Computer Aided Decision Systems Industrial Practices using Big Analytics
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Lecture 50
An Introduction to Networking

Good afternoon, everyone. Welcome to yet another lecture of Introduction to Networking, which is part of the Web-based Decision Support System course for decision makers and practitioners. And, this lecture, if you look into it, is to sort one of the major questions about people is why this specific network, why this specific Client-server (Network-Architecture) choice, why not something else?

And, we do not know much about Networks. Can you explain a little bit more about the Networks? So, I thought, I will cover that part of this. And then, the remaining aspects, how to build DSS Models etcetera, will be done as part of part two of this course. So, today's lecture is an Introduction to Networking, and we will try to make it as simple as possible.

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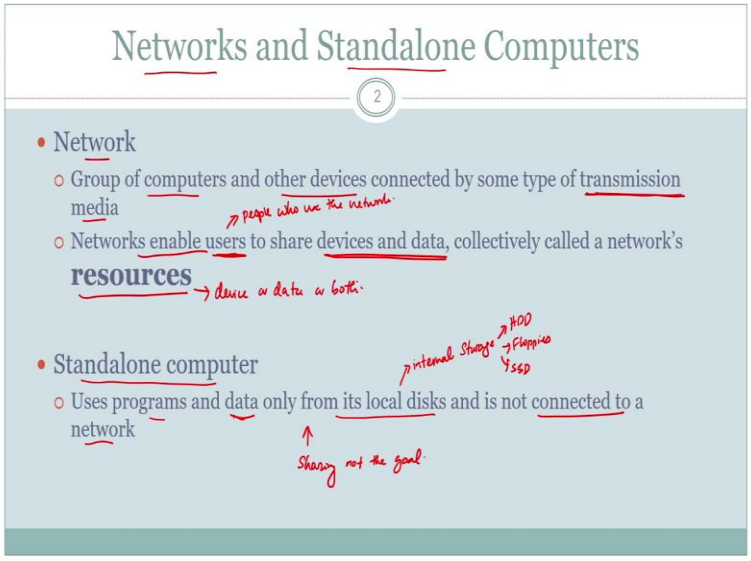

So, let us start with the two major aspects, Networks and Standalone Computers.

- So, we look at what a Standalone Computer is. So, a Standalone Computer, in the simpler sense, if it uses programs and data only from its local disks or its internal storage. It can be

hard disks, floppies, SSD that is digital drives, etcetera, and, it is not connected to a network. So, it is only able to do whatever the data that is available from the local disk.

- In a network, the simplest way to look into a network is,
  - a group of computers and other devices connected by some type of Transmission media. So, it is not just computers. Computers, and some other devices, are all connected with the help of some Transmission media, there is some mechanism to transmit things.
  - So, what does it do? It enables users, users mean the people who use the network to share devices and data. The main thing is sharing, not the goal. Whereas in the Networks, the main aim is to share devices and data. And, these devices and data are normally known as Network Resources. So, when somebody says I am using the network resource, literally means they are using either the device or the data or the both. So, resources are devices or data, or both. So, when somebody says I am using a network resource. I am using this resource that means it will either fall in a device for a date or both of them.

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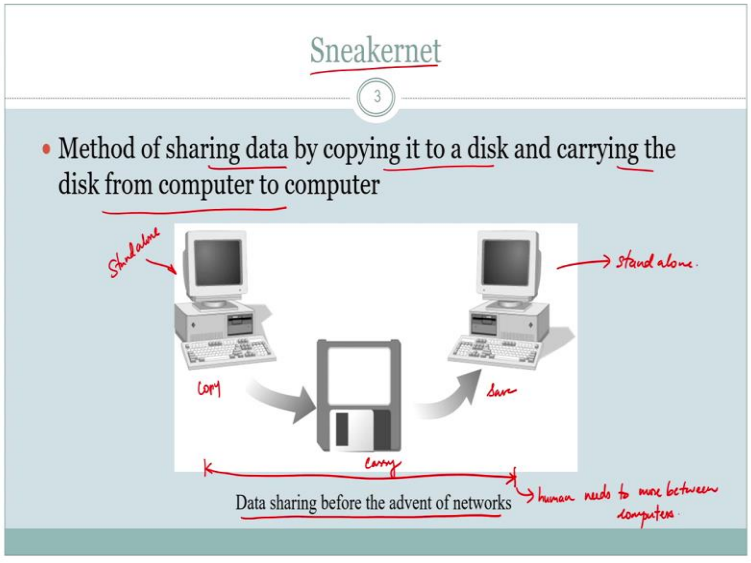

So, let us talk about what some called a Sneakernet.

