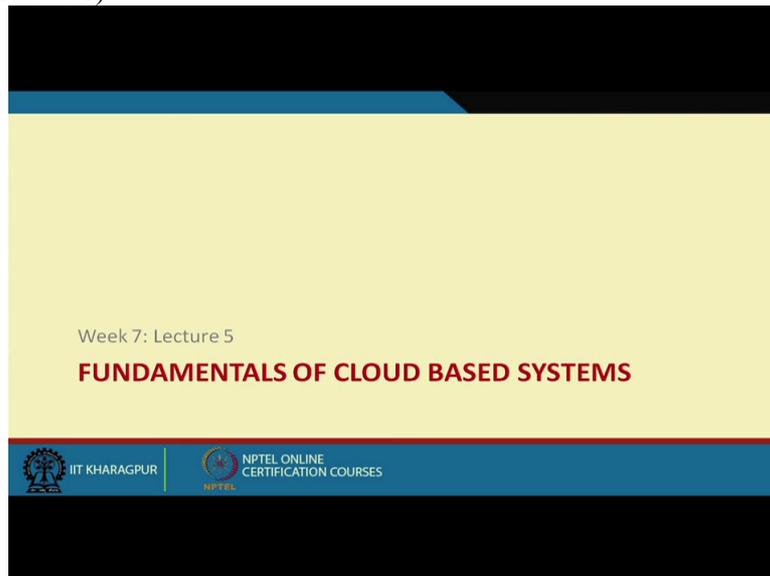


Course on E-Business
By Prof. Mamata Jenamani
Department of Industrial and Systems Engineering
Indian Institute of Technology Kharagpur
Lecture 37 Fundamentals Of Cloud Based Systems

Welcome back so far we have been talking about how two heterogeneous information systems can communicate and what are various ways to make them interoperable.

(Refer Slide Time: 0:31)



This we are talking this we were talking in the context of integrating the supply chain a new way of integrating the supply chain is through cloud infrastructure where many companies can be communicating with each other or taking advantage it is not that always there will be using it for communicating but they can actually decrease their own infrastructure cost and will be able to use mini advanced system by using this cloud based models.

(Refer Slide Time: 1:17)

We are going to learn

- What is cloud computing
- Characteristics of Cloud Computing
- Cloud Service Models
- Cloud Deployment Models
- Advantages and disadvantages

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

So in this lecture we are going to learn what is cloud computing what are the basic characteristics of it various service models deployment models and advantages and disadvantages of using cloud.

(Refer Slide Time: 1:39)

What is cloud computing

- **Cloud computing** is the delivery of computing as a service rather than a product, whereby shared computing resources, software, and information are provided to computers and other devices over a network.
 - Shared pool of configurable computing resources
 - On-demand network access
 - Provisioned by the Service Provider

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

Now this cloud computing is the delivery of computing as is a service rather than a product whereby shared computing resources, software, information are provided to computers and other devices over the network so if she's basically shared pool of configurable computing resources and you can access those resources over the network on demand and they are provided by certain service provider.

(Refer Slide Time: 2:18)

Characteristics of Cloud Computing

- **Remotely hosted:** Services or data are hosted on remote infrastructure.
- **Ubiquitous:** Services or data are available from anywhere.
- **Commodified:** The result is a utility computing model similar to traditional that of traditional utilities, like gas and electricity - you pay for what you would want!

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

These are basic characteristics of a cloud based system it is remotely hosted both the service and data are in remote location its a an remote infrastructure it is ubiquitous even if it is kept in a remote place which you possibly do not know in some data centre it is lying it is available to you from anywhere if you are connected to the Internet then the next thing is your the fact that you will be using it on a paper use mode if you use it pay it if you don't use it don't pay for it so it is now co modified this is based on the resource pooling by resource pooling we mean.

(Refer Slide Time: 3:32)

Characteristics of Cloud Computing

- **Resource pooling**
 - Location independence
 - Provider resources pooled to server multiple clients
- **Rapid elasticity**
 - Ability to quickly scale in/out service
- **Measured service**
 - control, optimize services based on metering

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

We have multiple number of resources handle together so that handle together and used by several entities so that the resource is not lost computing resources is very precious and many times we do not utilise full potential of the research resource so whenever somebody is not

utilising the resource and if somebody else is allowed to use that resource then the resource might not be fully utilised.

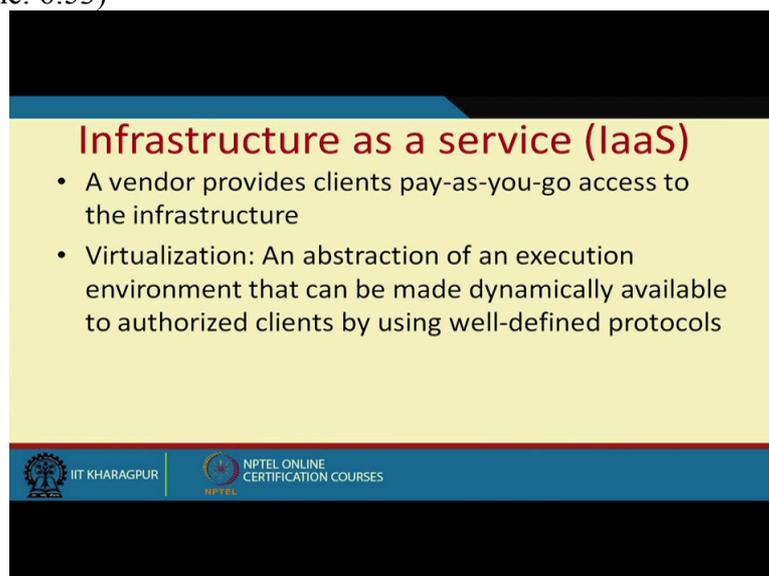
So it is based on the concept of resource pooling then it is rapid it has rapid elasticity which means today suppose you require some 1 GB of storage over the cloud next moment you your 1 GB is over and next one you want another GB unlike your physical world when you have to buy maybe possibly another GB memory here it will be given to you immediately because it is available in the pool.

