Unit 6

Cloud Platforms and Applications

A cloud platform refers to the operating system and hardware of a server in an Internet-based data center. It allows software and hardware products to co-exist remotely and at scale.

How do cloud platforms work?

Enterprises rent access to compute services, such as servers, databases, storage, analytics, networking, software, and intelligence. Therefore, the enterprises don't have to set up and own data centers or computing infrastructure. They simply pay for what they use.

Types of Cloud Platforms

There are several types of cloud platforms. Not a single one works for everyone. There are several models, types, and services available to help meet the varying needs of users. They include:

- **Public Cloud**: Public cloud platforms are third-party providers that deliver computing resources over the Internet. Examples include Amazon Web Services (AWS), Google Cloud Platform, Alibaba, Microsoft Azure, and IBM Bluemix.
- **Private Cloud**: A private cloud platform is exclusive to a single organization. It's usually in an on-site data center or hosted by a third-party service provider.
- **Hybrid Cloud**: This is a combination of public and private cloud platforms. Data and applications move seamlessly between the two. This gives the organization greater flexibility and helps optimize infrastructure, security, and compliance.

Web Services

Web service is a standardized medium to propagate communication between the client and server applications on the WWW (World Wide Web). A web service is a software module that is designed to perform a certain set of tasks.

- Web services in cloud computing can be searched for over the network and can also be invoked accordingly.
- When invoked, the web service would be able to provide the functionality to the client, which invokes that web service.

AWS (Amazon Web Service)

Amazon web service is a platform that offers flexible, reliable, scalable, easy-to-use and cost-effective cloud computing solutions.

AWS is a comprehensive, easy to use computing platform offered Amazon. The platform is developed with a combination of infrastructure as a service (IaaS), platform as a service (PaaS) and packaged software as a service (SaaS) offering.

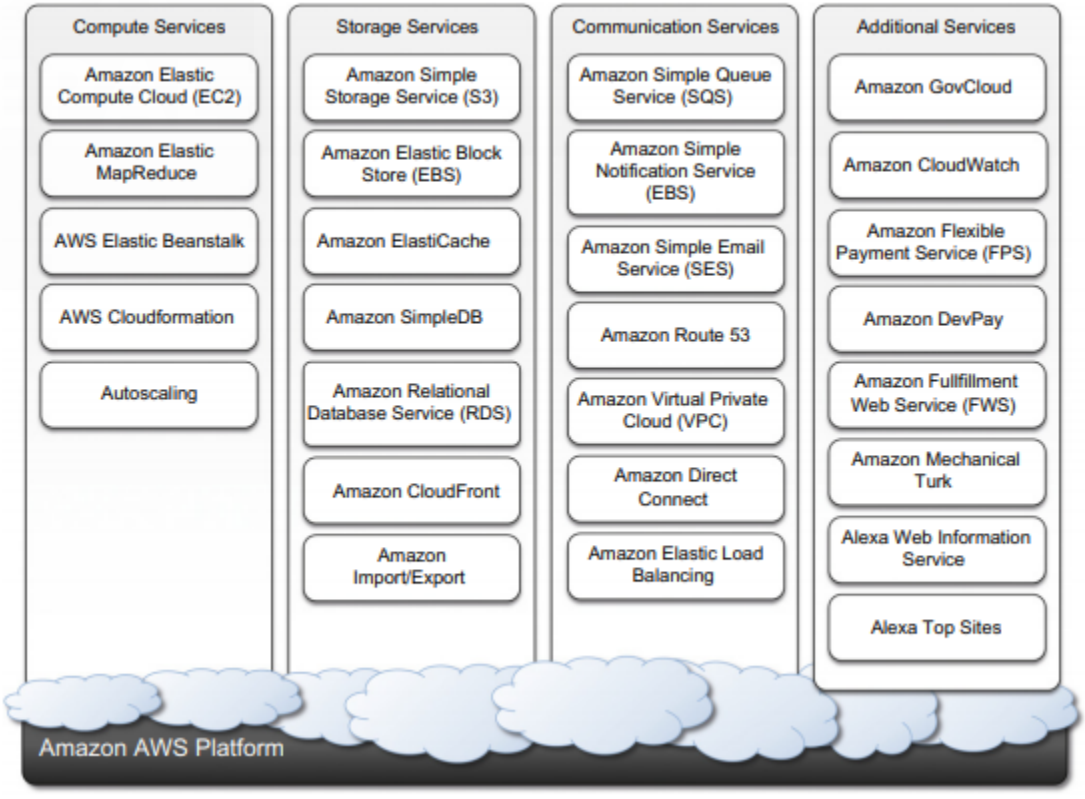
History of AWS

- 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

AWS Services

Amazon Web Services offers a wide range of different business purpose global cloud-based products. The products include storage, databases, analytics, networking, mobile, development tools, enterprise applications, with a pay-as-you-go pricing model.

Fig: Important AWS Services



Here, are essential AWS services.

AWS Compute Services

Here, are Cloud Compute Services offered by Amazon:

1. **EC2(Elastic Compute Cloud)-** EC2 is a virtual machine in the cloud on which you have OS level control. You can run this cloud server whenever you want.
2. **LightSail-** This cloud computing tool automatically deploys and manages the computer, storage, and networking capabilities required to run your applications.
3. **Elastic Beanstalk-** The tool offers automated deployment and provisioning of resources like a highly scalable production website.
4. **EKS (Elastic Container Service for Kubernetes)-** The tool allows you to Kubernetes on Amazon cloud environment without installation.
5. **AWS Lambda-** This AWS service allows you to run functions in the cloud. The tool is a big cost saver for you as you to pay only when your functions execute.

Migration

Migration services used to transfer data physically between your datacenter and AWS.

1. **DMS (Database Migration Service)-** DMS service can be used to migrate on-site databases to AWS. It helps you to migrate from one type of database to another — for example, Oracle to MySQL.
2. **SMS (Server Migration Service)-** SMS migration services allow you to migrate on-site servers to AWS easily and quickly.
3. **Snowball**— Snowball is a small application which allows you to transfer terabytes of data inside and outside of AWS environment.

Storage

1. **Amazon Glacier-** It is an extremely low-cost storage service. It offers secure and fast storage for data archiving and backup.
2. **Amazon Elastic Block Store (EBS)-** Amazon Elastic Block Store is a cloud-based block storage system provided by Amazon Web Services (AWS) that is best used for storing persistent data.
3. **AWS Storage Gateway-** This AWS service is connecting on-premises software applications with cloud-based storage. It offers secure integration between the company's on-premises and AWS's storage infrastructure.

Security Services

1. **IAM (Identity and Access Management)**— IAM is a secure cloud security service which helps you to manage users, assign policies, form groups to manage multiple users.
2. **Inspector**— It is an agent that you can install on your virtual machines, which reports any security vulnerabilities.
3. **Certificate Manager**— The service offers free SSL certificates for your domains that are managed by Route53.
4. **WAF (Web Application Firewall)**— WAF security service offers application-level protection and allows you to block SQL injection and helps you to block cross-site scripting attacks.

