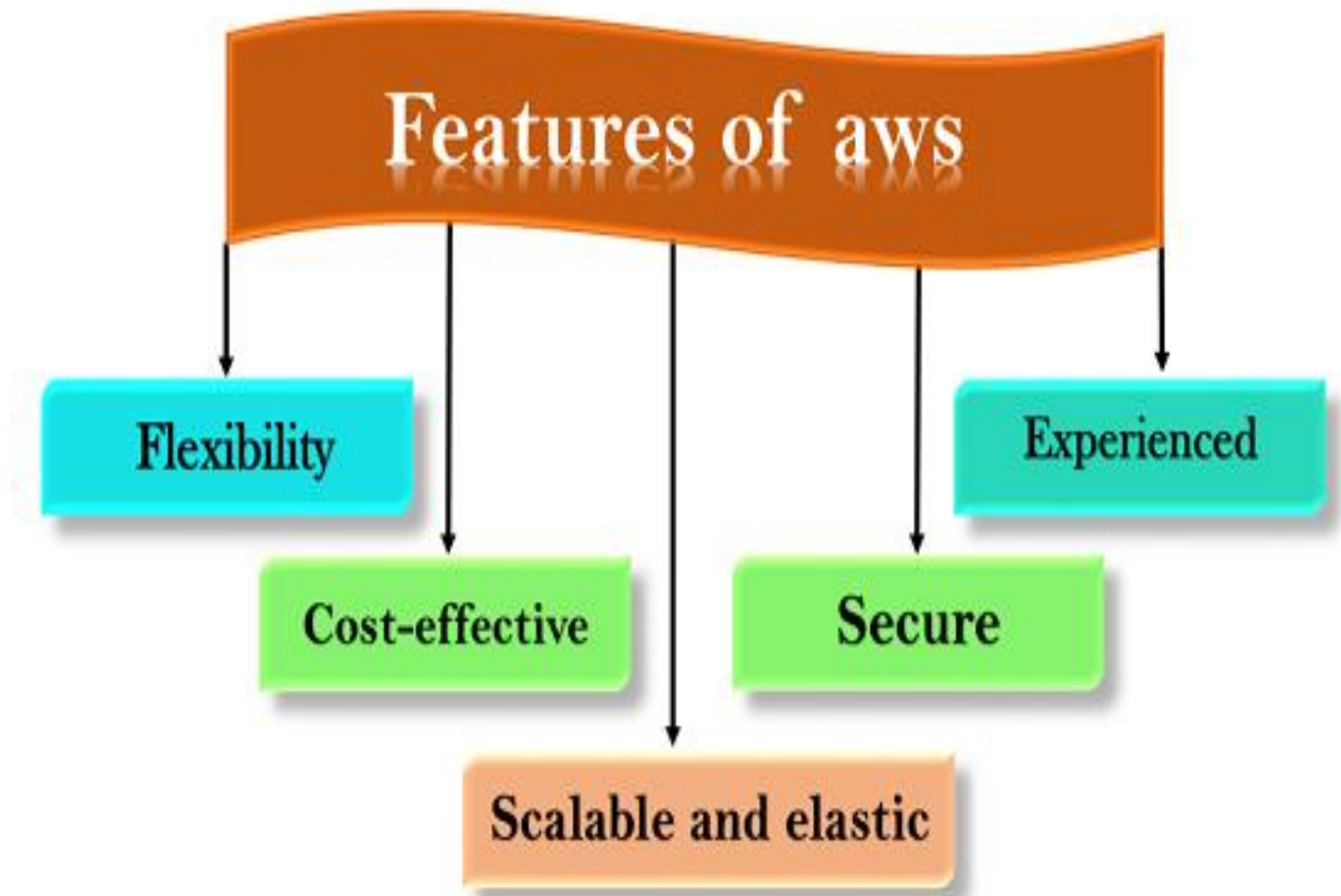**The following are the features of AWS:**

1. Flexibility

2. Cost-effective

3. Scalable and elastic

4. Secure

5. Experienced

Advantages of Amazon Web Services(AWS)

1. AWS allows organizations to use the already familiar programming models, operating systems, databases, and architectures.

2. It is a cost-effective service that allows you to pay only for what you use, without any up-front or long-term commitments.

3. You will not require to spend money on running and maintaining data centers.

4. Offers fast deployments

5. You can easily add or remove capacity.

6. You are allowed cloud access quickly with limitless capacity.

7. Total Cost of Ownership is very low compared to any private/dedicated servers.

8. Offers Centralized Billing and management

9. Offers Hybrid Capabilities

10. Allows you to deploy your application in multiple regions around the world

Disavantages of Amazon Web Services(AWS)

1. If you need more immediate or intensive assistance, you'll have to opt for paid support packages.

2. Amazon Web Services may have some common cloud computing issues when you move to a cloud. For example, downtime, limited control, and backup protection.

3. AWS sets default limits on resources which differ from region to region. These resources consist of images, volumes, and snapshots.

4. Hardware-level changes happen to your application which may not offer the best performance and usage of your applications.

Applications of AWS Services

Amazon Web services are widely used for various computing purposes like:

1. Web site hosting

2. Application hosting/SaaS hosting

3. Media Sharing (Image/ Video)

4. Mobile and Social Applications

5. Content delivery and Media Distribution

6. Storage, backup, and disaster recovery

7. Development and test environments

8. Academic Computing

9. Search Engines

10. Social Networking

Companies Using AWS Services

1. Instagram

2. Netflix

3. Twitch

4. LinkedIn

5. Facebook

6. Turner Broadcasting: $10 million

7. Zoopla

8. Smugmug

9. Pinterest

10. Dropbox

AWS Services and Components

Basics of Cloud Computing

1. Cloud computing adopts **scalable computing assets** and users have to pay as per use.

2. Users are able to access any of the assets that reside in the 'cloud' at any time and from any location over the Internet.

3. The user does not have to care about how things are being sustained behind the scenes in the cloud.

4. Cloud computing is a paradigm move in how we architect and consign scalable applications.

5. As compared to the previous traditional methods cloud utilize the surplus computing capability and give it to the next consumers.

Services of Amazon Web Services(AWS)
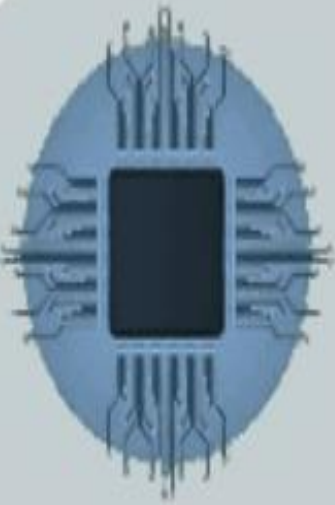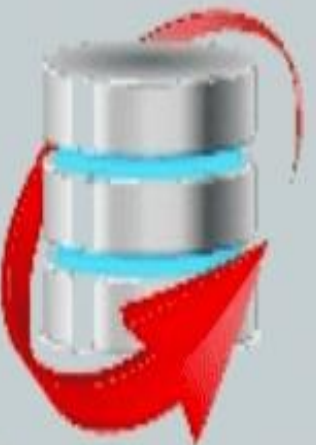
Compute

Migration

Security

Storage

Networking

Messaging

Database

Management Tools

Analytics

Cloud services offered by the AWS

AWS offers a number of cloud services in separate domains and services, we have enlisted them below:

1. **Networking**: All networking related services are included in this like security, faster access and other

 eg. Virtual Private cloud, Elastic load balancing

2. **Database**: This domain is used to provide reliable relational and non-relational database

Eg. Amazon simple DB,Relational Database service(RDS)

3. **Management Tools**: The services that are used to maintain and monitor AWS instances are included in this.

Eg. Amazon cloud watch

Cloud services offered by the AWS

4. Storage and Content Delivery: Storage is used to store cloud data, but content delivery is about data caching at nearby place or location.

Eg. S3,Elastic block storage,AWS Import/Exp,Amazon CloudFront

5. Application Services: Simple services like emailing, queuing and notifications are included in these services

Eg. Amazon SES,Amazon SQS

6. Compute: It is used to process the cloud data that needs powerful processors ahead to serve multiple instances together.

Eg. Elastic compute cloud(EC2),Elastic mapreduce,Auto scaling

AWS Components

a. Amazon S3(Storage)

Amazon Simple Storage Service (S3) provides a web service interface for the storage and retrieval of data. Easily accessible over internet. Provides storage with data security.

b.Amazon EC2 (Elastic Computing)

Amazon EC2 is a web service that provides virtual machines on demand. EC2 is constructed on Xan hypervisor(VM) allows AMI(Amazon Machines Images) to act as templates for the instances.EC2 scale up computing assets and the servers vary from Single core x86 to eight core x86_64 servers

c.Amazon SQS (Simple Queue Services)

Amazon Simple Queue Service (SQS) gives access to messaging infra structure. The user can send or receive messages by using REST(REpresentational State Transfer) based HTTP request. SQS works with other Amazon web services to coordinate the workflow and auto scaling EC2.

AWS Components

There are number of key components in AWS Cloud computing and the main components are :

1. **Simple E-mail Service:** It allows sending e-mail using RESTFUL API call or via regular SMTP.

2. **Identity and Access Management**: It provides enhanced security and identity management for your AWS account.

3. **Simple Storage Device or (S3):** It is a storage device and the most widely used AWS service.

AWS Components

There are number of key components in AWS Cloud computing and the main components are :

4. **Elastic Compute Cloud (EC2):** It provides on-demand computing resources for hosting applications. It is very useful in case of unpredictable workloads.

5. **Elastic Block Store (EBS):** It provides persistent storage volumes that attach to EC2 to allow you to persist data past the lifespan of a single EC2.

6. **CloudWatch:** To monitor AWS resources, It allows admins to view and collect key Also, one can set a notification alarm in case of trouble.

Amazon SimpleDB

- **Amazon SimpleDB** is a distributed database service developed by Amazon.com in the Erlang programming language. Released on December 13, 2007, Amazon SimpleDB is an Amazon Web Services (AWS) component that works in conjunction with Amazon Simple Storage Service (Amazon S3) and Amazon Elastic Compute Cloud (EC2).

- **Amazon SimpleDB** facilitates cloud storage, processing and query processing. The service is easy to use and provides most core traditional database features, including real-time processing and simplified structured data queries.

Features of Amazon SimpleDB

- **Amazon SimpleDB features include:**

1. **Flexibility:** Allows for the easy addition of new attributes without predefined data formats

2. **Efficiency:** Provides quick and easy data storage and retrieval

3. **Scalability:** Facilitates new domain creation to accommodate increases in data volume

4. **Easy integration:** Designed for easy integration with other Amazon Web services, such as Amazon EC2 and Amazon S3

5. **Cost effective:** Users only pay for actual consumed resources. Amazon usage types include structured data storage, data storage and machine utilization.

Benefits of Amazon SimpleDB

· **The following are Amazon SimpleDB benefits:**

1. Operational complexity is eliminated.

2. No schema is required.

3. A simple application programming interface (API) is used for access and storage.

4. Data is automatically indexed.

5. Administrative burden is reduced.

Amazon SimpleDB has several drawbacks, including weaker forms of consistency and storage limitations.

Elastic Compute Cloud(EC2)

- EC2 stands for Amazon Elastic Compute Cloud.

- Amazon EC2 is a web service that provides resizable compute capacity in the cloud.

- Amazon Elastic Compute Cloud (Amazon EC2) provides scalable computing capacity in the Amazon Web Services (AWS) Cloud. Using Amazon EC2 eliminates your need to invest in hardware up front, so you can develop and deploy applications faster. You can use Amazon EC2 to launch as many or as few virtual servers as you need, configure security and networking, and manage storage. Amazon EC2 enables you to scale up or down to handle changes in requirements or spikes in popularity, reducing your need to forecast traffic.

