Cloud Computing
Prof. Soumya Kanti Ghosh
Department of Computer Science and Engineering
Indian Institute of Technology, Kharagpur

Lecture – 02
Cloud Computing – Overview (Conld.)

Hi. So, we will continue our discussion on overview of computing and evolution of cloud computing. So, where we end in the last talk is where we are talking about the distributed systems, right.

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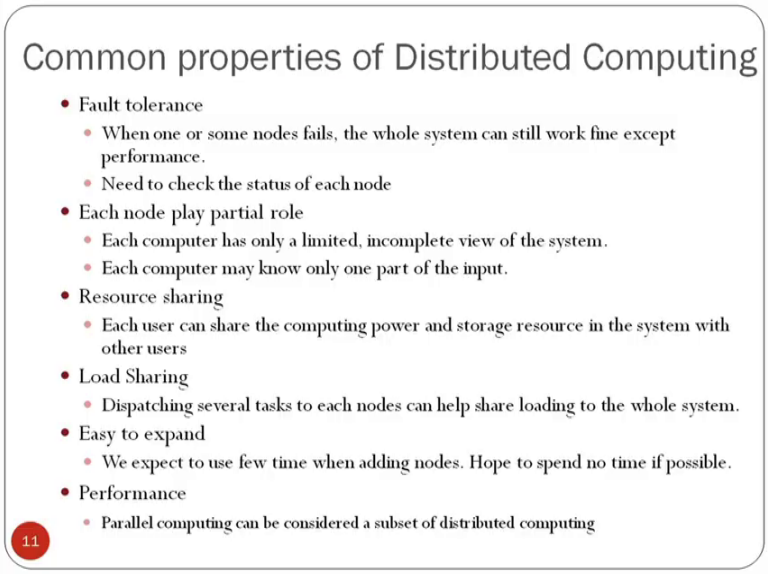

So, I believe that we are in this particular site or in this slide, why we require these distributed system. So, as we were discussing; so, the nature of the application is one of the driving force, performance is another major driving force like why if the some of the applications, some of the requirements are computing intensive or some of the things can be data intensive.

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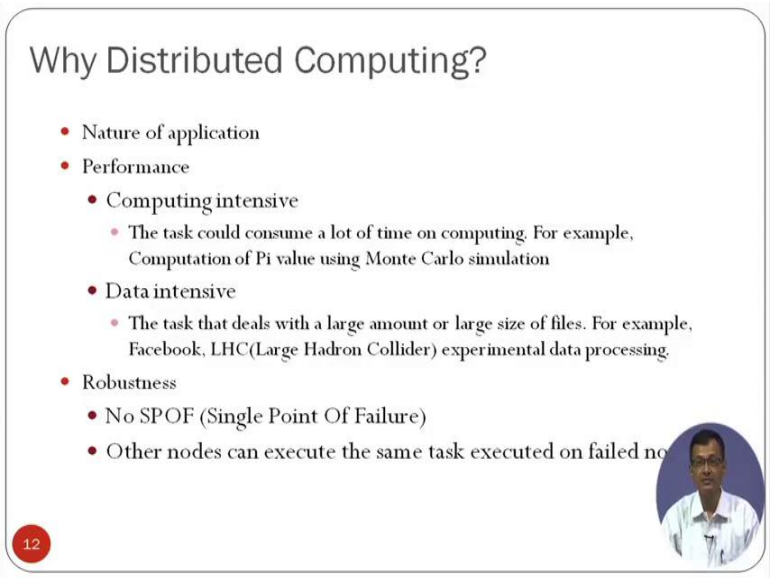

So, this requires distributed computing. So, another aspect is the robustness, right like as we were discussing that there should not be any single point of failure, my application does not want any single point of failure; that means, always it should be on. Even at a low performance level, I cannot say it should be a failure. In case of a centralized systems if the system fails, everything drops down, but in this case, we still work on a on the things.

Another other nodes can execute the same does executed on the failed nodes. So that means, I evolve as a system that if it is a failed, then the task which is working on the failed node can be executed or shared the load by the other node. So, this type of technology, algorithms are possible to develop or are being used in case of a distributed system.

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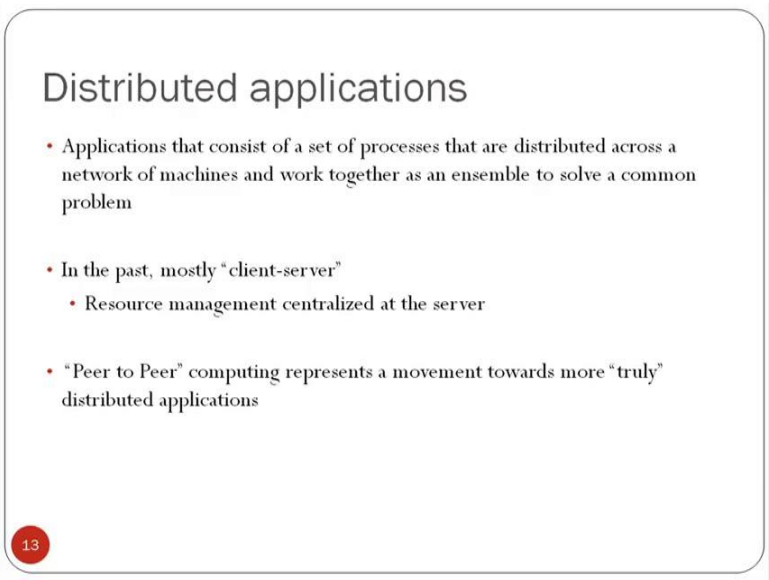

So, there are several another several distributed applications. So, application that consist of set of processes that are distributed across network of machines and work together as an ensemble to solve a common problem; In other sense, I have a several applications which coordinate among themselves to address a particular problem. So, this is; as if is a group of people working to address a particular problem. This is primarily useful for a large scale application development or large scale operational need, right where you have different operation being serve as different, and we have we realize a particular overall job at the end, right. So, there are not only computing aspect, there are several other aspects into the things as those who have worked or those who are read other things, there is a need of or orchestration of this processes, or orchestration of the services like who will do, etcetera. So, we have to form there. So, there are different aspects, but there is one of the major applications of this type of distributed computing.

And not only in the past; now also, it is mostly, several application are client server type of things, resource management centralized at the server. So, we want to make it an a distributed fashion. There are peer to peer computing which represents a movement towards truly distributed applications, right. So, there are other types of motivating forces or motivations towards the distributed system.

