Session 04

Advanced Cloud Computing Concepts

Objectives

❑ Explain various challenges and security threats associated with cloud computing

❑ Describe cloud storage services

❑ Describe open source tools to build cloud applications

❑ Describe mobile cloud computing

❑ Explain the architecture of mobile cloud computing

❑ Describe the various advantages and challenges of mobile cloud computing

❑ Explain cloud computing support for mobile devices

Introduction

Cloud computing brings value to businesses and makes them cost-effective by enabling use of sophisticated applications over the Web.

Therefore, more and more businesses – small and big – are moving towards cloud computing.

However, like any other new technology, even cloud computing has its own share of risks and challenges.

Therefore, it is highly important for the cloud users to do a thorough risk assessment when selecting a cloud deployment mode.

It is also important to have a good understanding of the challenges and security issues to ensure a smooth transition.

Availability of Persistent and Fast Internet Connection

- Without a good connection, the services offered by the cloud-computing provider cannot be utilized properly.
- The challenge here is that many users even today do not have high speed or continual connections.
- In such scenarios, implementing or utilizing cloud-computing services remains a major challenge.

Widespread Adoption

- As a number of cloud computing services and products may not be free and may be priced based on various factors, users may not readily adopt them into their everyday life.
- Many users who have become so accustomed to have free services may find it difficult to transition a paid cloud-based model even if the quality offered is much better.
- To overcome this challenge, providers can at least initially offer free or low-priced cloud computing solutions to lure in the users.

Security Threats

- Cloud computing most importantly faces the challenge of addressing concerns related to security and privacy that are raised by businesses planning to adopt and implement cloud computing.

- The major concern for an organization or business planning to adopt cloud computing is regarding the huge enterprise data that may be stored outside the protective corporate firewall.

- Hacking of or an attack on even a single site in the cloud infrastructure would result in disruption of activities for the clients.

- These tools also help in tracking and monitoring any unusual behavior across the servers. It is the responsibility of a cloud service provider to implement these security measures.

- Cloud security lies on a shared responsibility model. That means in the cloud both the service provider as well as the consumer are responsible for the security at different levels.

- There is a global body called Cloud Security Alliance that creates, manages, and governs cloud security related guidelines and best practices.

- Privacy in cloud revolves around the fact that the data resides at the provider's location and hence stands the risk of being accessed by someone else.

Introduction to Cloud Storage Services

Cloud storage is an enterprise storage model. It stores the data in a pool called virtualized pools. These pools are generally hosted by some third party or specific companies.

Hosting companies operate large data centers and facilitate buying or leasing of storage capacity for people wanting to host their data.

A data center is a computer system and its associated components, which hosts large volumes of data.

The resources are presented as storage pools, which the customers use to store files or data objects. The resource's physical presence can span multiple servers and multiple locations.

Cloud Drive Storage Services

A cloud drive is a channel to access cloud storage. It is supported by various cloud data storage providers. The installation and configuration of a cloud drive storage service is simple.

It can be installed on either a laptop for personal use, a server in the office, or a group of high-end 64-bit servers for an enterprise.

The cloud storage service enables reduction of data storage requirements while facilitating performance effectiveness.

Assuming that the actual write operations to data can take place any time before a subsequent read to the same data, the cloud drive speeds up the performance.

In addition, it does not download the data from the cloud storage provider when the data stored in the cloud has been completely overwritten by the 'delayed' write data.

Various Cloud Storage Services

❑ Users can access the services provided by using direct APIs or by using applications that in turn make use of the API.