5. **Cloud Directory**— This service allows you to create flexible, cloud-native directories for managing hierarchies of data along multiple dimensions.
6. **KMS (Key Management Service)**— It is a managed service. This security service helps you to create and control the encryption keys which allows you to encrypt your data.
7. **Organizations**— You can create groups of AWS accounts using this service to manages security and automation settings.
8. **Shield**— Shield is managed DDoS (Distributed Denial of Service protection service). It offers safeguards against web applications running on AWS.

Database Services

1. **Amazon RDS-** This Database AWS service is easy to set up, operate, and scale a relational database in the cloud.
2. **Amazon DynamoDB-** It is a fast, fully managed NoSQL database service. It is a simple service which allow cost-effective storage and retrieval of data. It also allows you to serve any level of request traffic.
3. **Amazon ElastiCache-** It is a web service which makes it easy to deploy, operate, and scale an in-memory cache in the cloud.
4. **Neptune-** It is a fast, reliable and scalable **graph database** service.

Analytics

1. **CloudSearch**— You should use this AWS service to create a fully managed search engine for your website.
2. **ElasticSearch**— It is similar to CloudSearch. However, it offers more features like application monitoring.
3. **Kinesis**— This AWS analytics service helps you to stream and analyzing real-time data at massive scale.
4. **QuickSight**— It is a business analytics tool. It helps you to create visualizations in a dashboard for data in Amazon Web Services. For example, S3, DynamoDB, etc.
5. **EMR (Elastic Map Reduce)**— This AWS analytics service mainly used for big data processing like Spark, Splunk, Hadoop, etc.
6. **Data Pipeline**— Allows you to move data from one place to another. For example from DynamoDB to S3.

Management Services

1. **CloudWatch**— Cloud watch helps you to monitor AWS environments like CPU utilization etc. It also triggers alarms depends on various metrics.
2. **CloudFormation**— It is a way of turning infrastructure into the cloud. You can use templates for providing a whole production environment in minutes.
3. **CloudTrail**— It offers an easy method of auditing AWS resources. It helps you to log all changes.
4. **Config**— This AWS service monitors your environment. The tool sends alerts about changes when you break certain defined configurations.
5. **Service Catalog**— This service helps large enterprises to authorize which services user will be used and which won't.
6. **AWS Auto Scaling**— The service allows you to automatically scale your resources up and down based on given CloudWatch metrics.
7. **Systems Manager**— This AWS service allows you to group your resources. It allows you to identify issues and act on them.
8. **Managed Services**— It offers management of your AWS infrastructure which allows you to focus on your applications.

Internet of Things

1. **IoT Core**— It is a managed cloud AWS service. The service allows connected devices like cars, light bulbs, sensor grids, to securely interact with cloud applications and other devices.
2. **IoT Device Management**— It allows you to manage your IoT devices at any scale.
3. **IoT Analytics**— This AWS IOT service is helpful to perform analysis on data collected by your IoT devices.

Application Services

1. **Step Functions**— It is a way of visualizing what's going inside your application and what different microservices it is using.

2. **SWF (Simple Workflow Service)**— The service helps you to coordinate both automated tasks and human-led tasks.
3. **SNS (Simple Notification Service)**— You can use this service to send you notifications in the form of email and SMS based on given AWS services.
4. **Elastic Transcoder**— This AWS service tool helps you to changes a video's format and resolution to support various devices like tablets, smartphones, and laptops of different resolutions.

Deployment and Management

1. **AWS CloudTrail:** The services records AWS API calls and send backlog files to you.
2. **Amazon CloudWatch:** The tools monitor AWS resources like Amazon EC2 and Amazon RDS DB Instances. It also allows you to monitor custom metrics created by user's applications and services.
3. **AWS CloudHSM:** This AWS service helps you meet corporate, regulatory, and contractual, compliance requirements for maintaining data security by using the Hardware Security Module(HSM) appliances inside the AWS environment.

Developer Tools

1. **CodeStar**— Codestar is a cloud-based service for creating, managing, and working with various software development projects on AWS.
2. **CodeCommit**— It is AWS's version control service which allows you to store your code and other assets privately in the cloud.
3. **CodeBuild**— This Amazon developer service help you to automates the process of building and compiling your code.
4. **CodeDeploy**— It is a way of deploying your code in EC2 instances automatically.
5. **CodePipeline**— It helps you create a deployment pipeline like testing, building, testing, authentication, deployment on development and production environments.
6. **Cloud9**— It is an Integrated Development Environment for writing, running, and debugging code in the cloud.

Mobile Services

1. **Mobile Hub**— Allows you to add, configure and design features for mobile apps.

2. **Cognito**— Allows users to signup using his or her social identity.
3. **Device Farm**— Device farm helps you to improve the quality of apps by quickly testing hundreds of mobile devices.

Business Productivity

1. **Alexa for Business**— It empowers your organization with voice, using Alexa. It will help you to Allows you to build custom voice skills for your organization.
2. **Chime**— Can be used for online meeting and video conferencing.
3. **WorkDocs**— Helps to store documents in the cloud
4. **WorkMail**— Allows you to send and receive business emails.

Desktop & App Streaming

1. **WorkSpaces**— Workspace is a VDI (Virtual Desktop Infrastructure). It allows you to use remote desktops in the cloud.
2. **AppStream—** A way of streaming desktop applications to your users in the web browser. For example, using MS Word in Google Chrome.

Artificial Intelligence

1. **Lex**— Lex tool helps you to build chatbots **quickly.**
2. **Polly**— It is AWS's text-to-speech service allows you to create audio versions of your notes.
3. **Rekognition** — It is AWS's face recognition service. This AWS service helps you to recognize faces and object in images and videos.
4. **SageMaker**— Sagemaker allows you to build, train, and deploy machine learning models at any scale.
5. **Transcribe**— It is AWS's speech-to-text service that offers high-quality and affordable transcriptions.
6. **Translate**— It is a very similar tool to Google Translate which allows you to translate text in one language to another.

AR & VR (Augmented Reality & Virtual Reality)

1. **Sumerian**— Sumerian is a set of tool for offering high-quality virtual reality (VR) experiences on the web. The service allows you to create interactive 3D scenes and publish it as a website for users to access.

Customer Engagement

1. **Amazon Connect**— Amazon Connect allows you to create your customer care center in the cloud.
2. **Pinpoint**— Pinpoint helps you to understand your users and engage with them.
3. **SES (Simple Email Service)**— Helps you to send bulk emails to your customers at a relatively cost-effective price.

Game Development

1. **GameLift**- It is a service which is managed by AWS. You can use this service to host dedicated game servers. It allows you to scale seamlessly without taking your game offline.

Applications of AWS services

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

- Web site hosting
- Application hosting/SaaS hosting
- Media Sharing (Image/ Video)
- Mobile and Social Applications
- Content delivery and Media Distribution
- Storage, backup, and disaster recovery
- Development and test environments
- Search Engines
- Social Networking

Companies using AWS

- Instagram

- Zoopla
- Smugmug
- Pinterest
- Netflix
- Dropbox
- Etsy
- Talkbox
- Playfish
- Ftopia

Advantages of AWS

Following are the pros of using AWS services:

- AWS allows organizations to use the already familiar programming models, operating systems, databases, and architectures.
- It is a cost-effective service that allows you to pay only for what you use, without any up-front or long-term commitments.
- You will not require to spend money on running and maintaining data centers.
- Offers fast deployments
- You can easily add or remove capacity.
- You are allowed cloud access quickly with limitless capacity.
- Total Cost of Ownership is very low compared to any private/dedicated servers.
- Offers Centralized Billing and management
- Allows you to deploy your application in multiple regions around the world with just a few clicks

Disadvantages of AWS

- If you need more immediate or intensive assistance, you'll have to opt for paid support packages.
- Amazon Web Services may have some common cloud computing issues when you move to a cloud. For example, downtime, limited control, and backup protection.