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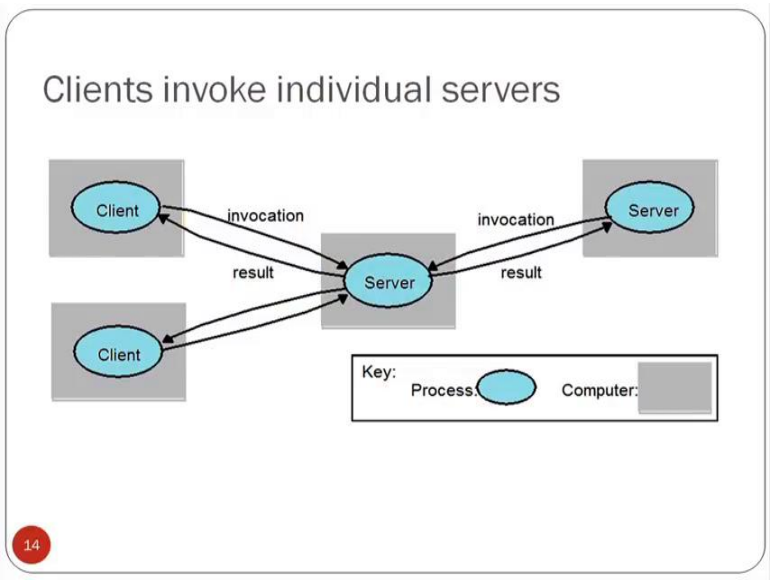

So, this is typically clients invoke individual servers we are used to that; like client invoke a particular server. So, invocation and results, the sever can as a client for another server, right and there are there be can be there. So, I can say that all those things works in a individually may be clients sever mode, but they are basically trying to realize a overall particular job.

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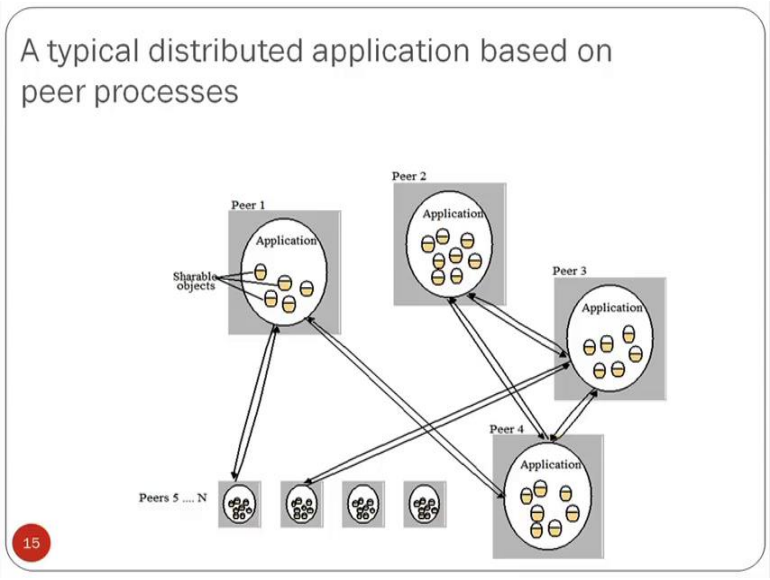

So, I can have a typical distributed application based on peer processes. So, there are different peers, there are different applications which are running in the peers, and it can

so happen that; this applications talk to each other to realize a particular job right. So, there are application based on this peer processes. So, these are different type of distributed computing paradigm, another computing paradigm which became popular rather still it is very much popular is the grid computing, right.

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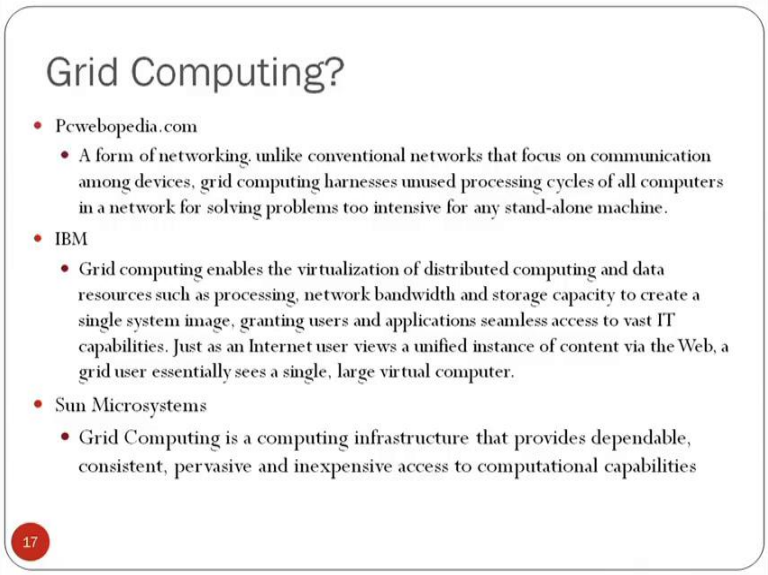

There are again different definition of grid computing, and if you look at some of them. So, a form of networking unlike conventional network, that focus on communication among devices, grid computing harnesses unused resource cycle of all computers in the network, can solve problems intensive for standalone systems. So that means, I have a network of system much stronger couple, solved some particular problems. So, if you look at other type of definitions grid computing enables virtualization of distributed computing, and data resources such as processing network, bandwidth, storage capacity to create a single system image granting user and application, seamless access to the vast IT applications.

This is another important way of looking at it; that means, I have a distributed computing paradigm and then I want to realize or virtualize another system over the things, right which is one of the prime over of this cloud computing paradigm, right. I have a several systems over the network, they have different processes etcetera, then I want to have a system evolved out of the things like I or popularly I can say that it is a I want to have

one or more virtual machines, with defined resources based on my requirement, right, this is one way of a looking at it.

So, there are the these are the different aspect and then grid computing is a computing infrastructure, that provides dependable, consistent, pervasive, inexpensive access to computing capability. In other sense I have resources which are available over the network.

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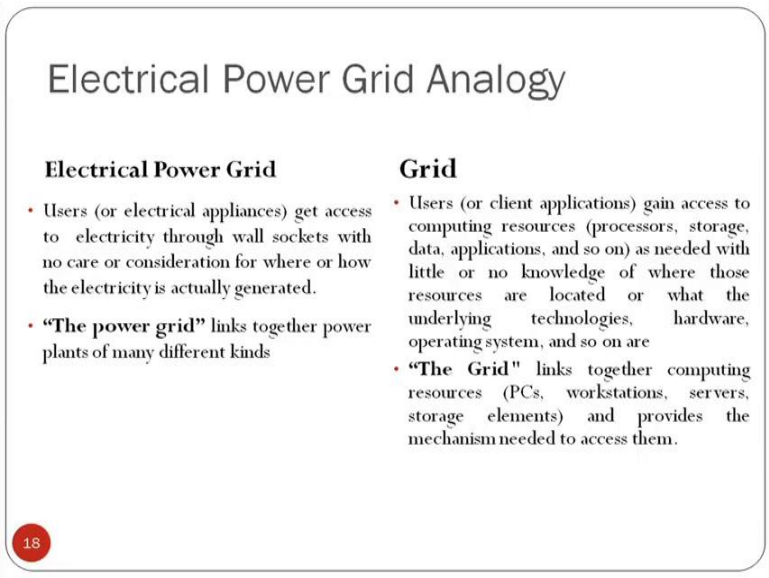

And one popular things what we have in our day today life is or hear about the things or experience the thing is the electrical grid, right. So, one good analogy is an electrical grid. So, electrical grids are running and we tap power, we in the sense that organizations or households or the power distribution systems tap power from the grid. So, it is a something available. So, in case of a; you can have computing analogies like users or client applications gain access to the computing resources, processors storage data applications so on as needed with little or more no knowledge of where those resources are locating.

