MURANG'A UNIVERSITY OF TECHNOLOGY DEPARTMENT OF IT

SIT407: CLOUD COMPUTING

CREDIT HOURS: 3 HOURS

COURSE NOTES

CLOUD SERVICE MODELS

Objectives
i) Explain the meaning of EUCALYPTUS
ii) Explain leveraging API's to query Eucalyptus Private Cloud
iii) Discuss the following concepts
  – Virtualization and Cloud Computing
  – Grid Computing vs Cloud Computing
  – Utility Computing Vs Cloud Computing
  – Security concerns for Cloud Computing
  – Privacy Concern & Cloud Computing
iv) Explain the advantages and disadvantages of cloud computing

EUCALYPTUS

EUCALYPTUS is an open source software platform for implementing Infrastructure as a Service (IaaS) in a private or hybrid cloud computing environment.

The Eucalyptus cloud platform pools together existing virtualized infrastructure to create cloud resources for infrastructure as a service, network as a service and storage as a service.

The name Eucalyptus is an acronym for Elastic Utility Computing Architecture for Linking Your Programs To Useful Systems.

Eucalyptus was founded out of a research project in the Computer Science Department at the University of California, Santa Barbara, and became a for-profit business called Eucalyptus Systems in 2009.

EUCALYPTUS CONT'D

Eucalyptus Systems announced a formal agreement with Amazon Web Services (AWS) in March 2012, allowing administrators to move instances between a Eucalyptus private cloud and the Amazon Elastic Compute Cloud (EC2) to create a hybrid cloud. The partnership also allows Eucalyptus to work with Amazon's product teams to develop unique AWS-compatible features.

Eucalyptus features include:

- Supports both Linux and Windows virtual machines (VMs).
- Application program interface-(API) compatible with Amazon EC2 platform.
- Compatible with Amazon Web Services (AWS) and Simple Storage Service (S3).

EUCALYPTUS CONT'D

- Works with multiple hypervisors including VMware, Xen and KVM.
- Can be installed and deployed from source code or DEB and RPM packages.
- Internal processes communications are secured through SOAP and WS-Security.
- Multiple clusters can be virtualized as a single cloud.
- Administrative features such as user and group management and reports.

Version 3.3, which became generally available in June 2013, adds the following features:

- Auto Scaling: Allows application developers to scale Eucalyptus resources up or down based on policies defined using Amazon EC2-compatible APIs and tools

EUCALYPTUS CONT'D

Elastic Load Balancing: AWS-compatible service that provides greater fault tolerance for applications

CloudWatch: An AWS-compatible service that allows users to collect metrics, set alarms, identify trends, and take action to ensure applications run smoothly

Resource Tagging: Fine-grained reporting for showback and chargeback scenarios; allows IT/ DevOps to build reports that show cloud utilization by application, department or user

Expanded Instance Types: Expanded set of instance types to more closely align to those available in Amazon EC2. Was 5 before, now up to 15 instance types.

Maintenance Mode: Allows for replication of a virtual machine's hard drive, evacuation of the server node and provides a maintenance window.

EUCALYPTUS CONT'D

Basically, Eucalyptus provides an Infrastructure as a Service (IaaS) offering. The main advantage is that it provides easy and secure deployment.

The private cloud is deployed in the premises of the enterprise and can be accessed by users over the intranet, so critical and important data remains secure from outside intrusion.

Also, it provides AWS APIs. So, at any time, consumers can easily migrate or load balance their less sensitive data into the Amazon public cloud; thus, they don't have to worry about the elasticity of their network.

In 2014, it was acquired by HP (Hewlett-Packard), which incidentally has its own cloud offerings under the HPE Helion banner.

EUCALYPTUS CONT'D

The Helion portfolio has a variety of cloud related products, which includes HP's own flavour of OpenStack called HP Helion OpenStack. Now, Eucalyptus is a part of the HPE portfolio and is called HPE Helion Eucalyptus. It provides an open solution for building a hybrid cloud, leveraging the benefits of other HP Helion products.

Eucalyptus architecture

Figure 1 demonstrates the overall architecture of Eucalyptus in data centre design. Eucalyptus CLIs can manage both AWS and its own private instances. Users can easily migrate instances from Eucalyptus to Amazon Elastic Cloud.