❑ These applications may be a cloud desktop storage, cloud storage gateway, or a Web-based content management system.
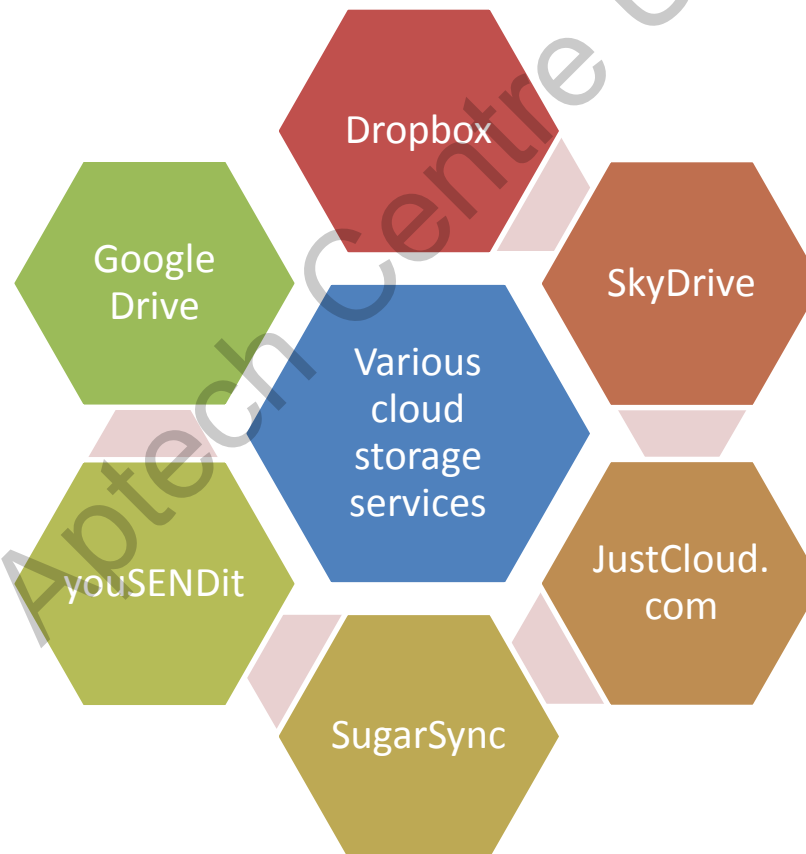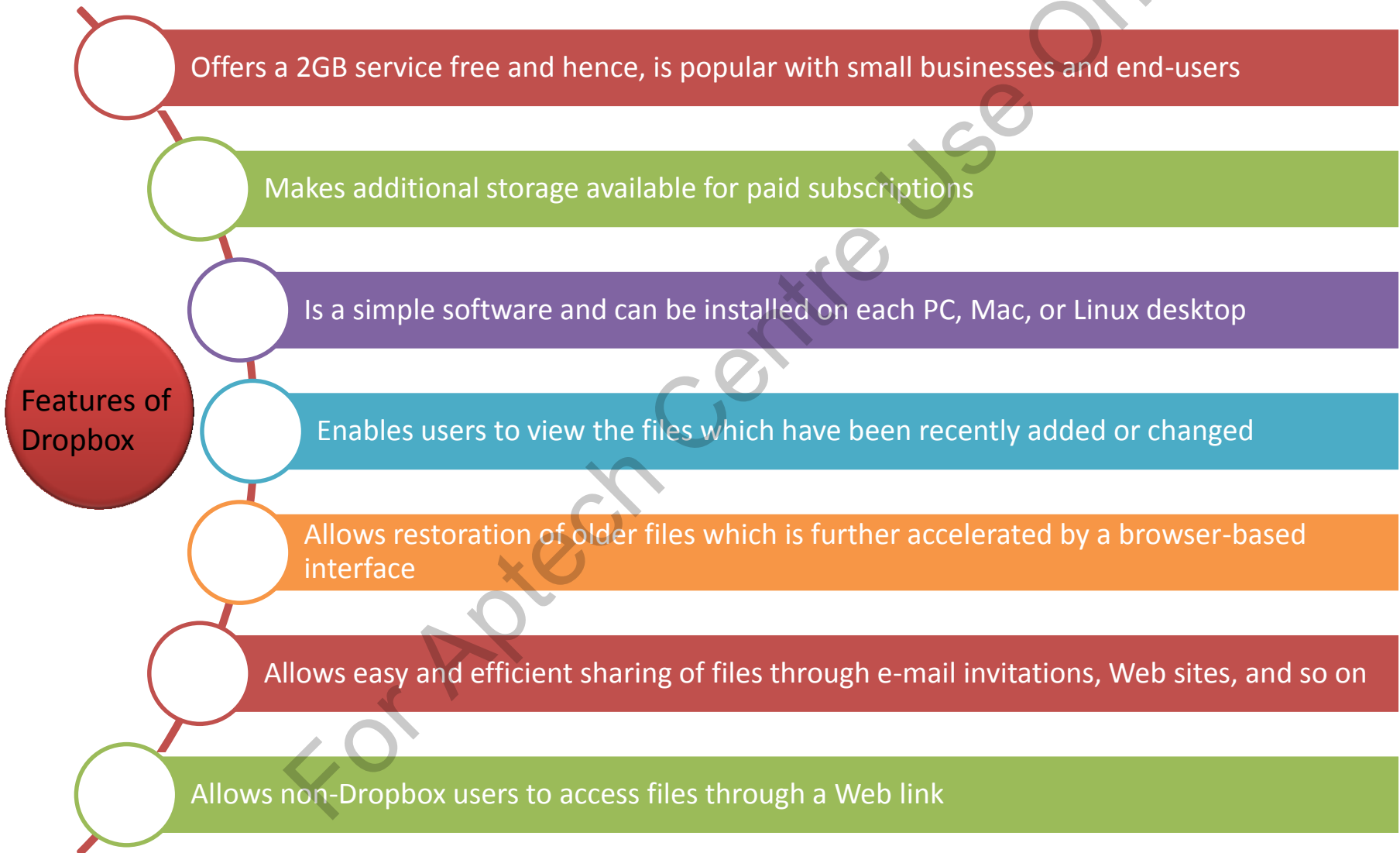
Various Cloud Storage Services-Dropbox 1-3