That means I it is a way of looking I have resources, I tap those resources and use it for my thing say I want to run something on a computing grid. So, I am more bothered about my own algorithm, methodology and I what I think that; what is the resource requirement? Now if I that particular grid particular computing grid allow me. So, I need to hook into the grid and run the resources, run my program or my; run my processes and

it detunes some the resources. So, the grid links together computing resources like PC, workstation, etcetera, and provides the mechanisms needed to accessing.

So, if I have agreed. So, what I require from the user point of view? A mechanism accesses this grid.

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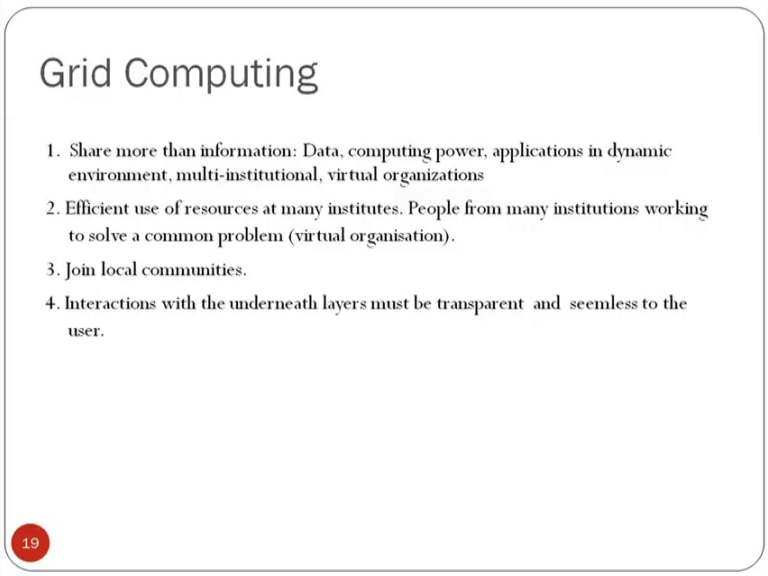

So if you look at grid computing characteristics. So, say are more than information it is not only information, it is something data computing per so and so, efficient use of resources at many organization or institutes. So, I can have an efficient use of resources like if you look at our typical computing lab of a UG-PG classes, they accept the lab classes as they are mostly underutilized. So, I could have form a computing grid during the off office hours, specially off academic hours. So, that other researches could have used as the as a computing platform. So, my PCs set of 100 PCs everything is fine.

I basically I virtualize with a layer of another middleware. So, that people can work and as a enducer I do not care that what is going at the other end. So, long my program my processes runs faithfully with a particular performance level, which is desired by me. So, this is a good chance of using underutilized resources. There is a join local communities. So, I can have different type of communities like I can say some grid resources for some biological sciences, some arts sciences some genetic research. So, there are not only computing, but they also give some basic processes to do that right. So, those things are available.

So, in other sense I want those resources without having to purchase install maintain at a my end. Interaction with underlying layers, must be transferred and seamless to the user. So that means, I have a interface as a end user, I should not be bothered about what is going on at the other end of the things like how you are using the other leverage resources etcetera. You may ask me for money like if may ask that you need to pay so much amount for so much utilization that is fine, but I may not be willing to I do not want to go to the nitty-gritty of how you maintain your resources, how you maintain your network, how what is the services etcetera that is your thing.

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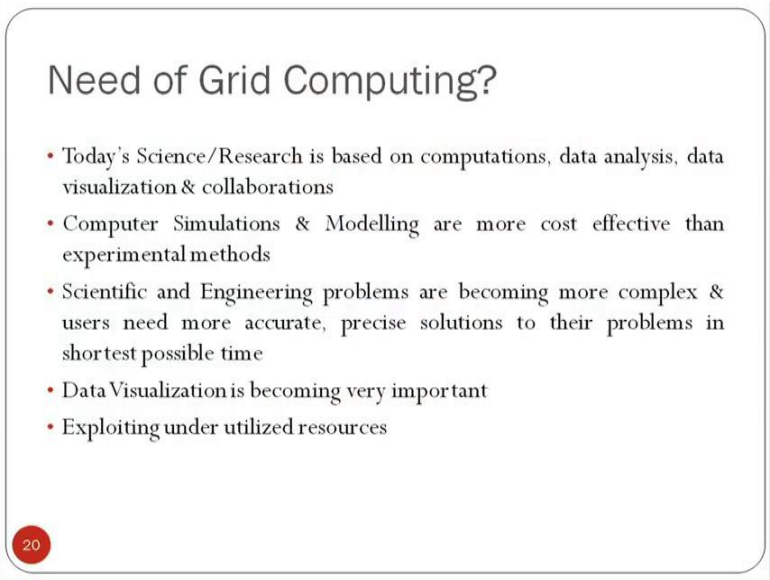

So, need of grid computing is well known. So, especially scientific research community is a big user of the things, specially data analysis, data analytics, visualization collaboration between the scientific wall, this days across continent people collaborate. Computer simulation and modeling are other common use; scientific and engineering problems are becoming more complex and need more accurate precise solution for their problem. Data visualization is becoming an important aspects of the thing. Exploiting underutilized resources maybe one of the motivating forces right. I have lot of resources which are underutilize; I am want to do that. Again this is another stepping stone for towards your cloud computing.

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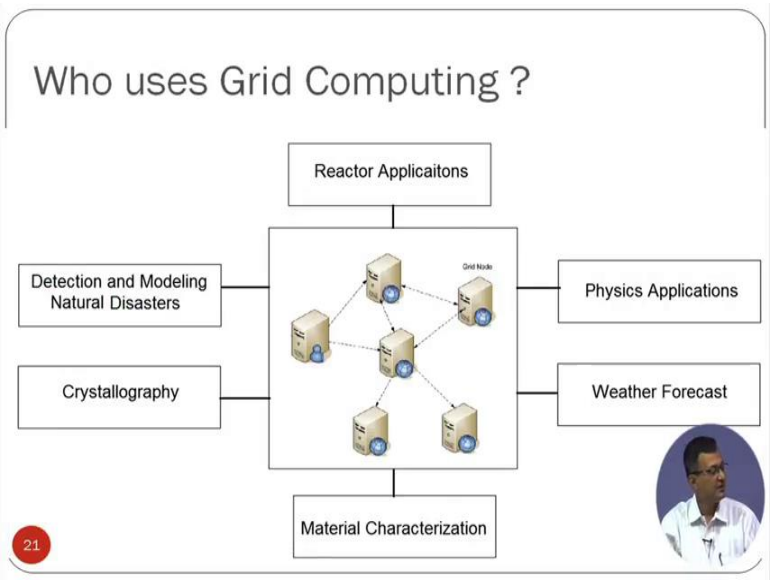

So, who uses grid? There are as we say that finally, there can physics application; weather application, material science reactor application and the so on and so forth; very few of them are there, but it you can see that all paradigm or of research or all paradigm of different scientific activities are there where who may be need grid.