- Sneaker means, you can think about shoes or you walk or something like that. So, there is a Standalone Computer. There is also a second Standalone Computer. The two Standalone

Computers and you are sharing the data from one computer to another by copying it into a disk and carrying the disk from computer to computer. So, you copy here then, carry then, save and then, other way also. So, in this process humans need to move between computers. Human beings will move from one computer to another. That is the reason why it is called a Sneakernet. So, it is a human who does this transaction on the network.

So, this is how the data was shared before the networks were found. So, we nickname it as Sneakernet because it is dependent on the sneaker or the shoes of the human being.

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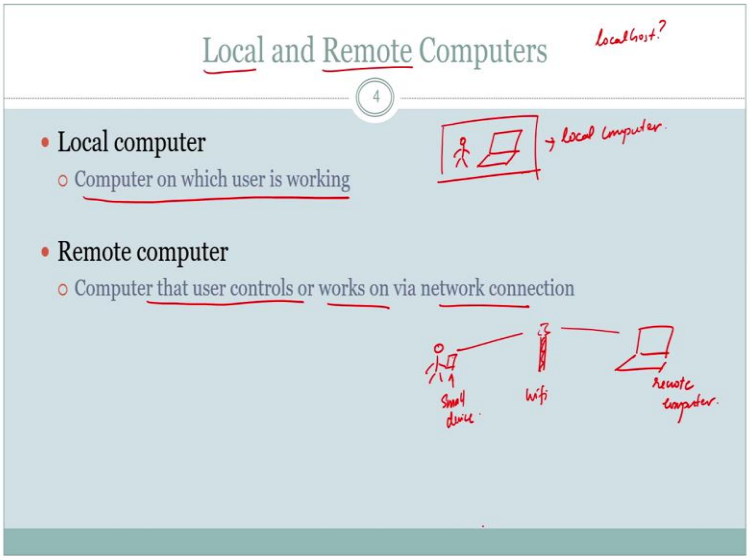

Now, the other two terms that you need to remember are called Local and Remote Computers and these also are two words that we have used in the lecture frequently. So, the simple way to do it is because you have asked me the question on what is a local Host etcetera, what is it?

- So, the Local Computer is the simplest way to think about the computer on which the user is working. So, whenever I draw a computer like this, this means a Local Computer. This implies that the human being is working. The user is working on that computer.
- When we say a Remote Computer, the computer the user controls or works via network connection. So, you have a computer here and draw a user here and he has maybe a mobile phone or something to use this, so, this is a small device then, there is a Wi-Fi or something or internet and then, it is connected to a Remote Computer. So, a Remote Computer is when you require a network connection to work on a computer remotely.

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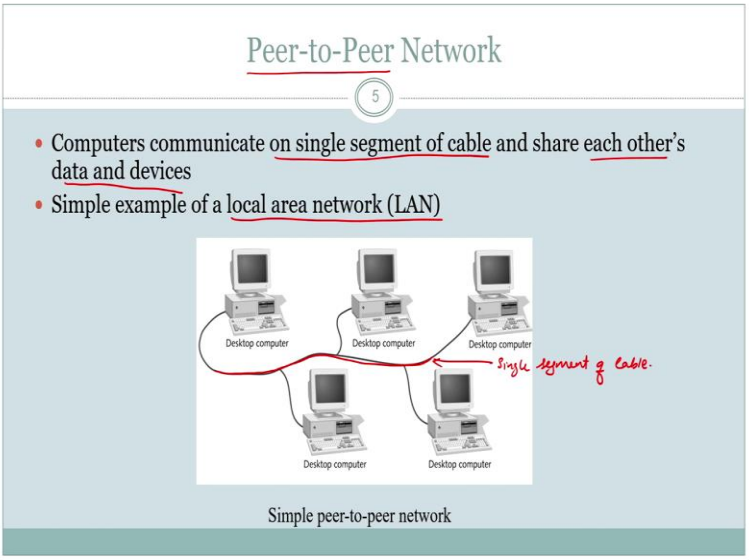

Then, what is a Peer-to-Peer Network? Why just Client-server architecture? A Peer-to-Peer Network is the easiest way to visualize it. In a computer there is a common cable, on which each computer is connected with this.

- So, computers communicate on a single segment of cable. The main critical part is the single segment of cable, that is what we talk about. So, the single segment of cable and the resources sharing each other's data and devices or the resources are shared using this single segment cable.
- So, here is an example what some people call it as LAN (Local Area Network).

A simple example of this is the set of computer integral desktop computers connected through a single segment of cable. So, this kind of network is called a simple Peer-to-Peer Network. So, when somebody says what is a Peer-to-Peer Network, remember this diagram, you should be able to answer that question.

