

- 9 a. Describe any four popular cloud computing products. Indicate their service type. (08 Marks)
 b. Describe in detail the “Simple Storage Service” offered by Amazon S3. (08 Marks)
- OR**
- 10 a. Explain online health monitoring system hosted in cloud. (08 Marks)
 b. What are dropbox and icloud? Which kind of problems do they solve by using cloud technologies? (08 Marks)

9A) Popular cloud computing products

1 Amazon web services

2 Google AppEngine

3 Microsoft Azure

9.1 Amazon web services

9.1.1 Compute services

9.1.2 Storage services

9.1.3 Communication services

9.1 Amazon web services

Amazon Web Services (AWS) is a platform that allows the development of flexible applications by providing solutions for elastic infrastructure scalability, messaging, and data storage.

The platform is accessible through SOAP or RESTful Web service interfaces and provides a Web-based console where users can handle administration and monitoring of the resources required, as well as their expenses computed on a pay-as-you-go basis.

Figure 9.1 shows all the services available in the AWS ecosystem. At the base of the solution stack are services that provide raw compute and raw storage: Amazon Elastic Compute (EC2) and Amazon Simple Storage Service (S3).

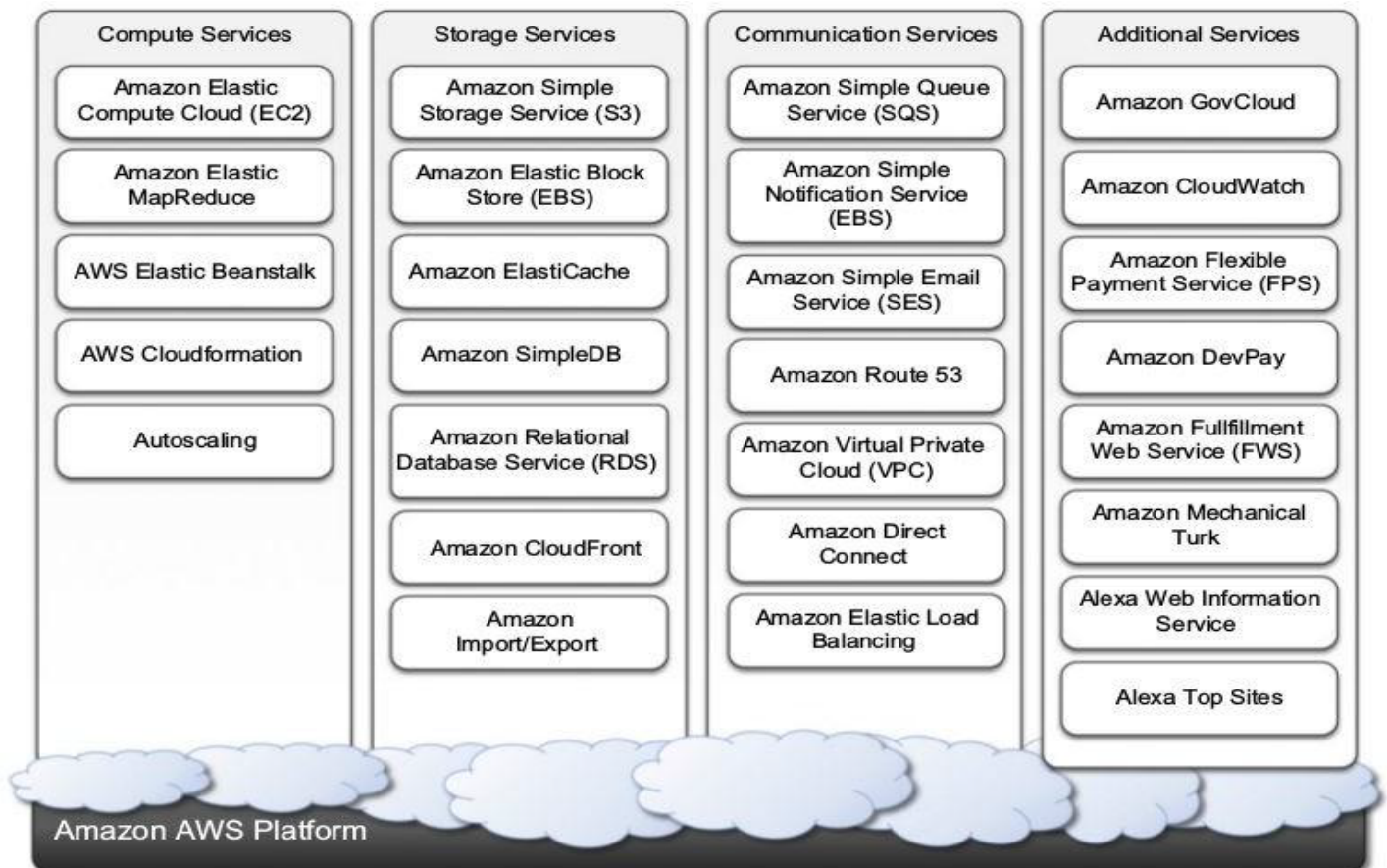


FIGURE 9.1

Amazon Web Services ecosystem.