Dropbox is a file-hosting service that offers many services, including storage on the cloud and synchronization of files.

Dropbox offers a special facility for users to create a special folder on their local computers.

Files stored in this local 'dropbox' can then be accessible through a Web browser from anywhere as the data is stored on the servers of Dropbox.

Various Cloud Storage Services-Dropbox 2-3

Features of Dropbox

- Offers a 2GB service free and hence, is popular with small businesses and end-users

- Makes additional storage available for paid subscriptions

- Is a simple software and can be installed on each PC, Mac, or Linux desktop

- Enables users to view the files which have been recently added or changed

- Allows restoration of older files which is further accelerated by a browser-based interface

- Allows easy and efficient sharing of files through e-mail invitations, Web sites, and so on

- Allows non-Dropbox users to access files through a Web link

Following Figure shows a dropbox. When the files are uploaded to the cloud, they can be accessed through linked accounts from different platforms such as laptops, computers, and smart phones.
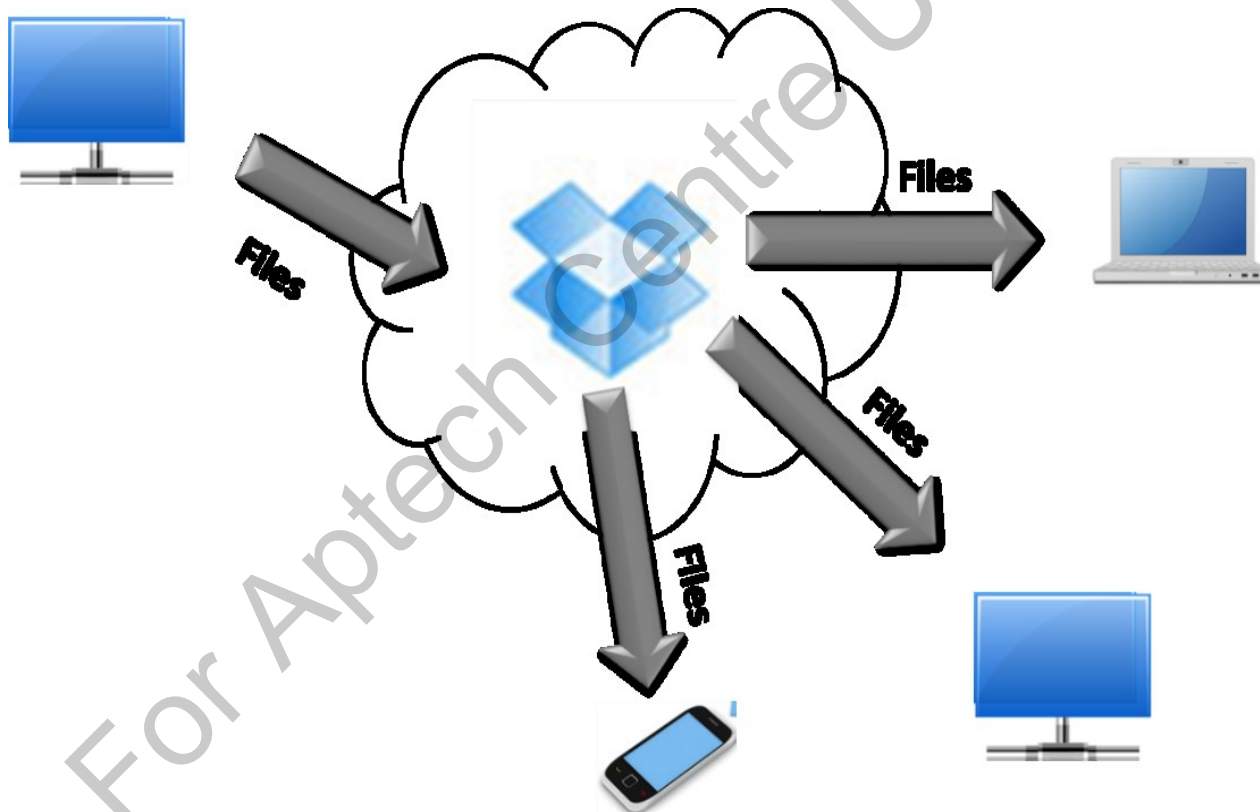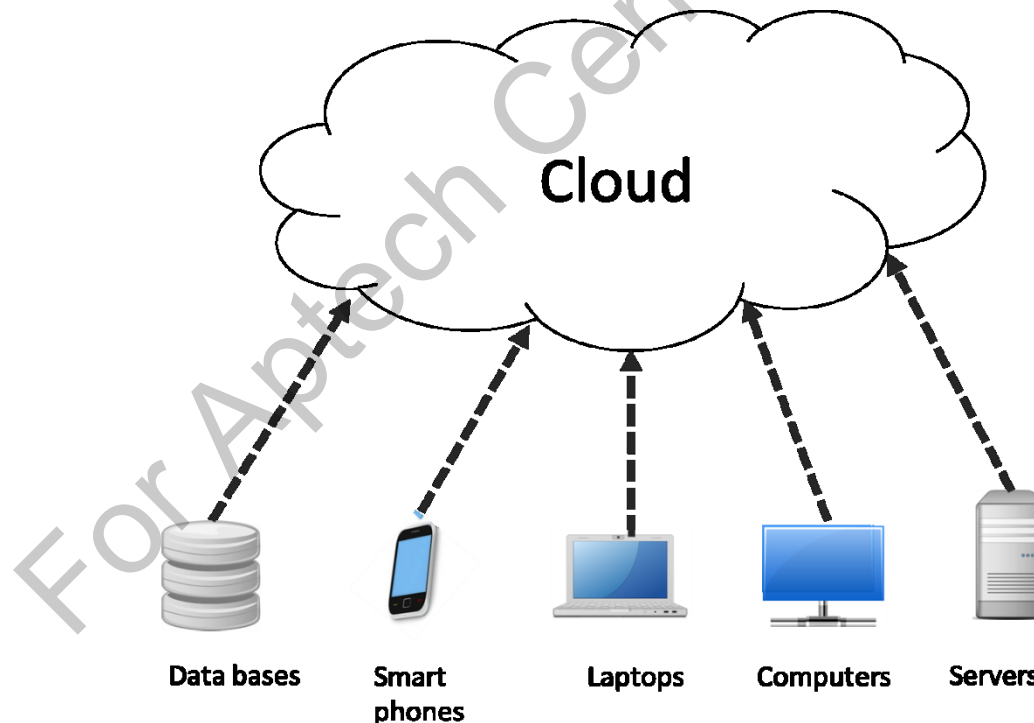
Various Cloud Storage Services-SkyDrive 1-2

SkyDrive is a file-hosting service by Microsoft that facilitates uploading of files to a cloud storage, which can then be accessed, from a Web browser or client software.

Files uploaded to an account are accessible only to the user unless he/she decides to share it. It can provide remote access to a PC, Mac, Windows Phone, Android, and iOS devices.

Figure shows how the files can be uploaded on Skydrive. Different files from different platforms can be uploaded or downloaded to/from the drive and it can be accessed through the Web browser.

Cloud

Data bases   Smart phones   Laptops   Computers   Servers

Features of SkyDrive

Allows sharing, creating, and editing of Office documents using Office Web Apps when on the run; it does not require installation of Office suite.

Provides 7 GB storage free additional storage can be purchased.

Allows granting permission to another SkyDrive user to modify files which facilitates online collaboration, irrespective of the document type.

Various Cloud Storage Services - JustCloud

Similar to other storage services, JustCloud enables syncing and sharing files across Macs, Windows, Linux machines, iPads, iPhones, and Androids, to name a few. It creates a backup of all computer files to the cloud by using a desktop application. The key features of JustCloud are as follows:

Does not restrict the amount of files that can be stored thus, providing the freedom of unlimited online storage to users

Ensures that backups are automated to avoid losing any files or data

Enables anywhere, anytime accessibility through the online control panel, mobile apps or mobile optimized site

Facilitates syncing multiple files across computers by working in the background to sync them to the cloud