Compute, storage and network is managed by the virtualisation layer. Instances are separated by hardware virtualisation.
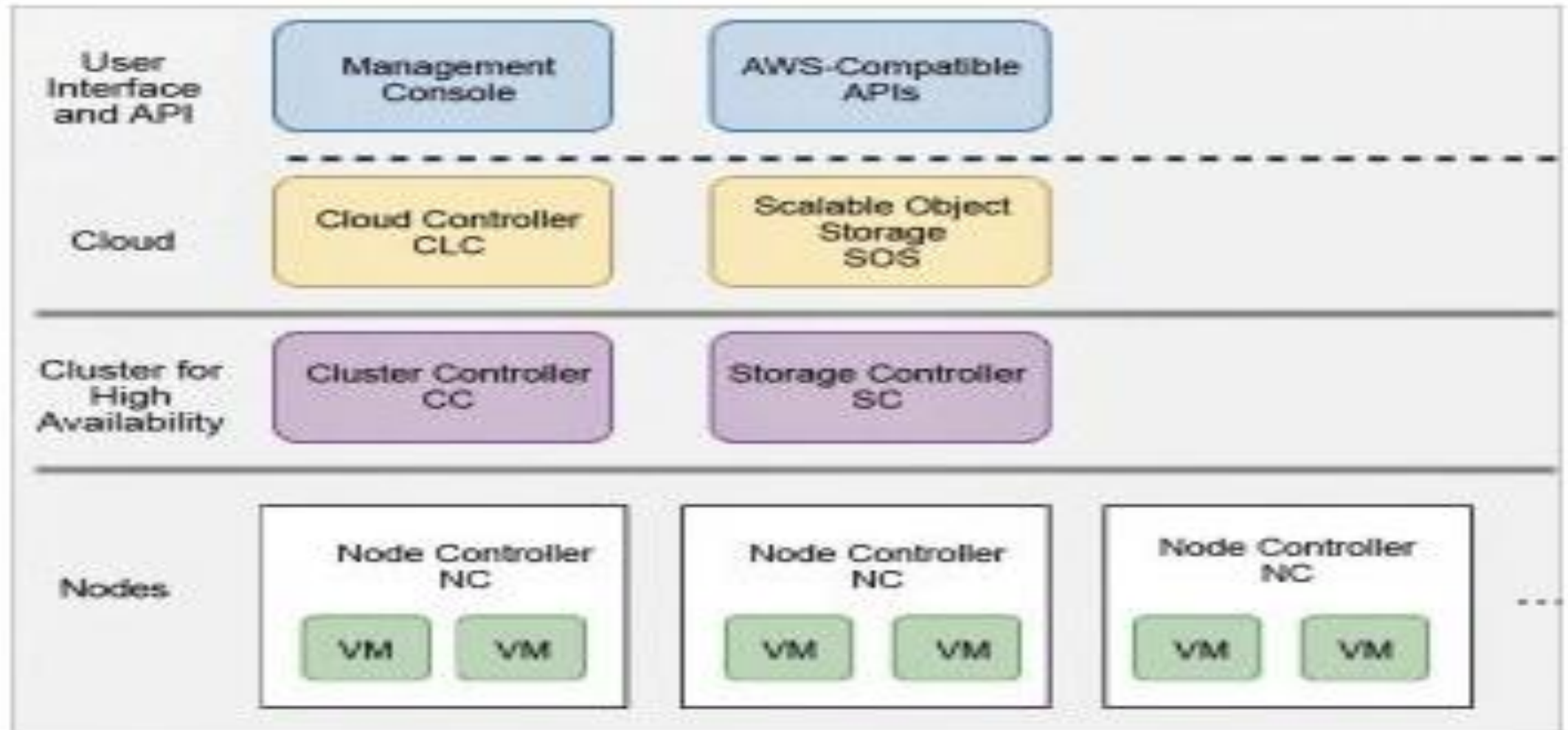
EUCALYPTUS CONT'D

Figure 1: Eucalyptus software architecture

EUCALYPTUS CONT'D

The following terminology is used by Eucalyptus

Images: Any software module, configuration, application software or system software bundled and deployed in the Eucalyptus cloud is called a Eucalyptus machine image (EMI).

Instances: When we run the image and use it, it becomes an instance. The controller will decide how much memory to allocate and provide all other resources.

Networking: The Eucalyptus network is divided into three modes:

- Managed mode: In this mode, it just manages a local network of instances, which includes security groups and IP addresses.

- System mode: In this mode, it assigns a MAC address and attaches the instance's network interface to the physical network through the NC's bridge.

- Static mode: In this mode, it assigns IP addresses to instances.

EUCALYPTUS CONT'D

Static and system mode do not assign elastic IPs, security groups, or VM isolation.

Access control is used to provide restriction to users. Each user will get a unique identity. All identities can be grouped and managed by access control.

Eucalyptus elastic block storage (EBS) provides block-level storage volumes, which we can attach to an instance.

Auto scaling and load balancing is used to automatically create or destroy instances or services based on requirements. CloudWatch provides different metrics for measurement.