Features of Elastic Compute Cloud(EC2)

- Virtual computing environments, known as instances

- Preconfigured templates for your instances, known as Amazon Machine Images (AMIs), that package the bits you need for your server (including the operating system and additional software)

- Various configurations of CPU, memory, storage, and networking capacity for your instances, known as instance types

- Secure login information for your instances using key pairs (AWS stores the public key, and you store the private key in a secure place)

- Storage volumes for temporary data that's deleted when you stop, hibernate, or terminate your instance, known as instance store volumes

- Persistent storage volumes for your data using Amazon Elastic Block Store (Amazon EBS), known as Amazon EBS volumes
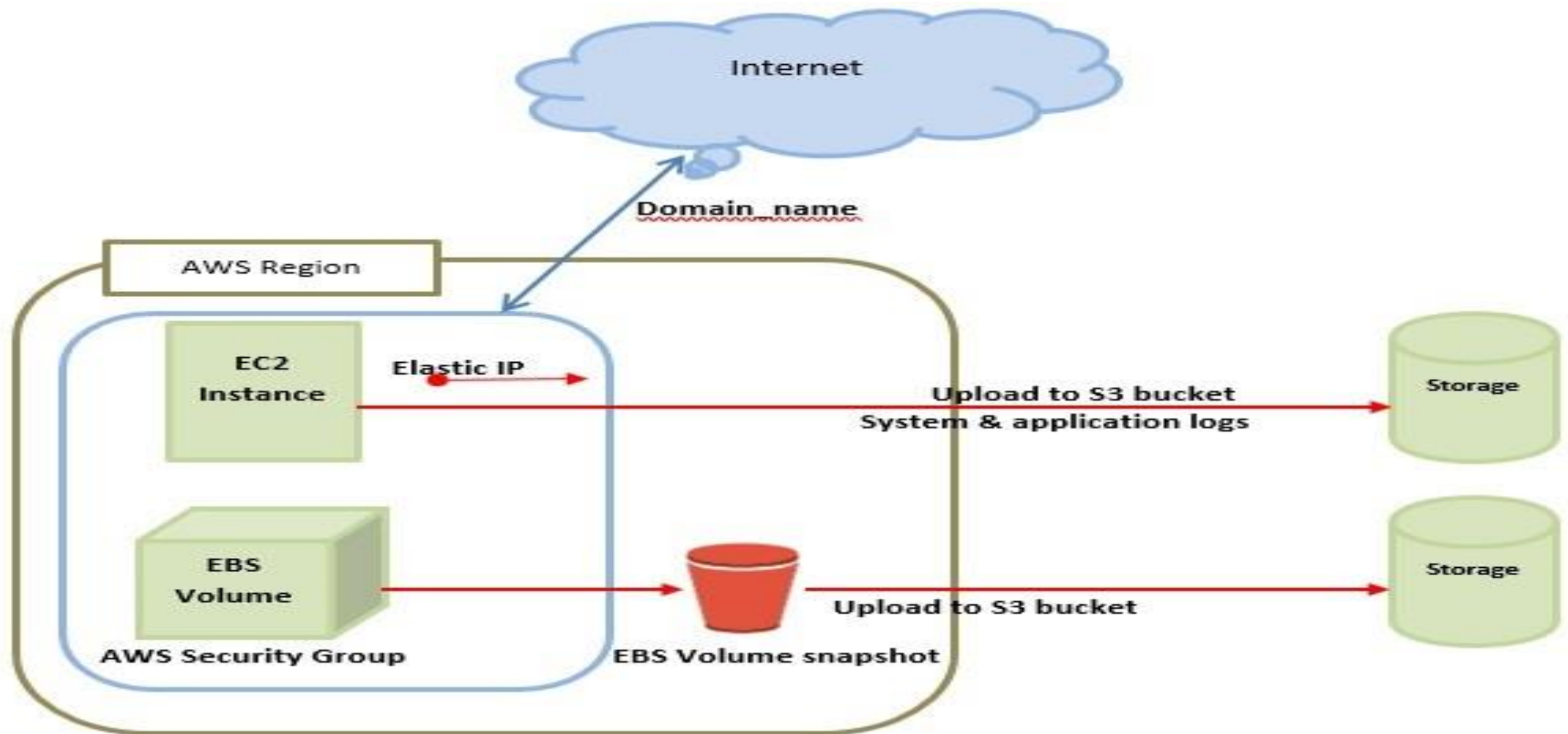
Features of Elastic Compute Cloud(EC2)

- Multiple physical locations for your resources, such as instances and Amazon EBS volumes, known as Regions and Availability Zones

- A firewall that enables you to specify the protocols, ports, and source IP ranges that can reach your instances using security groups

- Static IPv4 addresses for dynamic cloud computing, known as Elastic IP addresses

- Metadata, known as tags, that you can create and assign to your Amazon EC2 resources

- /Virtual networks you can create that are logically isolated from the rest of the AWS Cloud, and that you can optionally connect to your own network, known as virtual private clouds (VPCs)

Why is AWS EC2 important?

- You don't require any hardware units

- Easily scalable (up or down)

- You only pay for what you use

- You have complete control

- Highly secure

- You can access your assets from anywhere in the world

Elastic Compute Cloud(EC2)

- This is the basic structure of AWS EC2, where EC2 stands for Elastic Compute Cloud. EC2 allow users to use virtual machines of different configurations as per their requirement. It allows various configuration options, mapping of individual server, various pricing options, etc. We will discuss these in detail in AWS Products section. Following is the diagrammatic representation of the architecture.

Elastic Compute Cloud(EC2)

- **Note −** In the above diagram S3 stands for Simple Storage Service. It allows the users to store and retrieve various types of data using API calls. It doesn't contain any computing element. We will discuss this topic in detail in AWS products section.

- It is considered as the fundamental framework of AWS architecture or AWS EC2. Simply, EC2 is also called an Elastic Compute cloud which will permit the clients otherwise the customers of using various configurations in their own task or technique according to their requirement. There are also various incredible options such as price options, specific server mapping, arrangement server, and so on. S3 which is present in the AWS architecture is called Simple Storage Providers. By using this S3, customers can easily get or else shop data through different data types using Application Programs Interface calls. There will be no computing element for the services as well.

Components of Elastic Compute Cloud(EC2)

- **Load Balancing**
- Load balancing simply means to hardware or software load over web servers, that improver's the efficiency of the server as well as the application. Following is the diagrammatic representation of AWS architecture with load balancing.

- Hardware load balancer is a very common network appliance used in traditional web application architectures.

- AWS provides the Elastic Load Balancing service, it distributes the traffic to EC2 instances across multiple available sources, and dynamic addition and removal of Amazon EC2 hosts from the load-balancing rotation.

- **Elastic Load Balancing** can dynamically grow and shrink the load-balancing capacity to adjust to traffic demands and also support sticky sessions to address more advanced routing needs

Components of Elastic Compute Cloud(EC2)

- **Amazon Cloud-front**
- It is responsible for content delivery, i.e. used to deliver website. It may contain dynamic, static, and streaming content using a global network of edge locations. Requests for content at the user's end are automatically routed to the nearest edge location, which improves the performance.

- Amazon Cloud-front is optimized to work with other Amazon Web Services, like Amazon S3 and Amazon EC2. It also works fine with any non-AWS origin server and stores the original files in a similar manner.

- In Amazon Web Services, there are no contracts or monthly commitments. We pay only for as much or as little content as we deliver through the service.

Components of Elastic Compute Cloud(EC2)

- **Elastic Load Balancer**

- It is used to spread the traffic to web servers, which improves performance. AWS provides the Elastic Load Balancing service, in which traffic is distributed to EC2 instances over multiple available zones, and dynamic addition and removal of Amazon EC2 hosts from the load-balancing rotation.

- Elastic Load Balancing can dynamically grow and shrink the load-balancing capacity as per the traffic conditions**.**

- **Security Management**

- Amazon's Elastic Compute Cloud (EC2) provides a feature called security groups, which is similar to an inbound network firewall, in which we have to specify the protocols, ports, and source IP ranges that are allowed to reach your EC2 instances.

- Each EC2 instance can be assigned one or more security groups, each of which routes the appropriate traffic to each instance. Security groups can be configured using specific subnets or IP addresses which limits access to EC2 instances.

Elastic Compute Cloud(EC2)

- **Elastic Caches**

- Amazon Elastic Cache is a web service that manages the memory cache in the cloud. In memory management, cache has a very important role and helps to reduce the load on the services, improves the performance and scalability on the database tier by caching frequently used information.

- **Amazon RDS**

- Amazon RDS (Relational Database Service) provides a similar access as that of MySQL, Oracle, or Microsoft SQL Server database engine. The same queries, applications, and tools can be used with Amazon RDS.

- It automatically patches the database software and manages backups as per the user's instruction. It also supports point-in-time recovery. There are no up-front investments required, and we pay only for the resources we use

Major Components of EC2

- Amazon Machine Images and Instances

- Storage

- Amazon S3

- Databases

- Amazon Cloud Watch

Elastic Compute Cloud(EC2)

- Amazon Elastic Compute Cloud is a most important component of Amazon.com's cloud computing platforms as EC2 permits scalable deployment of applications.

- Amazon Elastic Compute Cloud (EC2) is a world wide web service that presents resizable computing capability , utilized to construct and host software systems

Amazon Machine Images & Instances

An *Amazon Machine Image (AMI)* is a template that contains a software configuration (for example, an operating system, an application server, and applications). It is possible to launch an *instance*, which is a copy of the AMI running as a virtual server in the cloud. The user can launch multiple instances until client halts or terminates them.
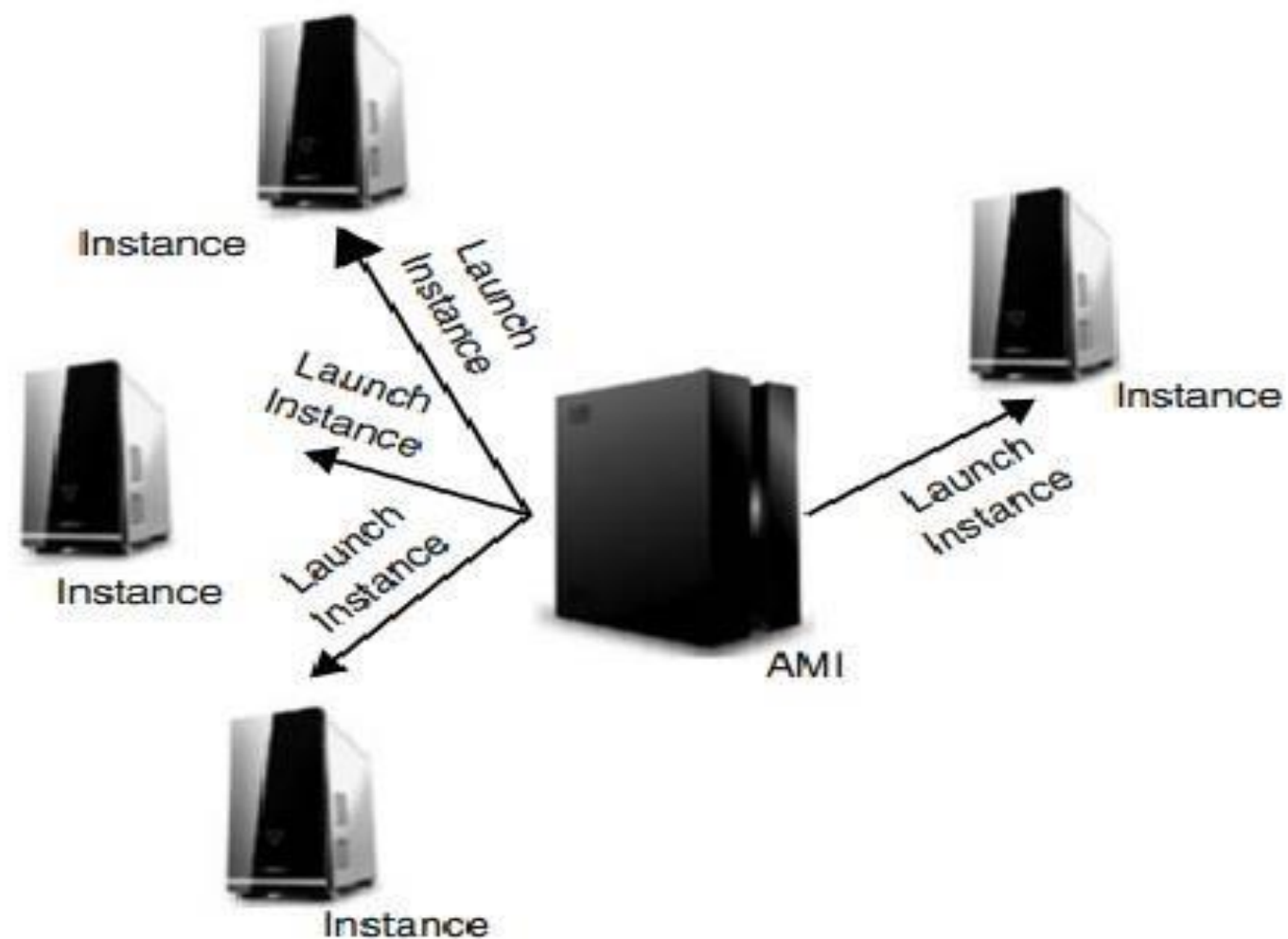
Fig 1 : Amazon Machines Images and Instances

Storage

- Working with EC2 need storage of data the two most popular storage types are :

1. Amazon Simple Storage Service (Amazon S3)

2. Amazon Elastic Block Store (Amazon EBS) volumes

Amazon S3

- Amazon S3 is a storage for the internet, connected with WWW service interface to ensure data accessibility over web.

- Amazon Elastic Block Store provides raw block-level storage that can be attached to Amazon EC2 instances and is used by Amazon Relational Database Service. Amazon EBS provides a range of options for storage performance and cost.