Ensures security by encrypting data transfers using 256-bit SSL encryption

Various Cloud Storage Services - SugarSync

SugarSync is a small but quick backup service that enables data syncing and sharing across any device. Apart from PC, Mac, and other Apple devices, SugarSync supports Android phones, BlackBerry phones, tablets, and so on. The features of SugarSync are as follows:

Facilitates syncing of multiple devices	Does not interfere in the other activities and works in the background	Provides accessibility to any device starting from Tablets, Smartphones, to PCs	Ensures data security by implementing industry best practices

Various Cloud Storage Services-Hightail (formerly known as YouSENDit)

YouSENDit, now known as Hightail, offers backup services, unlimited downloads and unlimited storage amount for files. It also allows tracking of downloads, return receipts, and digital signatures. The key features of Hightail are as follows:

Enables secure file sharing and control as to who can view or access the files

Facilitates sharing files such as project folders with clients and colleagues and allows to decide

who can edit and update the files

Provides unlimited file storage online, which facilitates anytime access to files using the mobile

and desktop apps

Various Cloud Storage Services-Google Drive

Google Drive allows users to create new documents, spreadsheets, and presentations. Multiple users can work on the document and the changes are reflected instantly. The features of Google Drive are as follows:

|					
Integrates Gmail and hence, sending a link from Google Drive in Gmail allows everyone to access and view the same file and same version	Enables accessing files quickly by recognizing objects in the images and text in scanned documents	Enables viewing more than 30 file types – HD video, Adobe Illustrator, and Photoshop – in the browser even when the program is not installed on the computer	Allows creating, editing and commenting on documents, slides, and so on, using Chrome even in the absence of a network connection	Enables chatting within the documents, sheets, or slides, and even leaving comments on files and images	If a '+' is added in front of the e-mail address in a comment, Drive sends an email to the person concerned, notifying that they should follow up

Open Source Tools to Build Cloud Applications 1-2

Open source software consists of mostly free or low-priced tools available in the market. These tools are not limited by software license models. A number of open source tools have made an impact in the field of cloud computing.

Few of the tools

- Kernel-based Virtual Machines (KVM)
- Deltacloud
- Eucalyptus
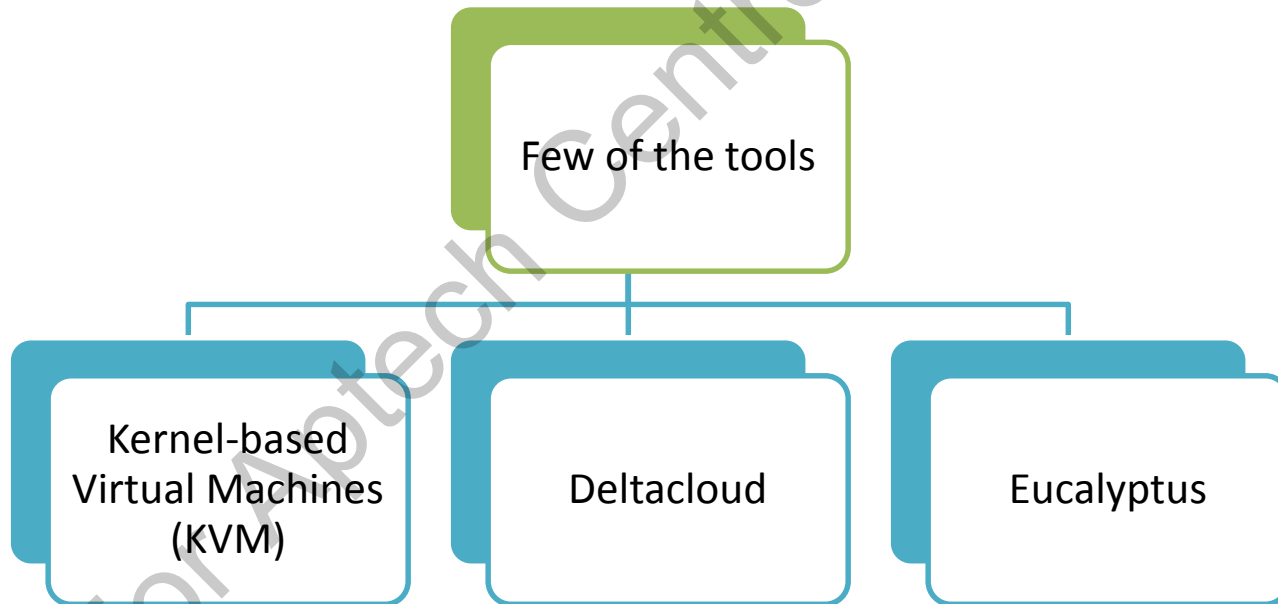
Open Source Tools to Build Cloud Applications 2-2

Kernel-based Virtual Machine(KVM)

- Kernel-based Virtual Machine is an open source hypervisor of the Linux operating system running on x86 hardware.
- A hypervisor is a virtual machine monitor and helps to create and manage virtual machines. KVM supports virtualization extensions for Intel Virtualization Technology (VT) or AMD-V.