Eucalyptus components

Eucalyptus has a total of six components, of which five are the main components and one is optional.
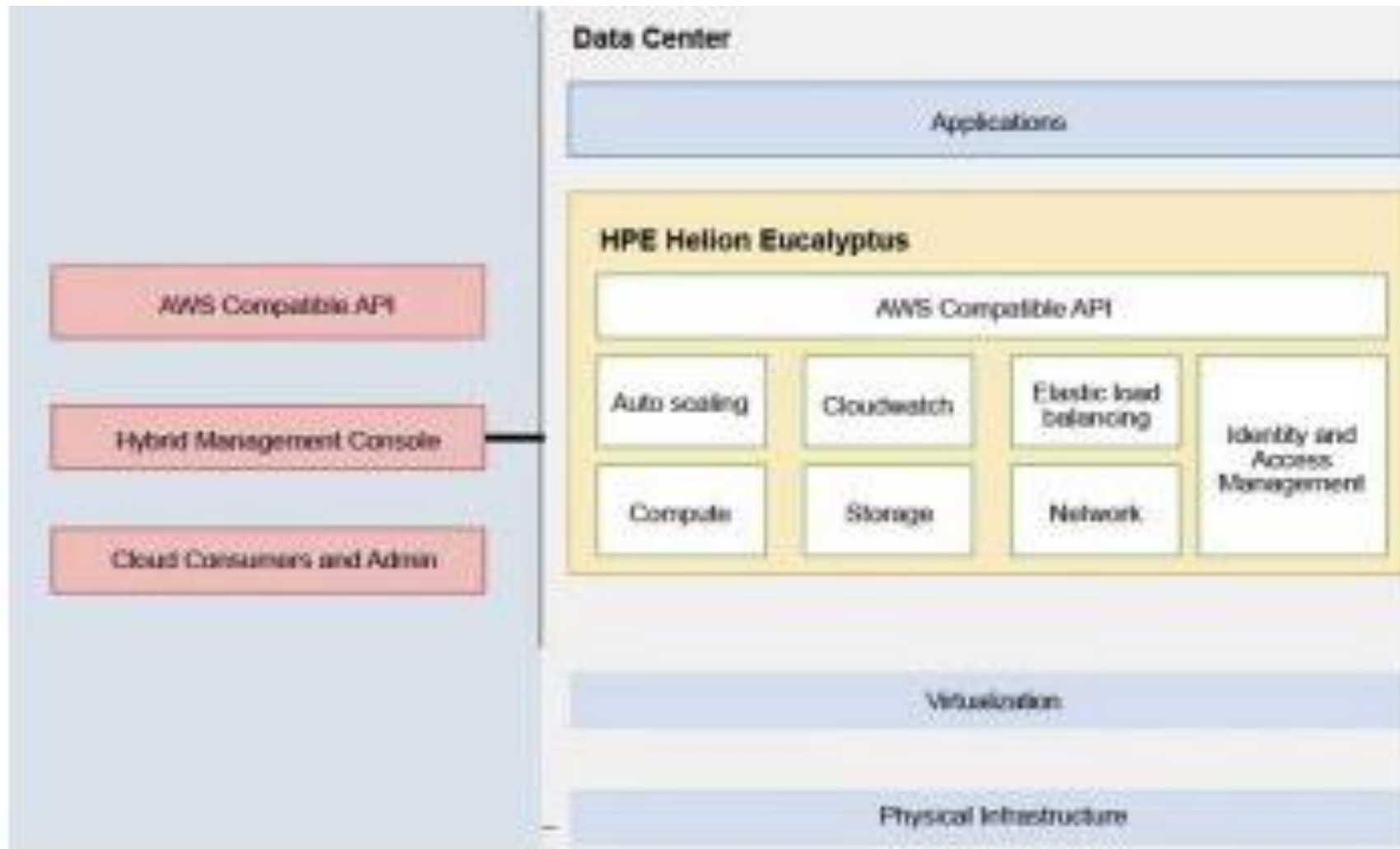
EUCALYPTUS CONT'D

Figure 2: Eucalyptus components

EUCALYPTUS CONT'D

Cloud controller: Cloud controller (CLC) is the main controller, which manages the entire cloud platform. It provides a Web and EC2 compatible interface. All the incoming requests come through the Cloud controller. It performs scheduling, resource allocation and accounting. It manages all the underlying resources. Only one controller can exist per cloud.

Walrus: This is similar to AWS S3 (Simple Storage Service). It provides persistent storage to all the instances. It can contain any kind of data like application data, volume or image snapshots.

Cluster controller: This is the heart of the cluster within a Eucalyptus cloud. It manages VM (instance) execution and service level agreements. It communicates with the storage and network controller.

EUCALYPTUS CONT'D

Storage controller: Storage controller (SC) is similar to AWS EBS (Elastic Block Storage). It provides block level storage to instances and snapshots within a cluster. If an instance wants persistent storage outside of storage, then it must pass through Walrus. The storage controller doesn't handle this kind of request.

Node controller: NC (node controller) hosts all the instances and manages their end points. There is no limit to the number of NCs in the Eucalyptus cloud. It takes images and also caches from Walrus and creates instances. One should manage the number of NCs used as it affects the performance.

Enterprises can use any AWS-compatible tools or scripts to manage their own on-premise infrastructure. AWS API is implemented above Eucalyptus; so both are backward compatible. Users can run any apps that are supported by AWS from Eucalyptus.

EUCALYPTUS CONT'D

Euca2ool: Euca2ool is the Eucalyptus CLI for interacting with Web services. It is a Python based tool which is compatible with all the AWS services like S3, auto scaling, ELB (Elastic Load Balancing), CloudWatch, EC2, etc. It is an all-in-one solution for both the AWS and the Eucalyptus platforms.

Other tools

There are many other tools that can be used to interact with Eucalyptus and AWS, and they are listed below.

s3curl: This is a tool for interaction between Eucalyptus Walrus and AWS S3.

Cloudberry S3 Explorer: This Windows tool is for managing files between Walrus and S3.

s3fs: This is a FUSE file system, which can be used to mount a bucket from S3 or Walrus as a local file system.

EUCALYPTUS CONT'D

The advantages of the Eucalyptus cloud

i) Eucalyptus can be used to get the advantages of both the public and private clouds.

ii) Users can run Amazon or Eucalyptus machine images as instances on both the clouds.

iii) It has 100 per cent API compatibility with all the AWS services. There are many tools developed to interact seamlessly between AWS and Eucalyptus.

iv) Eucalyptus can be used with DevOps tools such as Puppet and Chef. Popular SDKs like AWS SDKs for Java and Ruby and Fog work smoothly with Eucalyptus.

V) It is not very popular in the market but is a strong competitor to OpenStack and CloudStack.

EUCALYPTUS CONT'D

Table 1 sums up the features of the Eucalyptus private cloud software.