Databases

1. Amazon Relational Database Service (Amazon RDS), provides organized relational database in the cloud.

2. Launch an instance of a database AMI and use that EC2 instance as the database.

Amazon CloudWatch

- Web service that presents real-time supervising to Amazon's EC2 clients on their asset utilization, such as CPU, computer disk and network.

- CloudWatch does not supply any recollection, computer disk space or load average metrics.

- Data aggregated and supplied through the AWS administration which is accessed through console online tools and web API's

Amazon Storage System

Amazon Simple Storage Service (Amazon S3) is the most widely used object storage service and used by most of the companies, even startups to enterprise-level because of its scalability, data availability, security and performance any data stored over S3 is protected, secure and always available no matter what amount of data for a range of use cases, such as websites, mobile applications that generate lots of data, backups for applications, IoT devices, and big data analytics and all these at a very minimal cost with 99.99999999999% of durability, S3 is used as storage for many other AWS services like code commit, Streaming service, and many others.

Types of Amazon Storage System

1. Simple Storage Service (S3)

Amazon S3 is an object storage service that stores data of any type and size. It can store data for any business such as web applications, mobile applications, backup, archive, analytics. It also provides easy access control management for all your specific requirements and is almost 100% durable and by almost I mean 99.(11 nines)%. It can also be used to store all kinds of file formats as you would with a dropbox. S3 also allows a simple web-based file explorer to upload files, create folders or delete them.

2. Elastic Block Storage (EBS)

EBS provides block storage which is similar to hard drives to store any kind of data persistently. This can be attached to any EC2 instance and used as block storage, which even allows you to install any operating system. EBS volumes are placed in availability zones so that they are replicated to prevent loss of data due to single component failures. They provide absolute low-latency performance and you can also scale up or down your resources as and when required. EBS is available in both SSD and HDD formats depending on your requirement of speed and volume.

3. Elastic File System (EFS)

EFS is a managed network file system that is easy to set up right from the amazon console or CLI. When you have multiple EC2 instances needed to access the same file system EFS helps in providing just that. Unlike EBS, EFS is built using the NFS4.x protocol on SSDs and have a much faster throughput. This also means that EFS is much more expensive than EBS as it can be used on very large analytical workloads. EFS scales up or down based on the size of the files you store and is also accessible from multiple availability zones. The distributed nature of the file system can tempt you to use it as a CDN. But the costs of a CDN outweigh the benefits of using EFS. Hence it is better to use a CDN and use EFS in conjunction with files that can't be stored on a CDN.

4. AWS Storage Gateway

Storage Gateway is a simple way to let your on-premise applications store, access or archive the data into the AWS cloud. This is achieved by running on a hypervisor on one of the machines in your data center which contains the storage gateway and then is available on AWS to connect to S3, Glacier or EBS. It provides a highly optimized, network resilient and low-cost way to move your data from on-prem to the cloud. Local caching is also available on your on-prem to allow for accessing the more active data. Storage gateway also supports legacy backup stores such as tapes as virtual tapes backed up directly into AWS Glacier.

Amazon Storage System

- Amazon Simple Store Service (S3) is a service from Amazon that permits the users to store documents into dependable isolated storage for a very comparable price.

- S3 is utilized by businesses to store photographs and videos of their clients, back up their own data and more.

- S3 has API for both SOAP and REST.

- S3 manages objects and buckets which is accessible with permissions.

Amazon S3 is required for those who have the following issues

- Running out of bandwidth
- Better scalability
- Store documents online
- Easier documents retrieval and sharing

Amazon Database Service(DynamoDB)

Databases play a crucial role in the functioning of an application. Also, performance of an application is directly dependent on how the underlying database performs for the application. AWS Database Services is a set of databases offered by AWS on the cloud.

Amazon DynamoDB is a fast, fully managed, and flexible NoSQL database. It also supports document-based data. AWS affirms that DynamoDB delivers single-digit millisecond performance at any scale. DynamoDB comes with built-in Security, Backup, and Restore features.

Since DynamoDB is a NoSQL database, it doesn't require any schema. In DynamoDB, there are basically three core components:

Features of DynamoDB

1. **On-demand capacity mode:** The applications using the on-demand service, DynamoDB automatically scales up/down to accommodate the traffic.

2. **Built-in support for ACID transactions:** DynamoDB provides native/ server-side support for transactions.

3. **On-demand backup:** This feature allows you to create a complete backup of your work at any given point of time.

4. **Point-in-time recovery:** This feature helps you with the protection of your data in case of accidental read/ write operations.

5. **Encryption at rest:** It keeps the data encrypted even when the table is not in use. This enhances security with the help of encryption keys.
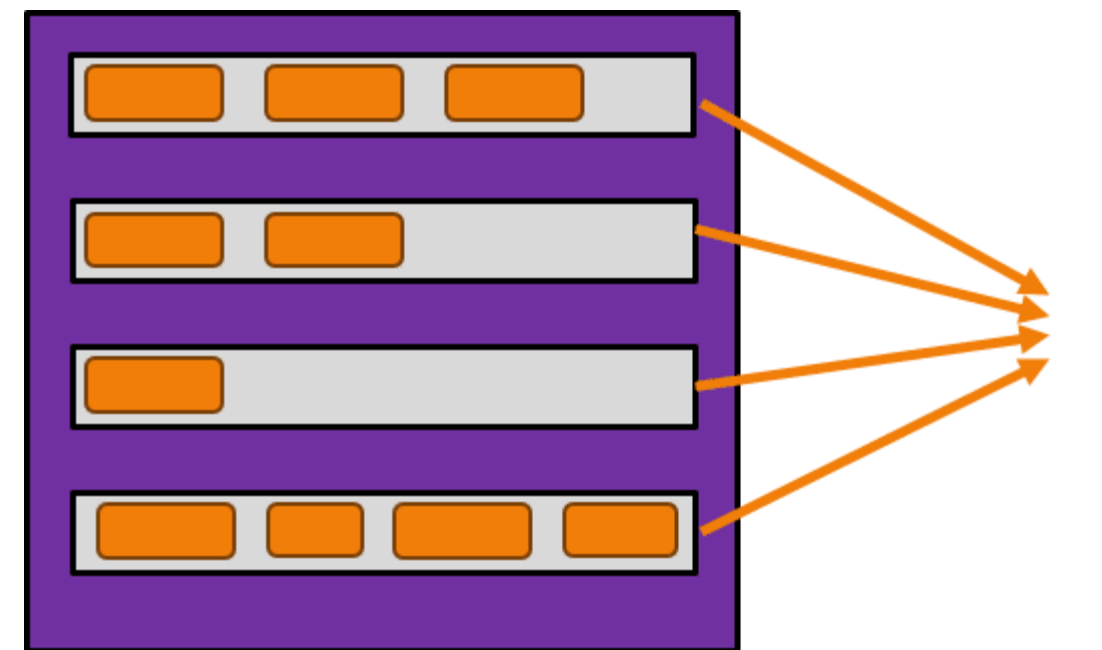
Amazon Database Service(DynamoDB)

1. Tables: The collection of data is called a table in DynamoDB. It's not a structured table with a fixed number of rows and columns.
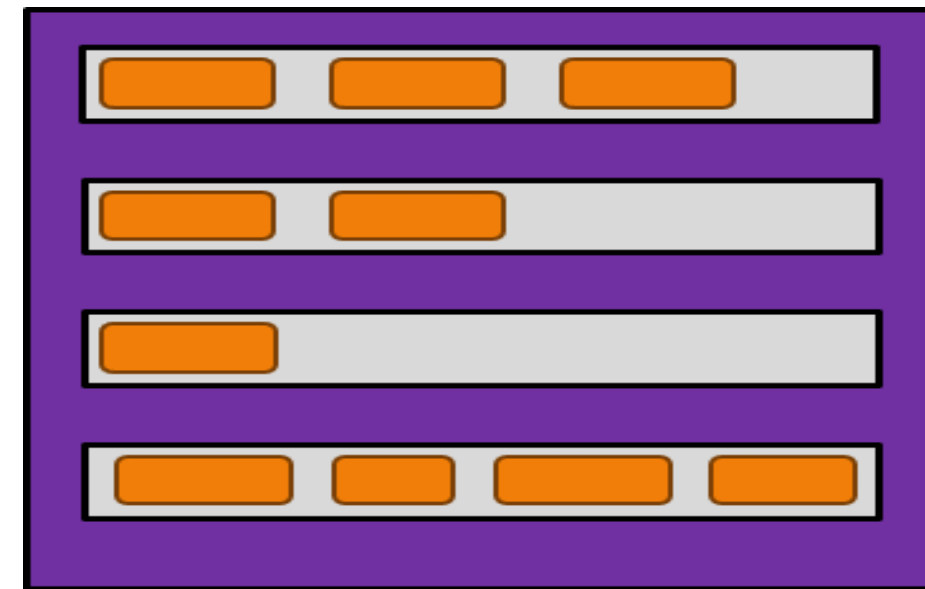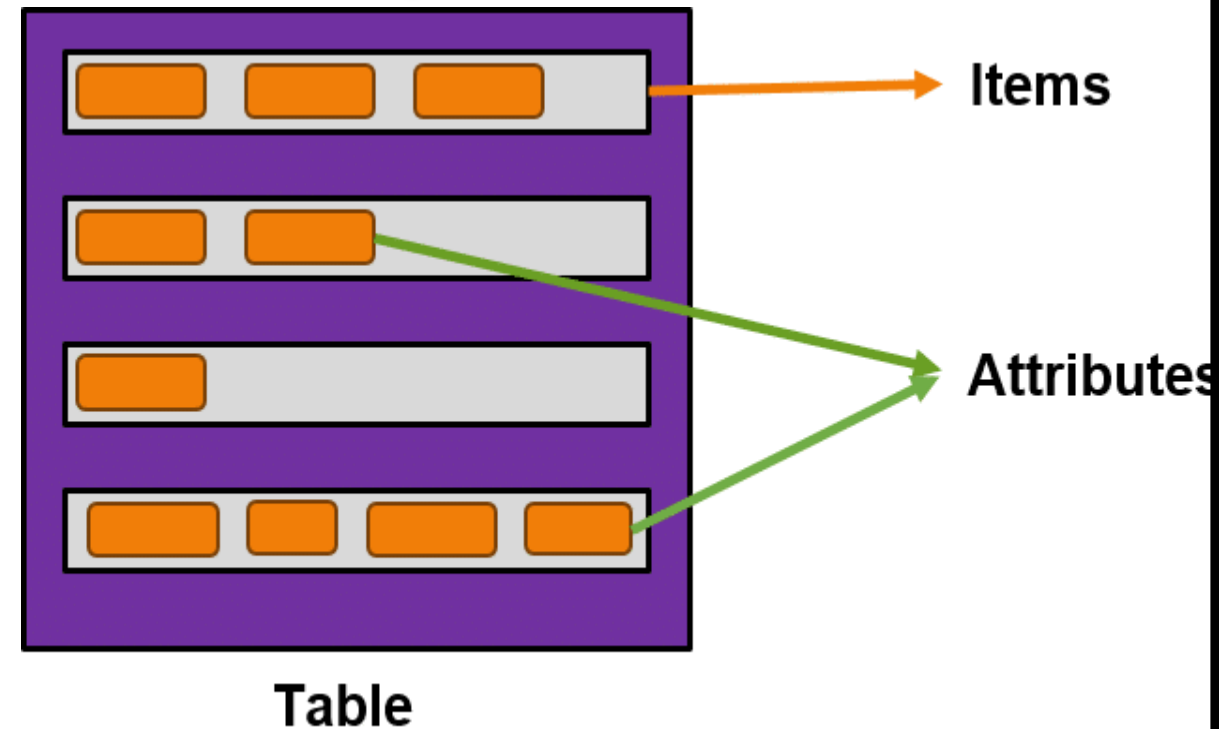
Table

2. Items: Tables in DynamoDB contain one or more items. Items are made up of a group of uniquely identifiable attributes.

Table

3. Attributes: Attributes are the data elements or values that reside in each item. They are equivalent to data values in a relational database that reside in a particular cell of a table.

Following are some of the benefits of using Amazon DynamoDB:

- Easy to set up and manage
- Data is automatically replicated across multiple Availability Zones
- Supports both key–value and document-based data models

Advantages of Amazon Database Service(DynamoDB)

Highly Scalable: You can scale your database as your application grows without any downtime!

Fully Managed: Everything, from maintenance to hardware upgrades, is managed by AWS.

Enterprise Class: You get the same world-class infrastructure used by Amazon's giant ecommerce platform.

Distributed: Now that your application and database exist on separate machines, your application becomes highly fault-tolerant.

Workforce Reduction: Since everything is managed by AWS, you don't need a Database Maintenance team in your organization.

