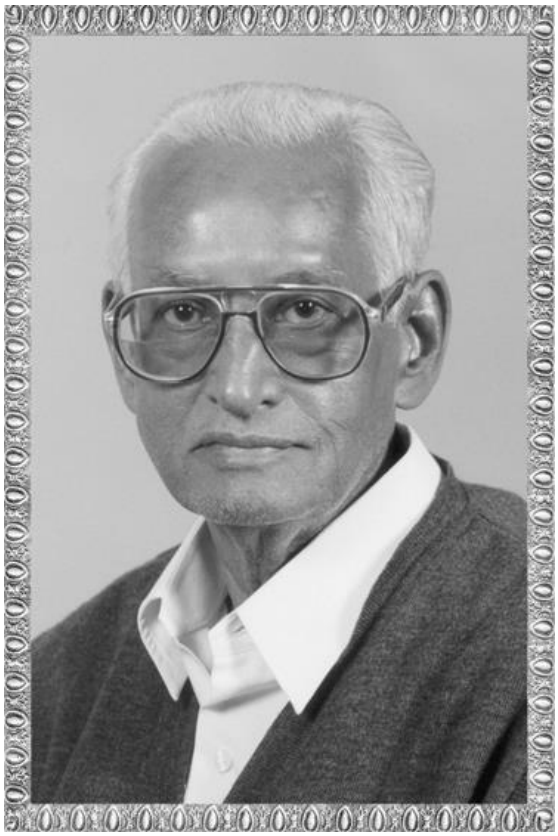
SHREE H. N. SHUKLA GROUP OF COLLEGES

(Affiliated to Saurashtra University & Gujarat Technological University)



Lt. Shree Chimanbhai Shukla

M.Sc I.T. SEM-2 - Cloud Computing

Shree H.N.Shukla College Campus,
Street No. 2, Vaishali Nagar,
Nr. Amrapali Railway Crossing,
Raiya Road, Rajkot.
Ph. (0281)2440478, 2472590

Shree H.N.Shukla College
Street No. 3, Vaishali Nagar,
Nr. Amrapali Railway Crossing,
Raiya Road, Rajkot.
Ph. (0281)2471645

Website: www.hnshukla.com
Email : hnsinfo@hnshukla.com

Index

Contents

UNIT -3

Unit - 3
Part 1- Platform as a Service (PaaS)

Introduction to PaaS: What is PaaS?

- PaaS cloud computing platform is a developer programming platform which is created for the programmer to develop, test, run and manage the applications.
- A developer is able to write the application as well as deploy it directly into this layer easily.
- PaaS extend and abstract the IaaS layer by removing the hassle of managing the individual virtual machine.
- In PaaS cloud computing platform, back end scalability is handled by the cloud service provider and the end user does not have to worry about to manage the infrastructure.
- All the infrastructure to run the applications will be over the internet.

Advantages of PaaS cloud computing layer

1. **Simplified Development**
   Developers can focus on development and innovation without worrying about the infrastructure.
2. **Lower risk**
   No requirements of up-front investment in hardware and software. Developers only need a PC and an internet connection to start building applications.
3. **Prebuilt business functionality**
   Some PaaS vendors also provide already defined business functionality so that users can avoid building everything from very scratch and hence can directly start the projects only.
4. **Instant community**
   PaaS vendors frequently provides online communities where developer can get the ideas, share experiences and seek advice from others.
5. **Scalability**
   Applications deployed can scale from one to thousands of users without any changes to the applications.

Disadvantages of PaaS cloud computing layer

1. **Vendor lock-in**
   One have to write the applications according to the platform provided by PaaS vendor so migration of an application to another PaaS vendor would be a problem.
2. **Data Privacy**
   Corporate data, whether it can be critical or not, will be private so if it is not located within the walls of the company there can be a risk in terms of privacy of data.
3. **Integration with the rest of the systems applications**

It may happen that some applications are local and some are in cloud. So there will be chances of increased complexity when we want to use data which in the cloud with the local data.