Then it is because it is you have it is co modified it has been used as a commodity it can be measured and It can be monitored it can be metered and it may be up to some extent can be controlled and optimised so that many people are able to use it and pay for it so that the person who is maintaining that infrastructure can charge small amounts amount from individual yet we'll be able to make the profit there are many cloud services model.

These are three basic models infrastructure as a service, platform as a service and software as a service when it comes to infrastructure as a service it is a cloud offering in which a vendor provides users access to the computing resources how much memory how much storage how many server you have a large computing system lets say there are 100 process are available to one person you give let's say 5 GB memory some 12 processors.

And so on out of your whole available resources so this model is called infrastructure as a service now the vendor provides and the amount of resource you consume depends on the kind of application right now you are running.

(Refer Slide Time: 6:53)



Infrastructure as a service (IaaS)

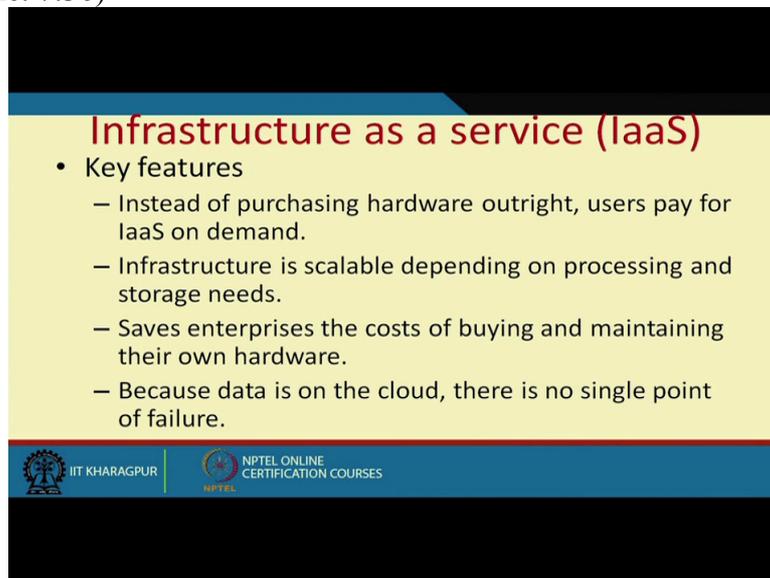
- A vendor provides clients pay-as-you-go access to the infrastructure
- Virtualization: An abstraction of an execution environment that can be made dynamically available to authorized clients by using well-defined protocols

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

And as you add more resources and as you keep using this is resources depending on your usage you pay. To do so a layer of virtualization is created which not physically but virtually

divides the entire resource among in number of requester's number of clients who request to consume the service.

(Refer Slide Time: 7:36)



Infrastructure as a service (IaaS)

- Key features
 - Instead of purchasing hardware outright, users pay for IaaS on demand.
 - Infrastructure is scalable depending on processing and storage needs.
 - Saves enterprises the costs of buying and maintaining their own hardware.
 - Because data is on the cloud, there is no single point of failure.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

So these are the key features so instead of purchasing the hardware outright the user pay for infrastructure as a service and depend infrastructure is scalable depending on the processing and storage need its saves enterprises cost of buying and maintaining their own hardware now because the data is on the cloud there is no single point failure so the bottleneck analysis of the individual companies E business infrastructure.

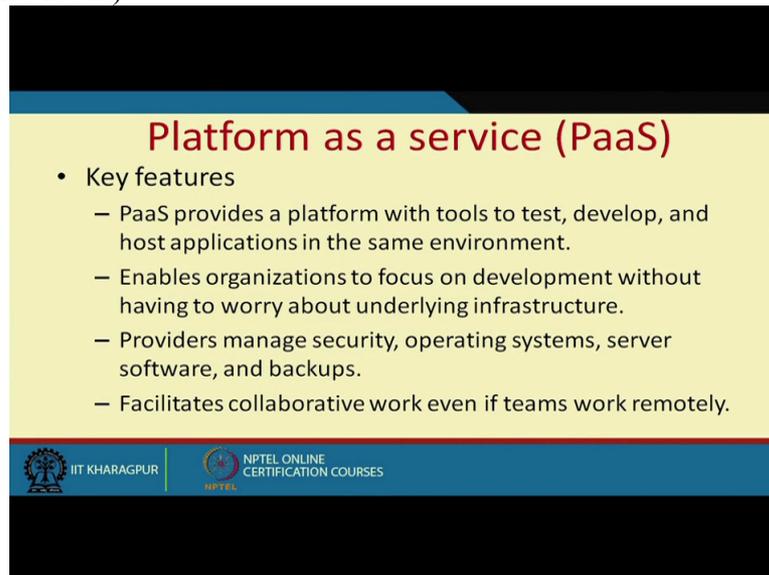
Which of course will be talking at after a after sometime is not required here so next model is platform as a service when you use your system hardware is 1 part but you above the hardware you use some kind of operating system or some system level software which helps you to used the computing hardware there are certain cloud services which provide not only the infrastructure but the platform above the infrastructure to be used by the client.

So the platform as a service is a cloud computing is a cloud computing offering that provides the user a cloud as a environment in which they can develop manage and deliver applications so in order to in order to storage and computing devices the user is able to use a suit of pre build tools to develop their own application so which means you will have one operating system.