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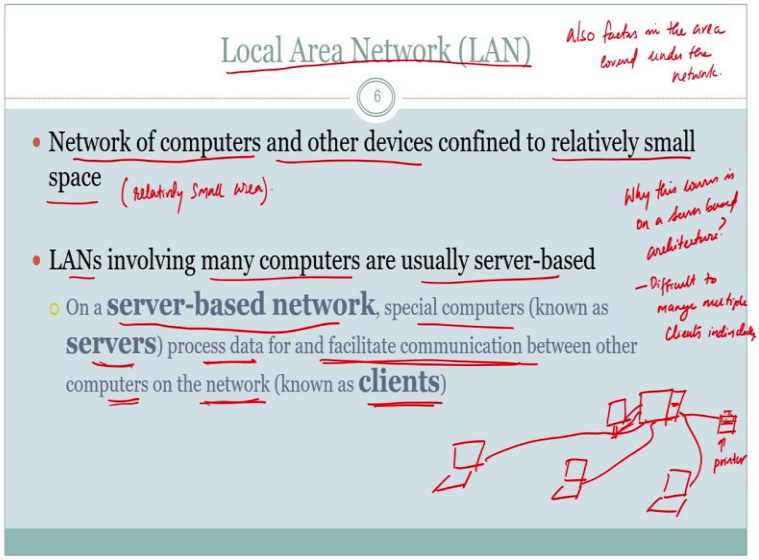

Now comes the LAN (Local Area Network). What is the LAN?

So, LAN is, to an extent, it also factors in the area covered under the network. So, it is a network of computers. The Local Area Network is a network of computers and other devices.

- So, it is a network but it is confined to a relatively small space or relatively small area. So, a relatively small area does not have to be space but area is relatively small.
- So, LAN typically involves many computers and most of the time they are Server-based.
  - So, Server-based means when you say, there is a network that is Server-based. When you say Server-based Network, the idea is that there are some certain computers or special computers (known as servers) that process the data and facilitate communication between other computers or the network which are known as Clients.

So, you have a network where you have one computer. This is a computer with its monitor, cables run between them and etcetera. This computer is the one that has connected to all of them and there could be a printer. So, this server basically integrates various computers and other devices like printer, scanner, fax, etcetera. And, what does it do?

These special computers which are known as the servers, process the data and facilitate communication between other computers of the network known as Clients. So, the clients communicate to the server and the server facilitates the communication between the clients,

sharing the data, processing the resources, etcetera. And, one of the reasons why we choose, why this course is on Server-based architecture?

The reason is, it is difficult to manage multiple clients individually. So, it is safer and easier to manage one server and how all the clients talk to the server and do what the server says. So, in a Web-based Decision Support System, in a factory or in a big organization where there are 1000s and 1000s of employees working, individually managing each client computer, or each user computer is a very difficult task.

So, hence it is better, easier and for the purpose of maintaining uniformity across. It is easy to do everything in a server and let the people use the clients to communicate to the server. So, that is why we have used this Server-based architecture as part of it. But, in the broad scheme of networks, Server-based architecture is also part of LAN.

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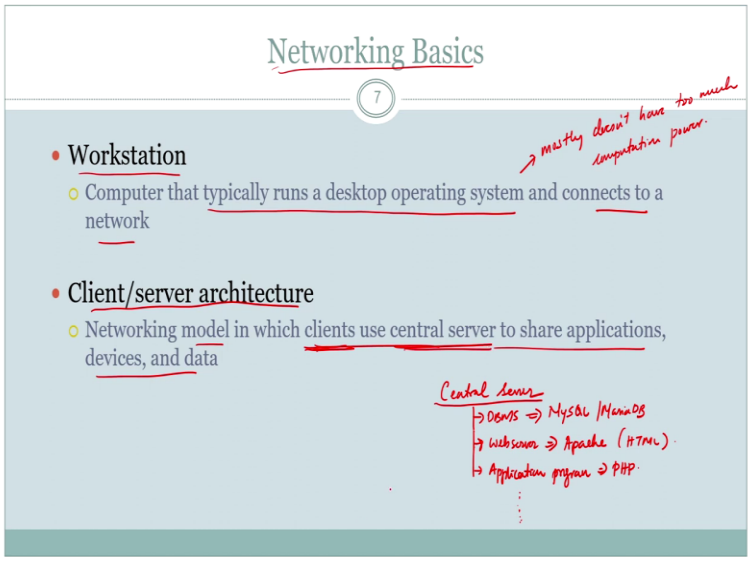

So then, another networking term that you need to understand and you need to think about it clearly is the term called Workstation. The term that we talked about earlier was a Standalone Machine, Client-server.

- And then, also what is called a Workstation. The idea is that it is a computer that typically runs a desktop operating system. Most of the time, it is called a desktop, it is not a laptop, and then, it is connected to a network. Lot of the time, it does not have too much

computation power. Many times, you do not have too much of it, too much computation power. But its job is basically to connect to the network, who can talk to the server.

