Unit : 2 - Cloud Architecture Technology and Architectural Requirements

Business Case for Clouds

What is the business case in cloud computing?

The business case should **calculate the costs of migrating to the cloud** -- which include the cost of moving systems over, as well as the cost of running services in the cloud after migration -- and then compare them to the costs of keeping systems in-house.

The Complete information about business case wil found by below link :

https://www.claranet.co.uk/sites/all/assets/uk/Claranet_WP_Business%20case%20for%20cloud%20computing_0.pdf

Hardware and Infrastructure

What Forms Your Cloud Infrastructure?

Cloud infrastructure is the vital hardware and software that underpins your cloud computing processes. In an enterprise, it's the servers, **networking equipment, virtualization software, and data storage that supports the delivery of your cloud solutions**.

While cloud infrastructure differs depending on your business, **such as public, private, or hybrid architectures,** the best practice for cloud infrastructure management remains the same. Organizations are looking for more effective ways to control costs, remain secure, and optimize assets.

As enterprise cloud environments continue to grow, businesses must implement measures to optimize their cloud. Here are our three top concerns to look out for.

The 3 Key Cloud Infrastructure Concerns of 2021

1. The Costs of the Cloud

It's estimated that <u>one-third</u> of cloud spending is wasted. This can be due to several challenges, from lack of visibility of your entire IaaS, PaaS, or SaaS environments to inefficient pricing

models. Additionally, the COVID-19 pandemic has accelerated uptake of the cloud, with most businesses using more cloud services than planned.

The shift to remote working has increased demand for cloud solutions, tools, and services that enable end-users to work away from the office. And now, <u>over half</u> of business leaders are more confident putting workloads and data in the cloud. But many lack effective measures to control costs.

Organizations are looking to the future. Your cloud environment will keep growing as confidence and reliance on cloud solutions does too. In 2021, enterprises will need to implement <u>cloud cost optimization</u> processes to better control the costs of the cloud. The biggest challenge will be finding the right cloud expertise to do so.

Your enterprise needs complete visibility of your cloud infrastructure environment. With cloud cost optimization, a team of experts will conduct an extensive audit your cloud. This gives you total visibility of your cloud infrastructure assets and its associated costs, all within one centralized portal. Then, if you choose to, cloud cost optimization experts can set up continuous reporting on your cloud, helping to control costs over time. This immediately identifies ways to minimize costs for the future, and the right provider can implement up to 550 best-practice audit checks against your environment.

2. Multi-cloud Challenges

There's no doubt that the past year has impacted cloud complexity. <u>93%</u> of enterprise organizations now have a multi-cloud environment and multi-cloud strategy, for example. And the next year will see businesses looking for better ways to manage their complex cloud environment.

Many cloud application workloads can't move between multi-cloud environments easily. Cloud service providers (CSPs) can't share application resources if one of them doesn't have the capabilities. This creates inflexibility and risks of vendor lock-in. And while vendor lock-in is <u>not always a bad thing</u>, demand for different application services across multiple architectures continues to grow.

This demand comes with challenges. Maintaining security and compliance across multiple CSPs will need centralized visibility of the entire cloud environment. And effectively managing resources requires time and cloud skills that many internal teams lack. Ideally, you need a method of identifying the CSP resources that fit your business needs at the best rate.

Cloud management services can help you to achieve this. Expert teams can implement rightsizing measures across your environment that help you better allocate cloud resources.

Then, they'll work directly with industry-leading vendors on your behalf to implement reserved instance purchasing recommendations. This identifies methods of migrating to more affordable and effective pricing models. By working with a cloud management service provider, you can build a cloud infrastructure that overcomes the limitations of the common multi-cloud environment.

3. Compliance and Security

Using multiple CSPs for cloud data or workloads comes with inherent risks. And the most obvious risks are compliance and security related. If you lack the internal knowledge to stay on track with industry regulations or security risks, it's easy for critical errors to go unnoticed.

In 2021, businesses that have accelerated their adoption of cloud solutions will need to strengthen security and compliance. The cloud is here to stay, so your cloud infrastructure must be future-proof.

Many organizations mistakenly believe that all security and compliance concerns fall within the responsibility of the CSP. However, this is not the case, and the level of responsibility largely depends on what you've opted for with your cloud provider. This makes achieving great cloud security complex without the right expertise.

Cloud management service providers are well-equipped to manage the unique challenges of compliance and security in 2021.

By auditing your entire cloud infrastructure environment, they'll not only take steps to optimize processes and control costs. They'll also help you regain visibility over every asset within your cloud estate.

This makes identifying compliance and security issues straightforward, and some cloud management service providers can continuously compare your cloud against up to 35 industry standards. They can also implement proactive verification, risk identification, and resolution services to provide 24/7 support for multi-cloud and hybrid cloud environments. All from a single cloud management services provider.

Discover a Better Way to Manage Your Cloud Infrastructure Concerns

Managing your cloud environment will always be an uphill battle without the right resources and skills to do so. The growing complexity of the cloud only exacerbates its cost, architecture, compliance, and security concerns.

In 2021, your organization needs greater visibility of your cloud environment.

Access to the cloud

Identity and Access Management for cloud computing

What is Identity & Access Management?

Broadly speaking, IAM is the **consolidated management of users and corresponding authorizations via a centralized identity register**. IAM allows an organization to control who gets access to what and by what means. KPMG uses the following definition of IAM

"*The policies, processes and support systems to manage which users have access to information, IT applications and physical resources and what each user is authorized to do with it.*"

IAM is categorized as follows :

- *User management:* The activities related to managing end-users within the user administration.
- *Authentication management:* The activities related to the management of data and the **allocation (and de-allocation) of resources needed to validate t**he identity of a person.
- *Authorization management:* The activities related to **defining and managing the access rights** that can be assigned to users.
- *Access management:* The actual identification, authentication and authorization of end users for utilizing the target system.