Above that operating system maybe some compiler is loaded using that compiler you develop your own code now service provider offers access to the cloud west environment in which the user can build and deliver applications here unlike the other case where only the bear hardware is provided to you then depending on your requirement you load your own operating system and allied system level software.

So here the provider supplies the underlying infrastructure the key features it provides a platform with tools to test develop and host applications in the same environment it enables organisations to focus on development without having to worry about the underline infrastructure again it provides the it the person the organisation who is providing this platform is responsible for its security for its updated software, etc and they also take the response to backup your data.

(Refer Slide Time: 10:48)



Platform as a service (PaaS)

- Key features
 - PaaS provides a platform with tools to test, develop, and host applications in the same environment.
 - Enables organizations to focus on development without having to worry about underlying infrastructure.
 - Providers manage security, operating systems, server software, and backups.
 - Facilitates collaborative work even if teams work remotely.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

Say they such infrastructure fascinated collaborative work even if the teams work remotely may there will be sharing some documents where which all of us are acquainted with google doc can be they can share and individually they can write. Then software as a service here the software as the service is a cloud computing offering that provides users with the access to user to access to vendors cloud base software by software.

Here we mean then application level software lets say you are using certain data mining software which runs over the operating system so in this model you will have the hardware you will have the operating system above that hardware additionally you will have a application levels software to run over it.

In fact while discussing about enterprise resource planning TRP we I told you that there are cloud best versions an available here the provider provider delivers the software and application through the internet.

(Refer Slide Time: 12:07)

Software as a service (SaaS)

- Software as a service (SaaS) is a cloud computing offering that provides users with access to a vendor's cloud-based software. Users do not install applications on their local devices. Instead, the applications reside on a remote cloud network accessed through the web or an API. Through the application, users can store and analyze data and collaborate on projects.
- A service provider delivers software and applications through the Internet. Users subscribe to the software and access it via the web or vendor APIs.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

The user subscribe to the software and access it via its the web or vendors API these are the key features.

(Refer Slide Time: 12:20)

Software as a service (SaaS)

- Key features
 - SaaS vendors provide users with software and applications on a subscription model.
 - Users do not have to manage, install, or upgrade software; SaaS providers manage this.
 - Data is secure in the cloud; equipment failure does not result in loss of data.
 - Use of resources can be scaled depending on service needs.
 - Applications are accessible from almost any Internet-connected device, from virtually anywhere in the world.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

SaaS vendors provide users with software and applications on subscription model user do not have to manage install upgrade software as this as model provide her manages this data is secured in the cloud equipment failures does not result the loss of fata now use a pre sources can be killed depending on the service need the application are accessible from almost any internet connect device from virtually anywhere in the world.

(Refer Slide Time: 12:58)

Infrastructure as a Service (IaaS)

amazon web services | rackspace HOSTING

Cloud Infrastructure IaaS

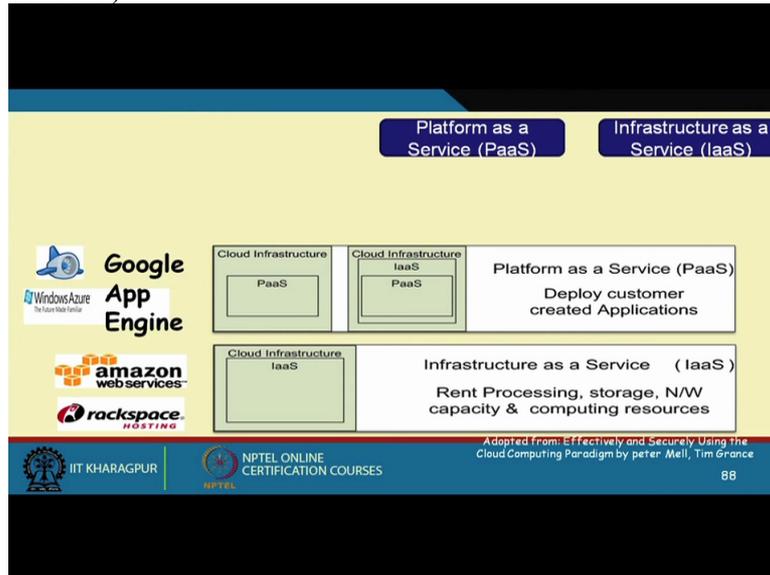
Infrastructure as a Service (IaaS)
Rent Processing, storage, N/W capacity & computing resources

Adopted from: Effectively and Securely Cloud Computing Paradigm by peter W.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

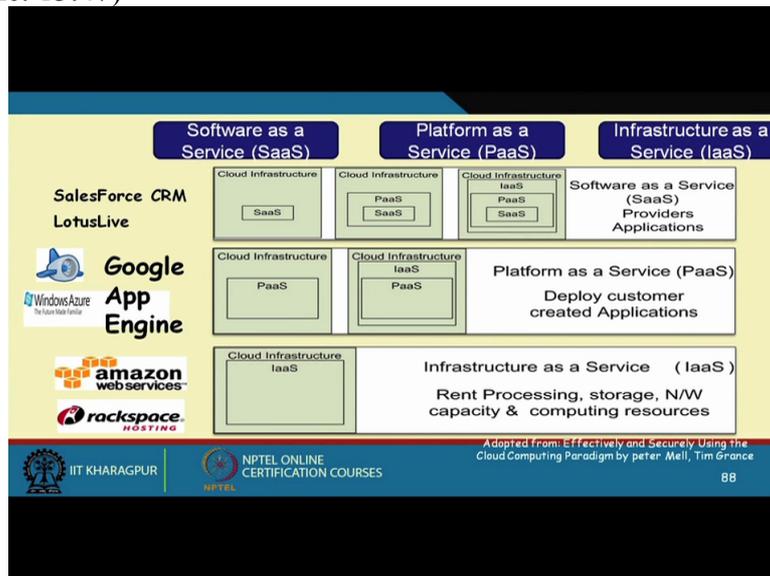
So if we look at this at the lowest level is your infrastructure as a service where you get the storage computing resource it's a trap with certain rent your Amazon web services is one example of this.