Advantages of Amazon Database Service(DynamoDB)

1. It has fast and predictable performance.

2. It is highly scalable.

3. It offloads the administrative burden operation and scaling.

4. It offers encryption at REST for data protection.

5. Its scalability is highly flexible.

6. AWS Management Console can be used to monitor resource utilization and performance metrics.

7. It provides on-demand backups.

8. It can be highly automated.

Limitation of Amazon Database Service(DynamoDB)

1. It has a low read capacity unit of 4kB per second and a write capacity unit of 1KB per second.

2. All tables and global secondary indexes must have a minimum of one read and one write capacity unit.

3. Table sizes have no limits, but accounts have a 256 table limit unless you request a higher cap.

4. Only Five local and twenty global secondary (default quota) indexes per table are permitted.

5. DynamoDB does not prevent the use of reserved words as names.

6. Partition key length and value minimum length sits at 1 byte, and maximum at 2048 bytes, however, DynamoDB places no limit on values.

Amazon Database Services

- Amazon Relational Database Service (Amazon RDS) is a popular web service.

- It makes relational database setup, functions and scale on cloud easier.

- It gives cost-efficient, resizable capability for multiple industry-standard relational databases.

- It gives access of MySQL or Oracle database server to users.

Advantages of Amazon RDS

- Accelerated deployment
- Manage administration tasks.
- Compatible
- Scalable
- Reliable
- Secure
- Inexpensive

Microsoft Cloud Services

Microsoft Cloud Services

- **Windows Azure :** PaaS, it is a functioning system gives scalable compute and storage facilities

- **SQL Azure :** A cloud based , scale out type of SQL server

- **Windows Azure AppFabric :** An assemblage of services carrying applications both in the cloud and on premise.

Window Azure

- Microsoft Windows Azure is Cloud operating system built on top of Microsoft data centers infrastructure and provides developers with a collection of services for building application with the Cloud technology.

- Supports computing, storage, and networking to application connectivity, access control, and business intelligence.
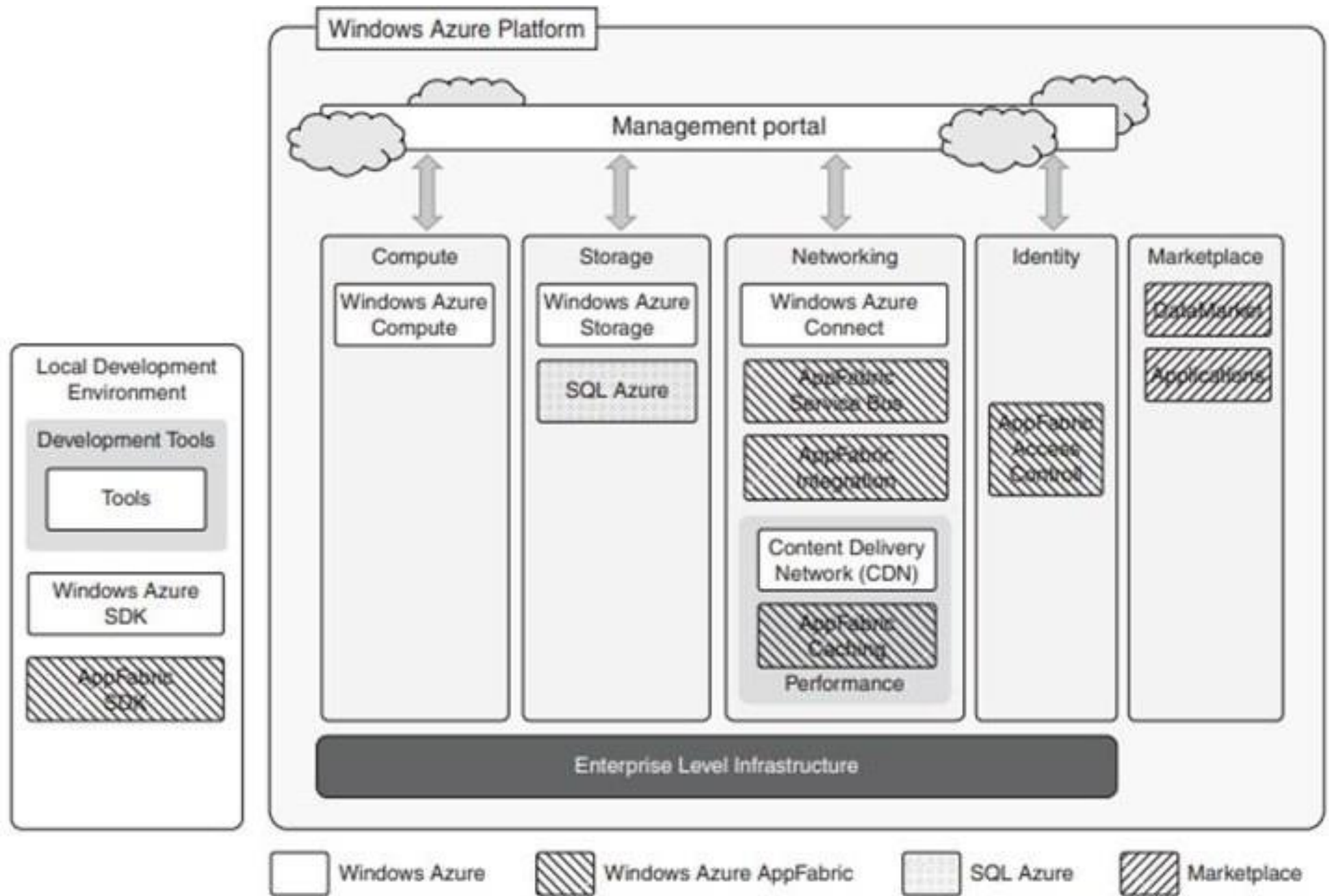
Overview of services provided by Azure. These services can be all managed and controlled through the Windows Azure Management Portal, which acts as administrative console for all the services of the Azure platform.

Azure Core Concepts

Microsoft Azure is a cloud computing platform that provides a wide variety of services that we can use without purchasing and arranging our hardware. It enables the fast development of solutions and provides the resources to complete tasks that may not be achievable in an on-premises environment. Azure Services like compute, storage, network, and application services allow us to put our effort into building great solutions without worrying about the assembly of physical infrastructure.

Definition :

"**Microsoft Azure** is a growing set of cloud computing services created by Microsoft that hosts your existing applications, streamline the development of a new application, and also enhances our on-premises applications. It helps the organizations in building, testing, deploying, and managing applications and services through Microsoft-managed data centers."

Azure Core Concepts

- **Compute services:** It includes the Microsoft Azure Cloud Services, Azure Virtual Machines, Azure Website, and Azure Mobile Services, which processes the data on the cloud with the help of powerful processors.

- **Data services:** This service is used to store data over the cloud that can be scaled according to the requirements. It includes Microsoft Azure Storage (Blob, Queue Table, and Azure File services), Azure SQL Database, and the Redis Cache.

Azure Core Concepts

- **Application services:** It includes services, which help us to build and operate our application, like the Azure Active Directory, Service Bus for connecting distributed systems, HDInsight for processing big data, the Azure Scheduler, and the Azure Media Services.

- **Network services:** It helps you to connect with the cloud and on-premises infrastructure, which includes Virtual Networks, Azure Content Delivery Network, and the Azure Traffic Manager.

Azure Core Concepts

How Azure works?

It is essential to understand the internal workings of Azure so that we can design our applications on Azure effectively with high availability, data residency, resilience, etc.

Azure Domains/ (Components)

Compute

Storage

Database

Security + Identify

Integration Services

Content Delivery Network

Monitoring

Networking

Mobile Services

Workflows

Web Services

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Applications of Microsoft Azure

Now in this Azure for beginners tutorial, we will learn the applications of Azure.

Microsoft Azure is used in a broad spectrum of applications like:

1. Infrastructure Services

2. Mobile Apps

3. Web Applications

4. Cloud Services

5. Storage, Backup, and Recovery

6. Data Management

7. Media Services

Advantages of Microsoft Azure

1. Azure infrastructure will cost-effectively enhance your business continuity strategy

2. It allows you to access the application without buying a license for the individual machine

3. Windows Azure offers the best solution for your data needs, from SQL database to blobs to tables

4. Offers scalability, flexibility, and cost-effectiveness

5. Helps you to maintain consistency across clouds with familiar tools and resources

Advantages of Microsoft Azure

1. You will not require processing power or hard disk space if you are using Azure

2. Cloud computing offers virtually limitless storage.

6. Sharing documents leads directly to better collaboration

7. If you change your device your computers, applications and documents follow you through the cloud.

8. You can deploy premium virtual machines in minutes which also include Linux and Windows servers

9. Helps you to scale your IT resources up and down based on your needs
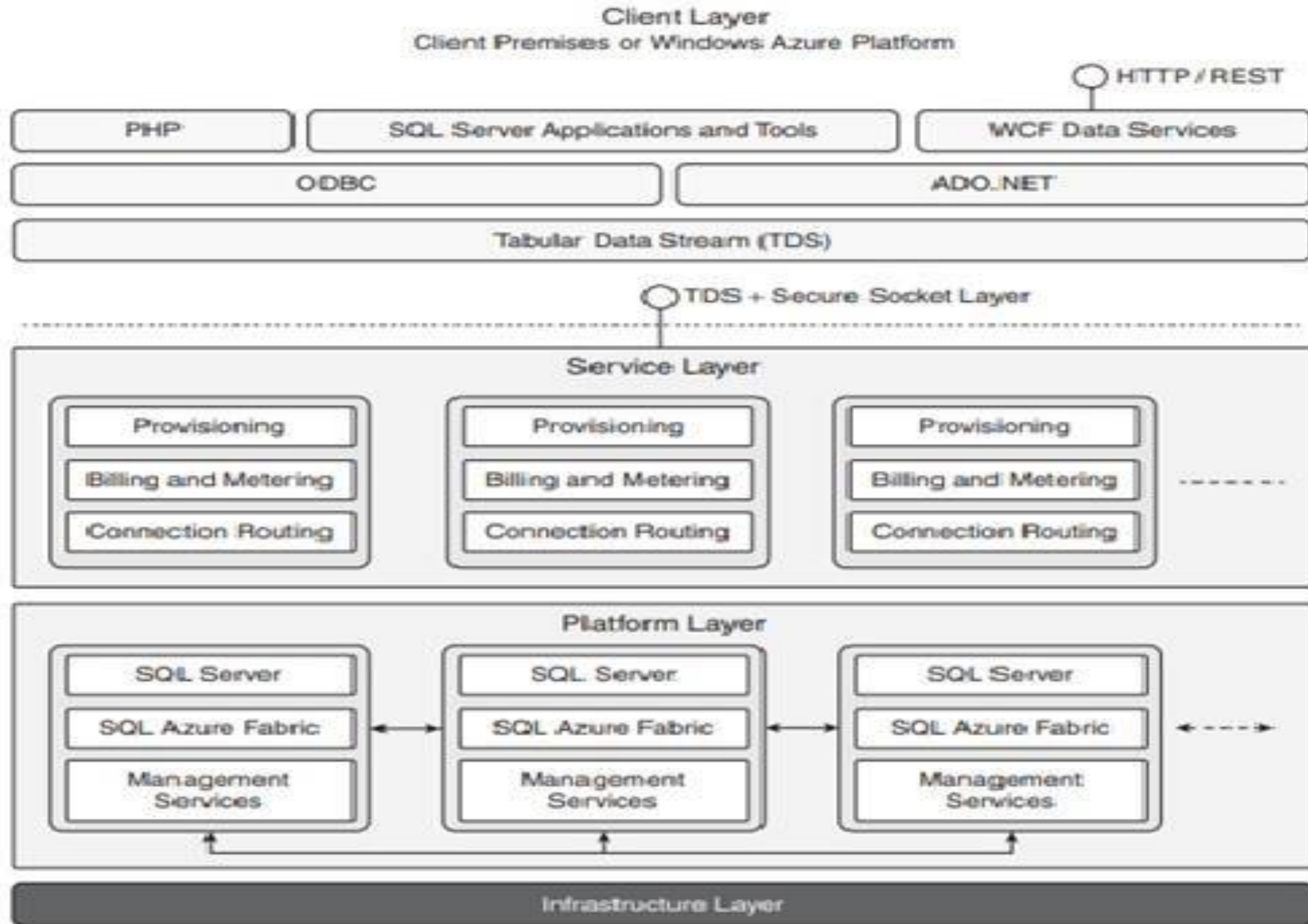
Disadvantages of Microsoft Azure

1. Cloud computing is not possible if you can't connect to the Internet

2. Azure is a web-based application which requires a lot of bandwidth to download, as do large documents

3. Web-based applications can sometimes be slower compared to accessing a similar software program on your desktop PC

SQL Azure

- SQL Azure is a relational database service hosted on Windows Azure and built on the SQL Server technologies.

- It is fully compatible with the interface exposed by SQL server, so that applications built for SQL server can transparently migrate to SQL Azure.