- AWS sets default limits on resources which differ from region to region. These resources consist of images, volumes, and snapshots.
- Hardware-level changes happen to your application which may not offer the best performance and usage of your applications.

Google App Engine

- Google App Engine is an example of Platform as a Service (PaaS).
- Google App Engine provides Web app developers and enterprises with access to Google's scalable hosting.
- Google App Engine provides a scalable runtime based on the Java and Python programming language.
- Applications in Google app engine stores data in Google BigTable.
- Application in Google app engine uses Google query language.
- If applications are non-compatible to Google app engine, than application needed to be make compatible with Google app engine. All application are not supported by Google app engine.
- Google App Engine also removed some system administration and developmental tasks to make it easier to write scalable applications.

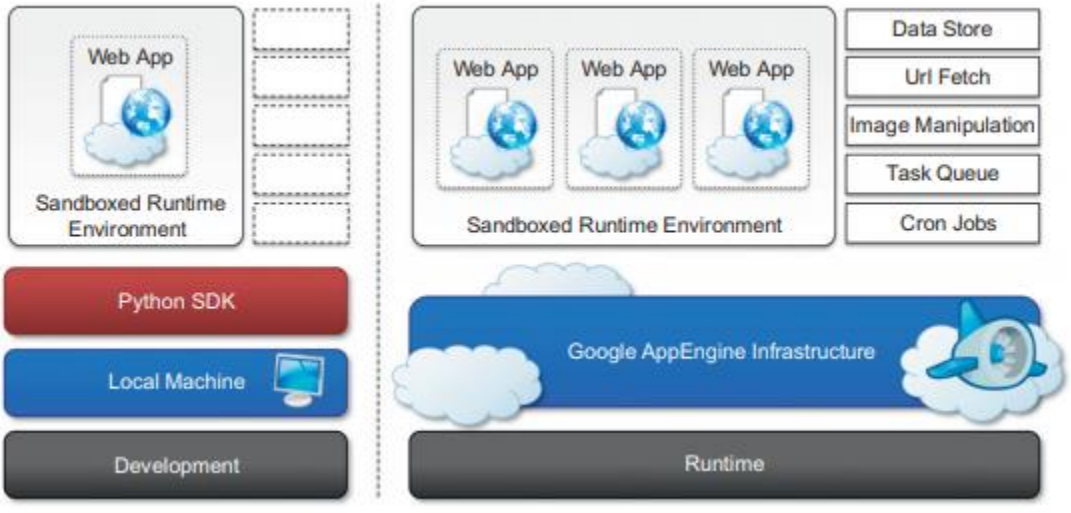


Fig: Google AppEngine platform architecture.

Cost of Google App Engine:

1. Google app engine provides limited resource usage as free of cost.
2. After free resource usage limit users can per day or per minute basis.

Why to use Google App Engine:

There are following reasons to use Google app engine:

1. Google app engine allows you to build web applications on the same stable and extendable platform which having support facility of Google's large number of applications.
2. Google app engine gives facility to use and run applications in Google's data center.
3. Google app engine's language Java and Python are easy to understand and implement.
4. This platform is absolutely free; you can purchase additional resources if needed.
5. Using Google accounts you can use Google app engine's services.
6. It is easy to scale up as your data storage and traffic needs grows with time.
7. Google also provides marketing facility to our apps.
8. User can easily write the application code, and can test it on own local system and upload it to Google at the click of a button or with a few lines of command script.
9. There is no need to take approval from system administration to upload or launch a new version of the application.
10. Google takes care of all the apps maintenance and allows users/developers to focus on the features of the application.

Major Features of Google App Engine in Cloud Computing

Some of the prominent Google App Engine features include:

1. Collection of Development Languages and Tools

The App Engine supports numerous programming languages for developers and offers the flexibility to import libraries and frameworks through docker containers. You can develop and test an app locally using the SDK containing tools for deploying apps. Every language has its SDK and runtime.

Some of the languages offered include — Python, PHP, .NET, Java, Ruby, C#, Go, Node.Js.

2. Fully Managed

Google allows you to add your web application code to the platform while managing the infrastructure for you. The engine ensures that your web apps are secure and running and saves them from malware and threats by enabling the firewall.

3. Pay-as-you-Go

The app engine works on a pay-as-you-go model, i.e., you only pay for what you use. The app engine automatically scales up resources when the application traffic picks up and vice-versa.

4. Effective Diagnostic Services

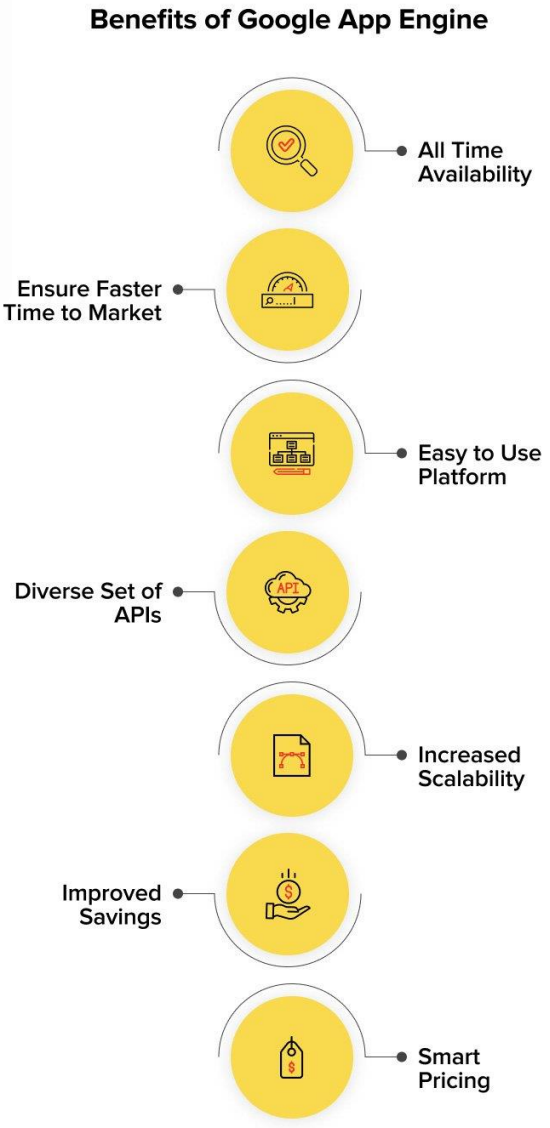
Cloud Monitoring and Cloud Logging that helps run app scans to identify bugs. The app reporting document helps developers fix bugs on an immediate basis.