- *Provisioning:* The propagation of **identities and authorization properties to IT system**s.
- *Monitoring and auditing:* The activities required to achieve **monitoring, auditing and reporting** goals.
- *Federation:* The system of **protocols, standards and technologie**s that make it possible for identities to be transferable and interchangeable between different autonomous domains.
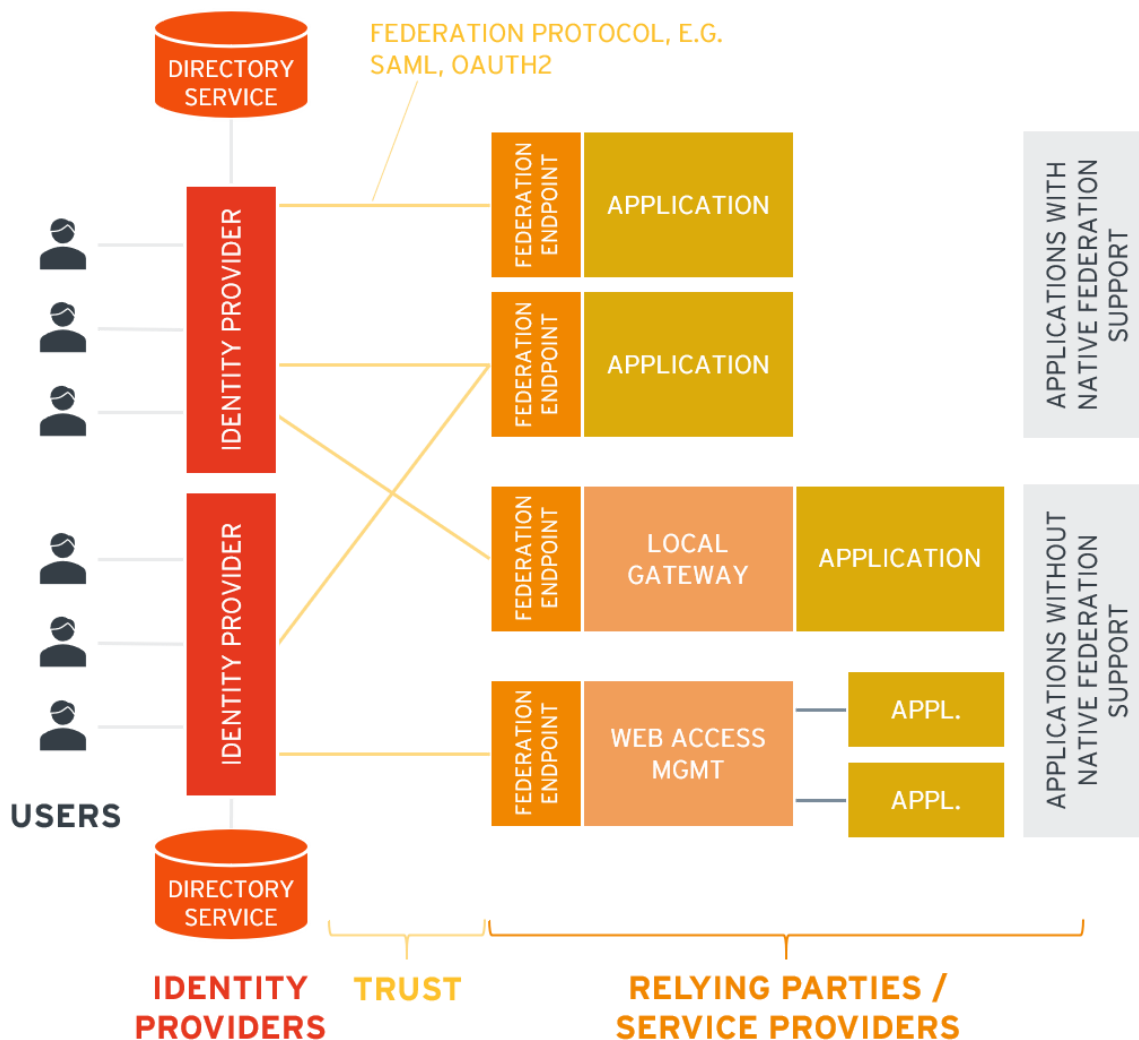

Figure : IAM reference architecture

Challenges related to the components of the IAM architecture

IAM plays a major role in **securing IT resources**. IAM faces many challenges when cloud computing is used.

1. IAM processes, **such as adding a user, are managed by the cloud provider** instead of the organization owning the data.
2. It is difficult for the organization using the cloud service to v**erify whether a modification has been completed successfully** within the administration of the cloud provider.
3. Furthermore, it is **harder to check whether the data stored by the cloud provider is only accessible to authorized users.**

Cloud storage

Cloud storage is a model of computer data storage in which the digital data is stored in logical pools, said to be on "the cloud". The physical storage spans multiple servers (sometimes in multiple locations), and the **physical environment is typically owned and managed by a hosting company**. These cloud storage providers are responsible for **keeping the data available and accessible,** and the physical environment **secured, protected, and running**. People and organizations **buy or lease storage** capacity from the providers to store user, organization, or application data.

Architecture

Cloud storage is based on **highly virtualized infrastructure** and is like broader cloud computing in terms of **interfaces, near-instant elasticity and scalability, multi-tenancy, and metered resources**. Cloud storage services can be used from an **off-premises service (Amazon S3) or deployed on-premises (ViON Capacity Services).**

There are three **types of cloud storage:**
1. **Object storage service**
2. **File storage**
3. **Block storage**.

Files, blocks, and objects are storage formats that hold, organize, and present data in different ways—each with their own capabilities and limitations. **File storage** organizes and represents data as a **hierarchy of files in folders; block storage chunks data into arbitrarily organized, evenly sized volumes**; and **object storage manages data and links it to associated metadata.**
Each of these cloud storage types offer their own unique advantages.

What is object storage?
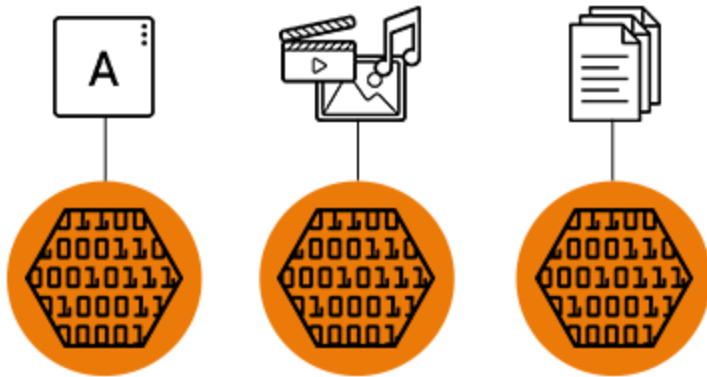
Object storage, also known as **object-based storage**, is a flat structure **in which files are broken into pieces and spread out among hardware**. In object storage, the **data is broken into discrete units called objects** and is kept in a single repository, instead of being kept as files in folders or as blocks on servers.

Object storage volumes work as **modular units**: each is a self-contained repository that owns the data, a **unique identifier** that allows the object to be found over a distributed system, and the **metadata that describes the data.** That metadata is important and includes details like age, privacies/securities, and access contingencies. Object storage metadata can also be extremely detailed, and is capable of storing information on where a video was shot, what camera was used, and what actors are featured in each frame. T**o retrieve the data, the storage operating system uses the metadata and identifiers,** which distributes the load better and lets administrators apply policies that perform more robust searches.

Object storage requires a simple HTTP application programming interface (API), which is used by most clients in all languages. Object storage is **cost efficie**nt: you only pay for what you use. It can scale easily, making it a **great choice for public cloud storage**. It's a storage system well suited for static data, and its agility and flat nature means it can scale to extremely large quantities of data. The objects have enough information for an application to find the data quickly and are good at storing unstructured data.