SQL Azure

Client Layer
Client Premises or Windows Azure Platform

○ HTTP / REST

PHP	SQL Server Applications and Tools	WCF Data Services

ODBC	ADO.NET

Tabular Data Stream (TDS)

○ TDS + Secure Socket Layer

Service Layer

Provisioning	Provisioning	Provisioning
Billing and Metering	Billing and Metering	Billing and Metering
Connection Routing	Connection Routing	Connection Routing

- - - - - - -

Platform Layer

SQL Server	SQL Server	SQL Server
SQL Azure Fabric	SQL Azure Fabric	SQL Azure Fabric
Management Services	Management Services	Management Services

← - - →

Infrastructure Layer

SQL AZURE Architecture

Window Azure Platform Appliance

➢ The Windows Azure platform can also be deployed as an appliance on third-party data centers and constitute the Cloud infrastructure governing the physical servers of the data center.

➢ Windows Azure Platform Appliance includes Windows Azure, SQL Azure, and Microsoft-specified configuration of network, storage, and server hardware.

➢ Its goal is to replicate Azure on a third-party infrastructure and make available its services beyond the boundaries of the Microsoft's Cloud.

➢ The appliance addresses two major scenarios: institutions that have very large computing needs (such as government agencies) and those that cannot afford to transfer their data outside their premises

Cloud Computing Applications
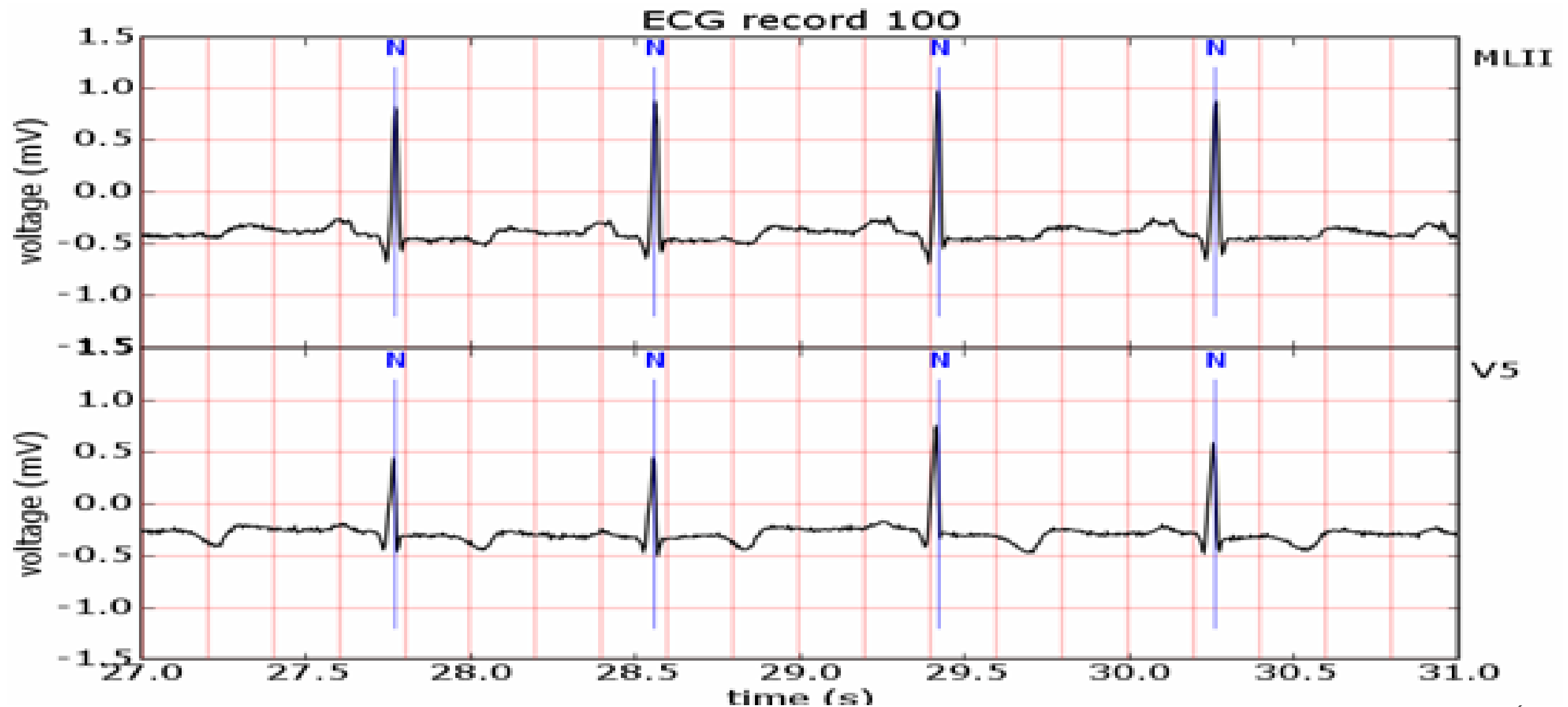
Applications in the Cloud Computing

1. Healthcare: ECG Analysis in the Cloud

2. Biology: Protein Structure Prediction

3. Geosciences: Satellite Image Processing

4. Business and Consumer Applications: CRM and ERP

5. Social Networking

Healthcare: ECG Analysis in the Cloud

1. Healthcare is a field or domain or area or a region where the information technology has found many of the applications.

2. These applications are getting involved to help business firms in assisting the scientists to develop solutions to prevent the diseases.

3. Due to the invention of internet or we can say due to the availability of internet cloud computing has came into the picture and represent itself as a attractive option for developing health monitoring system.

4. Example of health monitoring system is ECG machine which is used to measure the Heart-Beat of Human body and the output is get printed on the graph paper.

5. The full form of ECG is Electrocardiogram

Healthcare: ECG Analysis in the Cloud

- The analysis of the shape is used to identify arrhythmias, and it is the most common way of detecting the heart diseases.

- Here the meaning of arrhythmias means "not having a steady rhythm", "an arrhythmic heartbeat" means a heart beat which is not in it's rhythm.
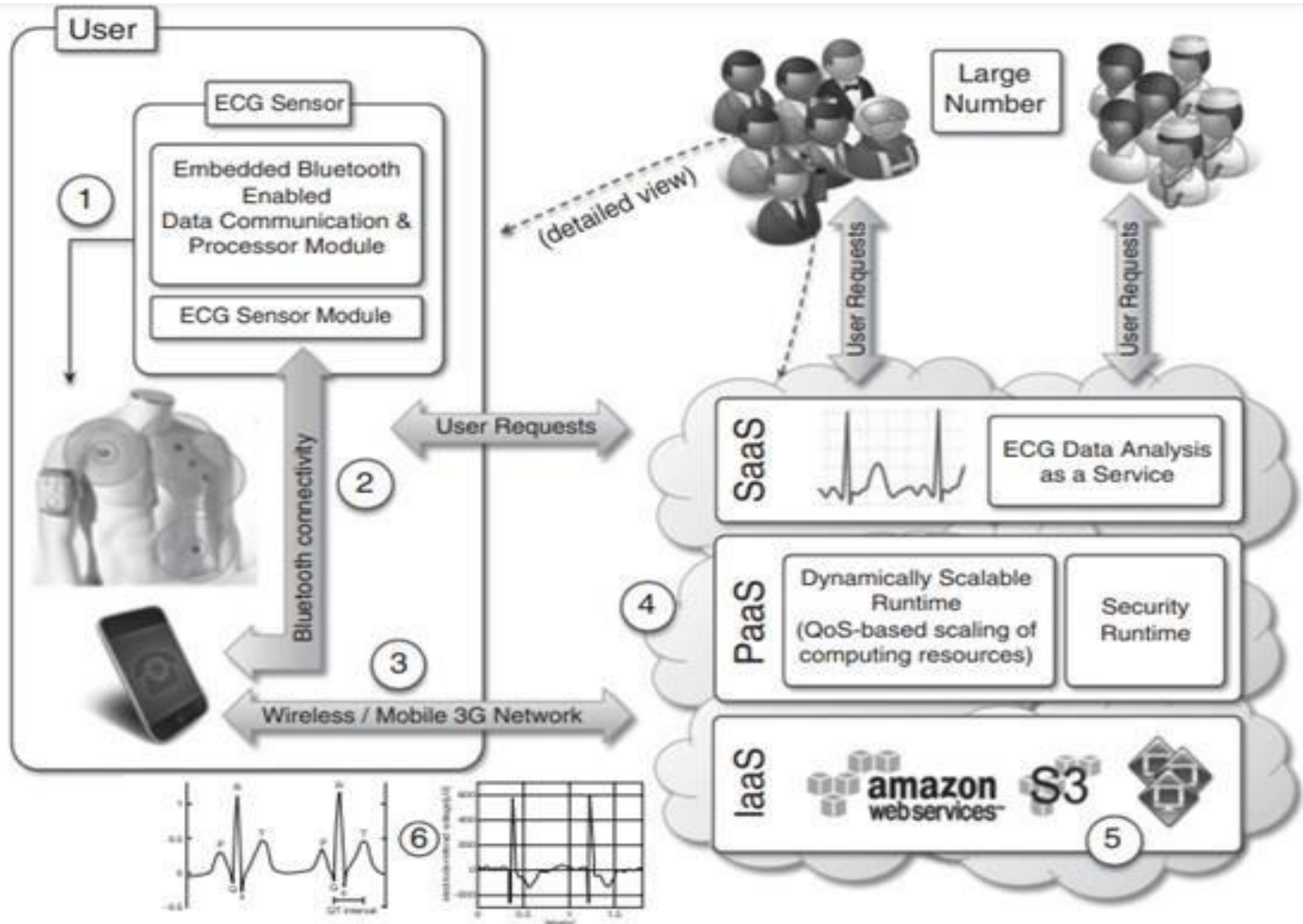
Healthcare: ECG Analysis in the Cloud

- Cloud computing technologies allows the remote monitoring of a patient's heart beat data.
- Through this way the patient at risk can be constantly monitored without going to the hospital for ECG analysis.
- At the same time the Doctor's can instantly be notified with cases that need's their attention.
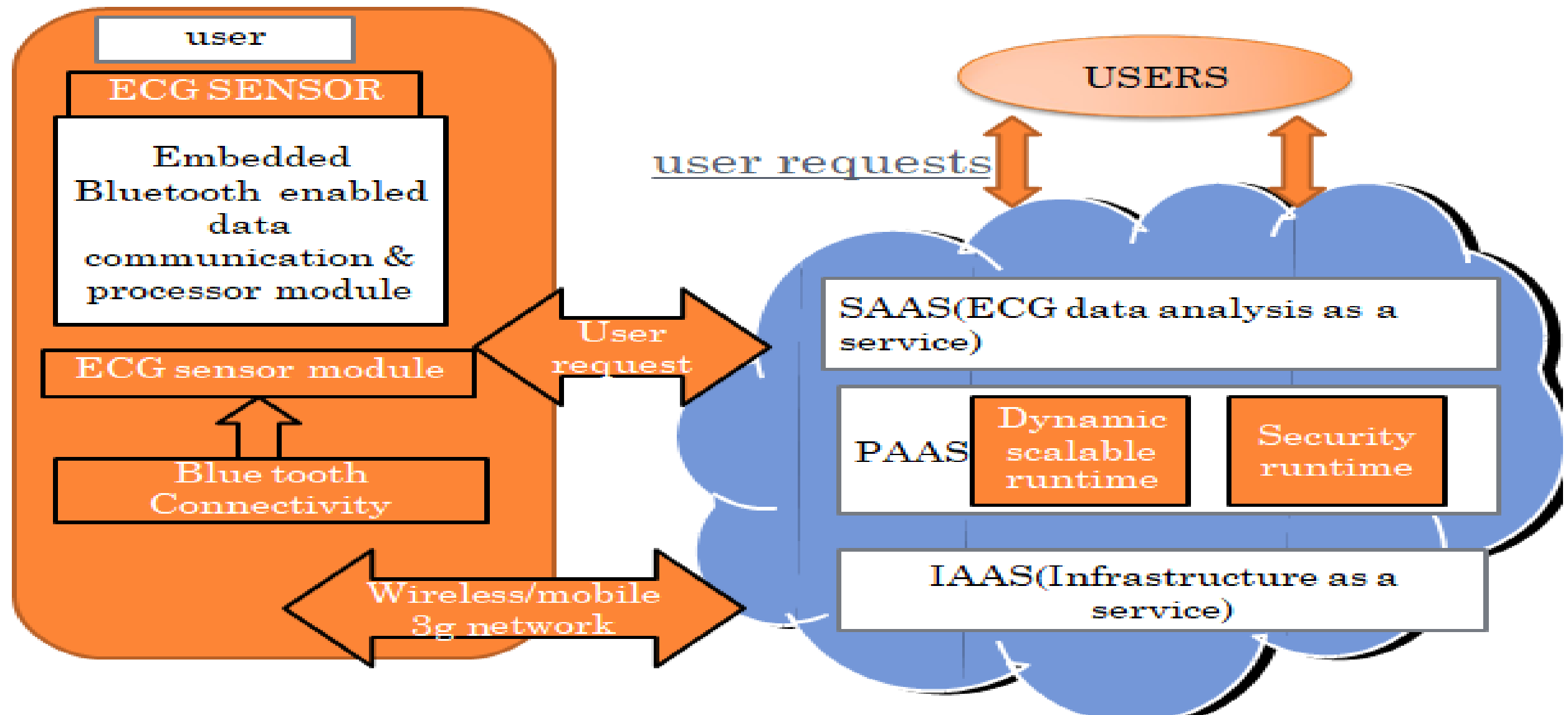
Healthcare: ECG Analysis in the Cloud

Online Health Monitoring System Using Cloud

Healthcare: ECG Analysis in the Cloud

- Here in this fig there are different types of computing devices equipped with ECG sensors to constantly monitor the patient's heart beat.