Amazon EC2 allows deploying servers in the form of virtual machines created as instances of a specific image. Images come with a preinstalled operating system and a software stack, and instances can be configured for memory, number of processors, and storage. Users are provided with credentials to remotely access the instance and further configure or install software if needed.

1. Amazon machine images
2. EC2 instances
3. EC2 environment
4. Advanced compute services

1. Amazon machine images

Amazon Machine Images (AMIs) are templates from which it is possible to create a virtual machine. They are stored in Amazon S3 and identified by a unique identifier in the form of ami-xxxxxx and a manifest XML file.

2. EC2 instances

EC2 instances represent virtual machines. They are created using AMI as templates, which are specialized by selecting the number of cores, their computing power, and the installed memory. The processing power is expressed in terms of virtual cores and EC2 Compute Units (ECUs).

3. EC2 environment

EC2 instances are executed within a virtual environment. The EC2 environment is in charge of allocating addresses, attaching storage volumes, and configuring security in terms of access control and network connectivity.

4. Advanced compute services

AWS CloudFormation constitutes an extension of the simple deployment model that characterizes EC2 instances. CloudFormation introduces the concepts of templates, which are JSON formatted text files that describe the resources needed to run an application or a service in EC2 together.

9.2 Google AppEngine

Google AppEngine is a PaaS implementation.

Distributed and scalable runtime environment that leverages Google's distributed infrastructure to scale out applications.

Architecture and core concepts

AppEngine is a platform for developing scalable applications accessible through the Web. **Figure 9.2.**

The platform is logically divided into four major components: infrastructure, the runtime environment, the underlying storage, and the set of scalable services.

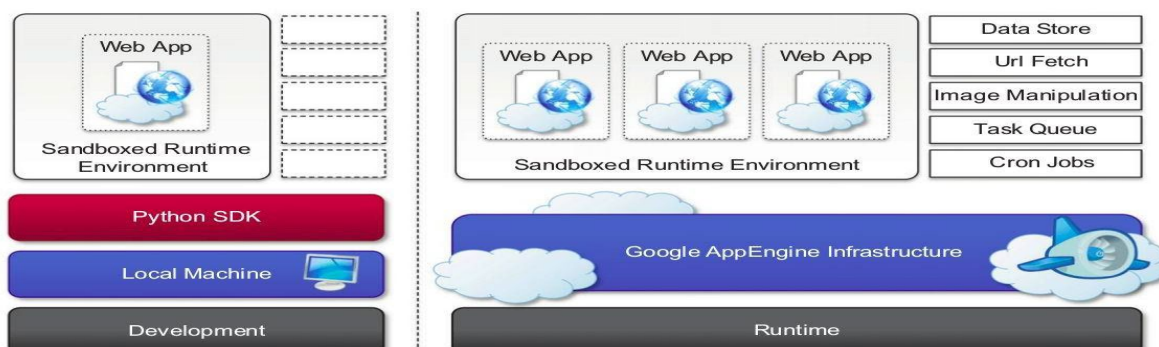


FIGURE 9.2

Google AppEngine platform architecture.

1 Infrastructure

AppEngine hosts Web applications, and its primary function is to serve users requests efficiently.

AppEngine's infrastructure takes advantage of many servers available within Google datacenters. For each HTTP request, AppEngine locates the servers hosting the application that processes the request, evaluates their load, and, if necessary, allocates additional resources or redirects the request to an existing server.

2 Runtime environment

The runtime environment represents the execution context of applications hosted on AppEngine.

Sandboxing- One of the major responsibilities of the runtime environment is to provide the application environment with an isolated and protected context in which it can execute without causing a threat to the server and without being influenced by other applications. In other words, it provides applications with a sandbox.

3 Storage

AppEngine provides various types of storage, which operate differently depending on the volatility of the data. **Static file servers-** Web applications are composed of dynamic and static data. Dynamic data are a result of the logic of the application and the interaction with the user.

4 Application services

Applications hosted on AppEngine take the most from the services made available through the runtime environment.

UrlFetch - The sandbox environment does not allow applications to open arbitrary connections through sockets, but it does provide developers with the capability of retrieving a remote resource through HTTP/HTTPS by means of the UrlFetch service

MemCache- This is a distributed in-memory cache that is optimized for fast access and provides developers with a volatile store for the objects that are frequently accessed.

Mail and instant messaging- AppEngine provides developers with the ability to send and receive mails through Mail.

Account management- AppEngine simplifies account management by allowing developers to leverage Google account management by means of Google Accounts.

5 Compute services

AppEngine offers additional services such as Task Queues and Cron Jobs that simplify the execution of computations.

Task queues- A task is defined by a Web request to a given URL, and the queue invokes the request handler by passing the payload as part of the Web request to the handler.

Cron jobs- the required operation needs to be performed at a specific time of the day, which does not coincide with the time of the Web request.

9.3 Microsoft Azure

Microsoft Windows Azure is a cloud operating system built on top of Microsoft datacenters' infrastructure and provides developers with a collection of services for building applications with cloud technology.