(Refer Slide Time: 13:23)



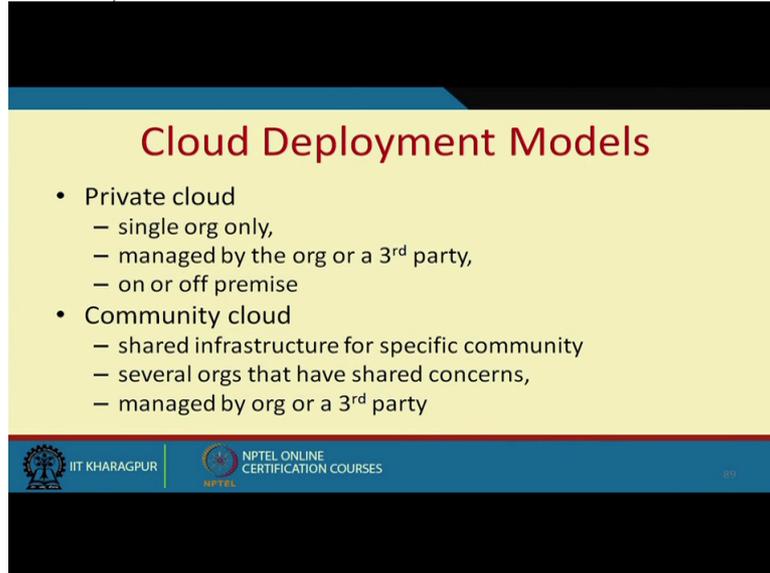
Next layer you have your infrastructure shared infrastructure as well as some cloud platform hosted on this you are example of your windows as you or your app Google App Engine are run at using this particular mode.

(Refer Slide Time: 13:47)



Next level is your software as a service where you have the underline hardware above which some operating system like stuff run then you have the software running over it so many shared software are of this type with examples include your sales force CRM lotuslive etc.

(Refer Slide Time: 14:19)



Cloud Deployment Models

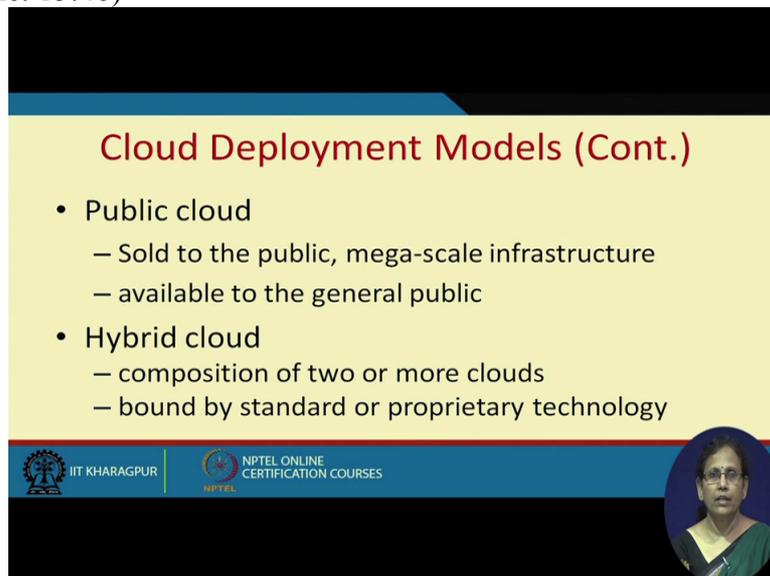
- Private cloud
 - single org only,
 - managed by the org or a 3rd party,
 - on or off premise
- Community cloud
 - shared infrastructure for specific community
 - several orgs that have shared concerns,
 - managed by org or a 3rd party

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

Then how this clouds are deployed and who is responsible for providing the cloud infrastructure this cloud infrastructure can be private which means only one organisation uses it and it may be managed by that Organisation or it can be managed by third party it may be within the premises of the organisation it may be outside that premises of the organisation but it is the organisation which who uses this cloud.

Then it can be community cloud its a shared infrastructure for a specific community all of them have invested in this infrastructure together and they use it so this community can be a Industry kansotiya it is a it is the company and its surprising partners and so on again this can be managed by one of the organisation who is taking initiative it about this or it can be a provided by the third party.

(Refer Slide Time: 15:46)



Cloud Deployment Models (Cont.)