There are **drawbacks**, to be sure. **Objects can't be modified**—you have to write the object completely at once. Object storage also **doesn't work well with traditional database**s, because writing objects is a slow process and writing an app to use an object storage API isn't as simple as using file storage.

Examples of object storage services that can be hosted and deployed with cloud storage characteristics include Amazon S3, Oracle Cloud Storage and Microsoft Azure Storage

What is file storage?
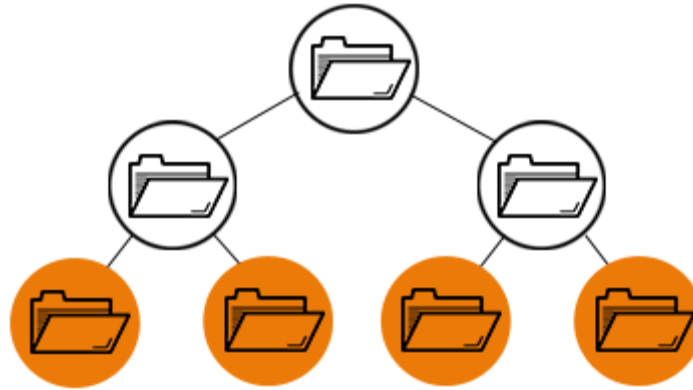
File storage, also called **file-level or file-based storage**, is exactly what you think it might be: **Data is stored as a single piece of information inside a folder**, just like you'd organize pieces of paper inside a manila folder. When you need to access that piece of data, your computer needs to know the path to find it. (Beware—It can be a long, winding path.) Data stored in files is **organized and retrieved** using a limited amount of **metadata** that tells the computer exactly where the file itself is kept. It's like a library card catalog for data files.

Think of a closet full of file cabinets. Every document is arranged in some type of logical hierarchy—by cabinet, by drawer, by folder, then by piece of paper. This is where the term **hierarchical storage comes** from, and this is file storage. It is the oldest and most widely used data storage system for direct and network-attached storage systems, and it's one that you've probably been using for decades. Any time you access documents saved in files on your personal computer, you use file storage. File storage has broad capabilities and can store just about anything. It's great for storing an array of complex files and is fairly fast for users to navigate.

The **problem is**, just like with your filing cabinet, that virtual drawer can only open so far. File-based storage systems must scale out by adding more systems, rather than **scale up by adding more capacity.**

Examples of file storage services include Amazon Elastic File System (EFS) and Qumulo Core,[8] **used for applications that need access to shared files and require a file system**. This storage is often supported with a **Network Attached Storage (NAS) server**, used for large content repositories, development environments, media stores, or user home directories. - **NAS**

What is block storage?
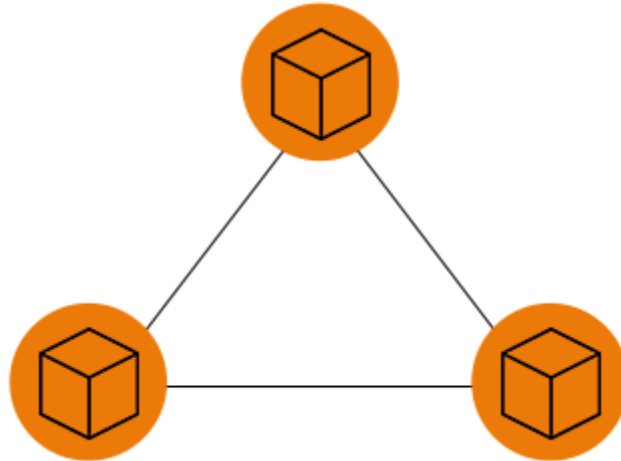
Block storage chops data into blocks—get it?—and **stores them as separate pieces**. Each **block of data is given a unique identifier, which allows a storage system to place the smaller pieces of data wherever is most convenient.** That means that some data can be stored in a Linux® environment and some can be stored in a Windows unit.

Block storage is often configured to decouple the data from the user's environment and spread it across multiple environments that can better serve the data. And then, when data is requested, the underlying storage software reassembles the blocks of data from these environments and presents them back to the user. It is usually deployed in storage-area network (SAN) environments and must be tied to a functioning server.

Because block storage doesn't rely on a single path to data—like file storage does—it can be retrieved quickly. Each block lives on its own and can be partitioned so it can be accessed in a different operating system, which gives the user complete freedom to configure their data. It's an efficient and reliable way to store data and is easy to use and manage. **It works well with enterprises performing big transactions and those that deploy huge databases, meaning the more data you need to store, the better off you'll be with block storage.**

There are som**e downsides,** though. Block storage can be **expensive**. It has l**imited capability to handle metadata**, which means it needs to be dealt with at the application or database level—adding another thing for a developer or systems administrator to worry about.

Examples of block storage services like Amazon Elastic Block Store (EBS) are used for other enterprise applications like databases and often require dedicated, low latency storage for each host. This is comparable in certain respects to **direct attached storage (DAS) or a storage area network (SAN).**

Cloud storage is:
- **Made up of many distributed resources**, but still acts as one, either in a federated or a cooperative storage cloud architecture
- **Highly fault tolerant** through redundancy and distribution of data

- **Highly durable** through the creation of versioned copies
- Typically eventually consistent with regard to data replicas[10]

Advantages

- **Companies need only pay for the storage they actually use,** typically an average of consumption during a month, quarter, or year. This does not mean that cloud storage is less expensive, only that it incurs operating expenses rather than capital expenses.
- Businesses using cloud storage can **cut their energy consumption by up to 70%** making them a more green business.
- Organizations can choose between **off-premises and on-premises cloud storage** options, or a mixture of the two options, depending on relevant decision criteria that is complementary to initial direct cost savings potential;
- Storage **availability and data protection is intrinsic to object storage architecture,** so depending on the application, the additional technology, effort and cost to add availability and protection can be eliminated.
- **Storage maintenance** tasks, such as purchasing additional storage capacity, are offloaded to the responsibility of a service provider.
- **Cloud storage provides users with immediate access to a broad range of resources and applications hosted in the infrastructure** of another organization via a web service interface.
- Cloud storage can be **used for copying virtual machine images** from the cloud to on-premises locations or to import a virtual machine image from an on-premises location to the cloud image library. In addition, cloud storage can be used to move virtual machine images between user accounts or between data centers.
- Cloud storage can be used as **natural disaster proof backup**, as normally there are 2 or 3 different backup servers located in different places around the globe.
- Cloud storage can be mapped as a local drive with the WebDAV protocol. It can function as a central file server for organizations with multiple office locations.

https://www.youtube.com/watch?v=3r9RGJ0_Bls

Cloud Development Services and Tools

○ Cloud computing is at an early stage of its development. This can be seen by observing the **large number of small and start-up companies offering cloud development tools.**

○ In a more established industry, the **smaller players eventually fall by the wayside** as larger companies take center stage.