- The respective information is transmitted to the patient's mobile device that will immediately forwarded to the cloud- hosted web services for analysis.

- The entire web services from the front end of a platform that is completely hosted in the cloud that consist of three layers:Saas,Paas,Iaas.
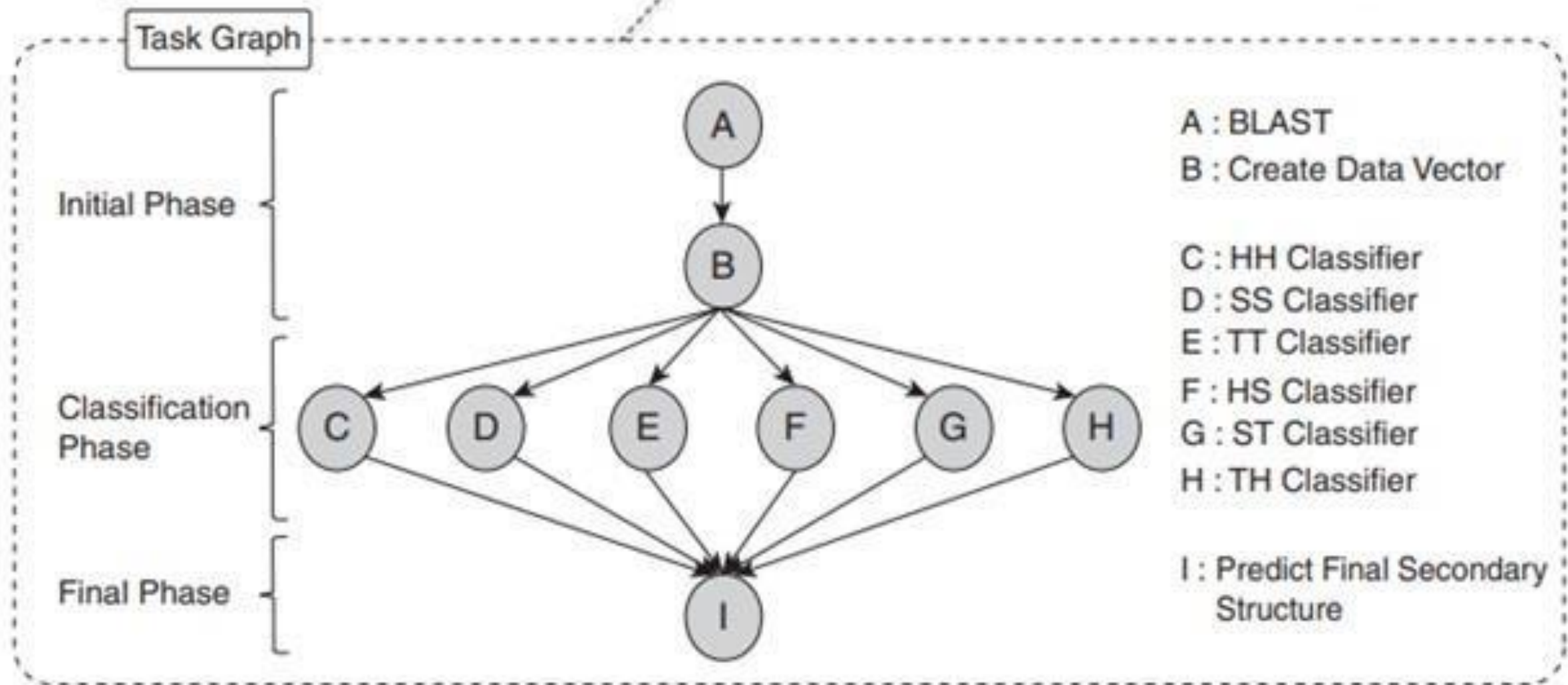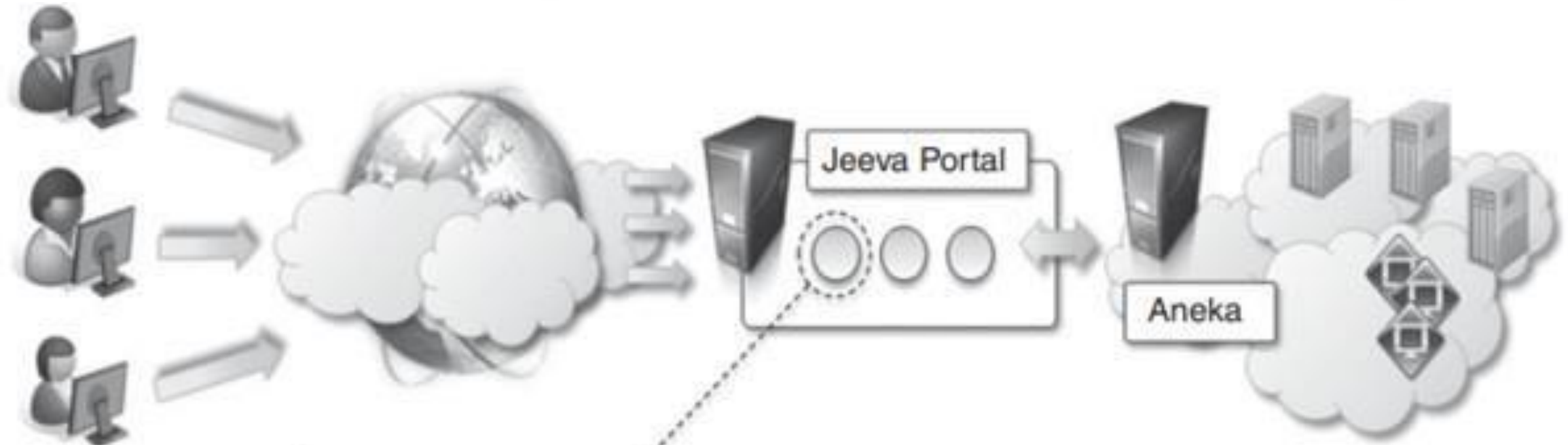
Healthcare: ECG Analysis in the Cloud

- **Advantages:**

- The first advantage is elasticity of the cloud infrastructure that can minimize and maximize according to the requests served.

- Second advantage is that cloud computing technologies are now become easily accessible and also it promises to deliver the services with minimum time.

- As a result the doctor's has no need to invest in large computing infrastructures.

Protein structure prediction in Cloud Computing

- Cloud computing is an emerging technology that provides various computing services on demand. It provides convenient access to a shared pool of higher-level services and other system resources. Nowadays, cloud computing has a great significance in the fields of geology, biology, and other scientific research areas.

- Protein structure prediction is the best example in research area that makes use of cloud applications for its computation and storage.

- A protein is composed of long chains of amino acids joined together by peptide bonds. The various structures of protein help in the designing of new drugs and the various sequences of proteins from its three-dimensional structure in predictive form is known as a Protein structure prediction.

Protein structure prediction in Cloud Computing

Jeeva Portal

Aneka

Task Graph

Initial Phase

Classification Phase

Final Phase

A : BLAST
B : Create Data Vector

C : HH Classifier
D : SS Classifier
E : TT Classifier
F : HS Classifier
G : ST Classifier
H : TH Classifier

I : Predict Final Secondary Structure

Protein structure prediction in Cloud Computing

- Firstly primary structures of proteins are formed and then prediction of the secondary, tertiary and quaternary structures are done from the primary one. In this way predictions of protein structures are done. Protein structure prediction also makes use of various other technologies like artificial neural networks, artificial intelligence, machine learning and probabilistic techniques, also holds great importance in fields like theoretical chemistry and bioinformatics.

Protein structure prediction in Cloud Computing

- There are various algorithms and tools that exists for protein structure prediction. CASP (Critical Assessment of Protein Structure Prediction) is a well-known tool that provides methods for automated web servers and the results of research work are placed on clouds like CAMEO (Continuous Automated Model Evaluation) server. These servers can be accessed by anyone as per their requirements from any place. Some of the tools or servers used in protein structure prediction are Phobius, FoldX, LOMETS, Prime, Predict protein, SignalP, BBSP, EVfold, Biskit, HHpred, Phre, ESyired3D. Using these tools new structures are predicted and the results are placed on the cloud-based servers.

Satellite Image Processing in Cloud Computing

- Satellite Image Processing is an important field in research and development and consists of the images of earth and satellites taken by the means of artificial satellites. Firstly, the photographs are taken in digital form and later are processed by the computers to extract the information. Statistical methods are applied to the digital images and after processing the various discrete surfaces are identified by analyzing the pixel values.

- The satellite imagery is widely used to plan the infrastructures or to monitor the environmental conditions or to detect the responses of upcoming disasters.

- In broader terms we can say that the Satellite Image Processing is a kind of remote sensing which works on pixel resolutions to collect coherent information about the earth surface.
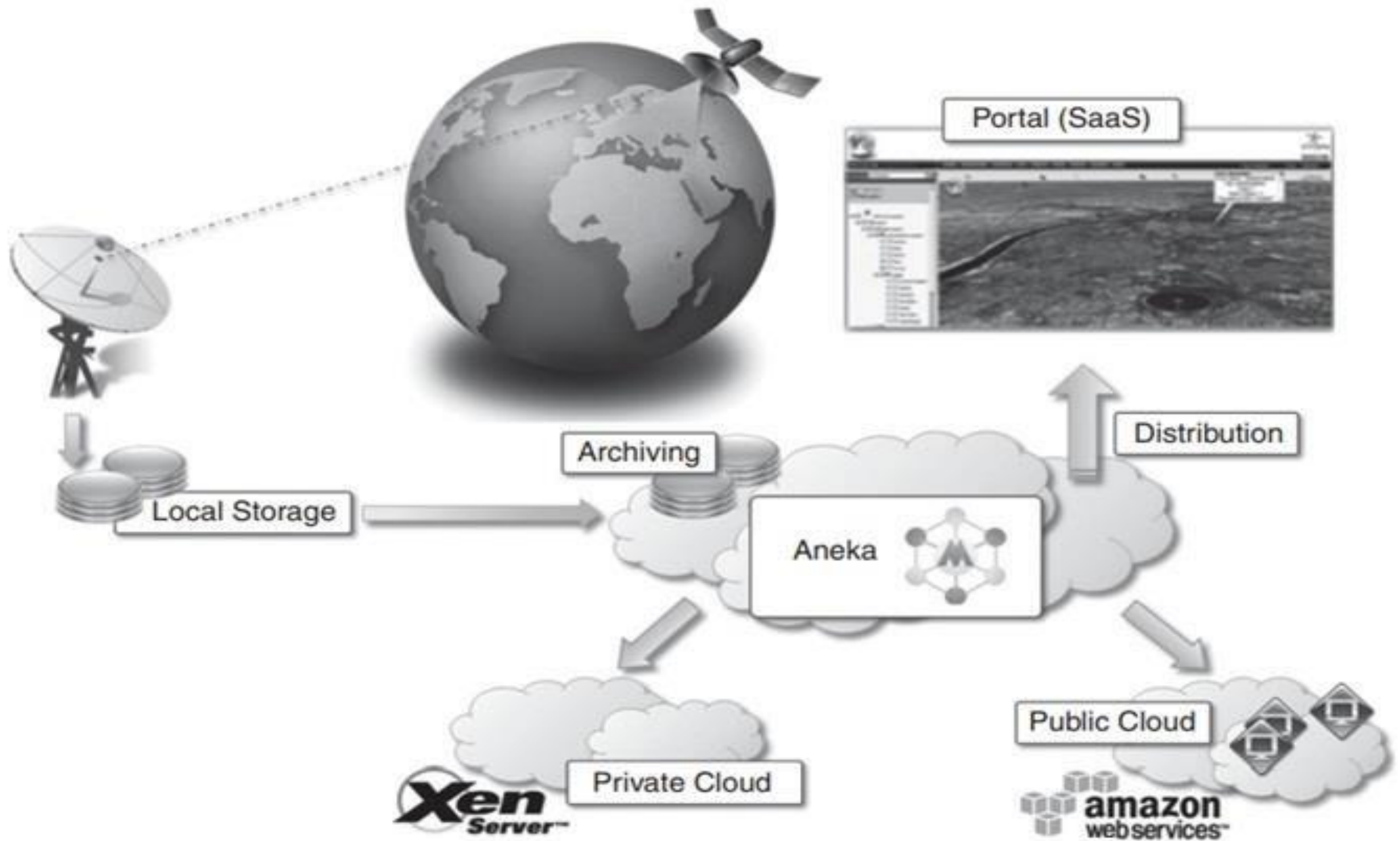
- **Cloud Environment for Cloud Data Processing**

Satellite Image Processing in Cloud Computing

- **Majorly there are four kinds of resolutions associated with satellite imagery. These are:**

- **Spatial resolution –**

It is determined by the sensors Instantaneous Field of View(IFoV) and is defined as the pixel size of an image that is visible to the human eye being measured on the ground. Since it has high resolving power or the ability to separate and hence is termed as Spatial Resolution.