Deltacloud

- It is an open source project offered by RedHat. Deltacloud maps a cloud client's API to the API of other popular clouds by removing the differences between clouds.
- Deltacloud facilitates management of any certified virtualized environment, from a single management interface.

Eucalyptus

- Eucalyptus is a private cloud platform that implements the Amazon specification for Elastic Compute Cloud (EC2) as Infrastructure as a Service (IaaS).
- Eucalyptus offers various administrative functionalities, such as user management, storage configuration, and network management for the management and maintenance of private clouds.

Introduction to Mobile Cloud Computing 1-2

With tremendous advances in mobile communications and networks, many applications are now available on mobile devices that offer rich user experiences.

However, mobile devices have their own limitations in terms of processing power, battery life, and storage.

Mobile Cloud Computing (MCC) is an emerging solution that attempts to extend the capabilities of mobile devices and platforms.

Mobile cloud computing is a new platform and refers to a combination of mobile devices and cloud computing to create a new infrastructure.

In the new infrastructure, data processing and data storage take place outside the mobile devices.

Introduction to Mobile Cloud Computing 2-2

The following factors are fostering the adoption of mobile cloud computing:

Changing Trends and demands

- Customers expect the convenience of accessing companies' Web sites or applications anywhere and at any time.
- Enterprise users require always-ON access to business applications and collaborative services so that they can increase their productivity from anywhere, even when they are on the commute.

Enhanced broadband coverage

- Services such as 3G and 4G along with Wi-Fi, fixed wireless, and so on are providing better connectivity for mobile devices and are making them favorable to cloud computing.

Enabling technologies

- Customization of various technologies such as HTML5, CSS3, hypervisor, and so on for mobile devices has helped the growth of mobile cloud computing.
- Emergence of new elements such as cloudlets and Web 4.0 is further boosting the growth of mobile cloud computing.

The general architecture of MCC is demonstrated in figure.
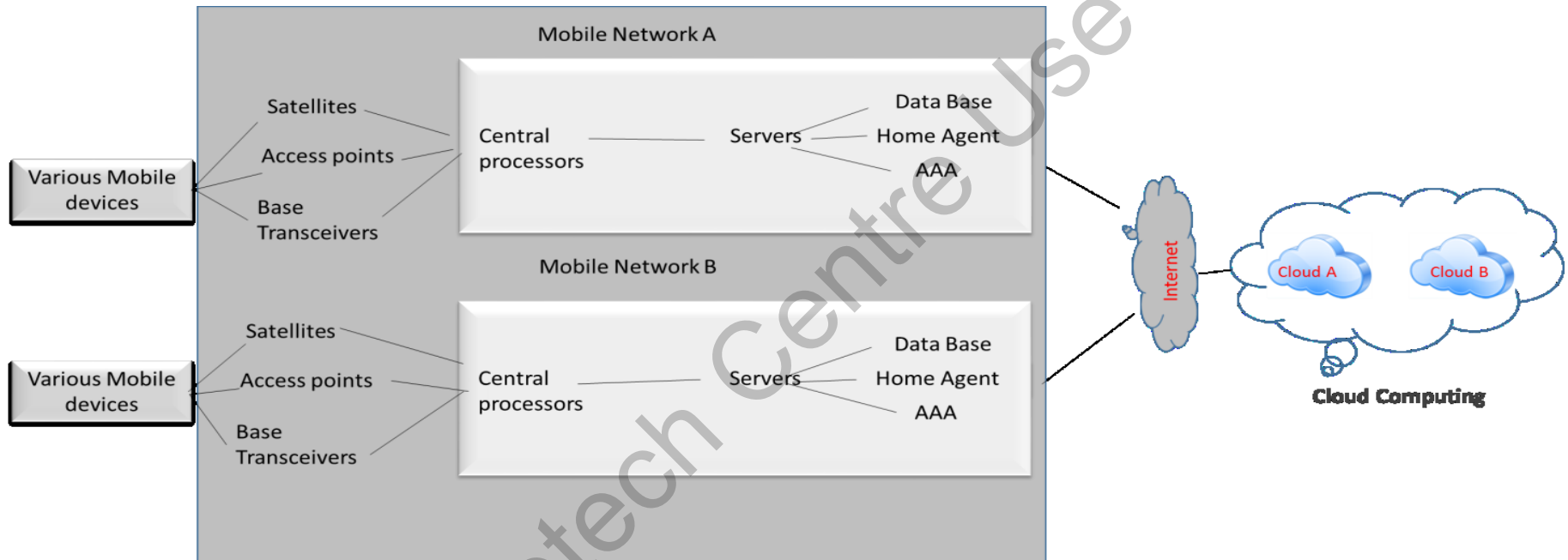
- As illustrated in figure, mobile devices are connected to the mobile networks through various base stations such as satellite, access point, or Base Transceiver Station (BTS).
- It facilitates wireless communication between user equipment and a network.