○ Cloud services development services and tools are offered by a variety of companies, both large and small.

The most basic offerings provide cloud-based **hosting for applications developed from scratch.**

○ The more fully featured offerings include development tools and pre-built applications that developers can use as the building blocks for their own unique web-based applications.

Amazon

○ Amazon, one of the **largest retailers on the Interne**t, is also one of the primary providers of cloud development services.

○ Amazon has spent a lot of **time and money setting up a multitude of servers** to service its popular website, and is making those vast hardware resources available for all developers to use.

○ The service in question is called the **Elastic Compute Cloud, also known as EC2.** This is a commercial web service that allows developers and companies to rent capacity on Amazon's proprietary cloud of servers— which happens to be one of the **biggest server farms in the world.**

○ EC2 enables scalable deployment of applications **by letting customers request a set number of virtual machines,** onto which they can load any application of their choice.

○ Thus, **customers can create, launch, and terminate server instances on demand**, creating a truly "elastic" operation. Amazon's service lets customers choose from three sizes of virtual servers:

    i. **Small,** which offers the equivalent of a system with 1.7GB of memory,160GB of storage, and one virtual 32-bit core processor.

ii. **Large,** which offers the equivalent of a system with 7.5GB of memory,850GB of storage, and two 64-bit virtual core processors.

iii. **Extra large,** which offers the equivalent of a system with 15GB of memory,1.7TB of storage, and four virtual 64-bit core processors

(In other words, you pick the size and power you want for your virtual server, and Amazon does the rest)

○ **EC2 is just part of Amazon's Web Services (AWS)** set of offerings, which provides developers with **direct access to Amazon's software and machines**.

○ By tapping into the computing power that Amazon has already constructed, developers can build reliable, powerful, and low-cost web-based applications.

○ Amazon provides the cloud (and access to it), and developers provide the rest. They pay only for the computing power that they use.

○ AWS is perhaps the **most popular cloud computing service to date**. Amazon claims a market of more than 330,000 customers—a combination of developers, start-ups, and established companies.

Google App Engine

- ○ **Google is a leader in web-based applications,** so it's not surprising that the company also offers cloud development services.

- ○ These services come in the form of the **Google App Engine**, which enables developers to build their own web applications utilizing the same infrastructure that powers Google's powerful applications.

- ○ The Google App Engine provides a fully **integrated application environment.** Using Google's development tools and computing cloud, App Engine applications are easy to build, easy to maintain, and easy to scale.

- ○ All you have to do is develop your application (**using Google's APIs and the Python programming language**) and upload it to the App Engine cloud; from there, it's ready to serve your users.

- ○ As you might suspect, Google offers a robust cloud development environment. It includes the following features:

  - ● Dynamic web serving
  - ● Full support for all common web technologies
  - ● Persistent storage with queries, sorting, and transactions
  - ● Automatic scaling and load balancing
  - ● APIs for authenticating users and sending email using Google Accounts

- ● In addition, Google provides a fully featured **local development environment t**hat simulates the Google App Engine on any desktop computer.

- ● And here's one of the best things about Google's offering: Unlike most other cloud hosting solutions, **Google App Engine is completely free to use**—at a basic level, anyway.

- ● A free App Engine account gets up t**o 500MB of storage and enough CPU strength and bandwidth for about 5 million page views a month.**

- ● If you need more storage, power, or capacity, Google intends to offer additional resources (for a charge) in the near future.

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- **Enterprise features:** Coming later this year - hosted SQL databases, SSL on your company's domain for secure communications, and access to advanced Google services.

Learn more about the preview of App Engine for Business.

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- Java Documentation
- Python Documentation

Getting Started
1. Sign up for an App Engine account.
2. Download the App Engine SDK.
3. Read the Getting Started Guide.

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Developing and deploying on Google App Engine.
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⊞ Services
Services Javadoc
JRE Class White List
⊞ Configuration
⊞ YAML Configuration
⊞ Tools
⊞ How-To

Python
Overview
CGI Environment
⊞ Storing Data

What Is Google App Engine?

Google App Engine lets you run your web applications on Google's infrastructure. App Engine applications are easy to build, easy to maintain, and easy to scale as your traffic and data storage needs grow. With App Engine, there are no servers to maintain: You just upload your application, and it's ready to serve your users.

You can serve your app from your own domain name (such as http://www.example.com/) using Google Apps. Or, you can serve your app using a free name on the appspot.com domain. You can share your application with the world, or limit access to members of your organization.

Google App Engine supports apps written in several programming languages. With App Engine's Java runtime environment, you can build your app using standard Java technologies, including the JVM, Java servlets, and the Java programming language—or any other language using a JVM-based interpreter or compiler, such as JavaScript or Ruby. App Engine also features a dedicated Python runtime environment, which includes a fast Python interpreter and the Python standard library. The Java and Python runtime environments are built to ensure that your application runs quickly, securely, and without interference from other apps on the system.

With App Engine, you only pay for what you use. There are no set-up costs and no recurring fees. The resources your application uses, such as storage and bandwidth, are measured by the gigabyte, and billed at competitive rates. You control the maximum amounts of resources your app can consume, so it always stays within your budget.

App Engine costs nothing to get started. All applications can use up to 500 MB of storage and enough CPU and bandwidth to support an efficient app serving around 5 million page views a month, absolutely free. When you enable billing for your application, your free limits are raised, and you only pay for resources you use above the free levels.

The Application Environment

Google App Engine makes it easy to build an application that runs reliably, even under heavy load and with large amounts of data. App Engine includes the following features:

- dynamic web serving, with full support for common web technologies
- persistent storage with queries, sorting and transactions
- automatic scaling and load balancing
- APIs for authenticating users and sending email using Google Accounts
- a fully featured local development environment that simulates Google App Engine on your computer
- task queues for performing work outside of the scope of a web request
- scheduled tasks for triggering events at specified times and regular intervals

Your application can run in one of two runtime environments: the Java environment, and the Python environment. Each environment provides standard protocols and common technologies for web application development.

The Sandbox

IBM

○ It's not surprising, given the company's strength in **enterprise-level computer hardware,** that IBM is offering a cloud computing solution.

○ The company is targeting **small- and medium-sized businesses** with a suite of cloud-based ondemand services via its Blue Cloud initiative.