Top vendors who are providing PaaS cloud computing platform

1. Google Apps Engine (GAE)
2. SalesFroce.com
3. Windows Azure
4. AppFog
5. Openshift
6. Cloud Foundary from VMware

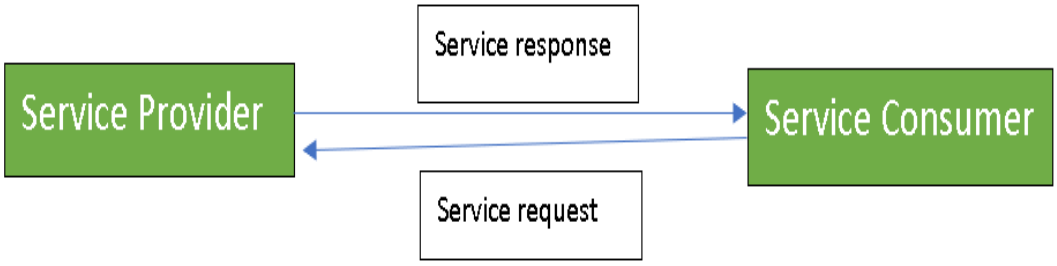
Service Oriented Architecture (SOA)

Service-Oriented Architecture (SOA) is an architectural approach in which applications make use of services available in the network. In this architecture, services are provided to form applications, through a communication call over the internet.

- SOA allows users to combine a large number of facilities from existing services to form applications.
- SOA includes a set of design principles that structure system development and provide means for integrating components into decentralized system.
- SOA based computing packages functionalities into a set of interoperable services, which can be integrated into different software systems belonging to separate business domains.
- SOA provides access to reusable Web services over a TCP/IP network, which makes this an important topic to cloud computing going forward.

There are two major roles within Service-oriented Architecture:

- **Service provider:** The service provider is the maintainer of the service and the organization that makes available one or more services for others to use.
- **Service consumer:** The service consumer can locate the service metadata in the registry and develop the required client components to bind and use the service.



Advantages of SOA:

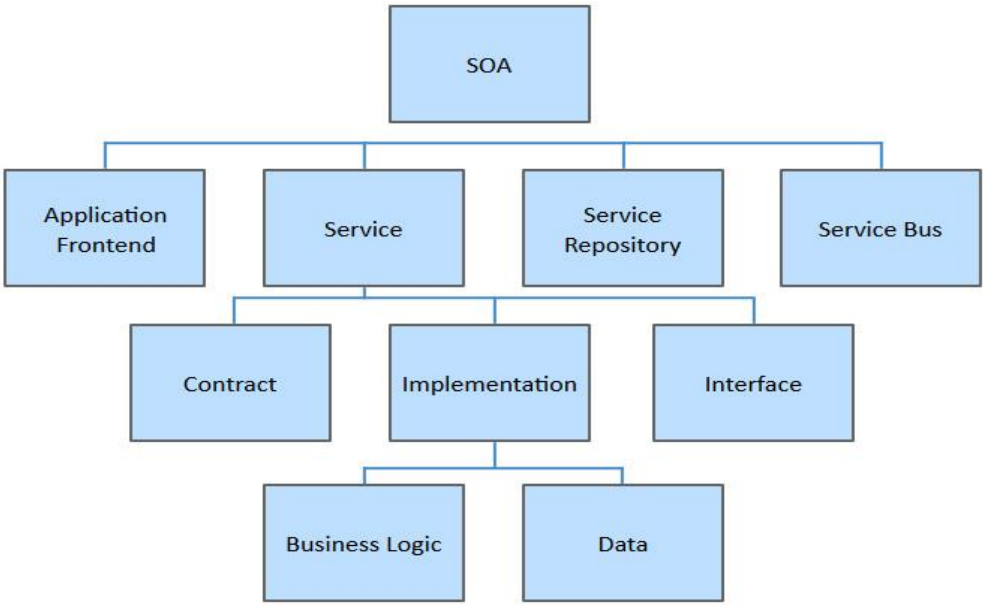
- **Service reusability:** In SOA, applications are made from existing services. Thus, services can be reused to make many applications.
- **Easy maintenance:** As services are independent of each other they can be updated and modified easily without affecting other services.

- **Platform independent:** SOA allows making a complex application by combining services picked from different sources, independent of the platform.
- **Availability:** SOA facilities are easily available to anyone on request.
- **Reliability:** SOA applications are more reliable because it is easy to debug small services rather than huge codes
- **Scalability:** Services can run on different servers within an environment, this increases scalability

Disadvantages of SOA:

- **High overhead:** A validation of input parameters of services is done whenever services interact this decreases performance as it increases load and response time.
- **High investment:** A huge initial investment is required for SOA.
- **Complex service management:** When services interact they exchange messages to tasks. the number of messages may go in millions. It becomes a unmanageable task to handle a large number of messages.