Services range from compute, storage, and networking to application connectivity, access control, and business intelligence.

Figure 9.3 provides an overview of services provided by Azure. These services can be managed and controlled through the Windows Azure Management Portal, which acts as an administrative console for all the services

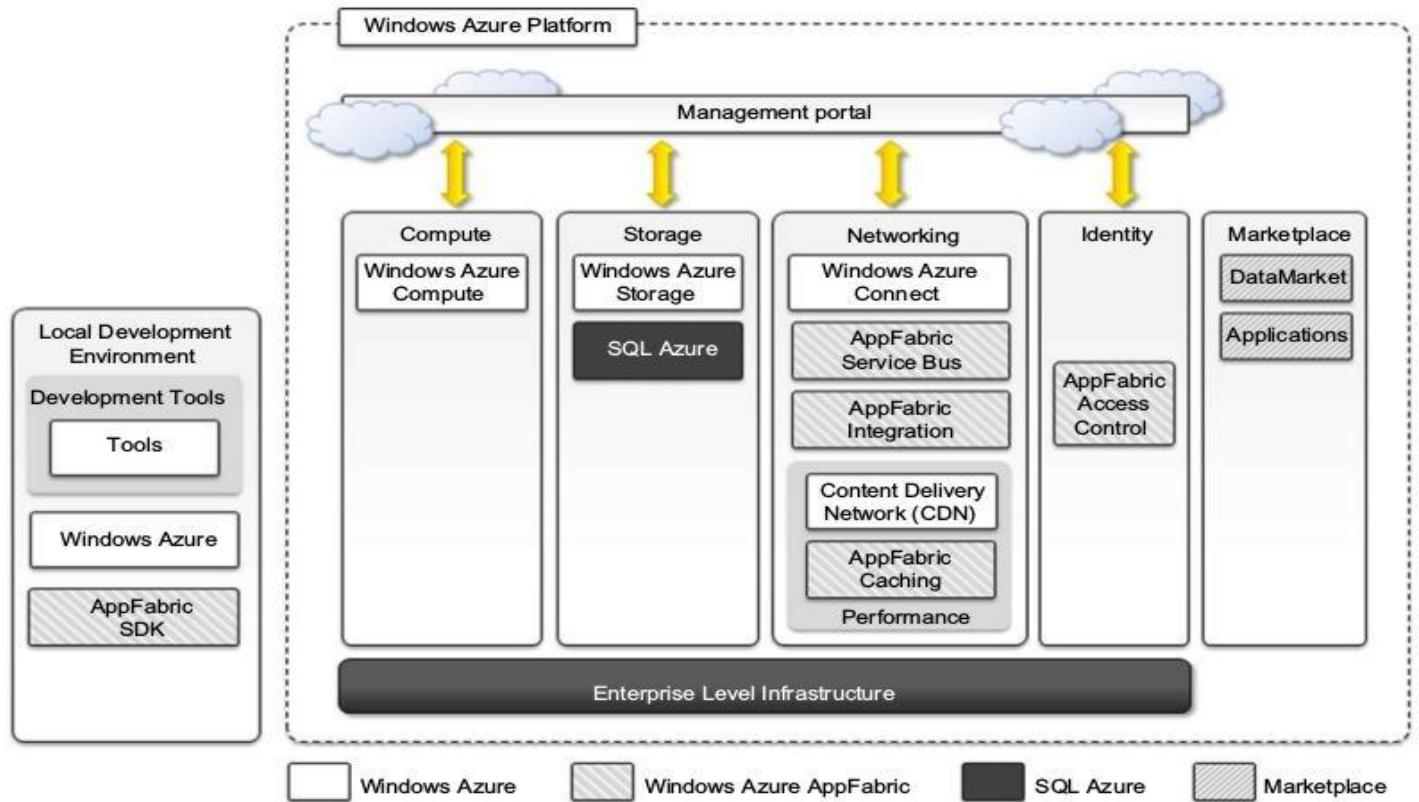


FIGURE 9.3

Microsoft Windows Azure Platform Architecture.

9.3.1 Azure core concepts

The Windows Azure platform is made up of a foundation layer and a set of developer services that can be used to build scalable applications. These services cover compute, storage, networking, and identity management, which are tied together by middleware called AppFabric.

1 Compute services

Compute services are the core components of Microsoft Windows Azure, and they are delivered by means of the abstraction of roles.

Currently, there are three different roles: Web role, Worker role, and Virtual Machine (VM) role.

Web role- The Web role is designed to implement scalable Web applications. Web roles represent the units of deployment of Web applications within the Azure infrastructure.

Worker role - Worker roles are designed to host general compute services on Azure. They can be used to quickly provide compute power or to host services that do not communicate with the external world through HTTP.

Virtual machine role- The Virtual Machine role allows developers to control computing stack of their compute service by defining a custom image of the Windows Server 2008 R2 operating system and all the service stack required by their applications.

2 Storage services

Compute resources are equipped with local storage in the form of a directory on the local file system.

Windows Azure provides different types of storage solutions that complement compute services with a more durable and redundant option.