Architecture	Five main components; same as AWS
Installation	Installation is easy compared to other IaaS offerings.
Administration	Strong CLI compatible with EC2 API
Security	Baseline security + component registration
Popularity	Medium
IaaS offering	Public + private (hybrid)

EUCALYPTUS CONT'D

Eucalyptus vs other IaaS private clouds

There are many IaaS offerings available in the market like OpenStack, CloudStack, Eucalyptus and OpenNebula, all of which are being used as both public and private IaaS offerings.

Of all the IaaS offerings, OpenStack still remains the most popular, active and biggest open source cloud computing project, yet enthusiasm for Eucalyptus, CloudStack and OpenNebula remains solid.

Based on business critical requirements, cloud service providers and administrators can choose specific IaaS offerings.

VIRTUALIZATION AND CLOUD COMPUTING

The main enabling technology for Cloud Computing is Virtualization. Virtualization is a partitioning of single physical server into multiple logical servers. Once the physical server is divided, each logical server behaves like a physical server and can run an operating system and applications independently.

Many popular companies's like VmWare and Microsoft provide virtualization services, where instead of using your personal PC for storage and computation, you use their virtual server. They are fast, cost-effective and less time consuming.

For software developers and testers virtualization comes very handy, as it allows developer to write code that runs in many different environments and more importantly to test that code.

VIRTUALIZATION AND CLOUD COMPUTING CONT'D

Virtualization is mainly used for three main purposes

1) Network Virtualization:- a method of combining the available resources in a network by splitting up the available bandwidth into channels, each of which is independent from the others and each channel is independent of others and can be assigned to a specific server or device in real time.

2) Storage Virtualization:- the pooling of physical storage from multiple network storage devices into what appears to be a single storage device that is managed from a central console. Storage virtualization is commonly used in storage area networks (SANs).

3) Server Virtualization:- the masking of server resources like processors, RAM, operating system etc, from server users. The intention of server virtualization is to increase the resource sharing and reduce the burden and complexity of computation from users.

VIRTUALIZATION AND CLOUD COMPUTING CONT'D

Virtualization is the key to unlock the Cloud system, what makes virtualization so important for the cloud is that it decouples the software from the hardware.

For example, PC's can use virtual memory to borrow extra memory from the hard disk. Usually hard disk has a lot more space than memory.

Although virtual disks are slower than real memory, if managed properly the substitution works perfectly.

Likewise, there is software which can imitate an entire computer, which means 1 computer can perform the functions equals to 20 computers.
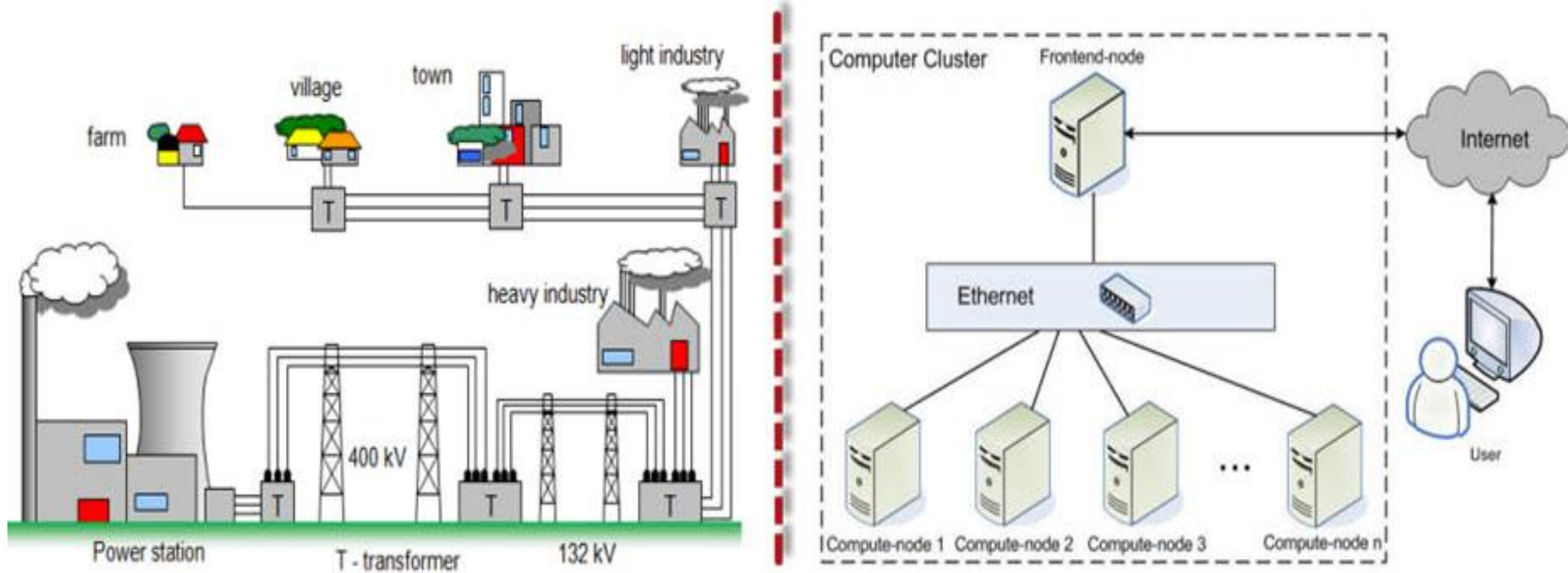
GRID COMPUTING VS CLOUD COMPUTING

When we switch on the fan or any electric device, we are less concern about the power supply from where it comes and how it is generated.