Elements/Components of SOA



Practical applications of SOA:

SOA is used in many ways around us whether it is mentioned or not.

1. SOA infrastructure is used by many armies and air force to deploy situational awareness systems.
2. SOA is used to improve the healthcare delivery.
3. Nowadays many apps are games and they use inbuilt functions to run. For example, an app might need GPS so it uses inbuilt GPS functions of the device. This is SOA in mobile solutions.
4. SOA helps maintain museums a virtualized storage pool for their information and content.

Unit - 3
Part 2- Software as a Service (SaaS)

Introduction to SaaS

- SaaS is a software distribution model in which applications are hosted by a cloud service provider and made available to customers over internet. SaaS is also known as "On-Demand Software".
- In SaaS, software and associated data are centrally hosted on the cloud server. SaaS is accessed by users using a thin client via a web browser.

Advantages of SaaS cloud computing layer

1. **Easy to buy**
   SaaS pricing is based on a monthly fee or annual fee, SaaS allows organizations to access business functionality at a low cost which is less than licensed applications.
   Unlike traditional software which is sold as a licensed based with an up-front cost (and often an optional ongoing support fee), SaaS providers generally pricing the applications using a subscription fee, most commonly a monthly or annually fee.
2. **Less hardware required**
   The software is hosted remotely, so organizations don't need to invest in additional hardware.
3. **Low Maintenance required**
   Software as a service removes the necessity of installation, set-up, and often daily unkeep and maintenance for organizations. Initial set-up cost for SaaS is typically less than the enterprise software. SaaS vendors actually pricing their applications based on some usage parameters, such as number of users using the application. So SaaS does easy to monitor and automatic updates.
4. **No special software or hardware versions required**
   All users will have the same version of software and typically access it through the web browser. SaaS reduces IT support costs by outsourcing hardware and software maintenance and support to the IaaS provider.

Disadvantages of SaaS cloud computing layer

1. **Security**
   Actually data is stored in cloud, so security may be an issue for some users. However, cloud computing is not more secure than in-house deployment. Learn more cloud security.
2. **Latency issue**
   Because the data and application are stored in cloud at a variable distance from the end user, so there is a possibility that there may be more latency while interacting with the application than a local deployment. So, SaaS model is not suitable for applications whose demand response times are in milliseconds.

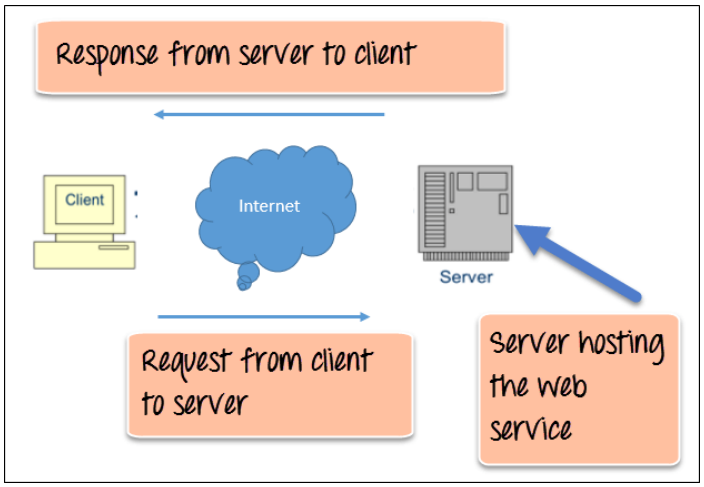
3. **Total Dependency on Internet**
   Without internet connection, most SaaS applications are not usable.
4. **Switching between SaaS vendors is difficult**
   Switching SaaS vendors involves the difficult and slow task of transferring the very large data files over the Internet and then converting and importing them into another SaaS also.

What is Web Service?

Web service is a standardized medium to propagate communication between the client and server applications on the World Wide Web.

A web service is a software module which is designed to perform a certain set of tasks.