- The Client-server architecture, which we talked about in this course, is the networking model in which clients use a central server to share applications, devices and data. So, we have a central server in our case that has a DBMS (Database Management System). In this case, it is MySQL, MariaDB. It has a web server. Now, in our case this is Apache, we also have what we call an Application Program. In our case, PHP and Apache also provide HTML capabilities, as part of it. And, we are not talking about sharing printers or scanners or etcetera.

But the idea is that all these capabilities are stored in our case and are available on a central server. And, the clients, the individual computers, or the user specific computer, they all talk to the central server. And, from where they share the applications, devices and data.

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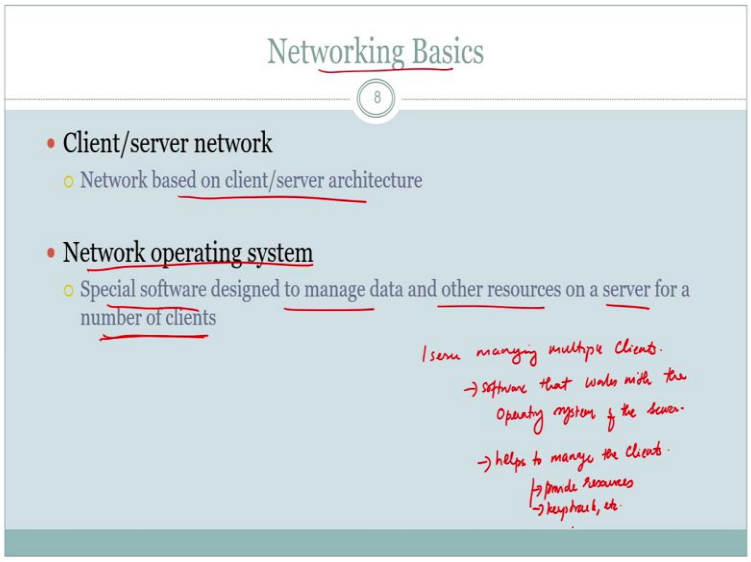

Continuing on the Network Basics. The Client-server network, when somebody says it is a Client-server network, what does it do?

- It means any network that is based on a Client-server architecture, is called a Client-server network. As simple as that. So, I am working on a Client-server network that means I am working on a network that is designed under the Client-server architecture.

- Then, there is another thing called Network Operating System, this is probably a new term. What does it do? It is a special software designed to manage data and other resources on a server for a number of clients. So, if you have one server managing multiple clients, you need certain software that works with the operating system of the server. So, the server has an operating system, then, you need some software that will work with the operating system. What is his job? It helps to manage the clients. It will assist the server, the computer to manage the number of clients and manage a client means by providing resources to keep track etcetera. So, this kind of specific software is what we call Network Operating System.

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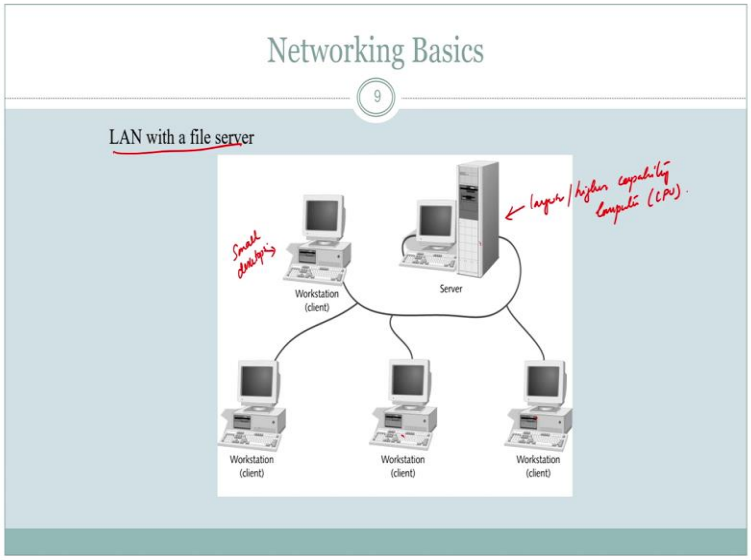

So, this is what we call LAN with a file server. Here is an example of this. So, there is a main server. So, these are all you can think about as small desktops. And, this is a larger or higher capability computer or CPU. So, the server has a much larger capability. And, everybody is talking to the server, all these clients 1, 2, 3, 4 clients are talking to the server through a single connection.

So, in this there is no storage, all the files are stored in the server. So, that is a file, the main job of the server is to store all the files there. So, here is an example of a LAN with a file server.