5. Traffic Splitting

The app engine automatically routes the incoming traffic to different versions of the apps as a part of A/B testing. You can plan the consecutive increments based on what version of the app works best.

What are the Benefits of Google App Engine for Websites?

Adopting the App Engine is a smart decision for your organization — it will allow you to innovate and stay valuable. Here the answer to why Google App Engine is a preferable choice for building applications:



1. All Time Availability

When you develop and deploy your web applications on the cloud, you enable remote access for your applications. Considering the impact of COVID-19 on businesses, Google App Engine is the right choice that lets the developers develop applications remotely, while the cloud service manages the infrastructure needs.

2. Ensure Faster Time to Market

For your web applications to succeed, ensuring faster time to market is imperative as the requirements are likely to change if the launch time is extended. Using Google App Engine is as easy as it can get for developers. The diverse tool repository and other functionalities ensure that the Google Cloud application development and testing time gets reduced, which, in turn, ensures faster launch time for consecutive launches.

3. Easy to Use Platform

The developers only require to write code. With zero configuration and server management, you eliminate all the burden to manage and deploy the code. Google App Engine makes it easy to use the platform, which offers the flexibility to focus on other concurrent web applications and processes. The best part is that GAE automatically handles the traffic increase through patching, provisioning, and monitoring.

4. Diverse Set of APIs

Google App Engine has several built-in APIs and services that allow developers to build robust and feature-rich apps. These features include:

- Access to the application log
- Blobstore, serve large data objects
- Google App Engine Cloud Storage
- SSL Support
- Page Speed Services
- Google Cloud Endpoint, for mobile application
- URL Fetch API, User API, Memcache API, Channel API, File API

5. Increased Scalability

Scalability is synonymous with growth — an essential factor that assures success and competitive advantage. The good news is that the Google App Engine cloud development platform is automatically scalable. Whenever the traffic to the web application increases, GAE automatically scales up the resources, and vice-versa.

6. Improved Savings

With Google App Engine, you do not have to spend extra on server management of the app. The Google Cloud service is good at handling the backend process.

Also, Google App Engine pricing is flexible as the resources can scale up/down based on the app's usage. The resources automatically scale up/down based on how the app performs in the market, thus ensuring honest pricing in the end.

7. Smart Pricing

The major concern of organizations revolves around how much does Google App Engine cost? For your convenience, Google App Engine has a daily and a monthly billing cycle, i.e.,

- **Daily:** You will be charged daily for the resources you use
- **Monthly**: All the daily charges are calculated and added to the taxes (if applicable) and debited from your payment method

Also, the App Engine has a dedicated billing dashboard, "App Engine Dashboard" to view and manage your account and subsequent billings.

Microsoft Azure

Azure is a cloud computing platform which was launched by Microsoft in February 2010. It is an open and flexible cloud platform which helps in development, data storage, service hosting, and service management. The Azure tool hosts web applications over the internet with the help of Microsoft data centers.

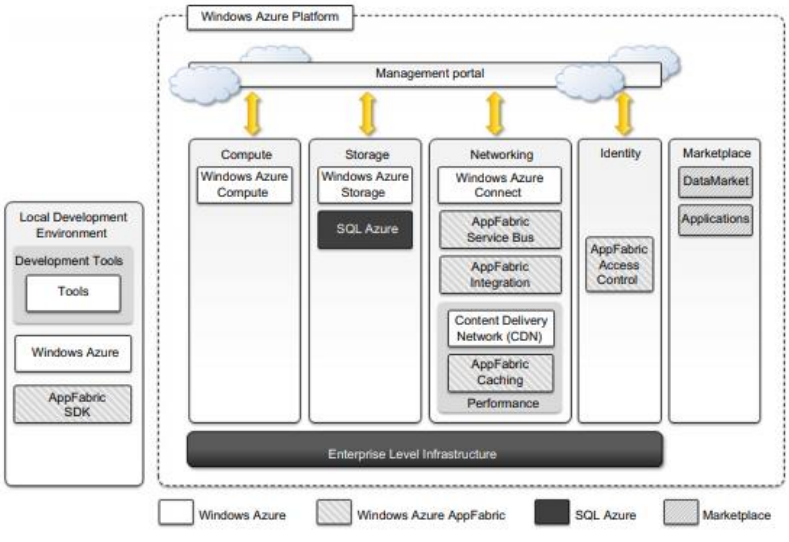
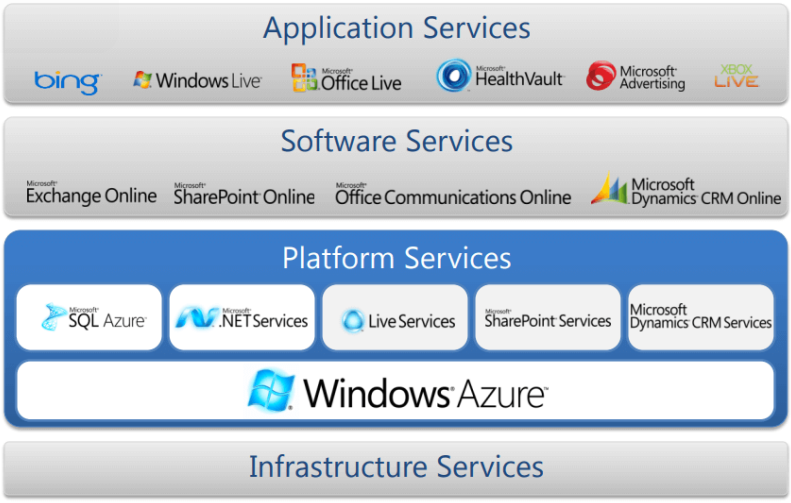


Fig: Microsoft Windows Azure Platform Architecture.

Types of Azure Clouds

There are mainly three types of clouds in Microsoft Azure are:

1. PAAS
2. SAAS
3. IAAS



Azure as IaaS

IaaS (Infrastructure as a Service) is the foundational cloud platform layer. This Azure service is used by IT administrators for processing, storage, networks or any other fundamental computer operations. It is one of the Azure topics to learn that allows users to run arbitrary software.
Advantages:

- It is advisable for the application which needs complete control
- IaaS offers quick transition of services to clouds
- The apparent benefit of laaS is that it frees you from the concerns of setting up many physical or virtual machines.
- Helps you to access, monitor and manage datacenters

Disadvantages of Iaas:

- Plenty of security risks from unpatched servers
- Some companies have defined processes for testing and updating on-premise servers' vulnerabilities. This cannot be done with Azure.

Azure as PaaS

PaaS is a computing platform which includes an operating system, programming language execution environment, database or web services. This Azure service is used by developers and application providers.

As its name suggests, this platform is provided to the client to develop and deploy software. It is one of the Azure basic concepts which allows the client to focus on application development instead of worrying about hardware and infrastructure. It also takes care of operating systems, networking and servers' issues.