The power supply or electricity that we receives at our home travels through a chain of network, which includes power stations, transformers, power lines and transmission stations.

These components together make a 'Power Grid'. Likewise, 'Grid Computing' is an infrastructure that links computing resources such as PCs, servers, workstations and storage elements and provides the mechanism required to access them.

GRID COMPUTING VS CLOUD COMPUTING CONT'D

Computing grid is compared to electricity grid, where it spans through a network to provide its service

GRID COMPUTING VS CLOUD COMPUTING CONT'D

Grid Computing is a middle ware to co-ordinate disparate IT resources across a network, allowing them to function as whole. It is more often used in scientific research and in universities for educational purpose.

For example, a group of architect students working on a different project requires a specific designing tool and a software for designing purpose but only couple of them got access to this designing tool, the problem is how they can make this tool available to rest of the students.

GRID COMPUTING VS CLOUD COMPUTING CONT'D

Cloud Computing	Grid Computing
•Cloud computing works more as a service provider for utilizing computer resource	•Grid computing uses the available resource and interconnected computer systems to accomplish a common goal
•Cloud computing is a centralized model	•Grid computing is a decentralized model, where the computation could occur over many administrative model
•Cloud is a collection of computers usually owned by a single party.	•A grid is a collection of computers which is owned by a multiple parties in multiple locations and connected together so that users can share the combined power of resources
•Cloud offers more services all most all the services like web hosting, DB (Data Base) support and much more	•Grid provides limited services
•Cloud computing is typically provided within a single organization (eg : Amazon)	•Grid computing federates the resources located within different organization.

GRID COMPUTING VS CLOUD COMPUTING CONT'D

To make available for other students they will put this designing tool on campus network, now the grid will connect all these computers in campus network and allow student to use designing tool required for their project from anywhere.

Cloud computing and Grid computing is often confused, though their functions are almost similar the approach for their functionality is different.

UTILITY COMPUTING VS CLOUD COMPUTING

In our previous conversation in "Grid Computing" we have seen how electricity is supplied to our house, also we do know that to keep electricity supply we have to pay the bill.

Utility Computing is just like that, we use electricity at home as per our requirement and pay the bill accordingly likewise you will use the services for the computing and pay as per the use this is known as 'Utility computing'.

Utility computing is a good source for small scale usage, it can be done in any server environment and requires Cloud Computing.

UTILITY COMPUTING VS CLOUD COMPUTING

Utility computing is the process of providing service through an on-demand, pay per use billing method.

The customer or client has access to a virtually unlimited supply of computing solutions over a virtual private network or over the internet, which can be sourced and used whenever it's required.

Based on the concept of utility computing , grid computing, cloud computing and managed IT services are based.

Through utility computing small businesses with limited budget can easily use software like CRM (Customer Relationship Management) without investing heavily on infrastructure to maintain their clientele base.

UTILITY COMPUTING VS CLOUD COMPUTING CONT'D

Utility Computing	Cloud Computing
•Utility computing refers to the ability to charge the offered services, and charge customers for exact usage	•Cloud Computing also works like utility computing, you pay only for what you use but Cloud Computing might be cheaper, as such, Cloud based app can be up and running in days or weeks.
•Utility computing users want to be in control of the geographical location of the infrastructure	•In cloud computing, provider is in complete control of cloud computing services and infrastructure
•Utility computing is more favorable when performance and selection infrastructure is critical	•Cloud computing is great and easy to use when the selection infrastructure and performance is not critical
•Utility computing is a good choice for less resource demanding	•Cloud computing is a good choice for high resource demanding
•Utility computing refers to a business model	•Cloud computing refers to the underlying IT architecture

SECURITY CONCERNS FOR CLOUD COMPUTING

While using cloud computing, the major issue that concerns the users is about its security.

One concern is that cloud providers themselves may have access to customer's unencrypted data whether it's on disk, in memory or transmitted over the network.

Some countries government may decide to search through data without necessarily notifying the data owner, depending on where the data resides, which is not appreciated and is considered as a privacy breach (Example Prism Program by USA).

SECURITY CONCERNS FOR CLOUD COMPUTING CONT'D

To provide security for systems, networks and data cloud computing service providers have joined hands with TCG(Trusted Computing Group) which is non-profit organization which regularly releases a set of specifications to secure hardware, create self-encrypting drives and improve network security.

It protects the data from root kits and malware. As computing has expanded to different devices like hard disk drives and mobile phones, TCG has extended the security measures to include these devices. It provides ability to create a unified data protection policy across all clouds. Some of the trusted cloud services are Amazon, Box.net, Gmail and many others

PRIVACY CONCERN & CLOUD COMPUTING

Privacy present a strong barrier for users to adapt into Cloud Computing systems. There are certain measures which can improve privacy in cloud computing.

The administrative staff of the cloud computing service could theoretically monitor the data moving in memory before it is stored in disk.

To keep the confidentiality of a data, administrative and legal controls should prevent this from happening.

The other way for increasing the privacy is to keep the data encrypted at the cloud storage site, preventing unauthorized access through the internet; even cloud vendor can't access the data either.

CASE-STUDY OF CLOUD COMPUTING- ROYAL MAIL

Subject of Case-Study: Using Cloud Computing for effective communication among staff.