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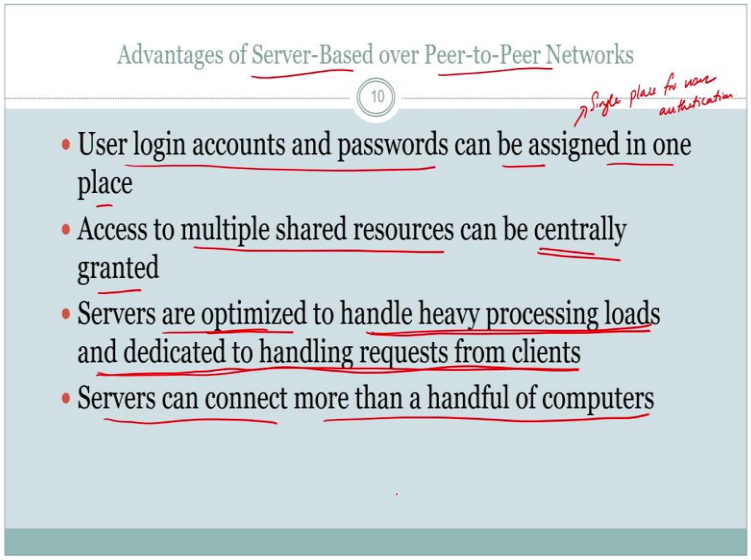

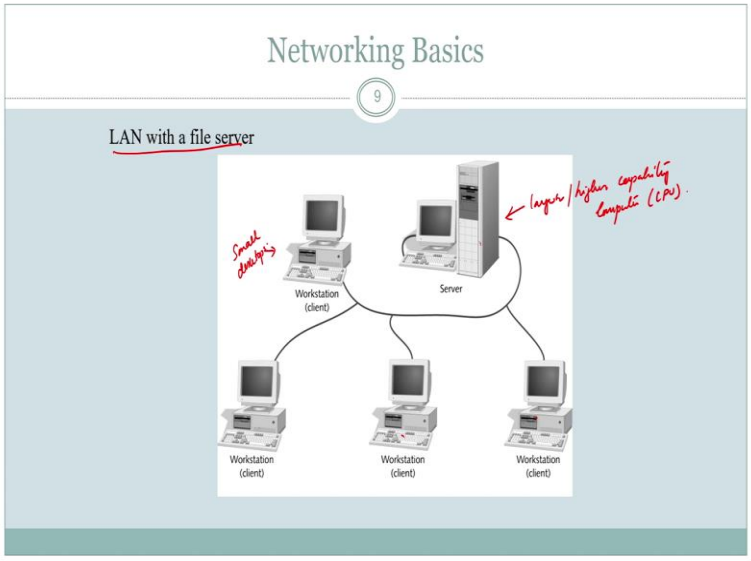

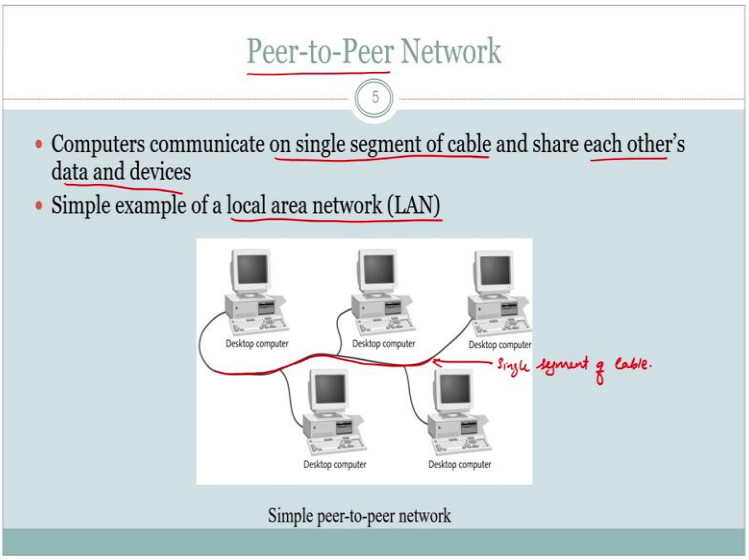

Now, what is the advantage of a Server-based System over Peer-to-Peer Networks? So, you may wonder, that this diagram, and this diagram kind of looks similar. So, what is the main difference? Except that there is one big server and everybody's talking to that. What are the main advantages of Server-based Systems?