Advantages:

- The total cost is low as the resources are allocated on demand and servers are automatically added or subtracted.
- Azure is less vulnerable because servers are automatically checked for all known security issues
- The entire process is not visible to the developer, so it does not have a risk of a data breach

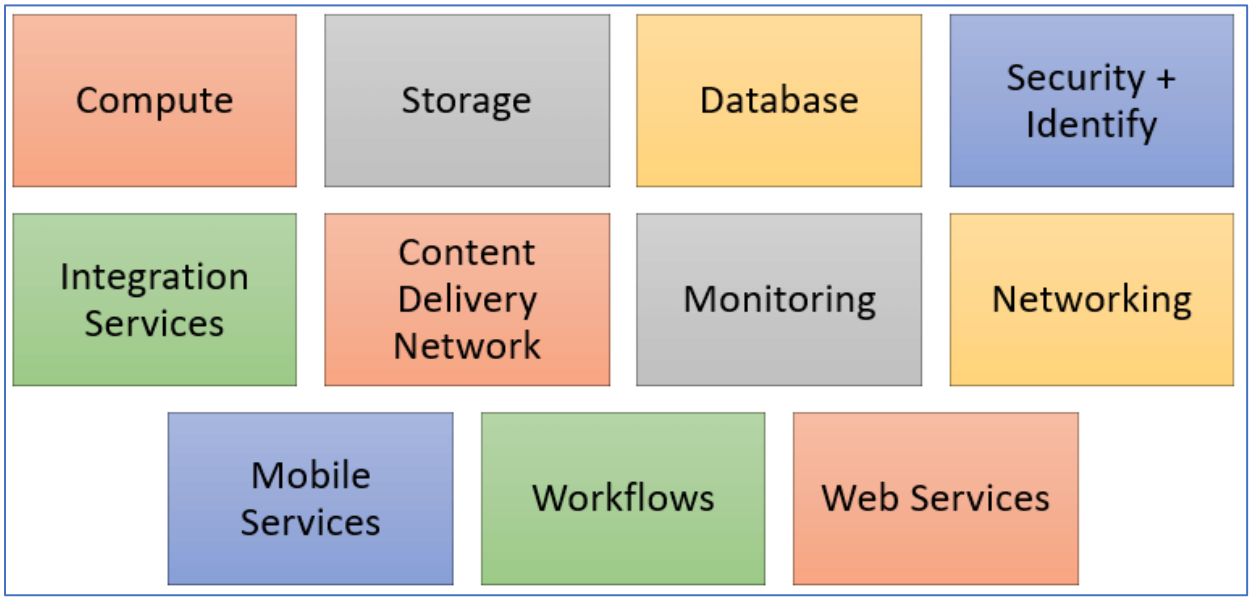
Disadvantages:

- Portability issues can occur when you use PaaS services
- There may be different environment at Azure, so the application needs to adapt accordingly.

Azure As SaaS

SaaS (Software as a Service) is software which is centrally hosted and managed. It is a single version of the application is used for all customers. You can scale out to multiple instances. This helps you to ensure the best performance in all locations. The software is licensed through a monthly or annual subscription. MS Exchange, Office, Dynamics are offered as a SaaS

Azure Domains (Components)



Key Azure Components

Compute

It offers computing operations like app hosting, development, and deployment in Azure Platform. It has the following components:

- Virtual Machine: Allows you to deploy any language, workload in any operating system
- Virtual Machine Scale Sets: Allows you to create thousands of similar virtual machines in minutes
- Azure Container Service: Create a container hosting solution which is optimized for Azure.

Storage

Azure store is a cloud storage solution for modern applications. It is designed to meet the needs of their customer's demand for scalability. It allows you to store and process hundreds of terabytes of data. It has the following components:

- Blob Storage: Azure Blob storage is a service which stores unstructured data in the cloud as objects/blobs. You can store any type of text or binary data, such as a document, media file, or application installer.
- Queue Storage: It provides cloud messaging between application components. It delivers asynchronous messaging to establish communication between application components.
- Table Storage: Azure Table storage stores semi-structured NoSQL data in the cloud. It provides a key/attribute store with a schema-less design

Database

This category includes Database as a Service (DBaaS) which offers SQL and NoSQL tools. It also includes databases like Azure Cosmos DB and Azure Database for PostgreSQL. It has the following components:

- SQL Database: It is a relational database service in the Microsoft cloud based on the market-leading Microsoft SQL Server engine.
- DocumentDB: It is a fully managed NoSQL database service which is It built for fast and predictable performance and ease of development.
- Redis Cache: It is a secure and highly advanced key-value store. It stores data structures like strings, lists, etc.

Content Delivery Network

Content Delivery Network (CDN) caches static web content at strategically placed locations. This helps you to offer speed for delivering content to users.

Security + Identify services

It provides capabilities to identify and respond to cloud security threats. It also helps you to manage encryption keys and other sensitive assets. It has the following components:

- Key Vault: Azure Key Vault allows you to safeguard cryptographic keys and helps you to create secrets used by cloud applications and services.
- Azure Active Directory: Azure Active Directory and identity management service. This includes multi-factor authentication, device registration, etc.
- Azure AD B2C: Azure AD B2C is a cloud identity management solution for your consumer-facing web and mobile applications. It allows you to scales hundreds of millions of consumer identities.

Enterprise Integration Services:

- Service Bus: Service Bus is an information delivery service which works on the third-party communication system.
- SQL Server Stretch Database: This service helps you migrates any cold data securely and transparently to the Microsoft Azure cloud
- Multi-Factor Authentication: Azure Multi-Factor Authentication (MFA) is two-step verification. It helps you to access data and applications to offers a simple sign-in process.

Monitoring + Management Services

These services allow easy management of Azure deployment.

- Azure Resource Manager: It makes it easy for you to manage and visualize resource in your app. You can even control who is your organization can act on the resources.
- Automation: Microsoft Azure Automation is a way to automate the manual, long-running, error-free, and constantly repeated tasks. These tasks are commonly performed in a cloud and enterprise environment.

Azure Networking

- Virtual Network: Perform Network isolation and segmentation. It offers filter and Route network traffic.
- Load Balancer: Offers high availability and network performance of any application. Load balance information Internet traffic to Virtual machines.
- Azure DNS: Azure DNS hosting service offers name resolution using Microsoft Azure infrastructure.

Web and Mobile Services:

- Web Apps: Web Apps allows you to build and host websites in the programming language of your choice without the need to manage its infrastructure.
- Mobile Apps: Mobile Apps Service offers a highly scalable, globally available mobile app development platform for users.
- API Apps: API apps make it easier to develop, host and consume APIs in the cloud and on-premises.

Workflows in the cloud

It provides a visual designer to create and automate your process as a series of steps known as a workflow

- Notification Hubs: Azure Notification Hubs offers an easy-to-use, multi-platform, scaled-out push engine
- Event Hubs: Azure Event Hubs is data streaming platform which can manage millions of events per second.
- Azure Search: It is a cloud search-as-a-service solution which offers server and infrastructure management. It offers ready-to-use service that you can populate with your data. This can be used to add search to your web or mobile application.

Migration

Migration tools help an organization estimate workload migration costs. It also helps to perform the migration of workloads from your local data centers to the Azure cloud.