Blobs

Azure allows storing large amount of data in the form of binary large objects (BLOBs) by means of the blobs service.

Block blobs- Block blobs are composed of blocks and are optimized for sequential access; therefore they are appropriate for media streaming. Currently, blocks are of 4 MB, and a single block blob can reach 200 GB in dimension.

Page blobs- Page blobs are made of pages that are identified by offset from beginning of blob. A page blob can be split into multiple pages or constituted of single page. This type of blob is optimized for random access and can be used to host data different from streaming. Maximum dimension of page blob can be 1TB.

Azure drive

Page blobs can be used to store an entire file system in the form of a single Virtual Hard Drive (VHD) file. This can then be mounted as a part of the NTFS file system by Azure compute resources, thus providing persistent and durable storage.

Tables

Tables constitute a semistructured storage solution, allowing users to store information in the form of entities with a collection of properties. Entities are stored as rows in the table and are identified by a key, which also constitutes the unique index built for the table. Users can insert, update, delete, and select a subset of the rows stored in the table.

Currently, a table can contain up to 100 TB of data, and rows can have up to 255 properties, with a maximum of 1 MB for each row. The maximum dimension of a row key and partition keys is 1 KB.

Queues

Queue storage allows applications to communicate by exchanging messages through durable queues, thus avoiding lost or unprocessed messages. Applications enter messages into a queue, and other applications can read them in a first-in, first-out (FIFO) style.

3 Core infrastructure: AppFabric

AppFabric is a comprehensive middleware for developing, deploying, and managing applications on the cloud or for integrating existing applications with cloud services.

Access control- AppFabric provides the capability of encoding access control to resources in Web applications and services into a set of rules that are expressed outside the application code base.

Service bus - Service Bus constitutes the messaging and connectivity infrastructure provided with AppFabric for building distributed and disconnected applications. The service is designed to allow transparent network traversal and to simplify the development of loosely coupled applications,

Azure cache- Windows Azure provides a set of durable storage solutions that allow applications to persist their data. Azure Cache is a service that allows developers to quickly access data persisted on Windows Azure storage or in SQL Azure.

9b)Simple Storage Service Offered by amazon S3

9.1.2 Storage services

The core service is represented by Amazon Simple Storage Service (S3). This is a distributed object store that allows users to store information in different formats. The core components of S3 are two: buckets and objects. Buckets represent virtual containers in which to store objects; objects represent the content that is actually stored. Objects can also be enriched with metadata that can be used to tag the stored content with additional information.

1 S3 key concepts

2 Amazon elastic block store

3 Amazon ElastiCache

4 Structured storage solutions

5 Amazon CloudFront

1 S3 key concepts

S3 has been designed to provide a simple storage service that's accessible through a Representational State Transfer (REST) interface.

- The storage is organized in a two-level hierarchy.
- Stored objects cannot be manipulated like standard files.
- Content is not immediately available to users.
- Requests will occasionally fail.

Access to S3 is provided with RESTful Web services. These express all the operations that can be performed on the storage in the form of HTTP requests (GET, PUT, DELETE, HEAD, and POST).

Resource naming

Buckets, objects, and attached metadata are made accessible through a REST interface. Therefore, they are represented by uniform resource identifiers (URIs) under the s3.amazonaws.com domain.

Amazon offers three different ways of addressing a bucket:

1. Canonical form: http://s3.amazonaws.com/bucket_name/
2. Subdomain form: <http://bucketname.s3.amazonaws.com/>
3. Virtual hosting form: <http://bucket-name.com/>

Access control and security : Amazon S3 allows controlling the access to buckets and objects by means of Access Control Policies (ACPs). An ACP is a set of grant permissions that are attached to a resource expressed by means of an XML configuration file.

A policy allows defining up to 100 access rules, each of them granting one of the available permissions to a grantee.

Currently, five different permissions can be used:

- A. READ allows the grantee to retrieve an object and its metadata and to list the content of a bucket as well as getting its metadata.
- B. WRITE allows the grantee to add an object to a bucket as well as modify and remove it.
- C. READ_ACP allows the grantee to read the ACP of a resource.
- D. WRITE_ACP allows the grantee to modify the ACP of a resource.
- E. FULL_CONTROL grants all of the preceding permissions.

2 Amazon elastic block store

- The Amazon Elastic Block Store (EBS) allows AWS users to provide EC2 instances with persistent storage in the form of volumes that can be mounted at instance startup.
- They accommodate up to 1 TB of space and are accessed through a block device interface, thus allowing users to format them according to the needs of the instance they are connected to.
- EBS volumes normally reside within the same availability zone of the EC2 instances that will use them to maximize the I/O performance.
- It is also possible to connect volumes located in different availability zones. Once mounted as volumes, their content is lazily loaded in the background and according to the request made by the operating system. This reduces the number of I/O requests that go to the network.

3 Amazon ElastiCache

- ElastiCache is an implementation of an elastic in-memory cache based on a cluster of EC2 instances.
- It provides fast data access through a Memcached-compatible protocol so that applications can transparently migrate to ElastiCache.
- ElastiCache is based on a cluster of EC2 instances running the caching software, which is made available through Web services.