○ **Blue Cloud is a series of cloud computing offerings that enables enterprises to distribute their computing needs across a globally accessible resource grid.**
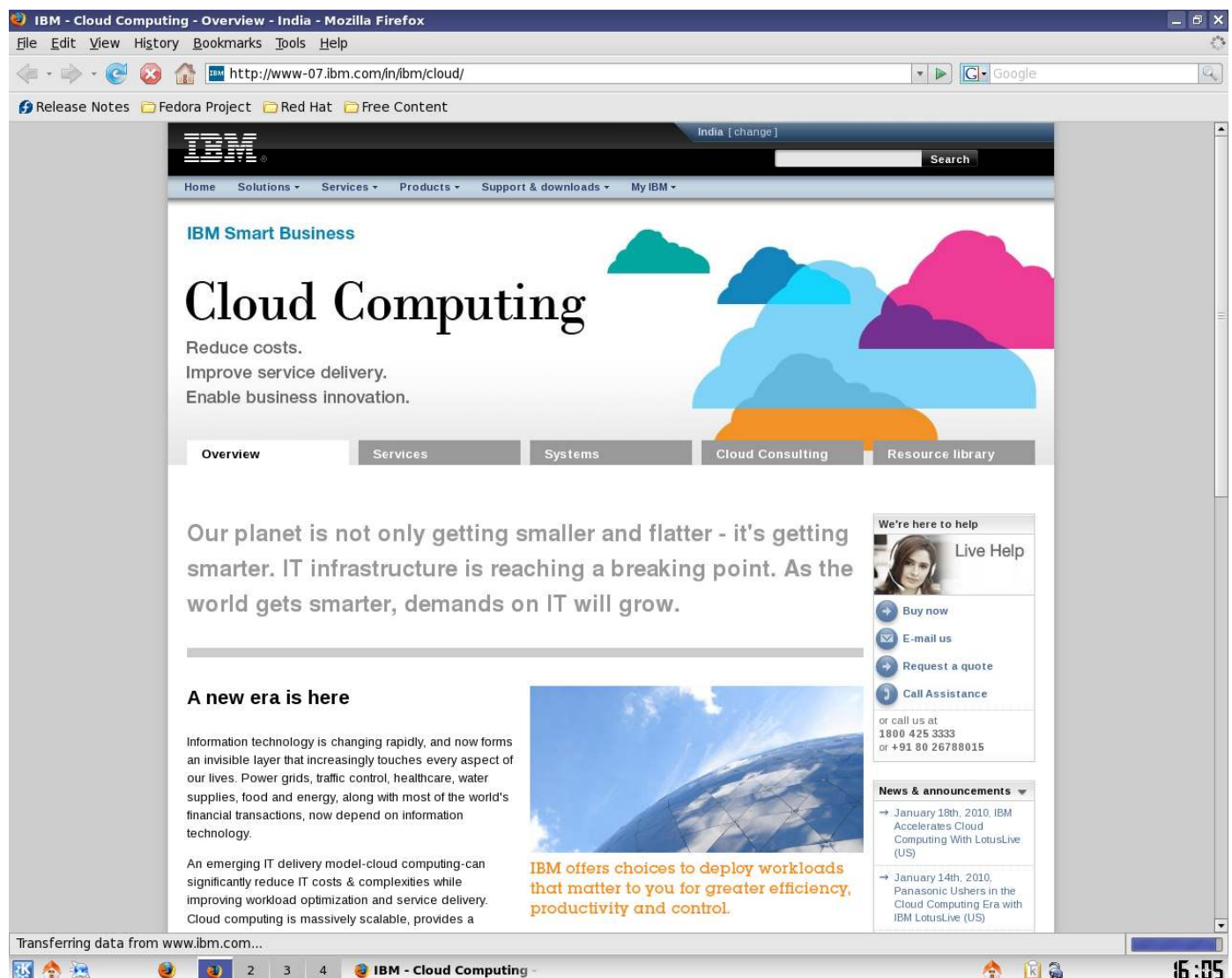
- One such offering is the Express Advantage suite, which includes data backup and recovery, email continuity and archiving, and data security functionality—some of the more data-intensive processes handled by a typical IT department.

- To manage its cloud hardware, IBM provides open source workload-scheduling software called Hadoop, which is based on the MapReduce software usedGoogle in its offerings. Also included are PowerVM and Xen virtualization tools,along with IBM's Tivoli data center management software.

Salesforce.com

Salesforce.com is the Enterprise Cloud Computing Company. Put simply, we provide CRM and Collaboration applications that you access over the Internet and pay-as-you-go. You can also build your own apps on our Force.com platform, all without the need to run and manage your own data centre and software. Find out why more than 87,200 companies have chosen salesforce.com to help run their business

- Salesforce.com is probably best known for its **sales management SaaS**, but it's also a leader in cloud computing development.

- The company's cloud computing architecture is dubbed Force.com. The **platform as a service is entirely on-demand, running across the Internet.**

- Salesforce provides its own **Force.com API** and developer's toolkit. Pricing is on a per log-in basis. Supplementing Force.com is AppExchange, a directory of web-based applications.

  Developers can use **AppExchange applications** uploaded by others, share their own applications in the directory, or publish private applications accessible only by authorized companies or clients.

- Many applications in the AppExchange library are free, and others can be purchased or licensed from the original developers.

- Most existing **AppExchange applications are sales related**—sales analysis tools, email marketing systems, financial analysis apps, and so forth. But companies can use the Force.com platform to develop any type of application.

- In fact, many small businesses have already jumped on the Force.com bandwagon. For example, an April 2008 article in *PC World* magazine quoted Jonathan Snyder, CTO of Dreambuilder Investments, a 10-person mortgage investment company in New York.