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



- The client would invoke a series of web service calls via requests to a server which would host the actual web service.
- These requests are made through what is known as **remote procedure calls**. Remote Procedure Calls**(RPC)** are calls made to methods which are hosted by the relevant web service.
- As an example, **Amazon provides** a web service that provides prices for products sold online via amazon.com.
- The front end or presentation layer can be in **.Net or Java** but either programming language would have the ability to communicate with the web service.
- The main component of a web service is the data which is transferred between the client and the server, and that is XML.
- **XML (Extensible markup language)** is a counterpart to HTML and easy to understand the intermediate language that is understood by many programming languages.
- So when applications talk to each other, they actually talk in XML.

- This provides a common platform for application developed in various programming languages to talk to each other.
- Web services use something known as SOAP **(Simple Object Access Protocol)** for sending the XML data between applications.
- The data is sent over normal HTTP.
- The data which is sent from the web service to the application is called a SOAP message.
- The SOAP message is nothing but an XML document.
- Since the document is written in XML, the client application calling the web service can be written in any programming language.

Type of Web Service

There are mainly two types of web services.

1. SOAP web services.
2. RESTful web services.

Advantages of web services

1. **Exposing Business Functionality on the network** - A web service is a unit of managed code that provides some sort of functionality to client applications or end users.
2. **Interoperability amongst applications** - Web services allow various applications to talk to each other and share data and services among themselves.
3. **A Standardized Protocol which everybody understands** - Web services use standardized industry protocol for the communication.
4. **Reduction in cost of communication** - Web services use SOAP over HTTP protocol, so you can use your existing low-cost internet for implementing web services.

Web 2.0

- Web 2.0 is the name used to the describe the second generation of the world wide web, where it moved static HTML pages to a more interactive and dynamic web experience.
- Web 2.0 is focused on the ability for people to collaborate and share information online via social media, blogging and Web-based communities.
- Web 2.0 are websites and applications that make use of user-generated content for end-users.
- Web 2.0 is characterized by greater user interactivity and collaboration, more persistent network connectivity and enhanced communication channels.
- One of the most significant differences between Web 2.0 and the traditional World Wide Web (WWW, retroactively referred to as Web 1.0) is greater collaboration among Internet users, content providers and enterprises.

Elements of Web 2.0

- **Wikis:** Websites that enable users to contribute, collaborate and edit site content. Wikipedia is one of the oldest and best-known wiki-based sites.
- The increasing prevalence of Software as a Service (SaaS), web apps and cloud computing rather than locally-installed programs and services.

- **Mobile computing**, also known as **nomadicity**, the trend toward users connecting from wherever they may be.
- **Mash-ups**: Web pages or applications that integrate complementary elements from two or more sources.
- **Social networking:** The practice of expanding the number of one's business and/or social contacts by making connections through individuals. Social networking sites **include Facebook, Twitter, LinkedIn and Google+**.
- **User-generated content (UGC):** Writing, images, audio and video content -- among other possibilities -- made freely available online by the individuals who create it.
- **Unified communications (UC):** The integration of multiple forms of call and multimedia/cross-media message-management functions controlled by an individual user for both business and social purposes.
- **Social curation**: The collaborative sharing of content organized around one or more particular themes or topics. Social content curation sites include Reddit, Digg, Pinterest and Instagram.

Web OS

- Web OS is designed as a distributed system.
- The Web OS framework enables a new paradigm for Internet services.
- Web OS goal is to provide a platform which allows the user to benefit from the computational potential offered by the Web.
- It's aimed is to make available to all sites of the network resources to execute computations for which local resources are missing.
- The kernel of a Web OS node is a system, a reactive system responding to requests from users or system.
- A Web OS-node integrates user, server, and applications.
- It is capable of providing a set of services, which can pass on to each other requests when appropriate.
- Each Web OS node is using its own warehouses to store and continuously update information about the node and available services and resources.
- It's basically a virtual desktop that gives user communication tools like email, productivity tools like word processing and ability to play games and any other application that user would find on a typical OS like Microsoft Windows.
- Web OS is network based service where a user can access his system through network. It is an introduction of one or more operating system in the category of Web operating systems.
- Web OS was introduced as a thought that one might be able to play with application, store data, for sharing on the web from anywhere.
- Today Web OS are capable of storing large amount of data as large as 30 GB. User can share applications.