Applications of Azure

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

- Infrastructure Services
- Mobile Apps
- Web Applications
- Cloud Services
- Storage, Backup, and Recovery
- Data Management
- Media Services

Advantages of Azure

Here, are the advantages of using Azure:

- Azure infrastructure will cost-effectively enhance your business continuity strategy
- It allows you to access the application without buying a license for the individual machine
- Windows Azure offers the best solution for your data needs, from SQL database to blobs to tables
- Offers scalability, flexibility, and cost-effectiveness
- Helps you to maintain consistency across clouds with familiar tools and resources
- Allows you to extend data center with a consistent management toolset and familiar development and identity solutions.
- You can deploy premium virtual machines in minutes which also include Linux and Windows servers
- Helps you to scale your IT resources up and down based on your needs

- You are not required to run the high-powered and high-priced computer to run cloud computing's web-based applications.
- You will not require processing power or hard disk space if you are using Azure
- Cloud computing offers virtually limitless storage
- If your personal computer or laptop crashes, all your data is still out there in the cloud, and it is still accessible
- If you change your device your computers, applications and documents follow you through the cloud

Disadvantages of Azure

- Cloud computing is not possible if you can't connect to the Internet
- Azure is a web-based application which requires a lot of bandwidth to download, as do large documents
- Web-based applications can sometimes be slower compared to accessing a similar software program on your desktop PC

Summary

- Cloud computing is a term referred to storing and accessing of data over the internet
- Azure is a cloud computing platform which was launched by Microsoft in February 2010
- There are mainly three types of clouds in Microsoft Azure: 1) PAAS 2) SAAS 3) IASS
- IaaS (Infrastructure as a Service) is the foundational cloud platform layer.
- PaaS is a computing platform which includes an operating system, programming language execution environment, database or web services
- SaaS (Software as a Service) is software which is centrally hosted and managed.
- Important components of Microsoft Azure are Compute, Storage, Database, Monitoring & management services, Content Delivery Network, Azure Networking, Web & Mobile services, etc.
- Important applications of Microsoft Azure are: Infrastructure Services, Mobile Apps, Web Applications, Cloud Services, Storage, Backup, and Recovery, Data Management, and Media Services
- The biggest advantage of Microsoft Azure infrastructure is that it will cost-effectively enhance your business continuity strategy
- Web-based applications like Azure can sometimes be slower compared to accessing a similar software program on your desktop PC

ANEKA:

- ✓ Aneka is the product of Manjarasoft.
- ✓ Aneka is used for developing, deploying and managing cloud applications.
- ✓ Aneka can be integrated with existing cloud technologies.

- ✓ Aneka includes extensible set of APIs associated with programming models like MapReduce.
- ✓ These APIs supports different types of cloud models like private, public, hybrid cloud.

Aneka framework:

- ✓ Aneks is a software platform for developing cloud computing applications.
- ✓ In Aneka cloud applications are executed.
- ✓ Aneka is a pure PaaS solution for cloud computing.
- ✓ Aneka is a cloud middleware product.
- ✓ Aneka can be deployed on a network of computers, a multicore server, datacenters, virtual cloud infrastructures, or a mixture of these.

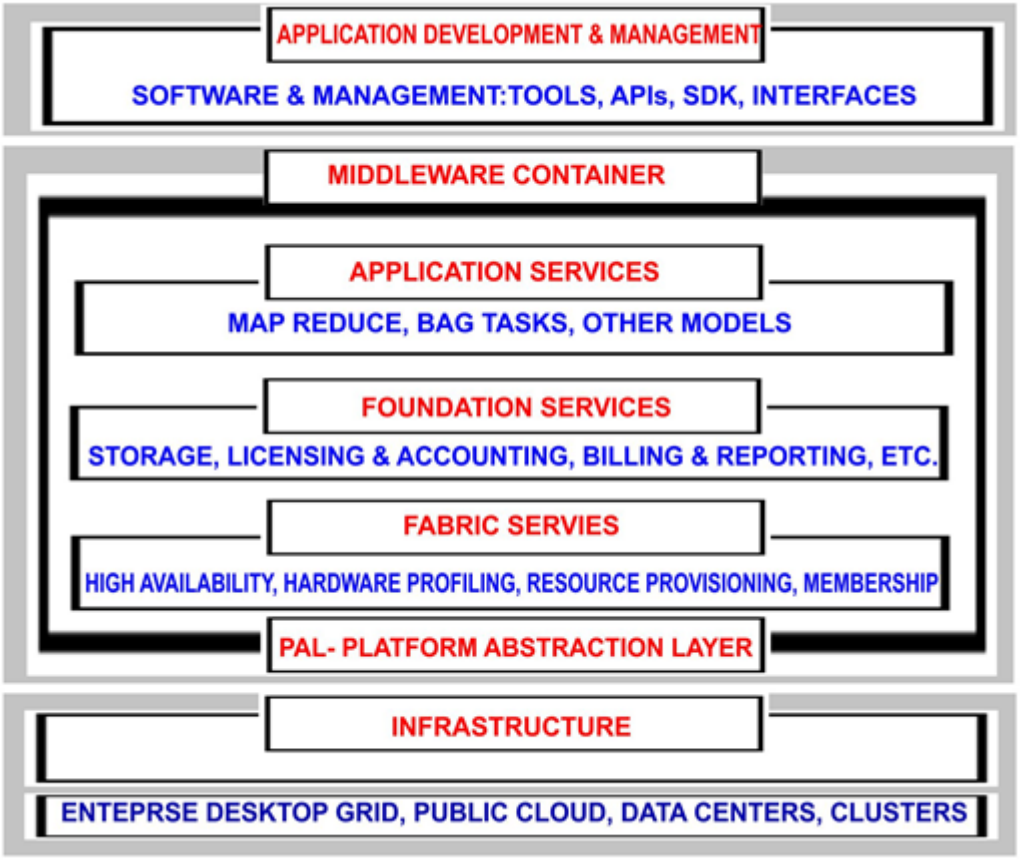


Fig: Aneka framework overview

Aneka container can be classified into three major categories:

1. Fabric Services
2. Foundation Services
3. Application Services

1. Fabric services:

Fabric Services define the lowest level of the software stack representing the Aneka Container. They provide access to the resource-provisioning subsystem and to the monitoring facilities implemented in Aneka.

2. Foundation services:

Fabric Services are fundamental services of the Aneka Cloud and define the basic infrastructure management features of the system. Foundation Services are related to the logical management of the distributed system built on top of the infrastructure and provide supporting services for the execution of distributed applications.

3. Application services:

Application Services manage the execution of applications and constitute a layer that differentiates according to the specific programming model used for developing distributed applications on top of Aneka.

Cloud Applications

 # Scientific applications

Scientific applications are a sector that is increasingly using cloud computing systems and technologies. The immediate benefit seen by researchers and academics is the potentially infinite availability of computing resources and storage at sustainable prices compared to a complete in-house deployment. Cloud computing systems meet the needs of different types of applications in the scientific domain: high-performance computing (HPC) applications, high-throughput computing (HTC) applications, and data-intensive applications. The opportunity to use cloud resources is even more appealing because minimal changes need to be made to existing applications in order to leverage cloud resources.