- **Spectral resolution –**

This resolution measures the wavelength internal size and determines the number of wavelength intervals that the sensor measures.

Satellite Image Processing in Cloud Computing

- **Temporal resolution –**

The word temporal is associated with time or days and is defined as the time that passes between various imagery cloud periods**.**

- **Radiometric resolution –**

This resolution provides the actual characteristics of the image and is generally expressed in bits size. It gives the effective bit depth and records the various levels of brightness of imaging system.

   Thus, Satellite Image Processing has huge amount of applications in research and development fields, in remote sensing, in astronomy and now even in cloud computing on a large scale.

CRM and ERP in Cloud Computing

- **What is CRM?**

- CRM stands for Customer Relationship Management and is a software that is hosted in cloud so that the users can access the information using internet. CRM software provides high level of security and scalability to its users and can be easily used on mobile phones to access the data.

- Now a days, many business vendors and service providers are using these CRM software to manage the resources so that the user can access them via internet. Moving the business computation from desktop to the cloud is proving a beneficial step in both the IT and Non-IT fields. Some of the major CRM vendors include Oracle Siebel, Mothernode CRM, Microsoft Dynamics CRM, Infor CRM, SAGE CRM, NetSuite CRM.

CRM and ERP in Cloud Computing
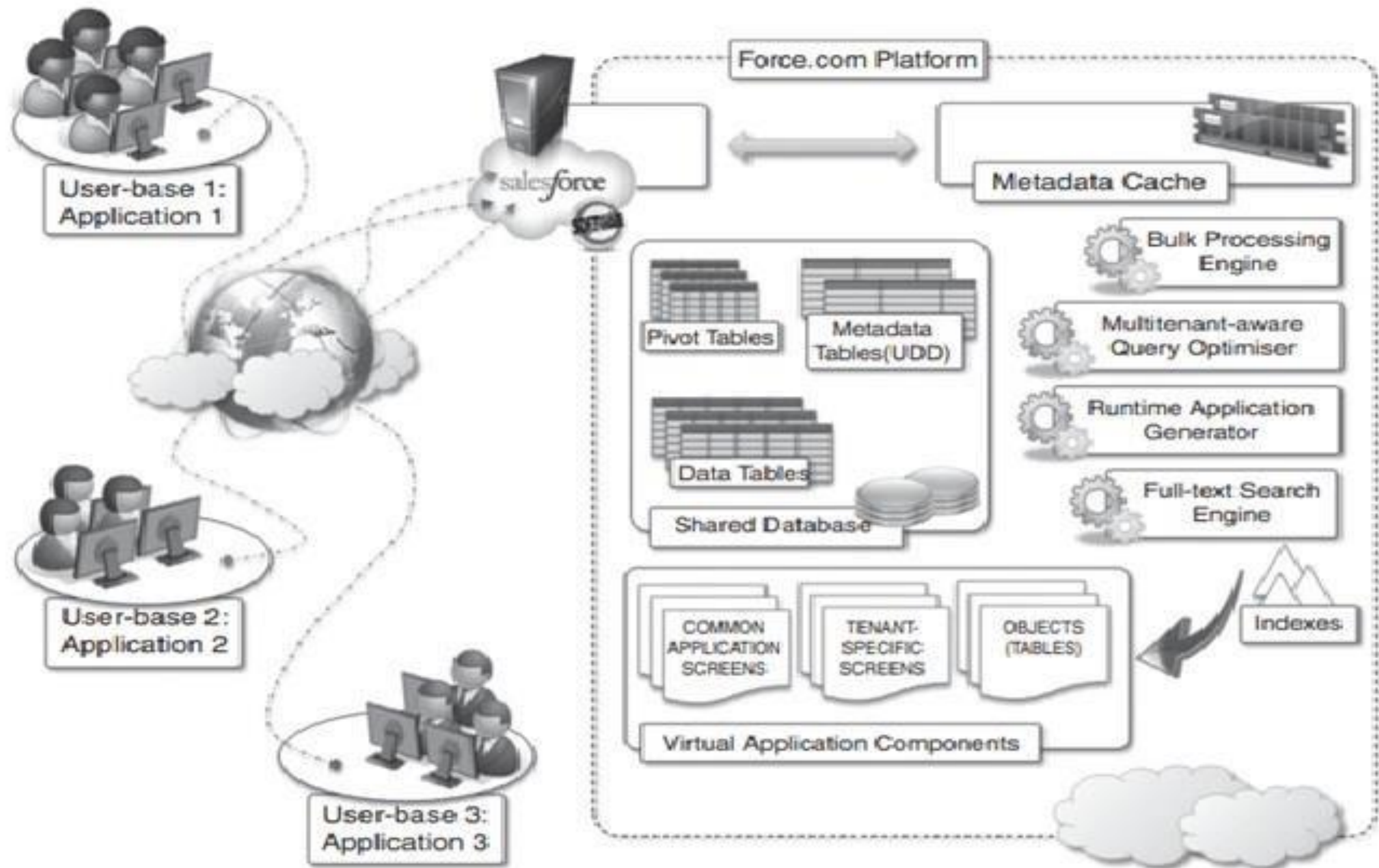
Salesforce.com(CRM)

CRM and ERP in Cloud Computing

- **Advantages:**

- **Few advantages of using CRM are as follows:**

- High reliability and scalability

- Easy to use

- Highly secured

- Provides flexibility to users and service providers

- Easily accessible

CRM and ERP in Cloud Computing

- **What is ERP?**

ERP is an abbreviation for Entity Resource Planning and is a software similar to CRM that is hosted on cloud servers which helps the enterprises to manage and manipulate their business data as per their needs and user requirements. ERP software follows pay per use methodologies of payment, that is at the end of the month, the enterprise pay the amount as per the cloud resources utilized by them. There are various ERP vendors available like Oracle, SAP, Epicor, SAGE, Microsoft Dynamics, Lawson Softwares and many more.

CRM and ERP in Cloud Computing

- **Advantages:**

- **Few advantages of using ERP softwares are:**

- Cost effective

- High mobility

- Increase in productivity

- No security issues

- Scalable and efficient

Social Networking in Cloud Computing

Social network platforms have rapidly changed the way that people communicate and interact. They have enabled the participation in digital communities as well as the representation, documentation and exploration of social relationships.

I personally believe that as "apps" become more sophisticated, it will become easier for users to share their own services, resources and data via social networks. At the same time, social media sites have large number of users all across the globe, and this makes them ideal candidates for cloud adaptation.

Social Networking in Cloud Computing

Social networks help boost internet usability by storing heavy multimedia content in cloud storage systems. Videos and photographs are the most popular content on social media, which essentially use up the maximum space allocated to them. They have the capacity to slow down applications and servers with all of their resource demands. Cloud computing vendors such as Salesforce and Amazon nowadays provide varied services including Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP). As they deliver these things through cloud servers, clients can use the flexibility and scalability of the system without purchasing standalone software or hardware.

Apart from data storage, the social networks are now also using clouds for various other tasks. For example, this can be ideal for big data analytics. One of the benefits of using cloud systems is that users can access vast amount of structured and even non-structured data easily. Just take a look at the much-improved analytics provided by sites like Facebook, especially for its business users

Social Networking in Cloud Computing

Another way cloud computing becomes helpful is by reducing the cost of data backup and recovery in case of a disaster. If the data is only stored in one central location, it becomes much riskier. If something happens there, it is almost impossible to recover the data. But through cloud they remain accessible through shared resources across the globe. This is especially useful for social networks as the store personal data of its users, and so cannot afford to lose even one part of it.

Overall, it can be said that cloud computing has several usages, and some of them are still being discovered. For instance, in the near future, personal secure clouds are likely to gain ground. New age social networks and messaging apps such as Snapchat thrive on privacy and they will eventually utilize such resources to offer a more secure and faster service to its users.

Google App Engine in CC

PaaS

Developing and hosting scalable web applications

Distributed and scalable run time environment

Languages Java, Python and Go

Examples   :   Google Apps   for   Business,   Education,

Government

Google App Engine in CC

Google App Engine (GAE) is a platform-as-a-service product that provides web app developers and enterprises with access to Google's scalable hosting and tier 1 internet service.

GAE requires that applications be written in Java or Python, store data in Google Bigtable and use the Google query language. Noncompliant applications require modification to use GAE.

GAE provides more infrastructure than other scalable hosting services, such as Amazon Elastic Compute Cloud (EC2). GAE also eliminates some system administration and development tasks to make writing scalable applications easier.
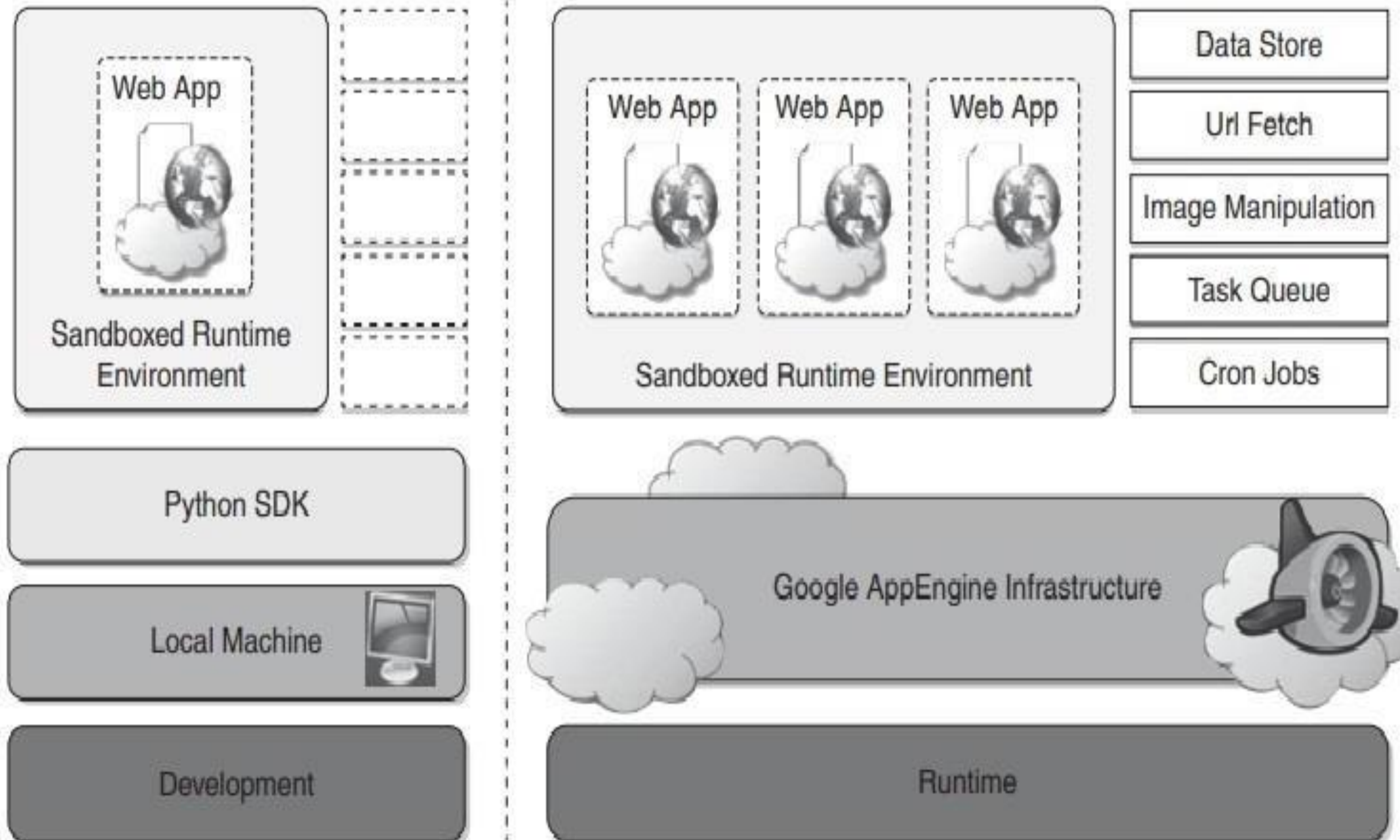
Google App Engine in CC

Google provides GAE free up to a certain amount of use for the following resources:

- processor (CPU)

- storage

- application programming interface (API) calls

- concurrent requests

- Users exceeding the per-day or per-minute rates can pay for more of these resources.