Task of WebOS

- In these a company provides computer services to users through an Internet connection.
- The provider runs a system of computers that include application servers and databases.
- With some systems, people access the applications using Web browsers.
- With other systems, users must download a program that creates a system-specific client.
- A client is software that accesses information or services from other software.
- A Web OS might look like a traditional OS, but it doesn't manage user computer's hardware or software.
- A Web OS allows user to access applications stored not on user computer, but on the Web.
- The applications exist wholly or in part on Web servers within a particular provider network.
- When user saves information in an application, user might not store it on user computer. Instead, user saves the information to databases connected to the Internet.
- Some Web operating systems also give user the option to save information to user local hard disk drive.

CHARACTERISTICS OF WEB OPERATING SYSTEM:

- Free sign up for personal use
- Online application services.
- No maintain charge and security cost
- Access to any Website
- Work as a social networking
- While the operating system will work as well as the Website.

FEATURES AVAILABLE IN WEBOS

- **Open API:** the typology of Application Programming Interface that it uses
- **Open-source:** the possibility for users and developers to contribute to the enrichment of the Web OS by creating new applications and widgets
- **Integrated apps:** the applications that the Web OS features by default (text editor)
- **Audio-video Player:** the availability of a media player within the Web OS
- **Photo editing tool:** the availability of a tool that allows the user to edit images.
- **E-mail client:** the presence of an email client.
- **Instant Messaging:** the availability of an integrated instant messenger.
- **Calendar:** the existence of a calendar.
- **Collaboration** - Conferencing tools: the presence of online collaboration tools (such as VoIP)
- **Mini-Browser:** the integration of a Web browser
- **File storage:** the amount of space if available to store files online
- **File sharing support:** the support for file sharing with other users.
- **Desktop Search:** the presence of a desktop search engine within the Web OS

Case Study on SaaS

- **Organization: British Gas**
- **SaaS provider: Salesforce.com**
- **Application: CRM -** Customer relationship management *(*CRM) is a technology for managing all your company's relationships and interactions with customers and potential customers.
- **British Gas Services**, part of the Centrica group, is the leading domestic central heating and gas appliance installation company in the UK With **no centralized CRM system**, its Central Heating Installations (CHI) business wanted to overcome the inefficiencies. The business also wanted to improve on the manual, paper-based customer support processes that made tracking, accountability, and the ability to capture institutional knowledge difficult.
- BGS CHI implemented Salesforce.com and has seen considerable benefits. "Automated workflows route leads to appropriate individuals and provide preset responses to web-captured leads," says Sexton.
- 'speed to market' is critical for us and therefore, as there is no infrastructure to "stand up", the solution can be ready to switch on in four months rather than six to 12 months for traditional solutions.
- Finally, cost profiling looks different as there is no large capital outlay as with a normal license purchase over time.
- However, where SaaS cost is consistent an on-premise solution will become cheaper.
- "We will now be able to systematically track sales leads and customer interaction, not possible with the former paper-based, disconnected support system.
- Sales and support benefit from new visibility into each other's respective activities with customers sharing one common view of customer issues allows for better customer service and more insight into up-sell and cross-sell opportunities."

Unit - 3
Part 3- Service Management in Cloud

Service Level Agreements (SLAs)

- A service-level agreement (SLA) is a contract between a service provider and its internal or external customers that documents what services the provider will provide and defines the service standards the provider is required to meet.
- Service providers need SLAs to help them manage customer expectations and define the situations under which they are not responsible for performance issues.
- Customers can also benefit from SLAs in that they describe the performance characteristics of the service, which can be compared with other vendors' SLAs.
- For a service provider, the SLA is typically one of two foundational agreements it has with customers.
- Many service providers establish a master services agreement to establish the general terms and conditions in which they will work with customers.
- Earlier, in cloud computing all Service Level Agreements were negotiated between a client and the service consumer.
- Nowadays, with the initiation of large utility-like cloud computing providers, most Service Level Agreements are standardized until a client becomes a large consumer of cloud services.
- Service level agreements are also defined at different levels which are mentioned below:

1. **Customer-based SLA**
   - A customer based SLA is an agreement with one customer, covering all the services used by this customer.
   - Let’s consider the relationship between you and your telecom operator.
   - You use the voice services, SMS services, data services, and several other services of the telecom operator.
   - For all these services, you have only one contract between you and the telecom operator.
   - Similarly, if the IT service provider provides several services for the business and the customers, and if all the service levels are documented in one service level agreement for the provided services, it will be a customer based SLA.
2. **Service-based SLA:**
   - A service based SLA covers one service for all customers.
   - Let’s consider that the IT service provider provides customer query service for many customers.
   - In a service based service level agreement, the service level of the customer query service will be same for all customers that will be using this service.