- So, the user login accounts and passwords can be assigned in one place. So, there is a single place for user authentication. You can have one individual machine, single machine where the user accounts and passwords are assigned. So, all the credentials of the user are managed in one location.
- Then, the second part is that multiple shared resources can be centrally granted. Instead of granting, let us say there is one printer, and the printer resource needs to be shared among other 10 computers of which, 4 need to be using the printer. So, instead of going to all the 4 and configuring it there, it is easier to do it in one place in the server and say, Workstation 1, 3, 5 and 7 will use the printer and nobody else can use the printer. And, that is it. So, the one printer which is ideally supposed to be shared among all the 10 computers, you can get. We will give it to a subset of the 10 clients. So, this can be a central leader.
- Servers are tip most of the time. It is optimized to handle heavy processing loads and dedicated to handling requests from clients. So, the server systems, its operating system, its hardware, everything is designed and geared and tested and optimized. These are optimized also towards handling heavy processing loads, large computational requests and dedicated to handling requests from clients. So, when multiple client requests come in, the

server can assign different resources to different clients to make sure that the work actually gets done properly. So, in this regard, servers are optimized to do this than individual desktops.

- Servers can connect more than a handful of computers.

The biggest disadvantage of a Peer-to-Peer Network is you can typically connect only 5-10 very limited numbers of computers, not more than that. Whereas servers can typically connect 5-6, beyond 6, beyond 10, it is very difficult to actually manage a Peer-to-Peer Network. But a server can connect more than a handful of computers, again 100 couple, 100 or even a couple, 1000 things can be done as part of the network.

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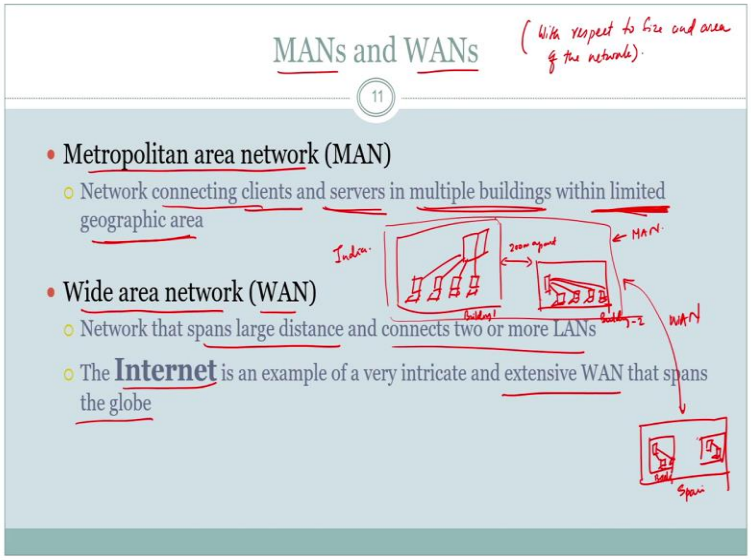

Then, there is something called MAN and WAN. This is another term that somebody asks, what is this WAN (Wide Area Network). So, there are new terms that come up as soon as the size and area of the network. So, with respect to size and area of the network, these things will change.

- So, the MAN stands for 'Metropolitan Area Network'.
  - The idea of a Metropolitan Area Network is a network connecting clients and servers in multiple buildings within a limited geographical area. So, you may have a tech park or something where there are 4 or 5 different buildings and all the computers in those buildings are connected to one network. So, typically that kind of architecture is called a MAN (Metropolitan Area Network). The multiple servers and clients are in multiple

buildings and they are all connected but within a limited geographic area, that is a critical component.

- Whereas on the converse side the Wide Area Network which is also known as WAN.
  - So, the Wide Area Network is a network that spans a large distance and connects two or more LANs. So, with multiple LANs, you can think about it in a different way.

For ex- You can have a server here. So, the server is connected to all these networks. And then, there is this, let us say is one building, there is another building in which there is another server where they are also connected in another building. So, this is building one, building two. These buildings are, let us say, 200 meters apart. So, this will become what we call a MAN (Metropolitan Area Network). Whereas, let us say this is in India and there is another one like this in a building you have. It has two networks; it is another build one that is a server and there is only one client and let us say this is in Spain or something like that. These two can be called a WAN.

- So, a classic example of a WAN is the Internet. The internet is all across the globe, it is a WAN, Extensive WAN that spans the globe.

So, the idea of a WAN is, it is not geographically limited, whereas MAN is geographically limited. So, that is the difference between MAN and WAN.

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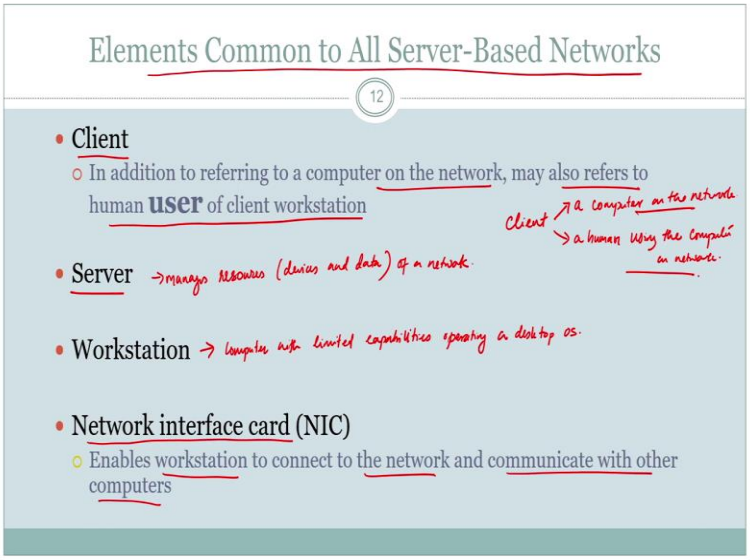