Google App Engine in CC

Google AppEngine Platform Architecture

Google App Engine in CC

Google Applications utilizing Cloud :

- Gmail
- Google Calendar
- Google Docs
- Google Sites
- Google Groups
- Google Video

Google App Engine in CC

How is GAE used?

GAE is a fully managed, serverless platform that is used to host, build and deploy web applications. Users can create a GAE account, set up a software development kit and write application source code. They can then use GAE to test and deploy the code in the cloud.

One way to use GAE is building scalable mobile application back ends that adapt to workloads as needed. Application testing is another way to use GAE. Users can route traffic to different application versions to A/B test them and see which version performs better under various workloads.

Google App Engine in CC

What are GAE's key features?

Key features of GAE include the following:

API selection. GAE has several built-in APIs, including the following five:

- **Blobstore** for serving large data objects;

- **GAE Cloud Storage** for storing data objects;

- **Page Speed Service** for automatically speeding up webpage load times**;**

- **URL Fetch Service** to issue HTTP requests and receive responses for efficiency and scaling; and

- **Memcache** for a fully managed in-memory data store

Google App Engine in CC

Benefits of GAE :

Ease of setup and use. GAE is fully managed, so users can write code without considering IT operations and back-end infrastructure. The built-in APIs enable users to build different types of applications. Access to application logs also facilitates debugging and monitoring in production.

Pay-per-use pricing. GAE's billing scheme only charges users daily for the resources they use. Users can monitor their resource usage and bills on a dashboard.

Scalability. Google App Engine automatically scales as workloads fluctuate, adding and removing application instances or application resources as needed.

Security. GAE supports the ability to specify a range of acceptable Internet Protocol (IP) addresses. Users can allowlist specific networks and services and blocklist specific IP addresses.
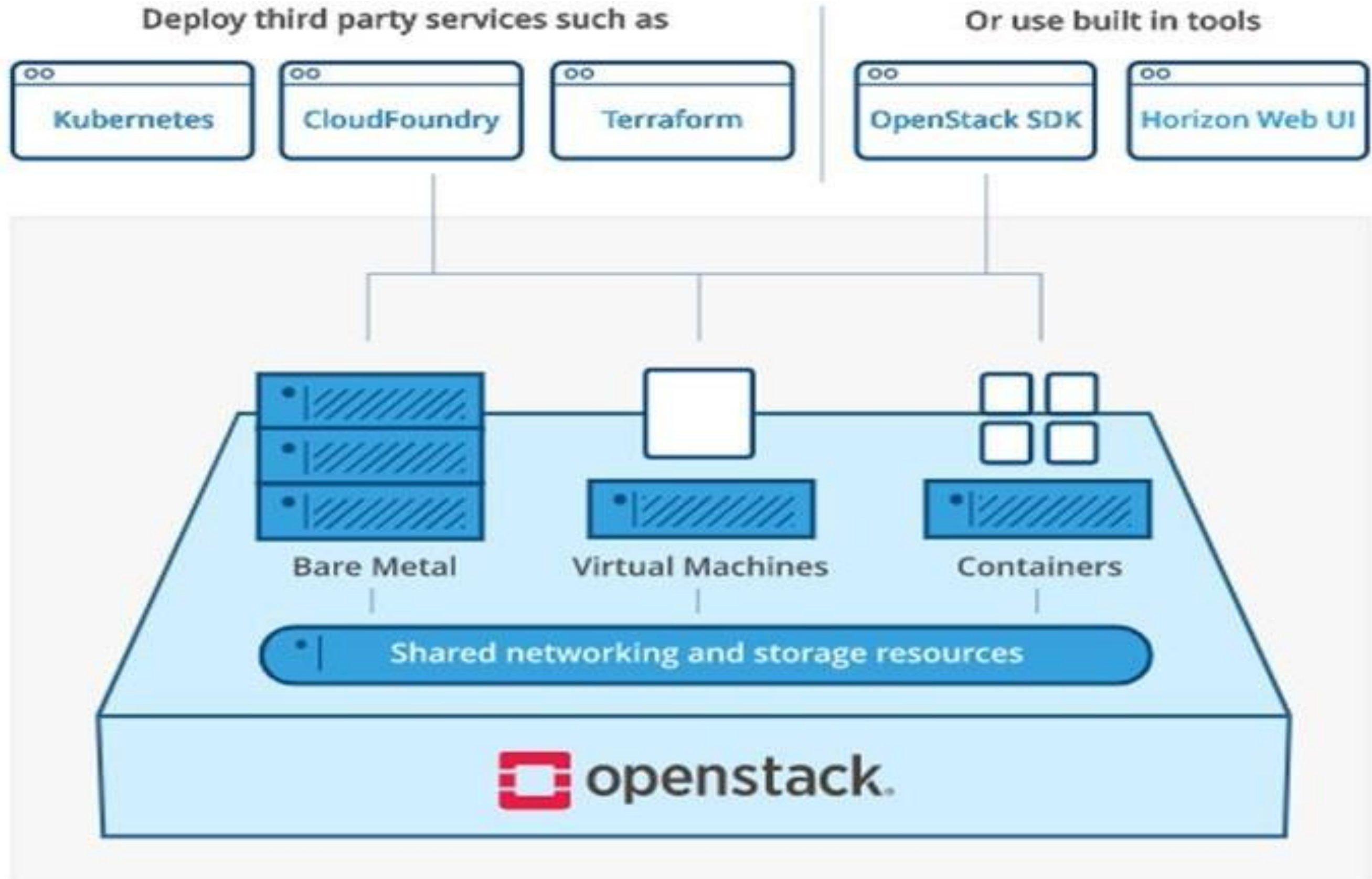
Google App Engine in CC

GAE challenges

- **Lack of control.** Although a managed infrastructure has advantages, if a problem occurs in the back-end infrastructure, the user is dependent on Google to fix it.

- **Performance limits.** CPU-intensive operations are slow and expensive to perform using GAE. This is because one physical server may be serving several separate, unrelated app engine users at once who need to share the CPU.

- **Limited access.** Developers have limited, read-only access to the GAE filesystem.

- **Java limits.** Java apps cannot create new threads and can only use a subset of the Java runtime environment standard edition classes.

Open Stack Architecture in CC

OpenStack is an open-standard and free platform for cloud computing. Mostly, it is deployed as IaaS (Infrastructure-as-a-Service) in both private and public clouds where various virtual servers and other types of resources are available for users. This platform combines irrelated components that networking resources, storage resources, multi-vendor hardware processing tools, and control diverse throughout the data center. Various users manage it by the command-line tools, RESTful web services, and web-based dashboard.

In 2010, OpenStack began as the joint project of NASA and Rackspace Hosting. It was handled by the OpenStack Foundation which is a non-profit collective entity developed in 2012 September for promoting the OpenStack community and software. 50+ enterprises have joined this project.
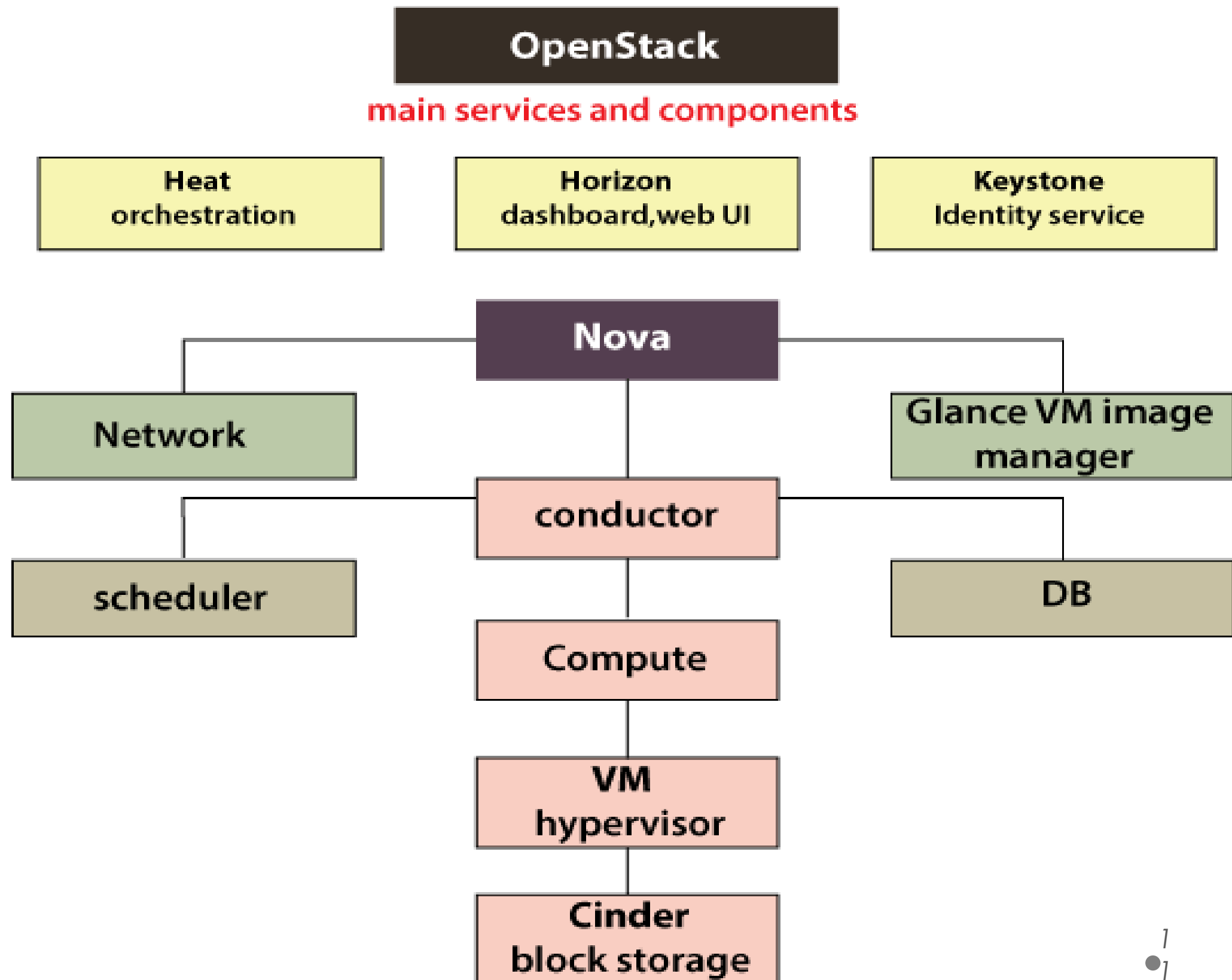
Open Stack Architecture in CC

Deploy third party services such as

Or use built in tools

Kubernetes   CloudFoundry   Terraform   OpenStack SDK   Horizon Web UI

Bare Metal   Virtual Machines   Containers

Shared networking and storage resources

openstack.

- **OpenStack Overview (Source: Openstack.org)**

Open Stack Architecture in CC

OpenStack contains a modular architecture along with several code names for the components.

OpenStack

main services and components

Heat orchestration	Horizon dashboard,web UI	Keystone Identity service

Nova

Network		Glance VM image manager

conductor

scheduler		DB

Compute

VM
hypervisor

Cinder
block storage

Open Stack Architecture in CC

- **Nova (compute service):** It manages the compute resources like creating, deleting, and handling the scheduling. It can be seen as a program dedicated to the automation of resources that are responsible for the virtualization of services and high-performance computing.

- **Neutron (networking service):** It is responsible for connecting all the networks across OpenStack. It is an API driven service that manages all networks and IP addresses.

- **Swift (object storage):** It is an object storage service with high fault tolerance capabilities and it used to retrieve unstructured data objects with the help of Restful API. Being a distributed platform, it is also used to provide redundant storage within servers that are clustered together. It is able to successfully manage petabytes of data.

- **Cinder (block storage):** It is responsible for providing persistent block storage that is made accessible using an API (self- service). Consequently, it allows users to define and manage the amount of cloud storage required.

Open Stack Architecture in CC

- **Keystone (identity service provider):** It is responsible for all types of authentications and authorizations in the OpenStack services. It is a directory-based service that uses a central repository to map the correct services with the correct user.

- **Glance (image service provider):** It is responsible for registering, storing, and retrieving virtual disk images from the complete network. These images are stored in a wide range of back-end systems.

- **Horizon (dashboard):** It is responsible for providing a web-based interface for OpenStack services. It is used to manage, provision, and monitor cloud resources.

- **Ceilometer (telemetry):** It is responsible for metering and billing of services used. Also, it is used to generate alarms when a certain threshold is exceeded.

Open Stack Architecture in CC

- **Advantages of using OpenStack**

- It boosts rapid provisioning of resources due to which orchestration and scaling up and down of resources becomes easy.

- Deployment of applications using OpenStack does not consume a large amount of time.

- Since resources are scalable therefore they are used more wisely and efficiently.

- The regulatory compliances associated with its usage are manageable.

Open Stack Architecture in CC

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THANK YOU!!!

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