- For instance, if the finance department and the human resources department are two customers which will be using this service, the same SLA will be valid between the IT service provider and these two departments since it is a service based SLA.

3. **Multilevel SLA**
   - In multi-level SLA, aspects of SLA are defined according to the organization of the customer using some kind of inheritance with overall definitions with relevance for all subordinate levels.
   - This SLA focuses on the organization of the customer. All services and their interrelationships with subordinate services are used when defining the multi-level service level agreement structure.
   - Maintaining service level agreements are part of service level management. Every time a service change, or the service level target of a service change, the service level agreement needs to be reviewed and revised. The new service level agreement needs to reflect the changes made to the service or the service level targets.

- Few Service Level Agreements are enforceable as contracts, but mostly are agreements or contracts which are more along the lines of an Operating Level Agreement (OLA) and may not have the restriction of law.
- It is fine to have an brief review the documents before making a major agreement to the cloud service provider.
- Service Level Agreements usually specify **some parameters** which are mentioned below:
  1. Availability of the Service (uptime)
  2. Latency or the response time
  3. Service components reliability
  4. Each party accountability
  5. Warranties

Billing & Accounting

- The billing management system mechanism is dedicated to the collection and processing of usage data as it pertains to cloud provider accounting and cloud consumer billing.
- Specifically, the billing management system relies on pay-per-use monitors to gather runtime usage data that is stored in a repository that the system components then draw from for billing reporting and invoicing purposes.
- The billing management system allows for the definition of different pricing policies as well as custom pricing models on a per-cloud consumer and/or per-IT resource basis.
- Pricing models can vary from the traditional pay-per-use models to flat-rate or pay-per-allocation models, or combinations.
- Billing arrangements can be based on pre-usage and post-usage payments.
- The latter type can include pre-defined limits or can be set up to allow for unlimited usage.
- When limits are established, they are usually in the form of usage quotas.

- When quotas are exceeded, the billing management system can block further usage requests by cloud consumers.

Comparing Scaling Hardware: Traditional vs. Cloud

- Cloud computing is really popular nowadays. More and more companies prefer using cloud infrastructure rather than the traditional one.

The differences between cloud computing and traditional IT infrastructure

1. **Elasticity and flexibility**
   - Do not need to buy the hardware and maintain it with your own team.
   - The information in the cloud is stored on several servers at the same time.
   - It means that even if 1 or 2 servers are damaged, you will not lose your information.
   - It also helps to provide the high uptime, up to 99.9%.
   - When we talk about their traditional infrastructure, you will have to buy and maintain the hardware and equipment. If something happens, you can lose the data and spend a lot of time and money to fix the issues.
2. **Scalability and flexibility**
   - The cloud computing is the perfect Choice for those who do not require a high performance constantly but use it time by time.
   - You can get a subscription and use the resources you paid for.
   - Most providers even let pause the subscription if you do not need it.
   - At the same time, you're able to control everything and get instant help from the support team.
   - The traditional infrastructure is not so flexible. You have to buy an equipment and maintain it even if you do not use it. In many cases, it's even more expensive because you might need their own technical crew.
3. **Automation**
   - One of the biggest differences between cloud and traditional infrastructure is how they are maintained.
   - Cloud service is served by the provider's support team. They take care of all the necessary aspects including security, updates, hardware, etc.
   - The traditional infrastructure required the own team to maintain and monitor the system. It requires a lot of time and efforts.
4. **Cost**
   - With cloud computing, you do not need to pay for the services you don't use: the subscription model means you choose the amount of space, processing power, and other components that you really need.
   - With traditional infrastructure, you are limited to the hardware you have. If your business is growing, you will regularly have to expand your infrastructure. At the same time, you will have to support and maintain it.

5. **Security**
   - Many people are not sure about the security of cloud services. Why can it be not so secure? As the company uses the third party solution to store data, it's reasonable to think that the provider can access the confidential data without permission. However, there are good solutions to avoid the leaks.
   - As for traditional infrastructure, you and only you are responsible for who will be able to access the stored data. For the companies who operate the confidential information, it's a better solution.