Reason for using Cloud Computing: Reducing the cost made after communication for 28,000 employees and to provide advance features and interface of e-mail services to their employees.

Royal mail group, a postal service in U.K, is the only government organization in U.K that serves over 24 million customers through its 12000 post offices and 3000 separate processing sites. Its logistics systems and parcel-force worldwide handles around 404 million parcel a year. And to do this they need an effective communicative medium. They have recognized the advantage of Cloud Computing and implemented it to their system. It has shown an outstanding performance in inter-communication. Before moving on to Cloud system, the organization was struggling with the out-of-date software, and due to which the operational efficiency was getting compromised.

# CASE-STUDY OF CLOUD COMPUTING- ROYAL MAIL CONT'D

As soon as the organization switched on to Cloud System, 28000 employees were supplied with their new collaboration suite, giving them access to tools such as instant messaging and presence awareness. The employees got more storage place than on local server. The employees became much more productive.

Looking to the success of Cloud Computing in e-mail services and communication .The second strategic move of Royal Mail Group, was to migrating from physical servers to virtual servers, upto 400 servers to create a private cloud based on Microsoft hyper V. This would give a fresh look and additional space to their employees desktop and also provides latest modern exchange environment.

The hyper V project by RMG's (Royal Mail Group) is estimated to save around 1.8 million pound for them in future and will increase the efficiency of the organization's internal IT system.

ADVANTAGES OF CLOUD COMPUTING

Here, we will learn what are the benefits of Cloud Computing in your organization:

Cloud Computing Overview
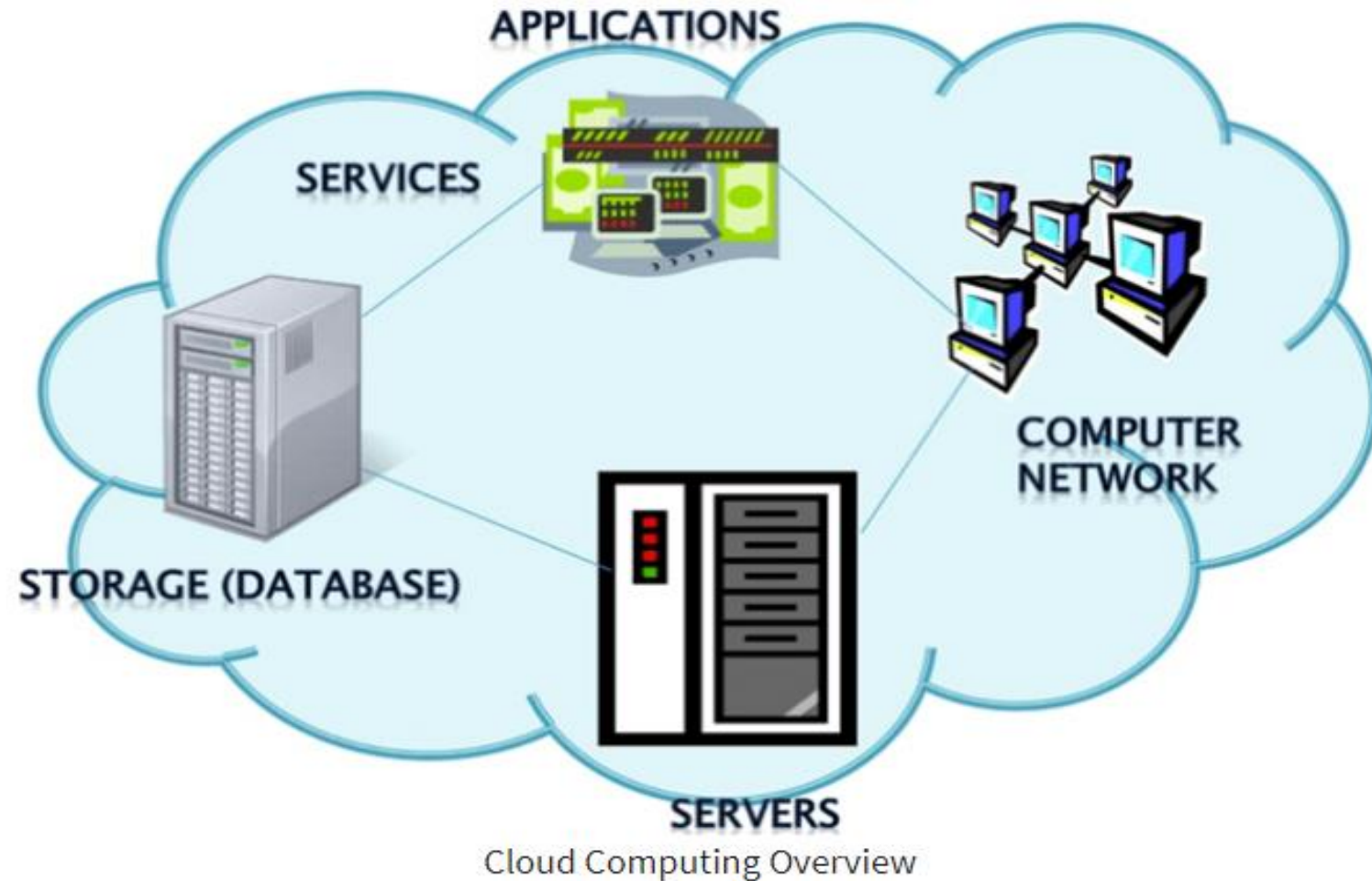
ADVANTAGES OF CLOUD COMPUTING CONT'D

I) Cost Savings

Cost saving is one of the biggest Cloud Computing benefits. It helps you to save substantial capital cost as it does not need any physical hardware investments. Also, you do not need trained personnel to maintain the hardware. The buying and managing of equipment is done by the cloud service provider.