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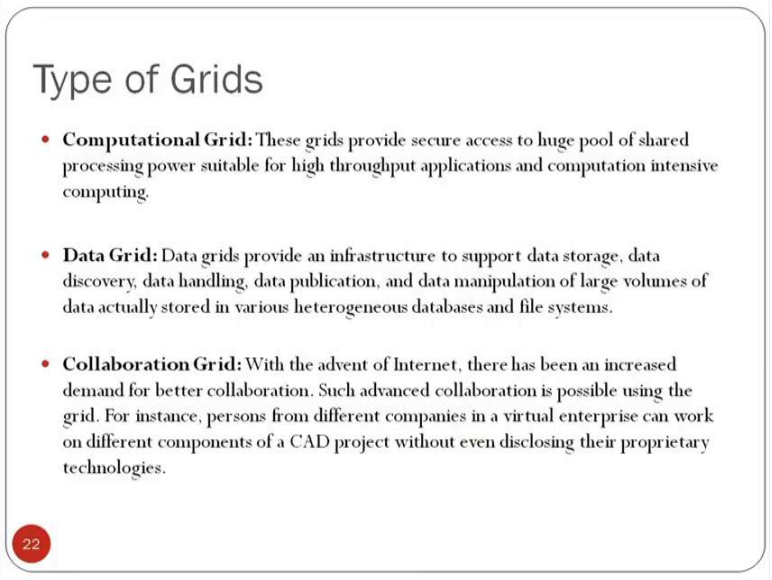

So, there are different type of grids. We will not go to much nitty-gritty, there is one maybe the computational grid more on the computing, one may the data grid which serves as a more of a data storage.

One maybe collaboratively grid with that means, so that it helps in doing collaborate physics; there are other grids like network grids. So, providing fault tolerant high performance communication services over the things, there can be utility grid in this is a utility form of grid in which not only data and computation cycles are shared, but software or just about any resources are shared of the things. So, I say this is a utility grid.

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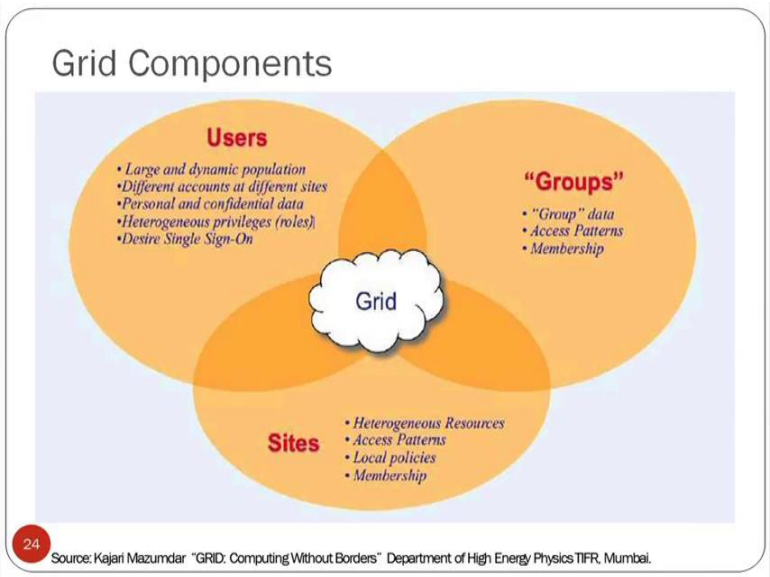

So, there can be different players into the thing, definitely grid is a central thing that is the; which provides the thing. There are users who uses grid there are groups which has a group activity, there are different sides or what we resource availability locations of a different heterogeneous sites, etcetera. Not only that; there are issues of policy maintaining and other things like which can be share which cannot be shared, which can be computed where a central things are there.

Then another important aspects towards computing which is pretty popular is the cluster computing. So, what is a cluster?

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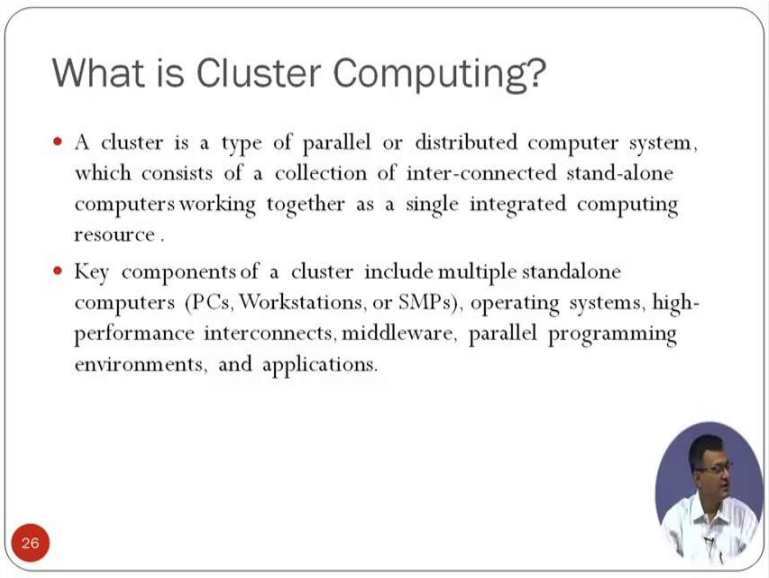

A cluster is a type of parallel or distributed computing platform, which consists of collection of interconnected stand alone computing computers working together in a single integrated computing resources, right. So, key components are stand alone computers may be PC workstation or SMPs operating system, hyper performance interconnects, middleware parallel programming environment and applications.

So, there are different these are there are different these are different components of the cluster computing.