- An ElastiCache cluster can be dynamically resized according to the demand of the client applications.

4 Structured storage solutions

Amazon provides applications with structured storage services in three different forms:

- Preconfigured EC2 AMIs,
- Amazon Relational Data Storage (RDS), and
- Amazon SimpleDB.

Preconfigured EC2 AMIs are predefined templates featuring an installation of a given database management system. EC2 instances created from these AMIs can be completed with an EBS volume for storage persistence. Available AMIs include installations of IBM DB2, Microsoft SQL Server, MySQL, Oracle, PostgreSQL, Sybase, and Vertica.

RDS is relational database service that relies on the EC2 infrastructure and is managed by Amazon. Developers do not have to worry about configuring the storage for high availability, designing failover strategies, or keeping the servers up-to-date with patches. Moreover, the service provides users with automatic backups, snapshots, point-in-time recoveries, and facilities for implementing replications.

Amazon SimpleDB is a lightweight, highly scalable, and flexible data storage solution for applications that do not require a fully relational model for their data. SimpleDB provides support for semistructured data, the model for which is based on the concept of domains, items, and attributes

10a) Online Health Monitoring System Hosted in cloud

10.1.1 Healthcare: ECG analysis in the cloud

Healthcare is a domain in which computer technology has found several and diverse applications: from supporting the business functions to assisting scientists in developing solutions to cure diseases.

An illustration of the infrastructure and model for supporting remote ECG monitoring is shown in **Figure 10.1**. Wearable computing devices equipped with ECG sensors constantly monitor the patient's heartbeat. Such information is transmitted to the patient's mobile device, which will eventually forward it to the cloud-hosted Web service for analysis

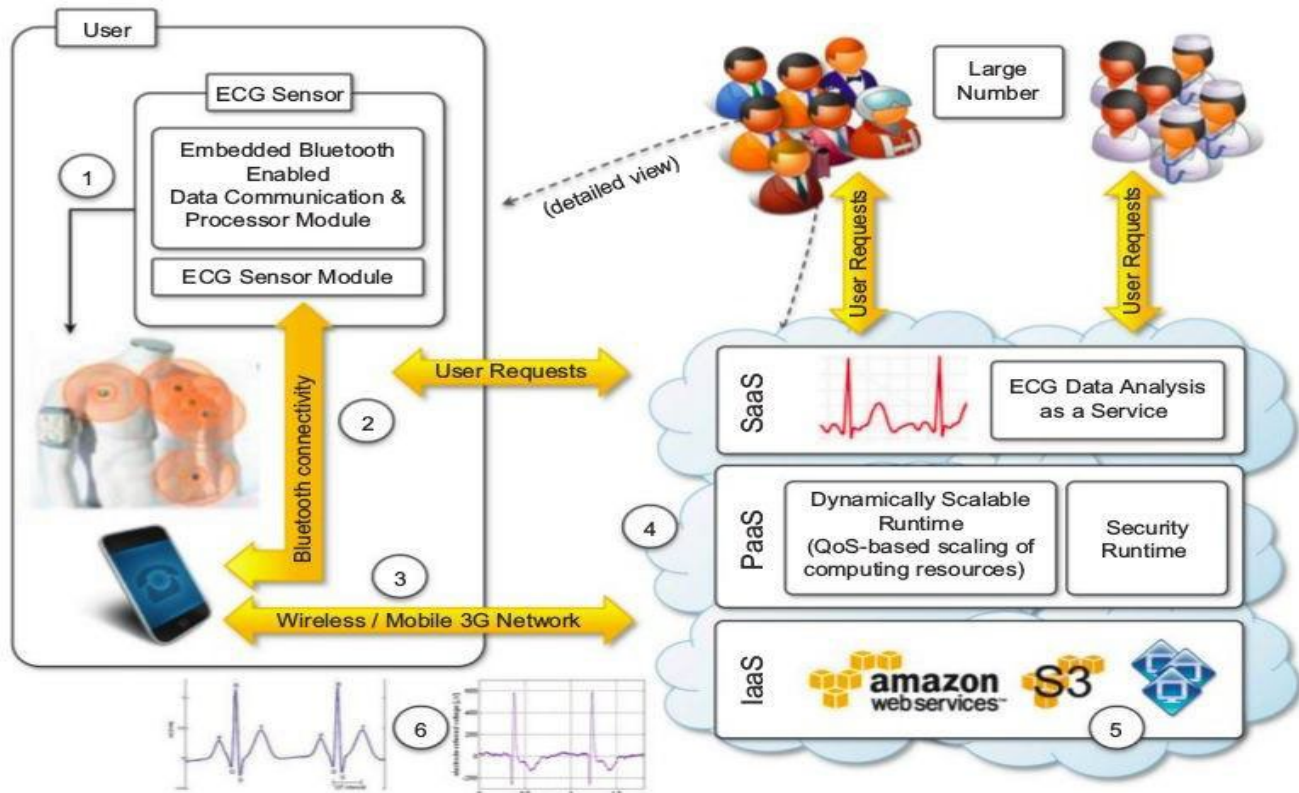


FIGURE 10.1

An online health monitoring system hosted in the cloud.