II) Strategic edge

Cloud computing offers a competitive edge over your competitors. It is one of the best advantages of Cloud services that helps you to access the latest applications any time without spending your time and money on installations.

III) High Speed

Cloud computing allows you to deploy your service quickly in fewer clicks. This faster deployment allows you to get the resources required for your system within fewer minutes.

ADVANTAGES OF CLOUD COMPUTING CONT'D

IV) Back-up and restore data

Once the data is stored in a Cloud, it is easier to get the back-up and recovery of that, which is otherwise very time taking process on-premise.

V) Automatic Software Integration

In the cloud, software integration is something that occurs automatically. Therefore, you don't need to take additional efforts to customize and integrate your applications as per your preferences.

VI) Reliability

Reliability is one of the biggest benefits of Cloud hosting. You can always get instantly updated about the changes.

VII) Mobility

Employees who are working on the premises or at the remote locations can easily access all the could services. All they need is an Internet connectivity.

ADVANTAGES OF CLOUD COMPUTING CONT'D

VIII) Unlimited storage capacity

The cloud offers almost limitless storage capacity. At any time you can quickly expand your storage capacity with very nominal monthly fees.

IX) Collaboration

The cloud computing platform helps employees who are located in different geographies to collaborate in a highly convenient and secure manner.

X) Quick Deployment

Last but not least, cloud computing gives you the advantage of rapid deployment. So, when you decide to use the cloud, your entire system can be fully functional in very few minutes. Although, the amount of time taken depends on what kind of technologies are used in your business.

OTHER IMPORTANT BENEFITS OF CLOUD COMPUTING

Apart from the mentioned advantages, some other Cloud Computing advantages are:

- On-Demand Self-service
- Multi-tenancy
- Offers Resilient Computing
- Fast and effective virtualization
- Provide you low-cost software
- Offers advanced online security
- Location and Device Independence
- Always available, and scales automatically to adjust to the increase in demand
- Allows pay-per-use
- Web-based control & interfaces
- API Access available.

DISADVANTAGES OF CLOUD COMPUTING

I) Performance Can Vary

When you are working in a cloud environment, your application is running on the server which simultaneously provides resources to other businesses. Any greedy behavior or DDOS attack on your tenant could affect the performance of your shared resource.

II) Technical Issues

Cloud technology is always prone to an outage and other technical issues. Even, the best cloud service provider companies may face this type of trouble despite maintaining high standards of maintenance.

III) Security Threat in the Cloud

Another drawback while working with cloud computing services is security risk. Before adopting cloud technology, you should be well aware of the fact that you will be sharing all your company's sensitive information to a third-party cloud computing service provider. Hackers might access this information.

DISADVANTAGES OF CLOUD COMPUTING CONT'D

IV) Downtime

Downtime should also be considered while working with cloud computing. That's because your cloud provider may face power loss, low internet connectivity, service maintenance, etc.

V) Internet Connectivity

Good Internet connectivity is a must in cloud computing. You can't access cloud without an internet connection. Moreover, you don't have any other way to gather data from the cloud.

VI) Lower Bandwidth

Many cloud storage service providers limit bandwidth usage of their users. So, in case if your organization surpasses the given allowance, the additional charges could be significantly costly

VII) Lacks of Support

Cloud Computing companies fail to provide proper support to the customers. Moreover, they want their user to depend on FAQs or online help, which can be a tedious job for non-technical persons.

CLOUD SERVICE PROVIDERS

Cloud Service providers are vendors which provide Information Technology (IT) as a service over the Internet. Cloud computing is a term which is used for storing and accessing data over the internet. It doesn't store any data on the hard disk of your PC. Cloud companies helps you to access your data from a remote server.

Cloud computing companies services range from full application development platforms to servers, storage, and virtual desktops.

This cloud provider list contains various types of cloud computing services that are available in the market.

CLOUD SERVICE PROVIDERS CONT'D

1) Amazon Web Services

AWS is Amazon's cloud web hosting platform which offers fast, flexible, reliable and cost-effective solutions. It is one of the top cloud service providers which offers a service in the form of building block which can be used to create and deploy any kind of application in the cloud. It is the most popular as it was the first to enter the cloud computing space.

Features:

- Easy sign-up process
- Fast Deployments
- Allows easy management of add or remove capacity
- Access to effectively limitless capacity
- Centralized Billing and management
- It is one of the cloud companies that offers Hybrid Capabilities and per hour billing

CLOUD SERVICE PROVIDERS CONT'D

2) Kamatera

A cloud server tool developed by Kamatera is very much similar to a physical server. It operated in a virtual infrastructure cloud, making it highly flexible and cost-effective. This cloud server pricing is based on pay as you use model a standard in the industry.