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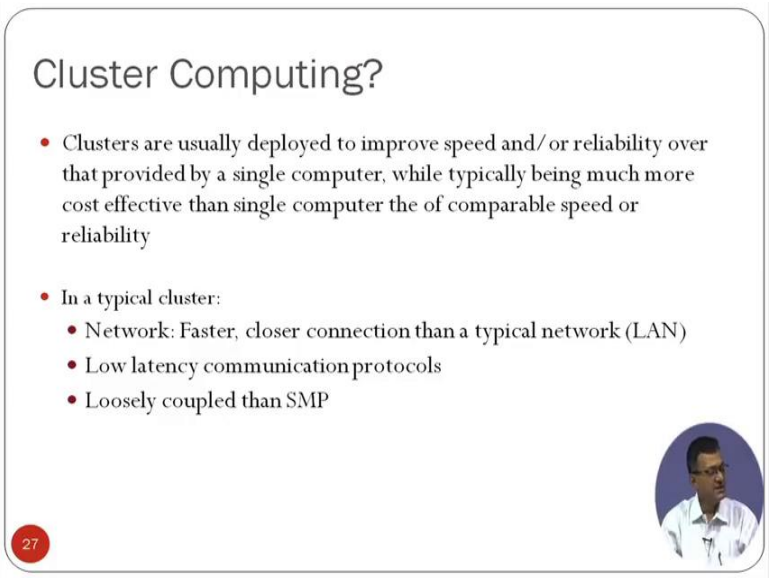

So, clusters are usually deployed to improve speed or reliability over that provided by the single computer, right typical clusters are like having the properties of the network faster, closer connection then a typical LAN, low latency of communication protocol and loosely coupled than our SMPs.

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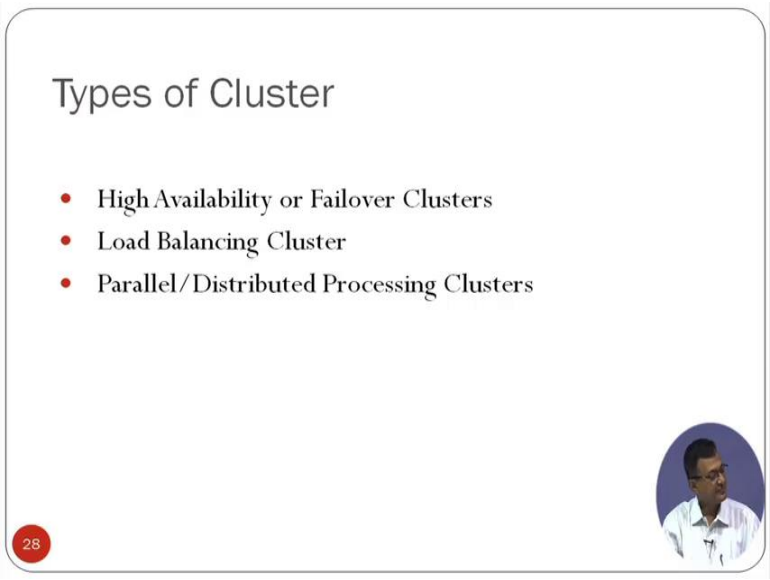

So, there are several type of clusters, right, few of them are high availability or failover clusters, like it say the resources are so be highly available if there is a any failure of the cluster node, the other things takes care etcetera. There are things are load balancing cluster like if I have particular processes. So, the load balancing is done by the cluster.

There are parallel distributed processing clusters, right, these are these helps or this facilitates parallel and distributed processing. So, these are the clusters which are there.

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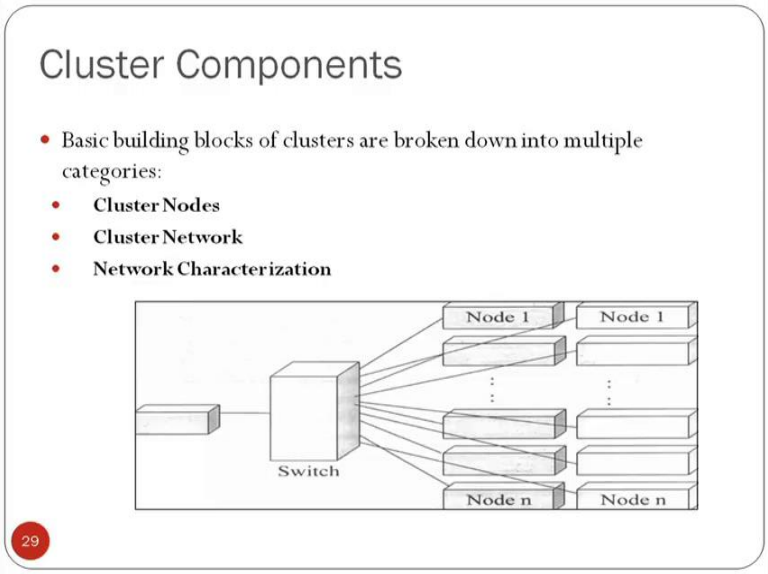

So, if you look at typical cluster nodes. So, there is a there is several cluster node. So, and a interconnect of network which connect the clusters, and there are different network characterization of the things like how it will be connected, what will be the different type of mechanisms so on the things.

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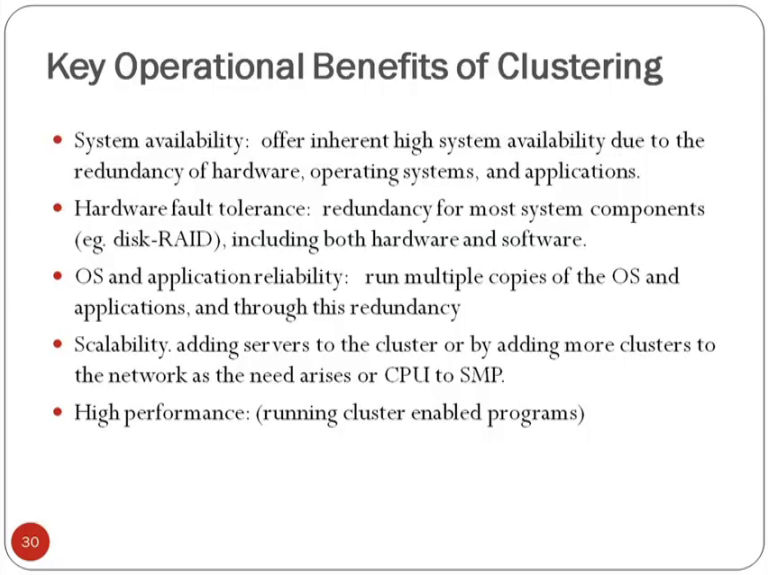

So, there are several operational benefit; one is the system availability is one of the thing, fault tolerance is one of the thing, scalability another aspects, OS and application reliability what we expect from the cluster and high performance. Usually cluster what

we try to use it as a high it will provide us high performance, right. Then there is with all this paradigm, we started with the distributed computing and different outsource like grid cluster and so and so forth, we this has motivated to a system or to a realization of a things what we say utility computing, right.

What is utility computing or what is utility? Utility typically means that if I have something I need something, I should be able to get it as and when I require it, right. It is as if you go to the market and purchase the thing or get the services like I want to book a railway or flight ticket. So, I require some interface it maybe a interface calling a broker or a travel agent, right.

So, what I do? I do not care about how things happens, I want a utility to be there I want a even a plumbing job in my home call up in my residential complex, the utility office and then I say this is the thing right. I do not care or I even that the person who is taking the call may not be knowing that how to any plumbing job, but he connects or he or she connects to the particular things. But as a user I want a utility thing there. So, as if resources are there as and when we require trying to that. If you look at distributed computing strum that a cluster and other type of a computing, they also some sort of provide try to provide some utility based on the user need. And try to I should not say disconnect try to basically make the enducer least bothered about the nitty-gritty of maintaining the whole resources, right.