- "**We're a small company**," Snyder said, "we don't have the resources to focus on buying servers and developing from scratch. For us, Force.com was really a jump-start."
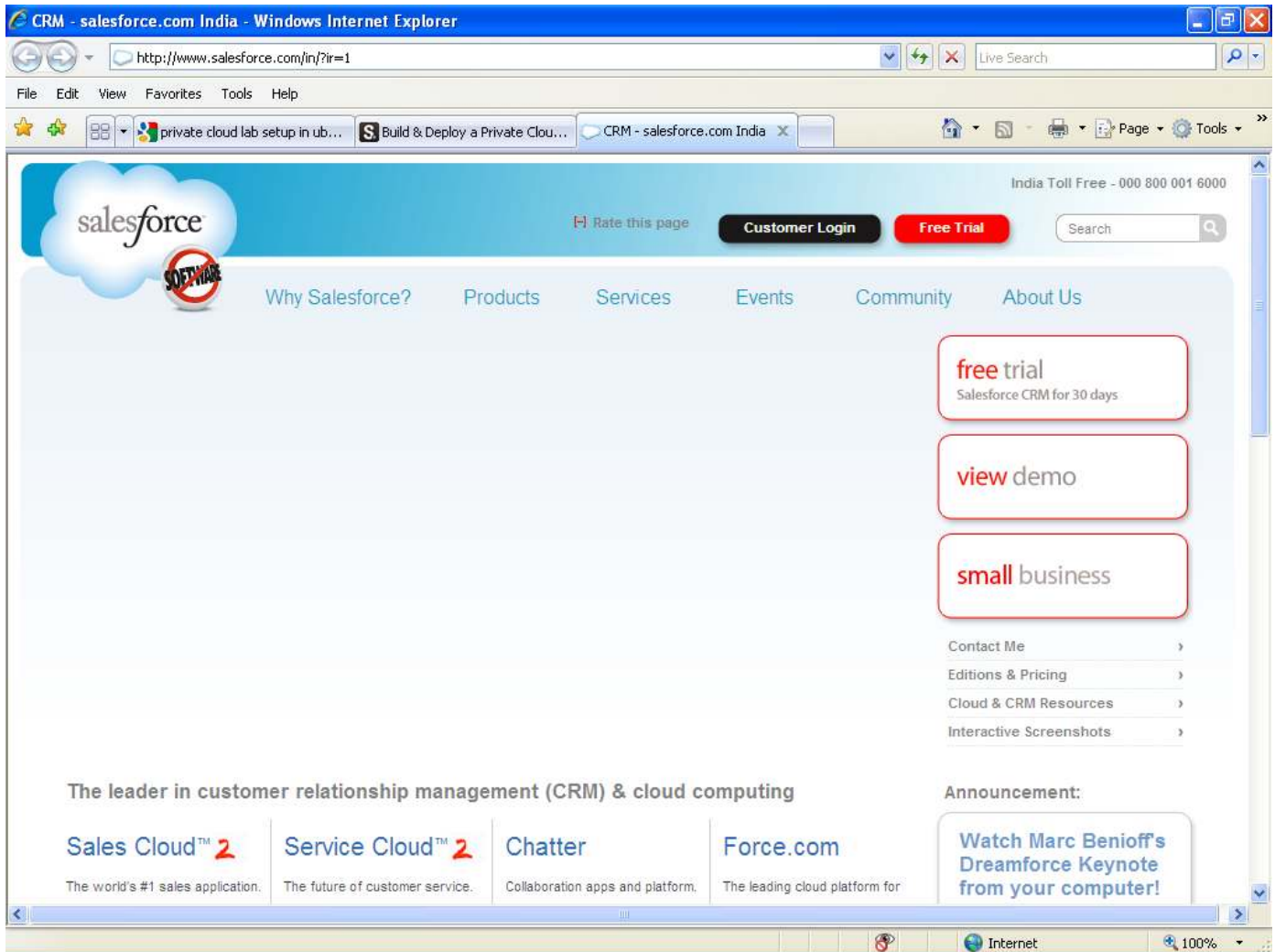
PRODUCTS:

1.**Accounts and contacts**

Everything you need to know about your customers and prospects - all in one place.

2.**Marketing and leads**

Close that gap between marketing and sales with better quality leads—and more of them.

3.**Opportunities and quotes**

When you have critical deals in the works, don't let anything slip through the cracks.

4.**Jigsaw data services**

Your CRM data just got a whole lot better with real-time contact info and automated data hygiene.

5.Analytics and forecasting

Get the insight you need to keep your sales on track and moving efficiently

6.Approvals and workflow

Nothing should impede the momentum of your sales efforts. Drag and drop to create automated processes with these tools.

7.Email and productivity

Don't change the way you work. With the Sales Cloud , you can work seamlessly with the tools you already use everyday.

8.Content library

Stop searching aimlessly for that killer presentation… that new product datasheet… that updated price sheet. It's right at your fingertips.

9.Genius

Find sales insights when you need them most. Genius connects you with people and resources to help you close deals.

10.Chatter

Collaborate instantly. Get real-time updates pushed to you on the people, data, and documents that can help you close your deals.

11.Partners

Stop waiting for partner updates. Now you can have complete visibility into both direct and indirect sales channels with one view.

12.Mobile

Having the latest information can improve customer relations and accelerate your deals. Stay on top of your business from any location on any device.

13.   AppExchange

Discover hundreds of apps that will expand your sales success. Want more solutions? Look no further

IOMoARcPSD|11845796

Other Cloud Services Development Tools

Amazon, Google, IBM, and Salesforce.com aren't the only companies offering tools for cloud services developers.
There are also a number of smaller companies working in this space that developers should evaluate, and that end users may eventually become familiar with. These companies include the following:

3tera (www.3tera.com)
10gen (www.10gen.com)

Cohesive Flexible Technologies (www.cohesiveft.com)
Joyent (www.joyent.com)
Mosso (www.mosso.com)

Nirvanix (www.nirvanix.com)
Skytap (www.skytap.com).
StrikeIron (www.strikeiron.com)

Sun Microsystems has an R&D project, dubbed Project Caroline (www.projectcaroline.net)

Cloud Computing Architecture

Cloud computing technology is used by both small and large organizations to **store the information** in the cloud and **access** it from *anywhere at any time using the internet connection.*

Cloud computing architecture is a combination of **service-oriented architecture** and **event-driven architecture**.

Cloud computing architecture is divided into the following two parts -

- Front End
- Back End

The below diagram shows the architecture of cloud computing -

Front End

The front end is **used by the client**. It **contains** client-side **interfaces and applications** that are required to access the cloud computing platforms. The front end includes web servers (including Chrome, Firefox, internet explorer, etc.), thin & fat clients, tablets, and mobile devices.

Back End

The back end is **used by the service provider.** It **manages** all the **resources** that are required to provide cloud computing services. It includes a **huge amount of data storage, security mechanisms, virtual machines, deploying models, servers, traffic control mechanisms,** etc.

Components of Cloud Computing Architecture

There are the following components of cloud computing architecture -

1. Client Infrastructure

Client Infrastructure is a Front end component. It provides **GUI** (Graphical User Interface) to interact with the cloud.