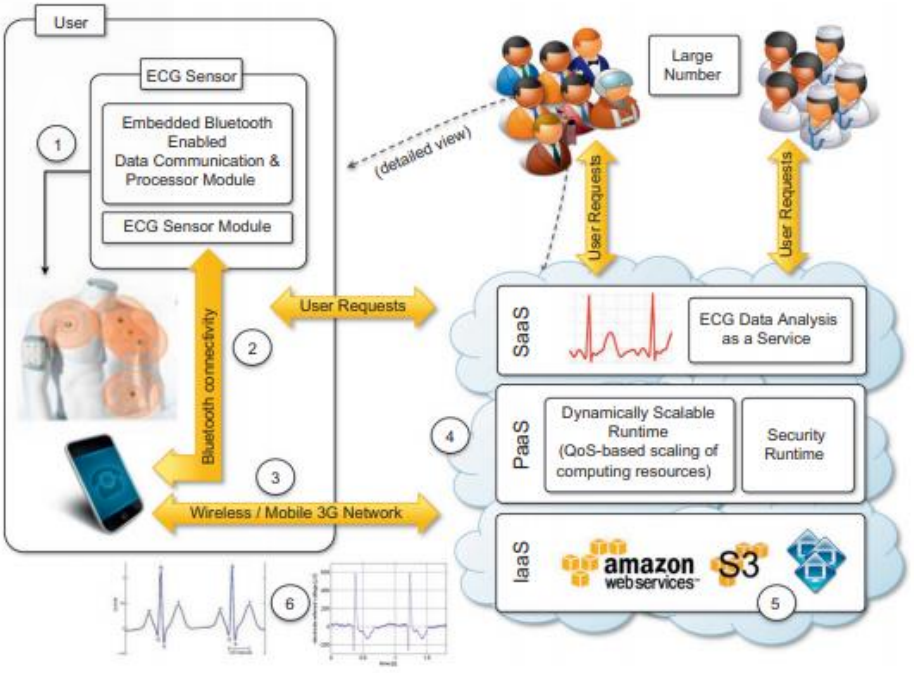
The most relevant option is IaaS solutions, which offer the optimal environment for running bag-of-tasks applications and workflows. PaaS solutions have been considered as well. They allow scientists to explore new programming models for tackling computationally challenging problems. Applications have been redesigned and implemented on top of cloud programming application models and platforms to leverage their unique capabilities. For instance, the MapReduce programming model provides scientists with a very simple and effective model for building applications that need to process large datasets. Therefore, it has been widely used to develop data-intensive scientific applications. The various case studies in which Aneka has been used.

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 important application is the use of cloud technologies to support doctors in providing more effective diagnostic processes. In particular, here we discuss electrocardiogram (ECG) data analysis on the cloud.

The capillary development of Internet connectivity and its accessibility from any device at any time has made cloud technologies an attractive option for developing health-monitoring systems. ECG data analysis and monitoring constitute a case that naturally fits into this scenario.

Cloud computing technologies allow the remote monitoring of a patient's heartbeat data, data analysis in minimal time, and the notification of first-aid personnel and doctors should these data reveal potentially dangerous conditions. This way a patient at risk can be constantly monitored without going to a hospital for ECG analysis. At the same time, doctors and first-aid personnel can instantly be notified of cases that require their attention



An online health monitoring system hosted in the cloud.

Biology: protein structure prediction

Applications in biology often require high computing capabilities and often operate on large datasets that cause extensive I/O operations. Because of these requirements, biology applications have often made extensive use of supercomputing and cluster computing infrastructures. Similar capabilities can be leveraged on demand using cloud computing technologies in a more dynamic fashion, thus opening new opportunities for bioinformatics applications

Protein structure prediction is a computationally intensive task that is fundamental to different types of research in the life sciences. Among these is the design of new drugs for the treatment of diseases

The computational power required for protein structure prediction can now be acquired on demand, without owning a cluster or navigating the bureaucracy to get access to parallel and distributed computing facilities. Cloud computing grants access to such capacity on a pay-per-use basis.

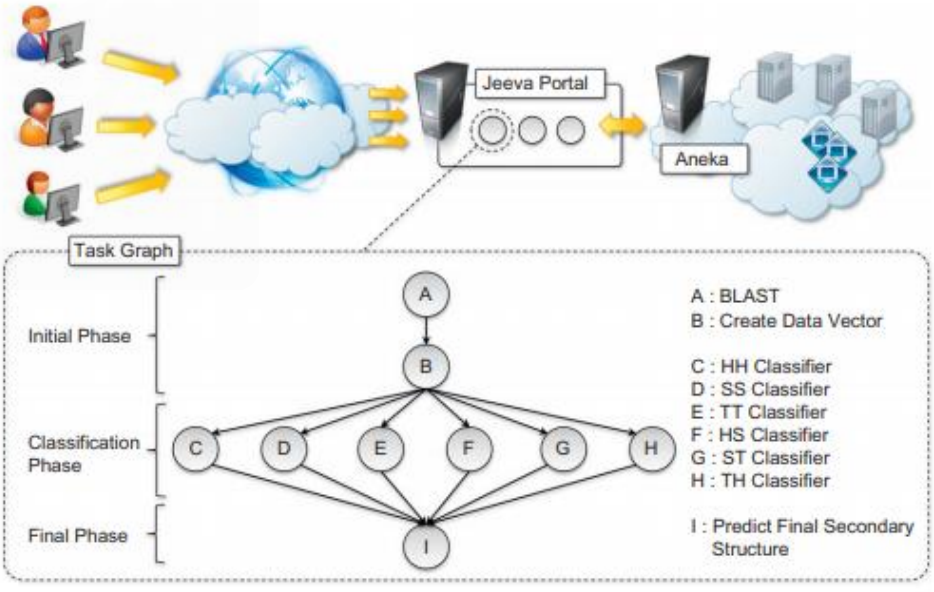


Fig: Architecture and overview of the Jeeva Portal.

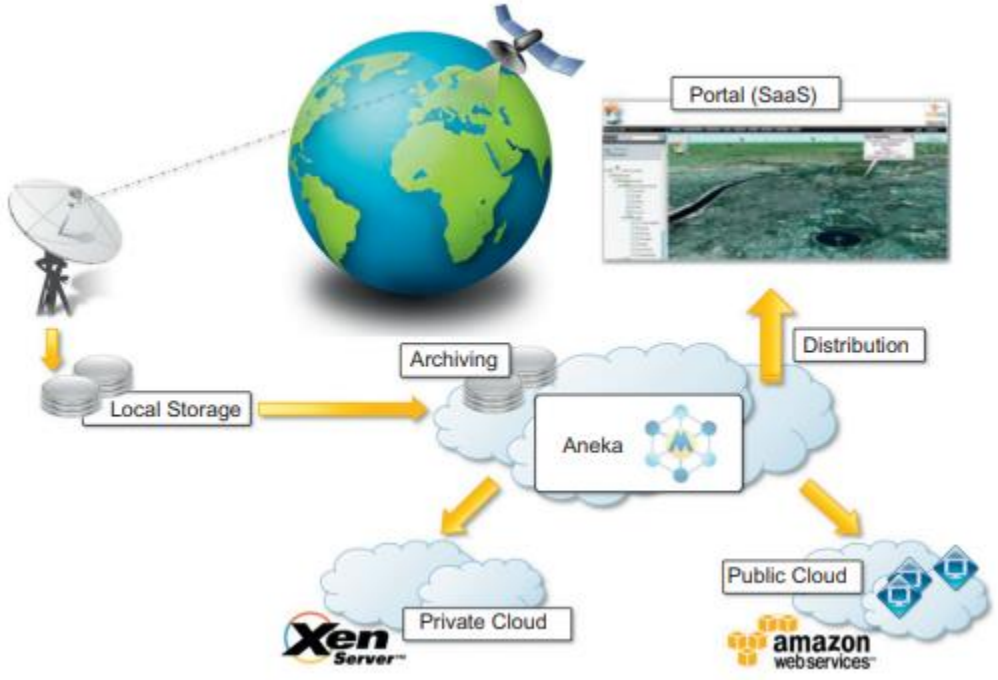
Biology: gene expression data analysis for cancer diagnosis