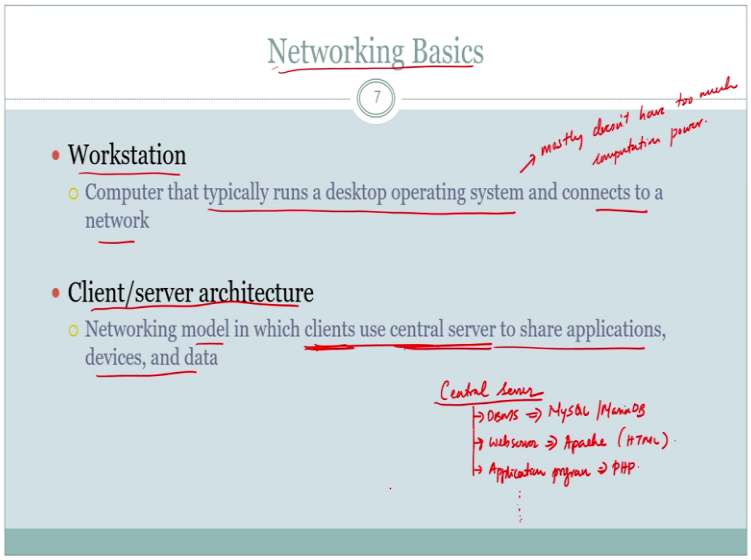

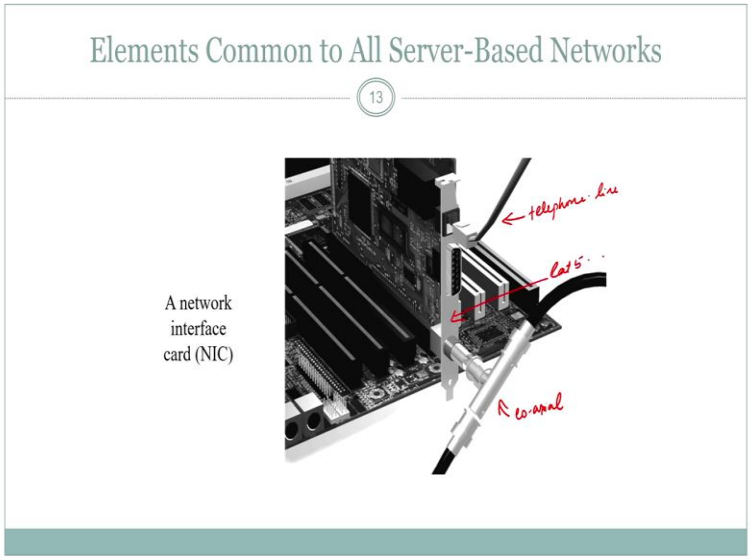

Then, certain elements that are common to all Server-based Networks. We need to understand some of the elements, some of the words or some of the technologies that are common to almost all of them.

- Number one is the Client, we already discussed that.
  - In addition to referring to a computer on the network, it may also refer to the human user of the client workstation. So, the Client, in the word, can mean two things: a computer on the network or a desktop computer, a dedicated computer, a lower-level computer available can be a human using the computer on the network, it can also be both as well. So, the client has typically two meanings most of the time, it means the

computer on the network, at certain times it also means or intends to the user of the client workstation.

- And, the Server, we saw what it was. We already said it is a high-power computer which actually manages the resources. Resources are devices and data of a network.
- Then, we saw what a Workstation is. A Workstation is a computer that typically runs a desktop operating system. So, computers with limited capabilities operate a desktop OS (Operating System).
- Then, there is something called a NIC (Network Interface Card). Many of the times you hear this term NIC, it is not the national informatics center, that is something else. This is a Network Interface Card. So, what does it do?
    - This enables a Workstation to connect to the network and communicate with other computers. So, the NIC (the Network Interface Card) is the intermediary in between the Workstation which will communicate to the network. So, the Workstation requires a Network Interface Card to communicate with the network and in that process, it can communicate with the other computers in the network. So, what does a Network Interface Card look like?