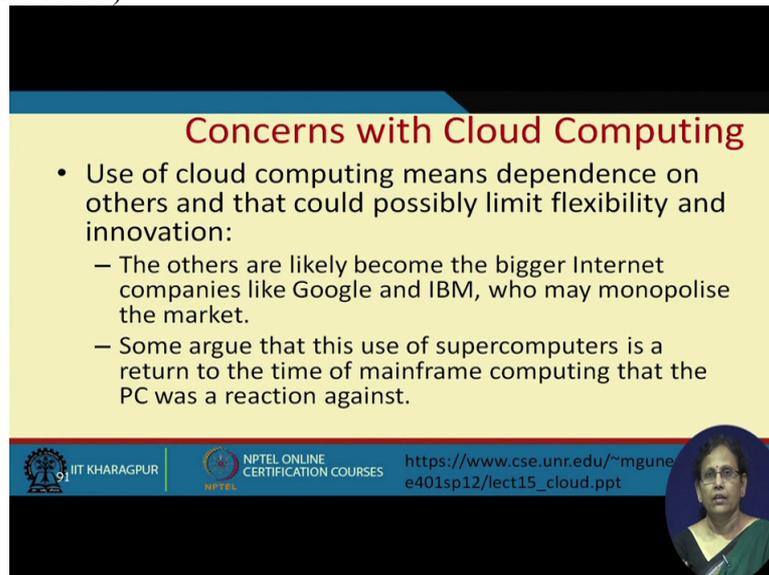
- Public cloud
 - Sold to the public, mega-scale infrastructure
 - available to the general public
- Hybrid cloud
 - composition of two or more clouds
 - bound by standard or proprietary technology

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES



Then you have something called a public cloud like your it is hosted by some by some company where anybody can use it in the first case only one company has his own cloud in the second case a group of companies have their own cloud in case of a public cloud it is provided by some company and anybody can use it then you can also have hybrid cloud where it composes of two or more clouds and they are bound by some standard or proprietary technology.

(Refer Slide Time: 16:35)



Concerns with Cloud Computing

- Use of cloud computing means dependence on others and that could possibly limit flexibility and innovation:
 - The others are likely become the bigger Internet companies like Google and IBM, who may monopolise the market.
 - Some argue that this use of supercomputers is a return to the time of mainframe computing that the PC was a reaction against.

Logos: IIT KHARAGPUR, NPTEL ONLINE CERTIFICATION COURSES, https://www.cse.unr.edu/~mgune401sp12/lect15_cloud.ppt



Now there are many concerns with this cloud computing what are this concerns now use of cloud computing means dependence on others and this could possibly limit the flexibility and innovation in a company this is a concern so what people perceive is that someday the companies like Google, IBM who are maybe your Amazon who are trying to Pioneer themselves in this cloud technology.

They will monopolise the market they will be the single leader now some other argue that use of supercomputer is a return to the time of mainframe computing which means at some point of time people will start using PC just like you know like in against the mainframe computing people started using small small unit called PCs so against this supercomputer people something else is going to happen it has many security concerns as well.

(Refer Slide Time: 18:14)

Concerns with Cloud Computing

- Security
 - It is still unclear how safe out-sourced data is and when using these services ownership of data is not always clear.
- There are also issues relating to policy and access:
 - If your data is stored abroad whose policy do you adhere to?
 - What happens if the remote server goes down?
 - How will you then access files?
 - There have been cases of users being locked out of accounts and losing access to data.

Logo of IIT Kharagpur | NPTEL ONLINE CERTIFICATION COURSES | https://www.cse.unr.edu/~mgunes/cpe401/cpe401sp12/lect15_cloud.ppt

So it is still it is not clear how safe is this the process of outsourcing the data is and why and where that this ownership of data goes I find my data is safe it is hosted in but somebody else might be seeing my data how I should be very sure about it now there are also issues related to policy and access like.

(Refer Slide Time: 18:51)

Concerns with Cloud Computing

- Security
 - It is still unclear how safe out-sourced data is and when using these services ownership of data is not always clear.
- There are also issues relating to policy and access:
 - If your data is stored abroad whose policy do you adhere to?
 - What happens if the remote server goes down?
 - How will you then access files?
 - There have been cases of users being locked out of accounts and losing access to data.

Logo of IIT Kharagpur | NPTEL ONLINE CERTIFICATION COURSES | https://www.cse.unr.edu/~mgunes/cpe401/cpe401sp12/lect15_cloud.ppt

If your data is stored abroad whose policy do you adhere to? The country where the data is there or the country where you are there now what happens if suppose you move over to the cloud now what happens that company is under attack and all your data etc are gone because you rely on only one company and he may be target targeted by lets say somebody may be a terrorist.

(Refer Slide Time: 19:31)

Concerns with Cloud Computing

- Security
 - It is still unclear how safe out-sourced data is and when using these services ownership of data is not always clear.
- There are also issues relating to policy and access:
 - If your data is stored abroad whose policy do you adhere to?
 - What happens if the remote server goes down?
 - How will you then access files?
 - There have been cases of users being locked out of accounts and losing access to data.

 IIT KHARAGPUR  NPTEL ONLINE CERTIFICATION COURSES https://www.cse.unr.edu/~mgunes/cpe401/cpe401sp12/lect15_cloud.ppt

All the data centre the company maintains is destroyed can destroyed at one go where where do you stand then.

(Refer Slide Time: 19:39)

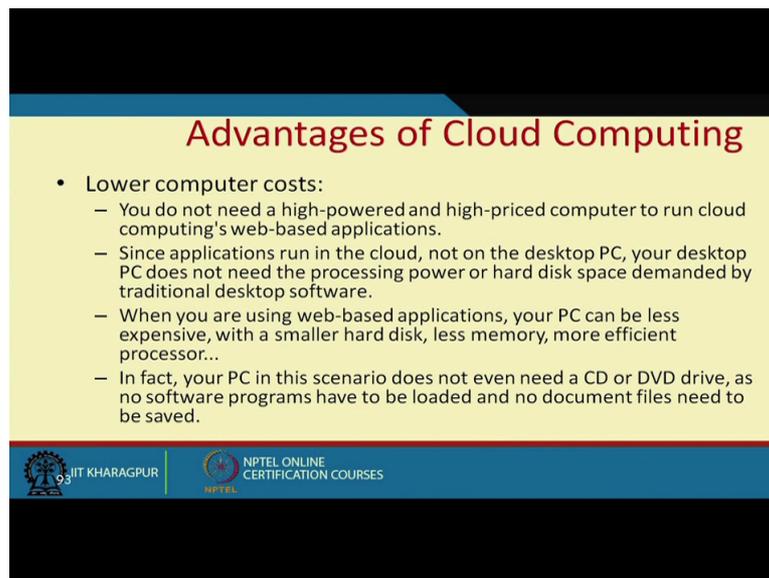
Concerns with Cloud Computing

- Security
 - It is still unclear how safe out-sourced data is and when using these services ownership of data is not always clear.
- There are also issues relating to policy and access:
 - If your data is stored abroad whose policy do you adhere to?
 - What happens if the remote server goes down?
 - How will you then access files?
 - There have been cases of users being locked out of accounts and losing access to data.