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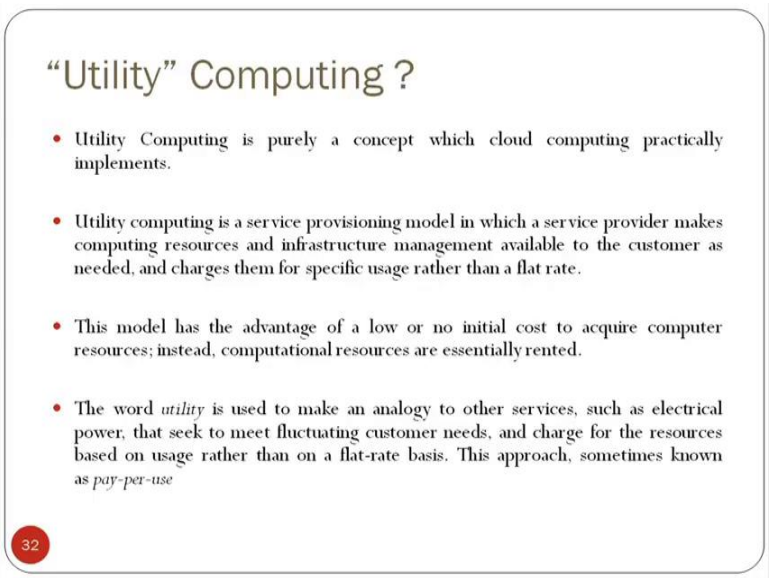

So, utility computing is that it is a purely a concept which cloud computing practically implements what we will see later on, its a service provisioning model right model, in which a service provider makes computing resources and infrastructure management available to the customer, as needed and charges them for specific uses rather than the flat rate, right. So, the word utility is used to make an analogy to a other services like electrical power, right. That seek to meet fluctuating customer needs, charge the resources based on the uses rather than the flat rate basis, and approach this approach sometimes called pay per use or what we say pay as you go model.

So, if we look at our electrical services electrical things. So, we have a meter. So, and we whenever I switch on any electrical appliances, it maybe power, it can be my electrical light or microwave oven or air conditioning or computing a computer whatever I resources the as much as I consume, that much I pay based on the rates etcetera what is decided by the electrical that electric authority or electric power authority and type of things.

Now, I really do not care or do not know how these powers are generated, how these are coming to up to my home. Only what I care that I have metered service right whatever I use it is a service which is meter. Another popular uses is our telecom services especially the mobile services right. So, that also we use as utility and we take a connection from a again telephone or mobile service provider and then, I want, I use, I pay as I use, right, it may be postpaid prepaid and type of things, and based on that whatever the model of payment model but do not care that whether the service provider one mobile service provider 1, whom I am using another mobile service provider to connect me to somebody else, etcetera, etcetera.

What I need that facility like calling, sending messages and may be data services right data video services all the things and I am ready to pay the things right. So, based on that I select the service so, this is also utility services. So, this typically it is metered and pay as you go model or pay as you use model type of things. So, this is a paradigm shift or how we are looking at the computing though it is suddenly definitely it suddenly one day utility computing or term computing in come knocking at the door. So, it evolved from these all distributed systems to computing to cluster to type of other things, right.

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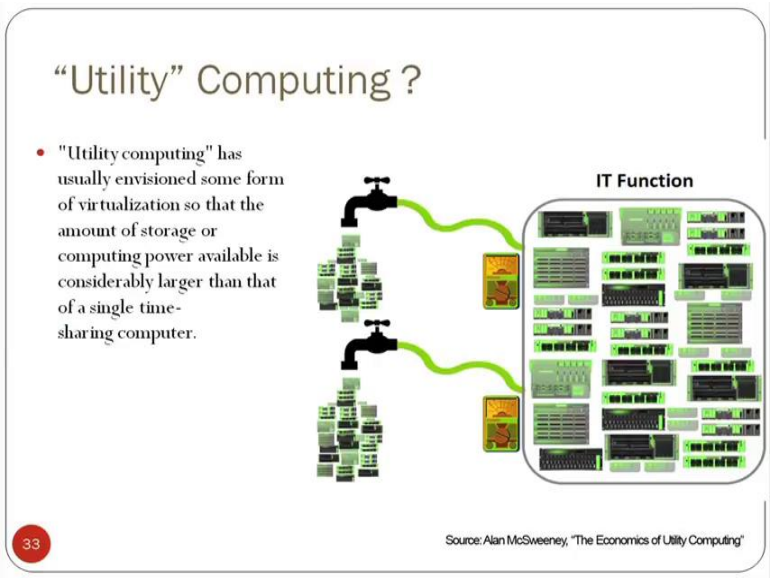

So, that is a nice picture nice analogy, like assume that there are different it resources and I if I open up the tap it, I can have this applications resources falling from the tap when I do not require I close it. So, utility computing as a usually, what we view as form of virtualization, so that the amount of storage or computing power available is considerably larger than a single system sharing computer. So, what we are thinking it is a enormous amount of resources are there which is which I can use as I. It can be unlimited computing thing which is there, it is a unlimited networking unlimited application which is there.

Like think about if we try to make a analogy, when we using power right unless there is a restriction by the things that you cannot use more than so much kilowatt or so much megawatt that say one thing, otherwise what virtually we are thinking that there is a enormous resources available at the other end somewhere other, and I can tap anything which I want to use and I pay for the thing and I do not want to use I close the thing.

Similarly, for the computing also or even if for telecom or mobile services, what we say whenever I am downloading a particular say file, I say that the bandwidth is something which is available whatever I need, right. It may be 10 KB or 100 KB file or it may be 100 MB file, right so, but the resources are there I need to pay for it I need to pay for the whole thing, but I am able to use it. So, that there is another way of looking at it.

So, in the incase of utility computing what we are trying to see, that the computing itself starting from infrastructure computing resource may be that is hardware or the services

like may be a particular platform, we where we compile etcetera or may be that some particular data storage capability I can store any type of data or it can be some software like I want to run particular simulation or mathematical simulation tool when I say that whatever extend I want to use I can use it I need to pay away. So, it is as of a huge enormous storage of things which are there in the thing.