Features:

- 13 Data Centers across four continents for ultimate performance and availability
- Customized and Tailored Made VPS Hosting to fit your needs
- Scalability: Allows you to quickly add load balancers, firewalls, private networks and apps such as: pfSense, Docker, CPanel, Drupal, Jenkins, WordPress, Magento, node.JS and many more.
- All SSDs with UNLIMITED TRAFFIC. 99.95% Up-Time Guaranteed
- Scale across hundreds of servers in seconds
- Billing options – Per Month or Per Day
- 24/7/365 Tech Human Support
- 30 Day Free Trial to test the services

CLOUD SERVICE PROVIDERS CONT'D

3) Serverspace

Cloud works on innovative hyperconverged vStack platform based on superior Open Source technologies. Lightweight bhyve hypervisor and OS FreeBSD with simplified codebase help build new generation virtual machines.

Features:
- Easiest sign-up - only thing that you need is email
- Windows & Linux OS
- Based on the latest 2nd Gen Intel Scalable CPUs with 3.1 GHz frequency
- Fast-speed SSD's with awesome IOPS rate
- ?reate & Spin up in no time
- 24/7/365 Tech Human Support
- Pay&Go. Only for the VM you use. Charges every 10 minutes

CLOUD SERVICE PROVIDERS CONT'D

4) Microsoft Azure

Azure is a cloud platform which is launched by Microsoft in February 2010. This open source and flexible cloud platform which helps in development, data storage, service management & hosting solutions.

Features:

- Windows Azure offers the most effective solution for your data needs
- Provides scalability, flexibility, and cost-effectiveness
- Offers consistency across clouds with familiar tools and resources
- Allow you to scale your IT resources up and down according to your business needs

CLOUD SERVICE PROVIDERS CONT'D

5) Google Cloud Platform

Google Cloud is a set of solution and products which includes GCP & G suite. It is one of the top cloud service providers which helps you to solve all kind of business challenges with ease.

Features:

- It is one of the cloud companies that allows you to scale with open, flexible technology
- Solve issues with accessible AI & data analytics
- Eliminate the need for installing costly servers
- Allows you to transform your business with a full suite of cloud-based services
- Download link: https://cloud.google.com/

CLOUD SERVICE PROVIDERS CONT'D

6) Salesforce

Salesforce cloud computing offers multiple cloud services like Sales Cloud, Service Cloud, Marketing Cloud, etc. It is one of the top cloud computing companies which helps you to accelerate production of your environment.

Features:

- Salesforce Service Cloud offers 24 * 7 support
- Allows you to take a right and decisive decisions about your business
- This cloud computing provider helps in managing the customer's contact information, automating the business processes, etc.

https://www.salesforce.com/in/cloudcomputing/

CLOUD SERVICE PROVIDERS CONT'D

7) Oracle Cloud

Oracle Cloud offers innovative and integrated cloud services. It is one of the best cloud services providers that helps you to build, deploy, and manage workloads in the cloud or on premises. Oracle Cloud also helps companies to transform their business and reduce complexity.

Features:

- Oracle offers more options for where and how you make your journey to the cloud
- Oracle helps you realize the importance of modern technologies including Artificial intelligence, chatbots, machine learning, and more
- Offers Next-generation mission-critical data management in the cloud
- Oracle provides better visibility to unsanctioned apps and protects against sophisticated cyber attacks

Download link: https://www.oracle.com/cloud/

CLOUD SERVICE PROVIDERS CONT'D

8) IBM Cloud

IBM cloud is a full stack cloud platform which spans public, private and hybrid environments. It is one of the best cloud providers which is built with a robust suite of advanced and AI tools.

Features:

- IBM cloud offers infrastructure as a service (IaaS), software as a service (SaaS) and platform as a service (PaaS)
- IBM Cloud is used to build pioneering which helps you to gain value for your businesses
- It is one of the best name of cloud computing website that offers high performing cloud communications and services into your IT environment

Download link: https://www.ibm.com/cloud

CLOUD SERVICE PROVIDERS CONT'D

9) Dell Cloud

Dell offers a cloud platform, cloud-enabled infrastructure, models, and serves in a single place. It is one of the top cloud companies that allows your own or selects from reference architecture, integrated and public cloud platforms.

Features:

▪ Cloud that works with your existing operations

▪ Cloud consumption using Dell Financial Services

▪ Accelerate your transformation with expert Dell cloud services provider help.

Download link: https://www.delltechnologies.com/en-us/solutions/cloud/dell-technologies-

CLOUD SERVICE PROVIDERS CONT'D

10) Verizon Cloud

Verizon Cloud computing platform allows you to control your infrastructure with advanced set-up and customization options from a single user interface.

Features:

- Expand any workload quickly to help grow your business with less risk
- Helps you to build the right cloud with performance, support, and flexibility to make your business successful
- Allows you to select flexible service need according to your organizations
- You can trim down the risk and retain the data integrity across the apps

Download link: https://www.verizon.com/business/products/networks/

HOW TO SELECT THE BEST CLOUD SERVICE PROVIDER

Following factors should be considered while selecting a cloud company.

- Is your desired region supported?
- Cost for the service and your budget.
- For an outsourcing company, Customer/Client Preference of service provider needs to be factored in
- The cost involved in training employees on the Cloud Service Platform
- Customer support
- The provider should have a successful track record of stability/uptime/reliability
- Reviews of the company

HOW TO EVALUATE CLOUD SERVICE PROVIDER SECURITY?

Here are the factors you should consider to evaluate the security of a cloud service provider:

- Compliance with quality standards and having accredited certifications
- Data Management
- Data governance and security policies
- Service dependencies and partnerships with other vendors
- Contracts and SLAs
- Service delivery
- Legal protections
- Reliability & Performance
- Migration support and vendor lock-in
- Company profile of the service provider

The end.
Q & A