 IIT KHARAGPUR  NPTEL ONLINE CERTIFICATION COURSES https://www.cse.unr.edu/~mgunes/cpe401/cpe401sp12/lect15_cloud.ppt

Then there have been cases of users been locked out of the accounts and losing access to the data because Internet probably has not become mature enough to handle cloud.

(Refer Slide Time: 19:58)



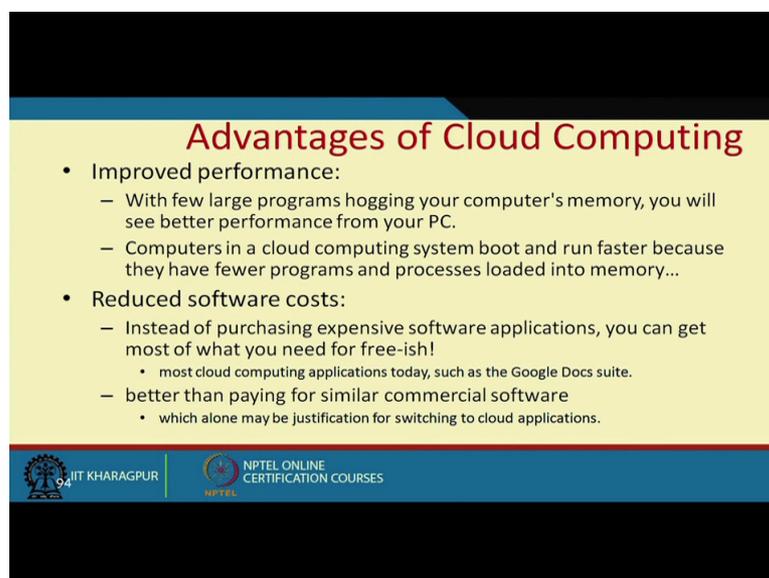
Advantages of Cloud Computing

- Lower computer costs:
 - You do not need a high-powered and high-priced computer to run cloud computing's web-based applications.
 - Since applications run in the cloud, not on the desktop PC, your desktop PC does not need the processing power or hard disk space demanded by traditional desktop software.
 - When you are using web-based applications, your PC can be less expensive, with a smaller hard disk, less memory, more efficient processor...
 - In fact, your PC in this scenario does not even need a CD or DVD drive, as no software programs have to be loaded and no document files need to be saved.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

Now there are advantages of course that is why people are adopting it lowers the computational cost which is quite obvious because you do not need some kind of high priced high performance mission to carry out a job by simply using your own PC which may not be powerful enough you access some powerful infrastructure and carry out your work your own computing power power that you have right now become irrelevant then.

(Refer Slide Time: 20:40)



Advantages of Cloud Computing

- Improved performance:
 - With few large programs hogging your computer's memory, you will see better performance from your PC.
 - Computers in a cloud computing system boot and run faster because they have fewer programs and processes loaded into memory...
- Reduced software costs:
 - Instead of purchasing expensive software applications, you can get most of what you need for free-ish!
 - most cloud computing applications today, such as the Google Docs suite.
 - better than paying for similar commercial software
 - which alone may be justification for switching to cloud applications.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES

Then because some specialists are maintaining this hardware software etc the infrastructure that is given to you they provide very high level performance because you can not afford that kind of infrastructure but on a shared basis you can definitely afford. You don't have to buy very expensive software you can be using in a free manner almost it is as it is free.

(Refer Slide Time: 21:16)

Advantages of Cloud Computing

- Instant software updates:
 - Another advantage to cloud computing is that you are no longer faced with choosing between obsolete software and high upgrade costs.
 - When the application is web-based, updates happen automatically
 - available the next time you log into the cloud.
 - When you access a web-based application, you get the latest version
 - without needing to pay for or download an upgrade.
- Improved document format compatibility.
 - You do not have to worry about the documents you create on your machine being compatible with other users' applications or OSes
 - There are potentially no format incompatibilities when everyone is sharing documents and applications in the cloud.

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES



Then you can have instant software updates as new patches or new versions come up that's because it is maintained in one place and one person is specifically responsible for this then it can also improve the document format compatibility you don't have to really worry about which format do you use the format will be provided by the service provider.

(Refer Slide Time: 21:54)

Advantages of Cloud Computing

- Unlimited storage capacity:
 - Cloud computing offers virtually limitless storage.
 - Your computer's current 1 Tbyte hard drive is small compared to the hundreds of Pbytes available in the cloud.
- Increased data reliability:
 - Unlike desktop computing, in which if a hard disk crashes and destroy all your valuable data, a computer crashing in the cloud should not affect the storage of your data.
 - if your personal computer crashes, all your data is still out there in the cloud, still accessible
 - In a world where few individual desktop PC users back up their data on a regular basis, cloud computing is a data-safe computing platform!