Gene expression profiling is the measurement of the expression levels of thousands of genes at once. It is used to understand the biological processes that are triggered by medical treatment at a cellular level. Together with protein structure prediction, this activity is a fundamental component of drug design, since it allows scientists to identify the effects of a specific treatment. Another important application of gene expression profiling is cancer diagnosis and treatment. Cancer is a disease characterized by uncontrolled cell growth and proliferation. This behavior occurs because genes regulating the cell growth mutate. This means that all the cancerous cells contain mutated genes. In this context, gene expression profiling is utilized to provide a more accurate classification of tumors. The classification of gene expression data samples into distinct classes is a challenging task. The dimensionality of typical gene expression datasets ranges from several thousands to over tens of thousands of genes. However, only small sample sizes are typically available for analysis.

Geoscience: satellite image processing

Geoscience applications collect, produce, and analyze massive amounts of geospatial and nonspatial data. As the technology progresses and our planet becomes more instrumented (i.e., through the deployment of sensors and satellites for monitoring), the volume of data that needs to be processed increases significantly.

In particular, the geographic information system (GIS) is a major element of geoscience applications. GIS applications capture, store, manipulate, analyze, manage, and present all types of geographically referenced data. This type of information is now becoming increasingly relevant to a wide variety of application domains: from advanced farming to civil security and natural resources management. As a result, a considerable amount of geo-referenced data is ingested into computer systems for further processing and analysis. Cloud computing is an attractive option for executing these demanding tasks and extracting meaningful information to support decision makers.



A cloud environment for satellite data processing.

Business and consumer applications

The business and consumer sector are the one that probably benefits the most from cloud computing technologies. On one hand, the opportunity to transform capital costs into operational costs makes clouds an attractive option for all enterprises that are IT-centric. On the other hand, the sense of ubiquity that the cloud offers for accessing data and services makes it interesting for end users as well. Moreover, the elastic nature of cloud technologies does not require huge up-front investments, thus allowing new ideas to be quickly translated into products and services that can comfortably grow with the demand. The combination of all these elements has made cloud

computing the preferred technology for a wide range of applications, from CRM and ERP systems to productivity and social-networking applications.

 # CRM and ERP

Customer relationship management (CRM) and enterprise resource planning (ERP) applications are market segments that are flourishing in the cloud, with CRM applications the more mature of the two. 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. Moreover, CRM is not an activity that requires specific needs, and it can be easily moved to the cloud. Such a characteristic, together with the possibility of having access to 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. Their goal is to provide a uniform view and access to all operations that need to be performed to sustain a complex organization. Because of the organizations that they target, the transition to cloud-based models is more difficult: he cost advantage over the long term might not be clear, and the switch to the cloud could be difficult if organizations already have large ERP installations. For this reason, cloud ERP solutions are less popular than CRM solutions at this time.

Salesforce.com

Salesforce.com is probably the most popular and developed CRM solution available today. As of today, more than 100,000 customers have chosen Safesforce.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 the operations of all Salesforce.com applications.

Microsoft dynamics CRM

Microsoft Dynamics CRM is the solution implemented by Microsoft for customer relationship management. Dynamics CRM is available either for installation on the enterprise’s premises or as

an online solution priced as a monthly per-user subscription. The system is completely hosted in Microsoft's datacenters across the world and offers to customers a 99.9% SLA, with bonus credits if the system does not fulfill the agreement. Each CRM instance is deployed on a separate database, and the application provides users with facilities for marketing, sales, and advanced customer relationship management.

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.

The services NetSuite delivers are powered by two large datacenters on the East and West coasts of the United States, connected by redundant links. This allows NetSuite to guarantee 99.5% uptime to its customers. Besides the prepackaged solutions, NetSuite also provides an infrastructure and a development environment for implementing customized applications. The NetSuite Business Operating System (NS-BOS) is a complete stack of technologies for building SaaS business applications that leverage the capabilities of NetSuite products. On top of the SaaS infrastructure, the NetSuite Business Suite components offer accounting, ERP, CRM, and ecommerce capabilities.

 # Productivity

Productivity applications replicate in the cloud some of the most common tasks that we are used to performing on our desktop: from document storage to office automation and complete desktop environments hosted in the cloud.

Dropbox and iCloud

One of the core features of cloud computing is availability anywhere, at any time, and from any Internet-connected device. Therefore, document storage constitutes a natural application for such technology.

Perhaps the most popular solution for online document storage is Dropbox, an online application that allows users to synchronize any file across any platform and any device in a seamless manner

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. Unlike Dropbox, which provides synchronization through the abstraction of a local folder, iCloud has been designed to be completely transparent once it has been set up. 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: taking a picture with your iPhone and having it automatically available in iPhoto on your Mac at home; editing a document on the iMac at home and having the changes updated in your iPad.

Google docs

Google Docs is a SaaS application that delivers the basic office automation capabilities with support for collaborative editing over the Web. The application is executed on top of the Google distributed computing infrastructure, which allows the system to dynamically scale according to the number of users using the service.

Google Docs allows users to create and edit text documents, spreadsheets, presentations, forms, and drawings. It aims to replace desktop products such as Microsoft Office and OpenOffice and provide similar interface and functionality as a cloud service.

 # Social networking

Social networking applications have grown considerably in the last few years to become the most active sites on the Web. To sustain their traffic and serve millions of users seamlessly, services such as Twitter and Facebook have leveraged cloud computing technologies.

Facebook

Facebook is probably the most evident and interesting environment in social networking. With more than 800 million users, it has become one of the largest websites in the world. To sustain this incredible growth, it has been fundamental that Facebook be capable of continuously adding capacity and developing new scalable technologies and software systems while maintaining high performance to ensure a smooth user experience

 # Media applications

Media applications are a niche that has taken a considerable advantage from leveraging cloud computing technologies. In particular, video-processing operations, such as encoding, transcoding, composition, and rendering, are good candidates for a cloud-based environment.

Animoto

Animoto is perhaps 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.

Multiplayer online gaming

Online multiplayer gaming attracts millions of gamers around the world who share a common experience by playing together in a virtual environment that extends beyond the boundaries of a normal LAN. Online games support hundreds of players in the same session, made possible by the specific architecture used to forward interactions, which is based on game log processing. Players update the game server hosting the game session, and the server integrates all the updates into a log that is made available to all the players through a TCP port. The client software used for the game connects to the log port and, by reading the log, updates the local user interface with the actions of other players.