- The Web service forms the front-end of a platform that is hosted in cloud and leverages three layers of cloud computing stack: SaaS, PaaS, and IaaS.
- The Web service constitute SaaS application that will store ECG data in the Amazon S3 service and issue a processing request to the scalable cloud platform.
- The runtime platform is composed of a dynamically sizable number of instances running the workflow engine and Aneka.
- The number of workflow engine instances is controlled according to the number of requests in the queue of each instance, while Aneka controls the number of EC2 instances used to execute the single tasks defined by the workflow engine for a single ECG processing job.

Advantages

1. The elasticity of cloud infrastructure that can grow and shrink according to the requests served. As a result, doctors and hospitals do not have to invest in large computing infrastructures designed after capacity planning, thus making more effective use of budgets.
2. Ubiquity. Cloud computing technologies are easily accessible and promise to deliver systems with minimum or no downtime. Computing systems hosted in cloud are accessible from any Internet device through simple interfaces (such as SOAP and REST-based Web services). This makes systems easily integrated with other systems maintained on hospital's premises.
3. Cost savings. Cloud services are priced on a pay-per-use basis and with volume prices for large numbers of service requests.

10b) Dropbox and iCloud

1 Dropbox and iCloud

- Online storage solutions have turned into SaaS applications and become more usable as well as more advanced and accessible.
- The most popular solution for online document storage is **Dropbox**, that allows users to synchronize any file across any platform and any device in a seamless manner (**Figure 10.6**).
- Dropbox provides users with a free storage that is accessible through the abstraction of a folder. Users can either access their Dropbox folder through a browser or by downloading and installing a Dropbox client, which provides access to the online storage by means of a special folder.

- All the modifications into this folder are silently synched so that changes are notified to all the local instances of the Dropbox folder across all the devices.
- Another interesting application in this area is **iCloud**, a cloud-based document-sharing application provided by Apple to synchronize iOS-based devices in a completely transparent manner.
- Documents, photos, and videos are automatically synched as changes are made, without any explicit operation. This allows the system to efficiently automate common operations without any human intervention.
- This capability is limited to iOS devices, and currently there are no plans to provide iCloud with a Web-based interface that would make user content accessible from even unsupported platforms.

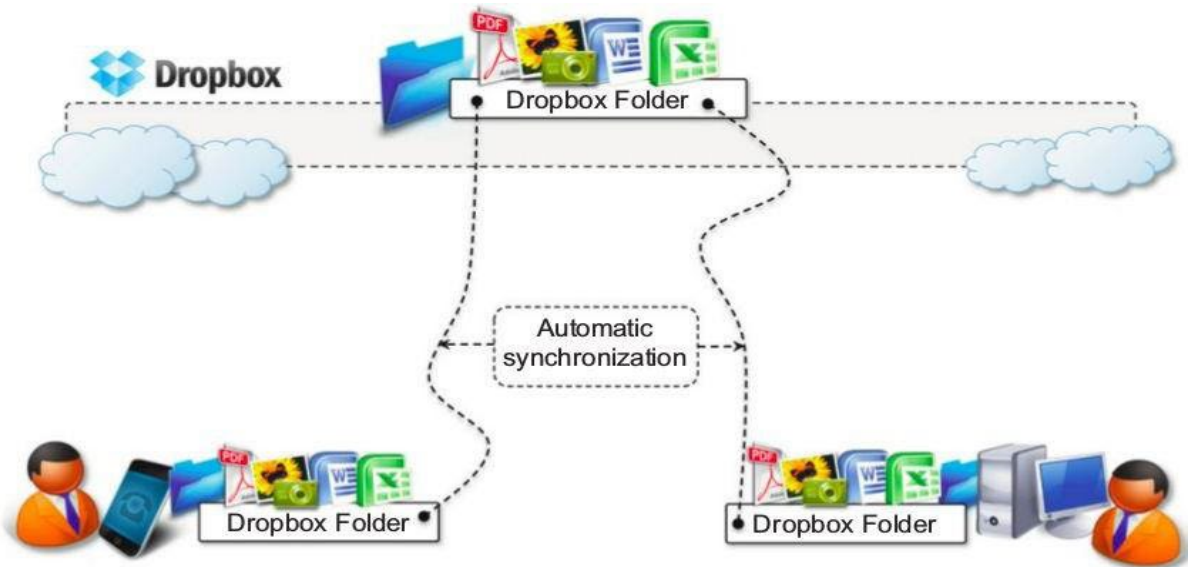


FIGURE 10.6

Dropbox usage scenario.