IIT KHARAGPUR | NPTEL ONLINE CERTIFICATION COURSES



You have unlimited virtually unlimited storage capacity and increased data reliability you do not you no longer worry that you are there will be a virus attack etc and your data will be lost with us somebody else is responsible for that.

(Refer Slide Time: 22:11)

Advantages of Cloud Computing

- Universal document access:
 - That is not a problem with cloud computing, because you do not take your documents with you.
 - Instead, they stay in the cloud, and you can access them whenever you have a computer and an Internet connection
 - Documents are instantly available from wherever you are
- Latest version availability:
 - When you edit a document at home, that edited version is what you see when you access the document at work.
 - The cloud always hosts the latest version of your documents
 - as long as you are connected, you are not in danger of having an outdated version

99 JIIT KHARAGPUR NPTEL ONLINE CERTIFICATION COURSES

Then documents can be accessed from anywhere then latest version of the document will be available to everybody group collaboration are easier because you can share documents and you can carry out the project easily where multiple sites are involved and multiple users are involved because all of you are using only one platform the question of device dependence does not arise all of you are accessing only one cloud base system through one web interface so that problem does not arise.

(Refer Slide Time: 23:06)

Disadvantages of Cloud Computing

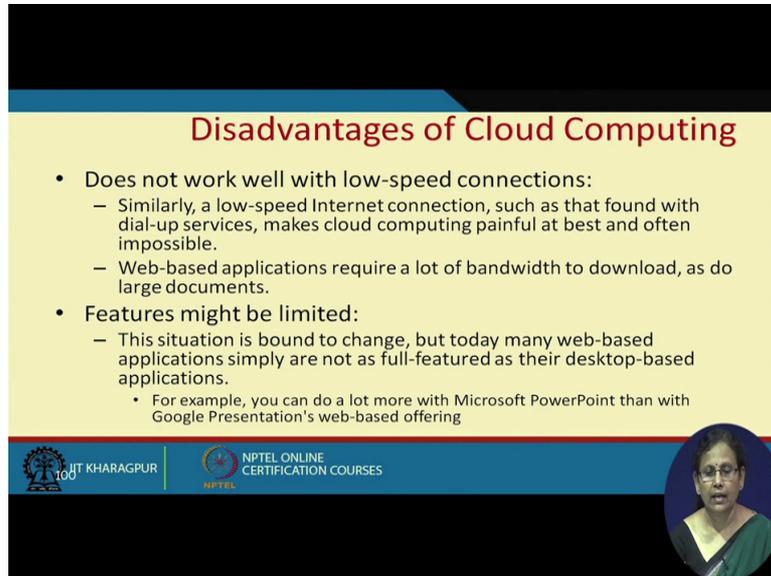
- Requires a constant Internet connection:
 - Cloud computing is impossible if you cannot connect to the Internet.
 - Since you use the Internet to connect to both your applications and documents, if you do not have an Internet connection you cannot access anything, even your own documents.
 - A dead Internet connection means no work and in areas where Internet connections are few or inherently unreliable, this could be a deal-breaker.

99 JIIT KHARAGPUR NPTEL ONLINE CERTIFICATION COURSES

Disadvantages are actually troubling users the fast and foremost is the availability of the Internet connection suppose you keep your everything in a remote server and you go to a place where you do not have Internet access such number of such places where Internet

access is not there is slowly decreasing but there are places where Internet access will not be there so the cloud computing is virtually impossible if you do not have.

(Refer Slide Time: 23:46)



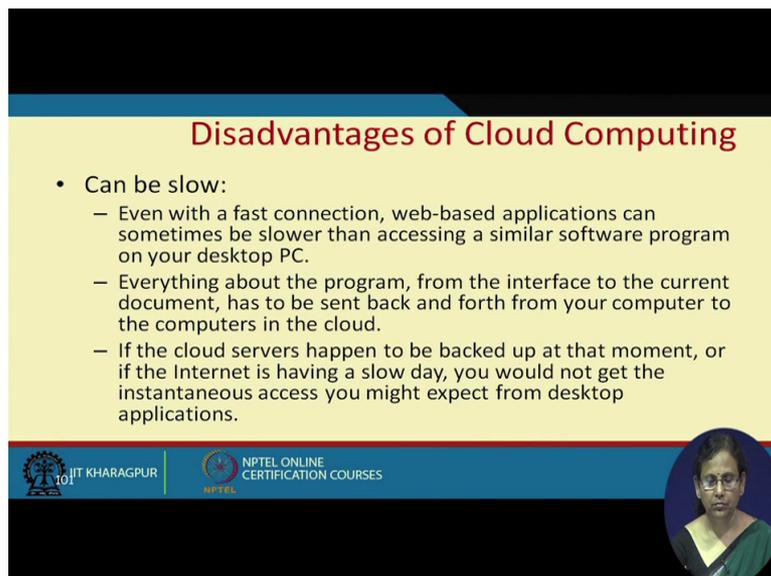
Disadvantages of Cloud Computing

- Does not work well with low-speed connections:
 - Similarly, a low-speed Internet connection, such as that found with dial-up services, makes cloud computing painful at best and often impossible.
 - Web-based applications require a lot of bandwidth to download, as do large documents.
- Features might be limited:
 - This situation is bound to change, but today many web-based applications simply are not as full-featured as their desktop-based applications.
 - For example, you can do a lot more with Microsoft PowerPoint than with Google Presentation's web-based offering

Logos for IIT KHARAGPUR and NPTEL ONLINE CERTIFICATION COURSES are visible at the bottom of the slide.

And more of speed also matters it does not work well with low speed connection and sometimes the features you have to pay if you are using a cloud base software you have to you can only have the features they are offering if you want to have more features of your own you cannot because you are limited by what they are offering.