2. Application

The application may be any **software or platform** that a **client wants to access.**
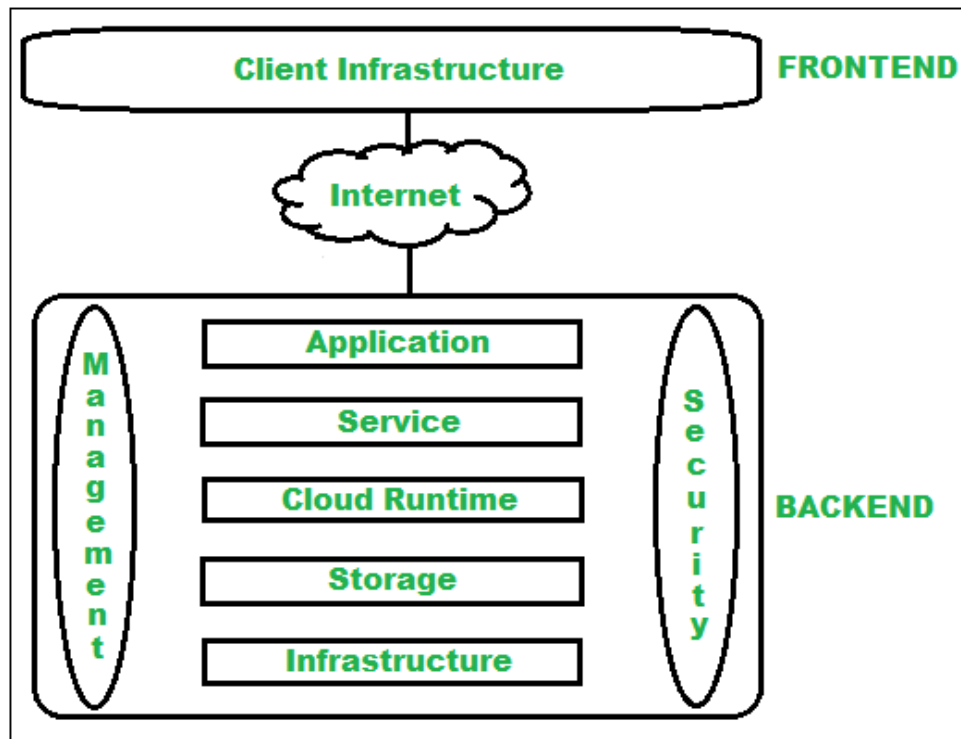
3. Service

A Cloud Services manages which type of service you access according to the client's requirement.

Cloud computing offers the following three type of services:

i. Software as a Service (SaaS) − It is also known as **cloud application services**. Mostly, **SaaS applications run directly** through the web browser means we do not require to download and install these applications. Some important example of SaaS is given below −

Example: Google Apps, Salesforce Dropbox, Slack, Hubspot, Cisco WebEx.

ii. Platform as a Service (PaaS) − It is also known as cloud platform services. It is quite similar to SaaS, but the difference is that **PaaS provides a platform for software**

creation, but using SaaS, we can access software over the internet without the need of any platform.

Example: Windows Azure, Force.com, Magento Commerce Cloud, OpenShift.

iii. Infrastructure as a Service (IaaS) – It is also known as **cloud infrastructure services**. It is responsible for managing applications data, middleware, and runtime environments.

Example: Amazon Web Services (AWS) EC2, Google Compute Engine (GCE), Cisco Metapod.

4. Runtime Cloud

Runtime Cloud provides the **execution and runtime environment** to the virtual machines.

5. Storage

Storage is one of the most important components of cloud computing. It provides a **huge amount of storage capacity** in the cloud to store and manage data.

6. Infrastructure

It provides services on the **host level**, **application level**, and **network level**. Cloud infrastructure includes hardware and software components such as **servers, storage, network devices, virtualization software, and other storage resources** that are needed to support the cloud computing model.

7. Management

Management is used to manage components such as application, service, runtime cloud, storage, infrastructure, and other security issues in the backend and establish coordination between them.

8. Security

Security is an in-built back end component of cloud computing. It implements a **security mechanism in the back end.**

9. Internet

The Internet is a medium through which the front end and back end can interact and communicate with each other.

Benefits of Cloud Computing Architecture :

- Makes the overall cloud computing system **simpler**.
- **Improves** data processing requirements.
- Helps in providing high **security**.
- Makes it more **modularized**.
- Results better **disaster recovery.**
- Gives good **user accessibility.**
- Reduces **IT operating costs.**

Cloud Service Provider Requirements

1. A Cloud Service Provider Will Take Care of Regulatory Compliance

Regulatory Compliance, in terms of cloud computing, means your business processes running on cloud-based systems are compliant with the **standards** which your customers require. However, such standards **won't VIOLATE various other laws and regulations** such as HIPPA, PCCI, and GDPR bound to data collection as well as data storage in an intimidating way. If your cloud service provider is taking care of the regulatory requirements of many of your existing businesses, then you better need **not WORRY ABOUT STAYING up-to-date with the brand-new rules and regulations constantly affecting your business data.** Curious to know what those conditions are related to regulatory compliance!! They are a) Setting out a STEP-BY-STEP process through which you are deploying well cloud technologies in compliance with the updated regulatory requirements like maintaining interdisciplinary principles while business processes are active, advertising and marketing regulations. b) Encouraging customer's choice by making your services available both online and offline with honest communication channels c) A standardized and auditable compliance framework to promote trust and swifter adoption of your cloud services across maximum sectors of the economy.

2. A Cloud Service Provider is Adaptable with Your Infrastructure Requirements

Infrastructure requirements can be defined as your list of various types of b**usiness hardware and software to enable cloud computing benefits in real-time.** While accessing your list of H/W (Hardware) and S/W (Software), the cloud service provider you have selected or will select some **must be adaptable with the varying behavior of components affecting your curated list.** Such components are virtualization, computing power, and availability of cloud resources sensed with strengthened virtualization techniques. Conceptualizing what the benefit of infrastructure would be in the long run!! This will offer agility to your businesses so that they can be operated with not much need to GIGANTIC CAPITAL EXPENSE on maintenance, or repairing of H/W & S/W. As a result, your business processes can scalably acquire a strong grip on everyday load demands since such loads will automatically be balanced without any HUMAN INTERVENTION and also, at lesser costs. So, you should be spending your valuable time and money in finding and then, hiring an adaptable cloud-service provider who understands your infrastructure requirements and offers solutions corresponding to that without compromising on business continuity.

3. A Cloud Service Provider will favor SLAs

SLAs i.e. Service-Level Agreements of Cloud Computing sincerely e**stablishes a relationship between a user (which is you) and a cloud service provider** (which you have

chosen or will choose). Indeed, such relationships are recognized as internal-level, customer-level, and multilevel service-level agreements and differentiate themselves well on the grounds of responsiveness, speed, volume and quality of work, and at last, efficiency. If your selected cloud service provider is clear with a**greeing upon any of the types of SLAs you require as per your business standards,** then you must not be waiting longer to establish such contractual relationships with the provider. In the long run, picking up a Cloud Service Provider who favorably shakes hands as per the SLA standards won't go waste because now, you are assured about what particularly the cloud service provider is managing and implementing actually? Now, both of you are connected on the grounds of trust and will communicate if something goes wrong as per the agreement's legal conditions.