AAA stands for Authentication, Authorization, and Accounting and here, it refers to the protocol that implements these functions in mobile network setup.

Home agent is typically the router that is at the end mobile device's location that maintains the device's network details such as IP address and location.

Home agent is a router on mobiles home network that keeps on updating the information about the mobiles location.

It uses the tunneling mechanism to forward the traffic, which helps in retaining the IP address even the device connects from different locations.

Based on the Home Agent and the data of the subscribers' stored in the database, the mobile network providers extend services as AAA to the mobile users.

Further, the subscriber requests are transmitted through the Internet to a cloud wherein the cloud controllers process the requests for providing cloud services.

Introduction to Mobile Cloud Computing- Advantages of Mobile Cloud Computing 1-4

Various characteristics such as mobility, communication, and portability, make cloud computing an effective solution for mobile computing. The advantages of mobile cloud computing are as follows:

Enhanced battery lifetime	Unlimited storage and processing power	Enhanced reliability	Cost-effective

Introduction to Mobile Cloud Computing- Advantages of Mobile Cloud Computing 2-4

Enhanced Battery Lifetime

- The key element of focus in mobile devices is the battery. There have been several proposed solutions to enhance the CPU performance or reduce power consumption in the disk and screen.
- Computation offloading is a proposed technique that aims at migrating the large computations and complex processing from resource-limited mobile devices, to servers in the cloud, which are resourceful machines.

Unlimited Storage and Processing Power

- Storage capacity is also a constraint for mobile devices. As storage information in the cloud offers unlimited storage capacity, cloud computing is a preferred option for mobile devices.
- The user does not have to worry about exhausting storage space or the requirement to increase the current storage availability.
- It enables users to access or store large amounts of data on the cloud via wireless networks.

Introduction to Mobile Cloud Computing- Advantages of Mobile Cloud Computing 3-4

Enhanced Reliability

- Storing data or running applications on clouds also ensures reliability because it provides storage and backup of data on multiple computers.
- This reduces the risk of losing data and application on mobile devices. Further, MCC can also be designed as an all-inclusive data security model that could be used by service providers as well as users.
- For instance, to protect copyrighted digital contents such as videos and music from abuse and unauthorized distribution.

Cost-effective

- Cloud computing is cost-effective, easy to maintain and upgrade as compared to the traditional desktop software, which costs a lot for companies.
- Further, in case of traditional applications, licensing fee for multiple users also places a burden on the firm, which is not there on mobile platforms as cloud computing software for mobiles is available at cheaper rates and thus, can reduce the burden of the firm on its IT expenditure.

Introduction to Mobile Cloud Computing- Advantages of Mobile Cloud Computing 4-4

A few more advantages of clouds for mobile services are as follows:

Dynamic on-demand provisioning	• Enables dynamic on-demand provisioning of resources on a self-service basis. • It is a flexible way that enables service providers and mobile users to run their applications without requiring to reserve their resources in advance.
Scalability	• Mobile applications that have been deployed can be scaled to meet the unpredictable user demands resulting from flexible resource provisioning. • It allows service providers to add and expand an application and service without or with minimal constraints on the use of resources.
Multi-tenancy	• Mobile cloud computing also facilitates service providers to share resources and costs in order to support varied applications and multiple users.
Easy integration	• Facilitates easy integration of multiple services through the cloud and the Internet from various service providers in order to meet the users' demands.

Introduction to Mobile Cloud Computing- Challenges of Mobile Cloud Computing

A few challenges in mobile cloud computing are as follows:

Low Bandwidth and Variable Reliability
- Wireless network uses more bandwidth compared to the wired networks. In fixed broadband, a physical link supports consistent network bandwidth, but in a wireless connectivity, there are variable data rates and irregular connectivity due to inconsistent coverage.