(Refer Slide Time: 24:19)



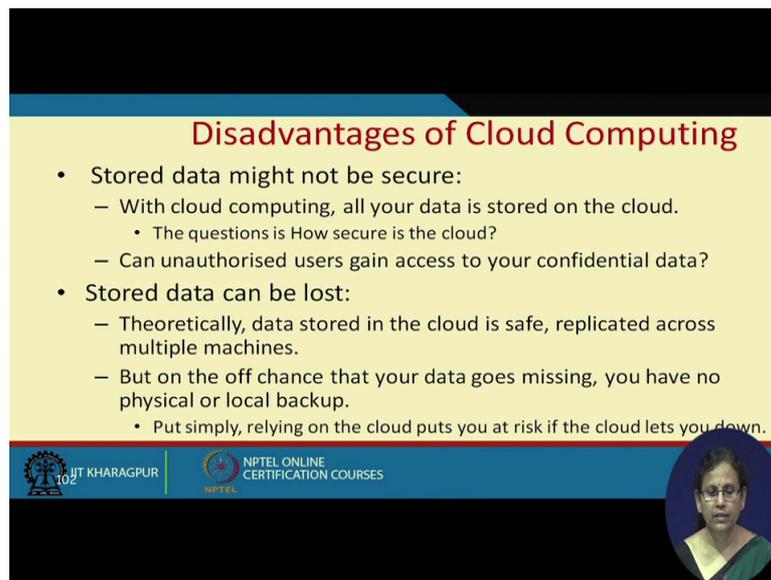
Disadvantages of Cloud Computing

- Can be slow:
 - Even with a fast connection, web-based applications can sometimes be slower than accessing a similar software program on your desktop PC.
 - Everything about the program, from the interface to the current document, has to be sent back and forth from your computer to the computers in the cloud.
 - If the cloud servers happen to be backed up at that moment, or if the Internet is having a slow day, you would not get the instantaneous access you might expect from desktop applications.

Logos for IIT KHARAGPUR and NPTEL ONLINE CERTIFICATION COURSES are visible at the bottom of the slide.

And if your network and computing devices etc are slow then the whole process can become very very slow.

(Refer Slide Time: 24:35)



Disadvantages of Cloud Computing

- Stored data might not be secure:
 - With cloud computing, all your data is stored on the cloud.
 - The questions is How secure is the cloud?
 - Can unauthorised users gain access to your confidential data?
- Stored data can be lost:
 - Theoretically, data stored in the cloud is safe, replicated across multiple machines.
 - But on the off chance that your data goes missing, you have no physical or local backup.
 - Put simply, relying on the cloud puts you at risk if the cloud lets you down.

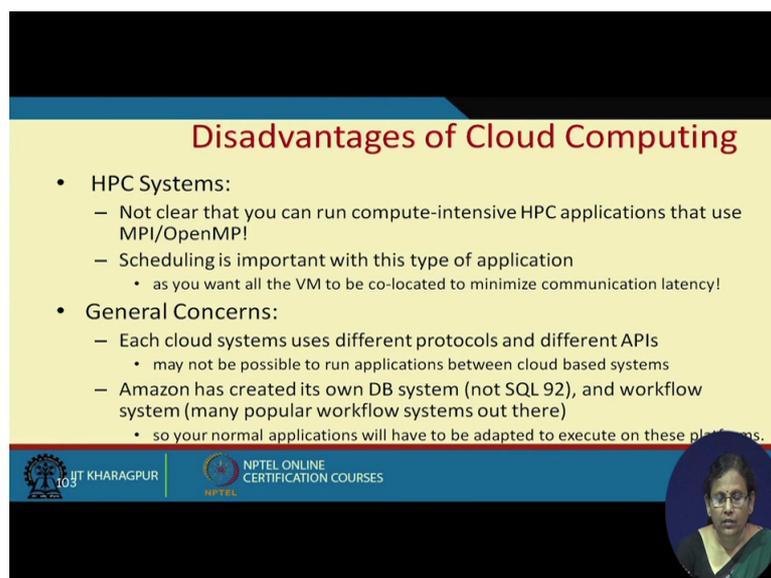
102 JIIT KHARAGPUR NPTEL ONLINE CERTIFICATION COURSES



The security council we have already discussed the store data might not be secure unauthorised access you never know about the what happens to your data and how the confidential confidentiality of the data is maintained you simply believe the stored data can be lost though the system is very reliable but I was as I was telling there is always a limit to everything.

So it means to happened that there is some damage done to the cloud infrastructure in that case everybody who is using that cloud may not may not be are likely to lost there data.

(Refer Slide Time: 25:19)



Disadvantages of Cloud Computing

- HPC Systems:
 - Not clear that you can run compute-intensive HPC applications that use MPI/OpenMPI!
 - Scheduling is important with this type of application
 - as you want all the VM to be co-located to minimize communication latency!
- General Concerns:
 - Each cloud systems uses different protocols and different APIs
 - may not be possible to run applications between cloud based systems
 - Amazon has created its own DB system (not SQL 92), and workflow system (many popular workflow systems out there)
 - so your normal applications will have to be adapted to execute on these platforms.

103 JIIT KHARAGPUR NPTEL ONLINE CERTIFICATION COURSES



Then it is also not understood that how this computing intensive disk high performance computing applications run over cloud it is not a sure because HPC is coming in a big way where you can use parallel computing to carry out very computational intensive jobs how to emulate it over the cloud is still not clear.

Then general concerns like use of different protocols etc using a specific database system following forced to follow certain standard which you are provider is providing are some of the other concerns so with this we finish this lecture and see you in the next lecture thank you very much!