What kind of infrastructure is a good choice for your business? It depends on what your company does and what are your needs. Nevertheless, more and more organizations today prefer cloud infrastructure.

Economics of scaling: Benefitting enormously

- Cloud computing allows online access to a centralized data storage and other resources.
- This leads to economies of scale as multi-tenancy based solutions are deployed on one piece of hardware, with pooled resources that are shared among different users.
- Managing cloud resources using a browser and network devices such as a smart phone, tablet and computer make operations smooth and easy.
- An important part of cloud computing services is flexibility in resources which can be managed both up and down.
- Various companies around the world are benefiting from economies of scale that cloud computing & services practice brings about.
- It offers the following **advantages:**
  - Fast implementation with loads of time savings
  - Fast scaling to keep pace with sudden spikes in growth
  - Reduction in cost of maintaining infrastructure
  - Control over access and content as per the specified provisioning
  - Increase in productivity of IT staff
  - Reduced investment in infrastructure and maintaining facility.
  - Look for a leading network infrastructure provider to make the most of your investment in such a high-end cloud based solution.
- You can use any popular web search engine to look for one.
- Make sure you choose one that is comfortable in running all types of applications in the cloud and has extensive experience in handling various cloud-based projects.

Managing Data: Looking at Data, Scalability & Cloud Services

What is Scalability in Cloud?

- Scalability is the capability of a process, network, software or appliance to grow and manage increased demands.
- This is one of the most valuable and prime feature of cloud computing.
- Through scalability you can scale up your data storage capacity or scale it down to meet the demands of your growing business.
- Scaling in the cloud provides you the best experience of flexibility of time and money for your business.
- When business demands are increasing, you can easily add nodes to increase your storage space, or you can increase the number of servers currently used.
- When the increased demand is reduced then you can move back to your original configuration.
- Scalability enables you to accommodate larger workloads without disruption or complete transformation of existing infrastructure.
- To effectively force scalability you need to understand the complexity and the types of scalability.
- Let's explore different types of scalability.

Three types of scalability – Vertical, Horizontal and Diagonal

1. Scale Vertically – Scale Up:

- Vertical Scaling or Scaling up is easy, it can be done by moving the application to bigger virtual machines deployed in the cloud or you can scale up by adding expansion units as well with your current infrastructure.
- This ability to add resources to accommodate increasing workload volumes is **vertical scaling**. It can resize your server with no change in your code.
- The downside to scaling up is that it increases storage capacity but the performance is reduced because the compute capacity remains the same.
- Workloads requiring higher throughput demand reduced latency and this can only by fulfilled by Horizontal Scaling / Scaling out.

2. Scale Horizontally – Scale out:

- Horizontal Scaling or Scaling out is the addition of nodes to the existing infrastructure to accommodate additional workload volumes.
- Contrary to Vertical Scaling, Horizontal Scaling also delivers performance along with storage capacity.
- The total workload volume is aggregated over the total number of nodes and latency is effectively reduced.
- This scaling is ideal for workloads that require reduced latency and optimized throughput.

3. Scale Diagonally:

- Diagonal scaling helps you combine the scaling up and scaling down.
- As the term suggests, scaling down is the removal of storage resources as requirements decrease.
- Diagonal scaling delivers flexibility for workload that require additional storage resources for specific instances of time.
- For ex, a website sets up diagonal scaling; as the traffic increases, the compute requirements are accommodated.
- As the traffic decreases, the computation capacity is restored to its original size.
- This type of scaling introduces enhanced budgeting and cost effectiveness for environments and businesses dealing with variable workload volumes.