Module-5

- 9 a. Explain Amazon S3 key concepts. (08 Marks)
 b. Describe the core components of Google AppEngine. (08 Marks)
- OR
- 10 a. Describe how cloud computing technology can be applied to support remote ECG monitoring. (08 Marks)
 b. Describe three examples of CRM and ERP implementations based on cloud computing technologies. (08 Marks)

9a)Repeated 9b)Repeated

10a)Repeated

10b) CRM and ERP

- Customer relationship management (CRM) and enterprise resource planning (ERP) applications are market segments that are flourishing in the cloud
- Cloud CRM applications constitute a great opportunity for small enterprises and start-ups to have fully functional CRM software without large up-front costs and by paying subscriptions.
- Your business and customer data from everywhere and from any device, has fostered the spread of cloud CRM applications.
- ERP solutions on the cloud are less mature and have to compete with well-established in-house solutions. ERP systems integrate several aspects of an enterprise: finance and

accounting, human resources, manufacturing, supply chain management, project management, and CRM.

1 Salesforce.com

- Salesforce.com is most popular and developed CRM solution available today.
- As of today more than 100,000 customers have chosen Salesforce.com to implement their CRM solutions.
- The application provides customizable CRM solutions that can be integrated with additional features developed by third parties.
- Salesforce.com is based on the Force.com cloud development platform.
- This represents scalable and high-performance middleware executing all operations of all Salesforce.com applications.
- The architecture of the Force.com platform is shown in Figure 10.5.

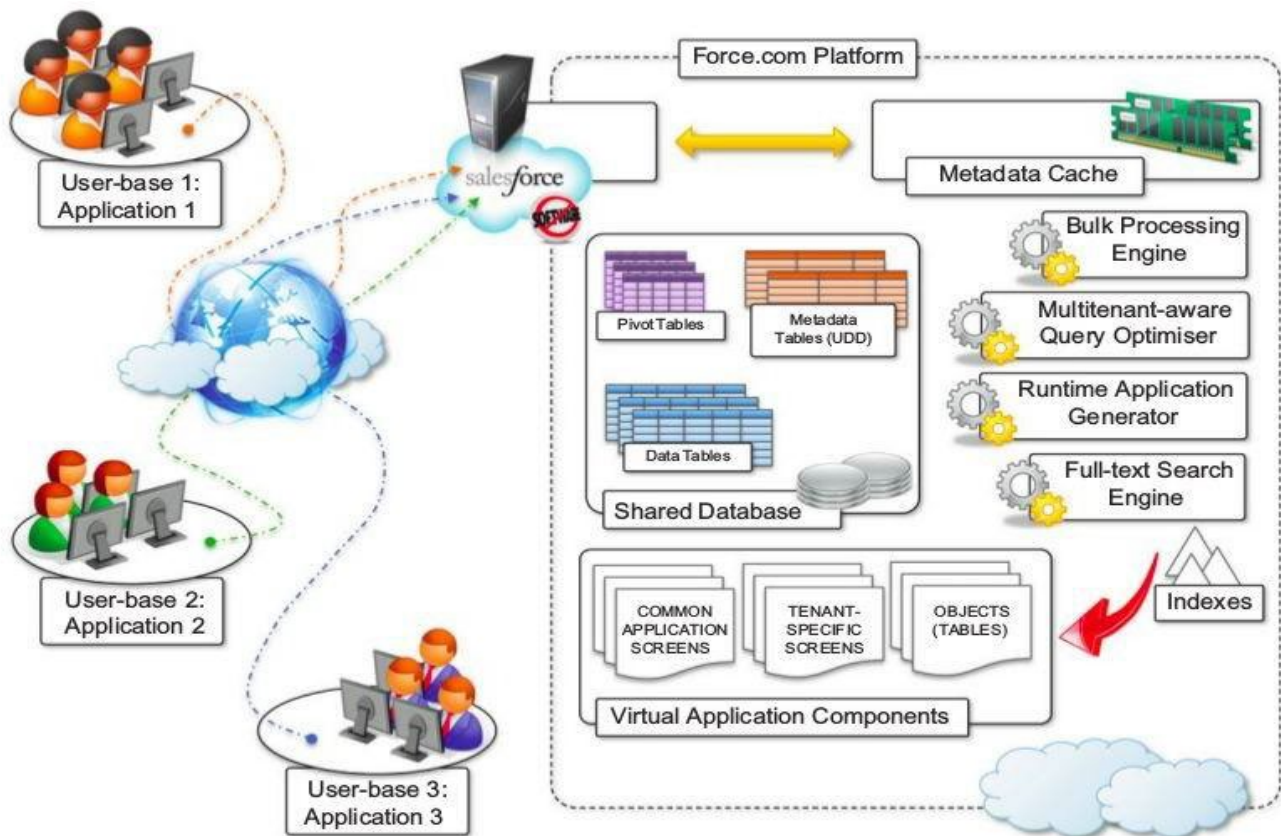


FIGURE 10.5

Salesforce.com and Force.com architecture.

2 Microsoft dynamics CRM

- The system is completely hosted in Microsoft's datacenters across the world and offers to customers a 99.9% SLA.
- Each CRM instance is deployed on a separate database, and application provides users with facilities for marketing, sales, and advanced customer relationship management.
- Dynamics CRM Online features can be accessed either through a Web browser interface or by means of SOAP and RESTful Web services.
- This allows Dynamics CRM to be easily integrated with both other Microsoft products and line-of-business applications.
- Dynamics CRM can be extended by developing plug-ins that allow implementing specific behaviors triggered on the occurrence of given events.