Limited Energy Source
- Mobile devices run on batteries and hence, have limited capacity. Therefore, increasing the battery life with division of application functions across servers and devices is a challenge.
- As display and connectivity consume a lot of energy, application-rich devices have heavier batteries to meet the excess energy demand for larger displays and high-end applications.

Data Access Efficiency
- On the computing side, with increase in the number of cloud services, the demand for accessing data resources such as files, images, and documents on the cloud too has increased.

Mobile Support for Cloud Computing 1-3

A number of top industry giants offer mobile support for cloud computing. One among this is Apple. iCloud is Apple's popular cloud storage product.

It enables users to access music, photos, documents, and many more items, from any Apple device they use. It is not only easy to set up but also makes synchronization and sharing easier.

It is not only easy to set up but also makes synchronization and sharing easier. Essentially, on enabling wireless syncing in the Settings, iCloud takes the existing content on a device and sends it wirelessly to the iPhone, iPad, iPod touch, Mac, and PC.

The key features of Apple iCloud are as follows:

iTunes in the Cloud

- iTunes has been the most requested feature in the cloud. Presence of iCloud facilitates iTunes to instantly download all music purchases to all the devices via Wi-Fi or 3G.
- It also becomes easier to download and synchronize the earlier iTunes purchases, to all iDevices without making any extra payment.

Calendar, Mail, and Contacts

- On registering a device with iCloud, the user receives a 'me.com' account. This account is synchronized by iCloud.
- The service facilitates automatic synchronization of calendar entries, contacts, and e-mail among multiple devices.

Backup

- iCloud also provides the feature of keeping a backup of data.
- This data includes everything from purchased music, TV shows, apps, books, photos, to device settings, app data, messages (including iMessage, SMS, and MMS), and even ring tones.

Mobile Support for Cloud Computing 3-3

Documents in the Cloud

- Having the same iCloud-enabled apps on more than one device facilitates automatic updation of all documents across all iDevices.
- It further allows the users to edit something in the Keynote on the iPad and everything on the iPhone is updated when the app is opened.

Find my iPhone, iPad, iPod touch, and Mac

- This feature is very useful in the event of losing an iDevice. It enables the owners of iPhone, iPad, iPod touch, and Mac to find their lost devices with ease.
- The user can send a message using another device to let the person who has taken it or anyone else know that the device has been lost and they are on the way to retrieve it.

Find My Friends

- This new Find My Friends app allows the users to find their friends and meet them.
- It also allows tracking down family members using the iOS and follow up whether a friend has arrived in town.

iBooks

- When a new iBook is downloaded, it is automatically made available on all other devices.
- Further, things such as notes, bookmarks, and highlights are synced so that all the iBooks are consistent across the iPhone, iPad, or any other device.

Mobile Support for Cloud Computing-Functioning of Apple iCloud

Apple iCloud is an all-inclusive app. It facilitates arranging the content on multiple devices so that the user does not have to worry about data being restricted to one device.

Apple iCloud works effectively and seamlessly across all Apple devices that are connected to the Internet.

However, iCloud is not the first online storage service offered by Apple. MobileMe preceded iCloud and primarily offered synchronization services.

It was revamped and the services were merged into iCloud. iCloud has added features and provides more flexibility as compared to MobileMe. It also offers 5 GB storage free.

Most existing cloud-driven services and apps are actually add-ons. However, Apple iCloud is different in that it is integrated into Apple's operating systems.

iCloud ensures continuous synchronization of data among the Apple devices provided Internet connection is available. It also provides password-protected access to online storage space.

Summary

❑ Availability of a persistent Internet connection, security and privacy, are some of the challenges and risks associated with cloud computing.

❑ Cloud storage is a model of networked enterprise storage that enables data storage in virtualized pools of storage.

❑ A cloud drive is a channel to access cloud storage. It is supported by various cloud data storage providers.

❑ Dropbox, SkyDrive, JustCloud.com, SugarSync, Hightail (youSENDit), and Google Drive are a few popular cloud storage services.

❑ All the cloud storage services essentially enable data storage and file synchronization facilities though with a few differences.

❑ KVM, Deltacloud, and Eucalyptus are a few open source tools used in cloud computing.

❑ Mobile Cloud Computing (MCC) is a combination of the mobile devices and cloud computing to create a new infrastructure that facilitates a cloud to carry out computing-intensive tasks and store huge amounts of data.

❑ iCloud is Apple's cloud storage product and enables users to access music, photos, documents, and many more from any device they use.