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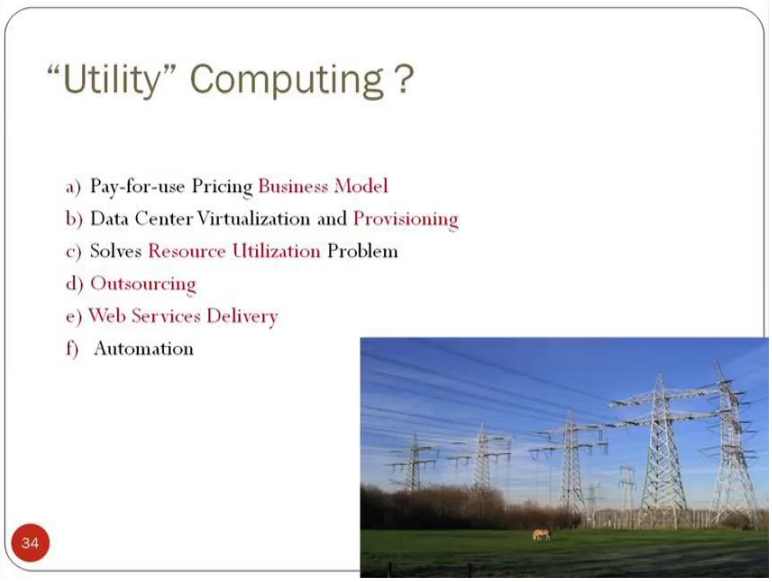

So, it has typical pricing model like our power grid pay for use pricing model so that is the one of the major thing there is a another aspects of data center virtualization or provisioning right that will come to that; that means, I virtualize the resource at my end. Say I want to emulate a particular system which has I want say a particular processor speed so much 8 GB, 16 GB or 128 GB RAM; so much hand disk and I want to run a particular scientific simulation for my purpose, right.

So, in from the whole volume of resource I virtualize a resource for my or customize the resource, which is as if as a virtual instance. Another user from the same pool of resources may be virtualize for some other things, right. So, it is a we say that the whole thing has the data center virtualization and provisioning, solves resource utilization problem, right, I may having lot of resource at my thing and this allows me to basically supplied this resources, I can do outsource some my thing like say whenever I am doing this, I am outsourcing say software maintenance to something else or data storage thing something. So, I can do outsourcing web service level delivery, right.

So, that we will see that is what we these days what we are or rather last couple means rather last one decade mode primarily, we have shifted from data driven architecture to a service driven architecture. So, what we look at more as services than the data; right. So, that is it utilization and then I have a enormous scope of automation, right. If I have different resources etcetera then the whole I can have; I can build a work flow which allows me to automate the whole resources. So, there is another aspect of this utility computing.

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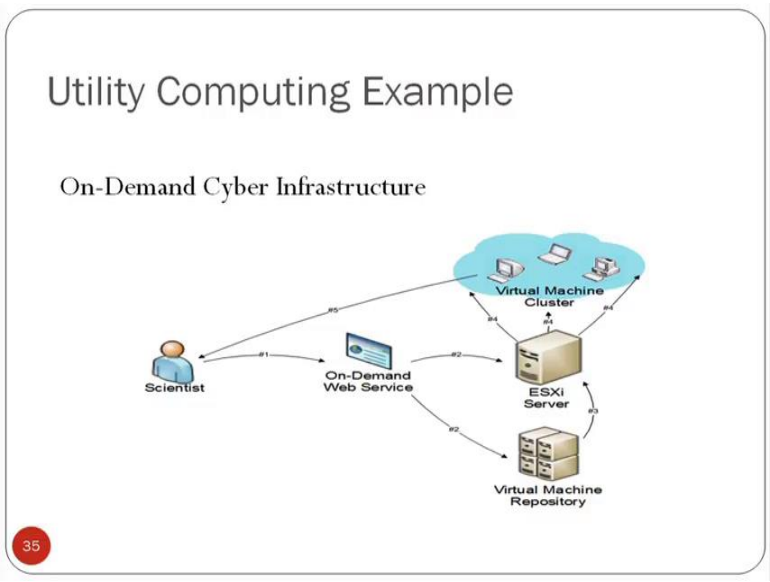

So, one example may be on demand cyber infrastructure; like I want to do a particular say examination for my for recruiting some recruiting or test of my students, and I want to have a separate infrastructure and they are they may be are in different physical location may be in different departments or if they different from their house, I want a cyber infrastructure which allows me to have a virtual resources which they can take their exam, right.

So, this I can have this type of cyber infrastructure, I can have a typical cyber infrastructure in case of a say some event management, typical event management like I want to manage a conference, and for that period I want to have service cyber infrastructure, I can have a infrastructure for disasters management which is more of a real time, that resource need maybe may vary from one to another, but I do not want to keep those resources like I say here at IIT Kharagpur we organizes conference say, it

may be coming in a one or two in a month or type of things workshop, etcetera, and I do not want to keep a separate infrastructure for the things, I want to make a infrastructure as and when I require, I may pay for the things. So, that is one demand cyber infrastructure may be the one thing.

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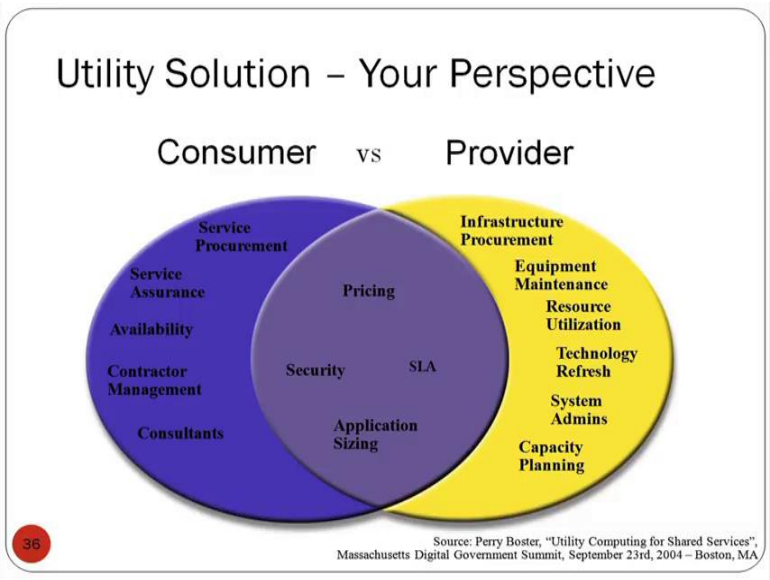

There is another aspects of things whenever so what we see, there is a provider or service provider, there is a consumer, those two category of things has different requirement and we have different models or different what we say management issues, which ties them together. Like one maybe pricing what price you give right. So, that say I want to if you take analogy, I want to take a service provider which gives me a favorable price for my services like I want more of a data service than calling. I want data services more. So, I want to invest on those I want to select those service providers, mobile service provider who gives me a better rate or better performance, I do not care about the rate performance on this data services somebody may be more interested in the calling or messaging. So, they will do on their own.

So, that is the pricing model there, there should be a service level agreement like if I do this type of things, what should be the service level agreement what should be the availability down time etcetera there can be a security aspects right; if I say I want to use and store data, etcetera. So, somebody else would not be using or looking at my data. So, there would a security aspects even security aspects like denial of services type of things

should not be there, that also I can look at the security aspects there can be a access mechanisms, etcetera.