3 NetSuite

- NetSuite provides a collection of applications that help customers manage every aspect of the business enterprise.
- Its offering is divided into three major products: NetSuite Global ERP, NetSuite Global CRM1 , and NetSuite Global Ecommerce.
- Moreover, an all-in-one solution: NetSuite One World, integrates all three products together.

Module-3

- 9 a. Write a note about the prominent cloud computing platforms. (06 Marks)
 b. Explain the windows azure platform architecture. (10 Marks)

OR

- 10 a. Describe how cloud computing technology can be applied to remote ECG monitoring. (08 Marks)
 b. Explain animoto media application that use cloud technologies. (08 Marks)

* * * * *

9a) Refer 1st question (page no 1)

An overview of a few prominent cloud computing platforms and a brief description of the types of service they offer.

A cloud computing system can be developed using either a single technology and vendor or a combination of them.

This chapter presents some of representative cloud computing solutions offered as Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) services in the market

)Popular cloud computing products

1 Amazon web services

2 Google AppEngine

3 Microsoft Azure

9b) Refer 1st question (page no 1) 3.Microsoft Asure

10a) Repeated

10b) 1 Animoto

- Animoto is the most popular example of media applications on the cloud. The Website provides users with a very straightforward interface for quickly creating videos out of images, music, and video fragments submitted by users.
- Users select a specific theme for a video, upload the photos and videos and order them in the sequence they want to appear, select the song for the music, and render the video. The process is executed in the background and the user is notified via email once the video is rendered.
- A proprietary artificial intelligence (AI) engine, which selects the animation and transition effects according to pictures and music, drives the rendering operation. Users only have to define the storyboard by organizing pictures and videos into the desired sequence.
- The infrastructure of Animoto is complex and is composed of different systems that all need to scale (**Figure 10.8**). The core function is implemented on top of the Amazon Web Services infrastructure. It uses Amazon EC2 for the Web front-end and worker nodes; Amazon S3 for the storage of pictures, music, and videos; and Amazon SQS for connecting all the components.

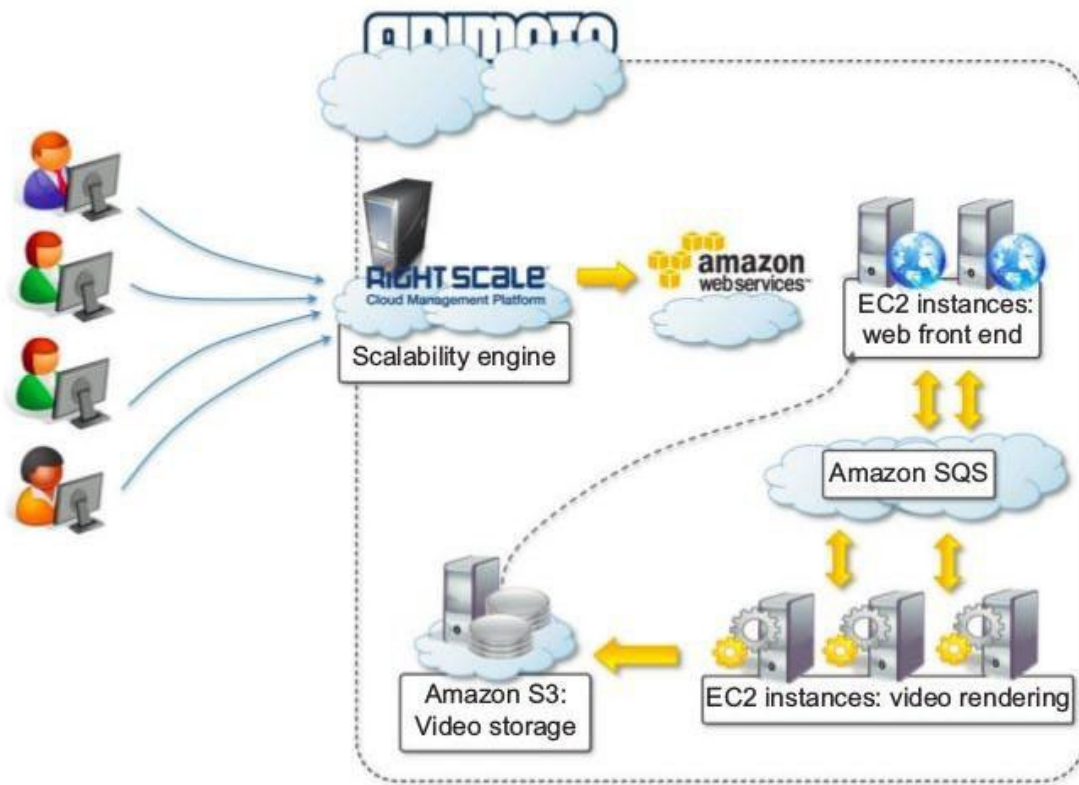


FIGURE 10.8

Animoto reference architecture.