Scalable Cloud Based Services:

- Infrastructure-as-a-Service (IaaS)
- Platform-as-a-Service (PaaS)
- Storage-as-a-Service (STaaS)
- Data-as-a-Service (DaaS)
- Database-as-a-Service (DBaaS)

Database & Data Stores in Cloud

- A cloud database is a collection of informational content, either **structured or unstructured,** that reside on a private, public or hybrid cloud computing infrastructure platform.
- From a structural and design perspective, a cloud database is no different than one that operates on a business's own on-premises servers.
- The critical difference lies in where the database resides.
- Where an on-premises database is connected to local users through a corporation's internal local area network (LAN), a cloud database resides on servers and storage furnished by a cloud or database as a service (DBaaS) provider and it is accessed only through the internet.
- To a software application, for example, a SQL database residing on-premises or in the cloud should appear identical.
- The behavior of the database should be the same whether accessed through direct queries, such as SQL statements, or through API calls.
- However, it may be possible to detect small differences in response time.
- An on-premises database, accessed with a LAN, is likely to provide a slightly faster response than a cloud-based database, which requires a round trip on the internet for each interaction with the database.

How Cloud Databases Work

- Cloud databases, like their traditional ancestors, can be divided into two broad categories: **relational and non-relational.**

- A relational database, typically written in **structured query language (SQL),** is composed of a set of interrelated tables that are organized into rows and columns.
- The relationship between tables and columns (fields) is specified in a **schema**.
- SQL databases, by design, rely on data that is highly consistent in its format , such as banking transactions or a telephone directory.
- Popular cloud platforms and cloud providers include **MySQL, Oracle, IBM DB2 and Microsoft SQL Server**.
- Some cloud platforms such as MySQL are open sourced.
- Non-relational databases, sometimes **called NoSQL,** do not employ a table model.
- Instead, they store content, regardless of its structure, as a single document.
- This technology is **well-suited for unstructured data**, such as social media content, photos and videos.

Types of Cloud Databases

- Two cloud database environment models exist: traditional and database as a service (DBaaS).
- In a traditional cloud model, a database runs on an IT department's infrastructure with a virtual machine. Tasks of database oversight and management fall upon IT staffers of the organization.
- The DBaaS model is a fee-based subscription service in which the database runs on the service provider's physical infrastructure. Different service levels are usually available. In a classic DBaaS arrangement, the provider maintains the physical infrastructure and database, leaving the customer to manage the database's contents and operation.
- Alternatively, a customer can set up a managed hosting arrangement, in which the provider handles database maintenance and management. This latter option may be especially attractive to small businesses that have database needs but lack adequate IT expertise.

Cloud database benefits

- Compared with operating a traditional database on an on-site physical server and storage architecture, a cloud database offers the following distinct advantages:
- **Elimination of physical infrastructure**- In a cloud database environment, the cloud computing provider of servers, storage and other infrastructure is responsible for maintenance and keeping high availability. The organization that owns and operates the database is only responsible for supporting and maintaining the database software and its contents. In a DBaaS environment, the service provider is responsible for managing and operating the database software, leaving the DBaaS users responsible only for their own data.
- **Cost savings**- Through the elimination of a physical infrastructure owned and operated by an IT department, significant savings can be achieved from reduced capital expenditures, less staff, decreased electrical and HVAC operating costs and a smaller amount of needed physical space.

- DBaaS benefits also include instantaneous scalability, performance guarantees, failover support, declining pricing and specialized expertise.
- Migrating legacy databases to the cloud
- An on-premises database can migrate to a cloud implementation. Numerous reasons exist for doing this, including the following:
- Allows IT to retire on-premises physical server and storage infrastructure.
- Fills the talent gap when IT lacks adequate in-house database expertise.
- Improves processing efficiency, especially when applications and analytics that access the data also reside in the cloud.
- Achieves cost savings through several means, including:
- Reduction of in-house IT staff.
- Continually declining cloud service pricing.
- Paying for only the resources consumed, known as pay-as-you-go pricing.

Relocating a database to the cloud can be an effective way to further enable business application performance as part of a wider software-as-a-service deployment. Doing so simplifies the processes required to make information available through internet-based connections. Storage consolidation can also be a benefit of moving a company's databases to the cloud. Databases in multiple departments of a large company, for example, can be combined in the cloud into a single hosted database management system.

Large Scale Data Analysis

- Large scale data analysis is a broad term that encompasses a series of different tools and systems to process big data.
- Typically, large scale data analysis is performed through two popular techniques: parallel database management systems (DBMS) or MapReduce powered systems.
- The parallel DBMS system requires that the data be in a DBMS supported schema, whereas the MapReduce option supports data in any form.
- Moreover, the data extracted or analyzed in large-scale data analysis can be displayed in various different forms, such as tables, graphs, figures and statistical analysis, depending on the analysis system.