And there may be a need for application sizing; the application need to be sized for me some application may be for doing data churning for terabytes of data, but I do want to analyze with some megabytes of data. So, I do not want that large application neither I want to purchase the thing, but I want to size the application based on my need right or in like reverse in the other way.

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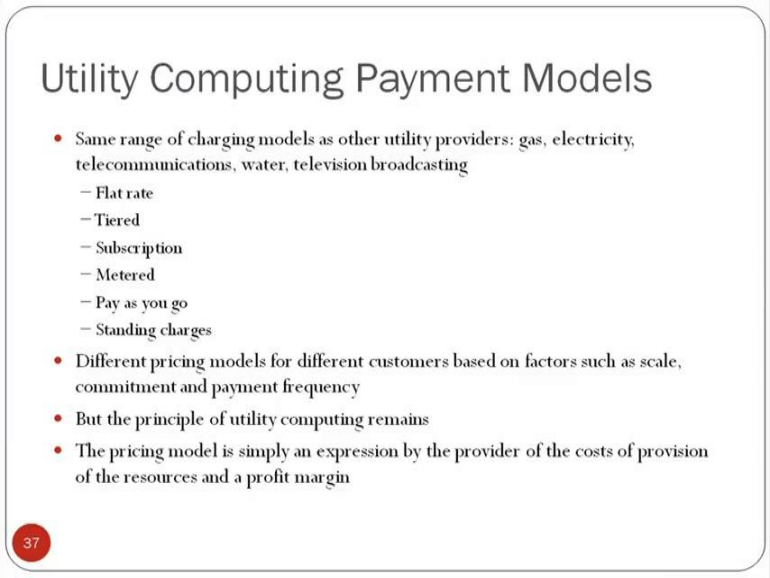

So, there can be different type of payment models, right. So, it can be flat rate, tiered and type of things. Different pricing model for different customer based on factors like scale commitment payment frequency, etcetera, I can have customized things.

Principle of utility computing remains same, the pricing model is simply an expression of the providers of the cost; that means, it is a how much provisioning of resources etcetera will come into the things.

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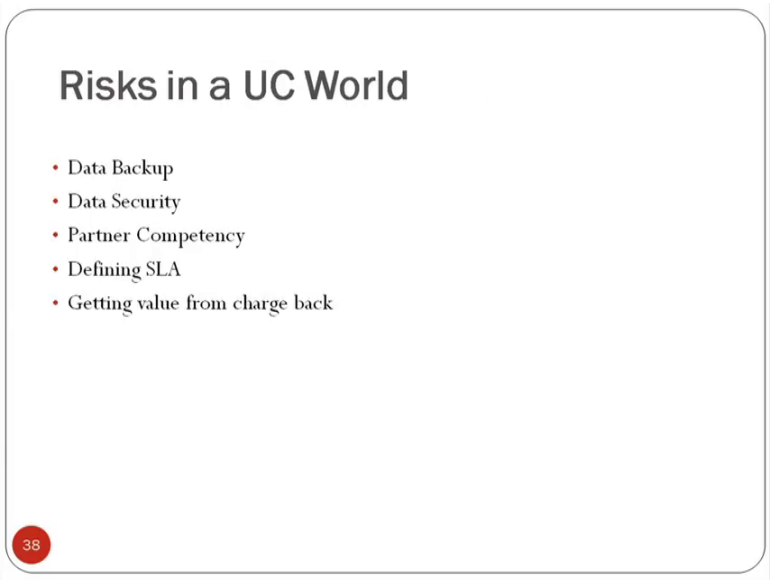

There are several risk; we say or disadvantages based on this utility computing one, one may be the data backup. My data is somewhere, if there is a crash what will happen, right, you store the data in third party and if there is a crash or that service provider itself goes out of the business then what will happen.

There is a data security aspect somebody else is reading or my data or not, there is a competence issue that what I am working with whether that organization is competent enough. Defining SLA is another big problem, because everybody want to define that agreements on their favor and there is still not very standard approach of doing that across the different provider and consumer, getting value from charge back that is also things which we look at that how I get values of my charge backs and these all will evolved as a cloud computing, all right.

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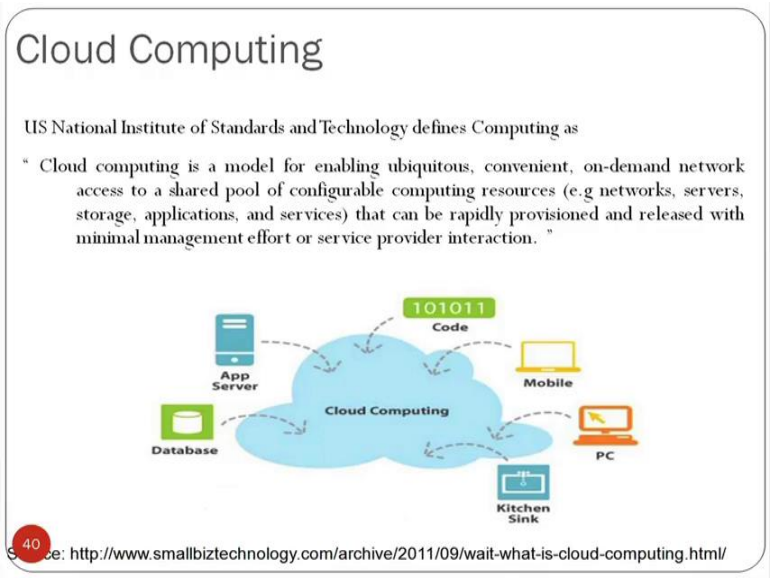

So, cloud computing is a model, for enabling ubiquitous convenient on demand network access to a sheared pool of resources or configurable resources, such as network server storage application services, that can be rapidly provision and released with minimal management effort or service provider interaction. So, it says everything; right. So, this is the typical NIST definition, which we all everybody try to what we say follow or respect. So, it says that any the huge pool of resources can be provisioned with minimal management referred, and provision and de-provision when I use it and when I have to release it both can be done in a very seamless manner.

So, this is this if you look at what we have discussed or from your background computing knowledge, this is something which is not came up suddenly on the table. What it there it evolved from some of the things; like rather we look we want to look the computing world in a different way and try to facilitate computing to different type of purposes with some basic modeling basic model. Like the pricing models, SLA model, say there is a security model management thing; that means, we want to place different things and so that a computing as service can be provided, like I want to provide computing as a service.

So, what we will do with this we will end our today's talk and we will continue with this thing with the different other aspects of the things. So, this we will do another aspect I want to mention that some of these materials, some of these figures etcetera are taken from different resources, we have I have tried to put all the references and acknowledge

those things we want to do it specifically for academic purpose only for that for our landing mechanisms no where it anything commercially using all.

So, what we do, we with this we end our today's talk and in the coming lectures we will look at other aspects or different aspects not other aspects, different aspects of cloud computing how it goes and what are the different what are the different properties advantages disadvantages and like that.

Thank you.