4. A Cloud Service Provider Should Offer Different Types of Cloud Services

Types of Cloud Services are three: a) IaaS b) PaaS c) SaaS. In an abbreviated manner, the IaaS is Infrastructure-As-A-Service, PaaS is directed towards Platform-As-A-Service, and SaaS is Software-As-A-Service. But before you see the magic of any of those in real-time, you better analyze your business requirements and then, consult a cloud-service provider to perceive solutions related to **deployment, maintenance of applications, and the architecture supporting them.** Otherwise, you may fall into the trap of selecting a service doing totally opposite of **WHAT YOUR BUSINESS REQUIREMENTS ARE?** So, you should be doing **R & D** at your own level of your business requirements. Then, you must consult your selected or any other cloud hosting provider handling brilliantly all your queries regarding the hardware, and other platforms driving the infrastructure of your business processes. More than expected, such a decision will help you in migrating from any of your traditional data-centric approaches of running businesses to the ones relying upon systematically documenting all the merits like SCALABILITY, RELIABILITY, SPEED, or ACCURACY bound to the powerful and dynamic cloud services.

5. A Cloud Service Provider Must Provide Recommended Security Measures

Recommended Security measures let you handle all your concerns of business data and networking principles establishing shareable and resourceful connections among different users. Just like N/W i.e. **Network Security, Cloud Security measures ensure that your data is SAFE** AND can traverse across different platforms **resilient with AUTHENTICATION and ease-of-availability.** Thoughtfully analyzing if your cloud service provider is critical with his/her act of supplying such recommended security measures!! To verify this, you must analyze or evaluate once the security procedures and policies of the cloud service provider have already been chosen or will be chosen by you in the future. If required, you must not be taking a step back in reviewing the provider's governance and compliance certifications which would be an EVIDENCE OF PROPORTIONATE INTERESTS acquired by your cloud service provider. So,

choosing a service provider recommending security measures in accordance with the essential cloud policies and procedures will help you manage challenges related to vulnerabilities in security filled with misconfigurations and sensitive DATA EXPOSURES.

6. A Cloud Service Provider Won't Refuse to Customer Support

Customer Support is another parameter that would require your CAREFUL consideration. The reason is obvious – **such support will help you get what your business demands simply and quickly**. Also, a CSP i.e. Cloud Service Provider should be flexible with his/her terms of providing support **round-the-clock** (HOLIDAYS ARE INCLUDED) via **live chat, phone calls, emails, and other communication channels.** This will help you a lot in increasing the response time and average resolution time of your businesses as your customers will get the right answers for all their queries bound to the constraints of time and access. Typically, the support will ensure that the quality of service, as well as the remedies doing wonders at times of performance failures, will scale your business processes in this mature market environment. So, ask your Cloud Service Provider upfront about the level and form of customer support you will be able to access after accepting his/her services at some monthly charges.

7. A Cloud Service Provider is Presentable with Flexibility in the Pricing Plans

Pricing Structure for Cloud Computing Services varies greatly. Here, you should understand that any of the **pricing plans you are choosing is matching with your business model, network, hardware requirements, and the number of users accommodated by the network.** Also, you should ask your chosen cloud service provider about the sticker price of your PRICING PLAN and other costs associated with consumption of value-added services for a month, an hour, half-yearly, or year-wise. If needed, you can raise a query to your service provider for the pricing models categorized on the basis of usage. A few of them from that categorization trending in the market are PAY-PER-USE (Pay only for WHAT you are using exclusive of UPFRONT COSTS), HYBRID (offers combined benefits of PAY-PER-USE and SUBSCRIPTION-BASED), & SUBSCRIPTION-BASED (lets you RESERVE cloud resources you may avail in the future for a specific period). Hence, you must not feel hesitant while asking about the available pricing plans, upfront costs associated, and ability to add services as per your business requirements from your CSP so that you can flexibly present maximum benefits of your business model which will benefit your customers located across any of the parts of GLOBE.

Cloud interoperability

Cloud Interoperability and standards:

Cloud interoperability refers to the ability of customers to use the same management tools, server images and other software with a variety of cloud computing providers and platforms.

Standards are important in cloud computing for a variety of reasons. Standards for interoperability and data and application portability can ensure an open competitive market in cloud computing because customers are not locked-in to cloud providers and can easily transfer data or applications between cloud providers.

Why cloud interoperability and standards?

Vendor lock-in can prevent a customer from **switching to another competitor's solution.**

If switching is possible, it happens at **considerable conversion cost and requires significant amounts of time**.

Switching happens because the customer **wants to find a more suitable solution for customer needs.**

Or vendors may not be able to provide the service required.

So, the presence of standards that are actually implemented and adopted in the cloud computing **community** gives power for interoperability and then lessens the risks resulting from vendor lock-in.

Service Centric Issues - Interoperability issues in cloud computing

When you decide to move an application between clouds, there are challenges. These include:

1. **Rebuilding** the application and application stack in the target cloud.
2. **Setting up the network** in the target cloud to give the application the support that it had in its original cloud.
3. **Setting up security** to match the capabilities provided by the source cloud.
4. **Managing the application** running in the target cloud.
5. Handling **data movement and the encryption of data** while it is in transit and when it gets to the target cloud.

QoS Parameters In Cloud Computing

Cloud Computing: Cloud computing, the old dream of computing, became true recently. It has the potential to transform a large part of the IT industry and make software having qualities as a service. Many cloud-computing operators are now active in the market, providing good services including Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS) solutions . Cloud computing is a type of computing that deals with shared computer resources and data to provide the data for a large number of users over the internet network. Cloud computing have strong points make it better than the normal computing system like

Mobility, mobility term means that spreading service in a wide space that y**ou can use this service from anywhere you have access to the internet.** You can access your documents you uploaded to cloud storage services like DropBox.

More Storage, initially, memory **storage was limited**. When you run out from memory, some functionality of your software will not work properly. You also need to get a USB drive to back up your current files. Cloud computing provides increasing storage, so you will not be worried about running out of space on your memory.

Easy Set-Up, Setting up cloud computing service **would be done in a few minutes.** Adjusting your setting, choosing a password for your network or service is very simple. After that, you can immediately start using your service and data.

Automatic Updates, Cloud computing providers are **responsible to provide updates and make it available,** you just need to download and install them. This does not need you to be an expert to update your device; cloud-computing providers will notify you when updates are available and will give you instructions to ease this process for you.

Cheap Service, Cloud computing is inexpensive compared to the other memory storage. The software is already installed online, so no need to install it by yourself. Many cloud computing providers provide spaces free like DropBox. As there is strong points, there are some weak point in cloud computing, for example

Security, when you are using cloud-computing services that mean you essentially handing over your service and data with a third party. As well as many users from different places in the world accessing the same server can access security issues.

Privacy, Cloud computing comes with the risk that unauthorized users might access your information. To protect against this happening, cloud-computing services offer password protection and operate on secure servers with data encryption technology.

Internet Reliance, While Internet access is increasingly widespread, it is not available everywhere just yet. If the area that you are in does not have Internet access, you will not be able to open any of the documents you have stored in the cloud.

Loss of Control Cloud computing entities control the users. It include what information you can store in your cloud, places where you can a