So, if you look into this, it can be that this is a coaxial connection. It is very rare now and in the early days used to be very popular. This is the telephone line, the dial up network, old school. Currently we have the Ethernet Cat5 cable. It can have another connection for Cat5 or what he calls the Ethernet cable.

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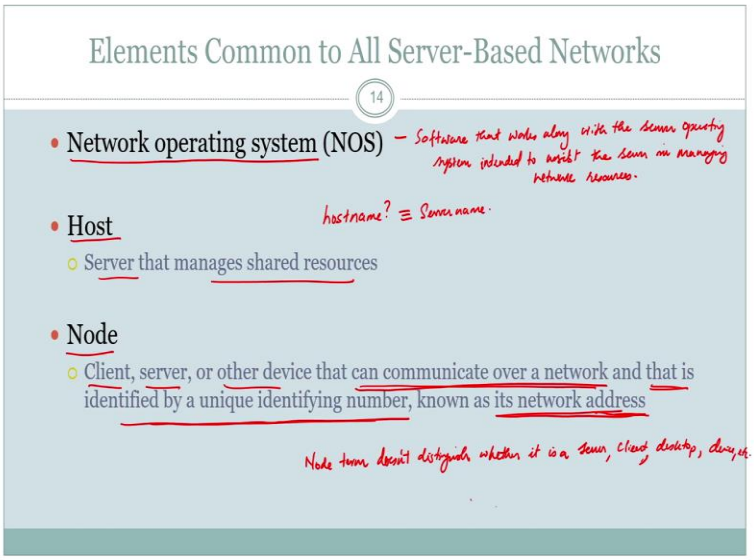

- So then, there is something we talked about: what is the Network Operating System. It is a software that works along with the server operating system intended to assist the server in managing network resources.

So, the two times again, this term also occurs very commonly between Host and Node.

- So, you are seeing another word in some of the script, you said what is the Host name?
  - So, the Host means the server that manages the shared resources. So, the Host name is equivalent to the server's name. So, a Host is a server that typically manages the resources.
- A Node means it can be a client, it can be a server or other device that can communicate over a network. And, that is identified by a unique identifying number, known as its network address. Node does not distinguish whether you are a device, whether you are a server, whether you are a desktop, whether you are a client, etcetera does not matter. It can be a client; it can be a server or neither device. The main aim is you have to be connected to a network, it can communicate over a network, and you should have a unique identifying number within that network known as its network address.

So, if you have an individual identity, a unique network identifying number. And, you can communicate over a network, then, you become a node. Node does not distinguish whether it is a server, client, desktop, device, etcetera. So, it is just something that gets connected to the network with a unique address.

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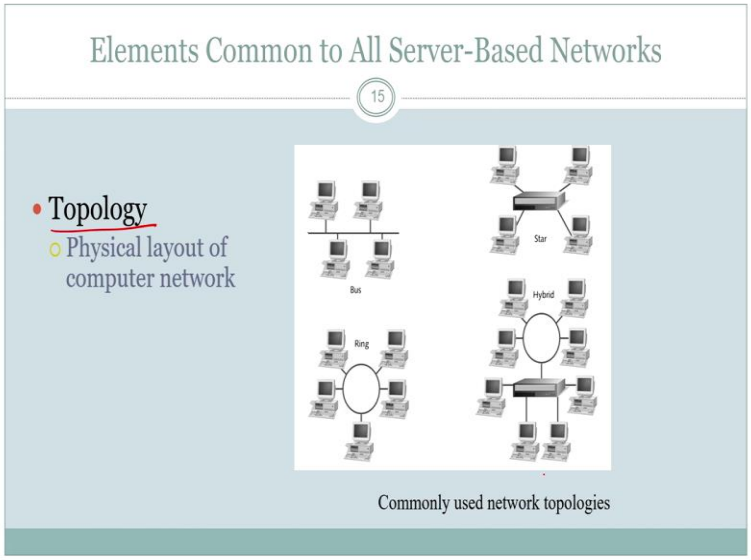

- So, there is somebody who says something called Topology.
  - And, the Topology in the simplest word is again, somebody was asking this question, the physical layout of a computer network. And, we are not going to get into too much of this, but these are the main things I can think about.
    - i) One is the Bus network; Bus network means there is a single line on which things are connected to each computer and communicate over a single connection line.
    - ii) Then, the second one is a Ring, you can think about it as a circular communication channel on which individual computers communicate through this circular Bus or Ring bus.
    - iii) Then, the Star connection is, you need a network, you need a device in between something like an Ethernet port or a switch or something, on which computers are connected to this switch and then, this switch manages the indoor connections in between.
    - iv) And, a Hybrid is a connection of any of these rings put together will give you what he calls a Hybrid network. So, the commonly used network Topologies, the Bus, Ring, Star and Hybrid. And, Topology literally means how the network is physically laid out.

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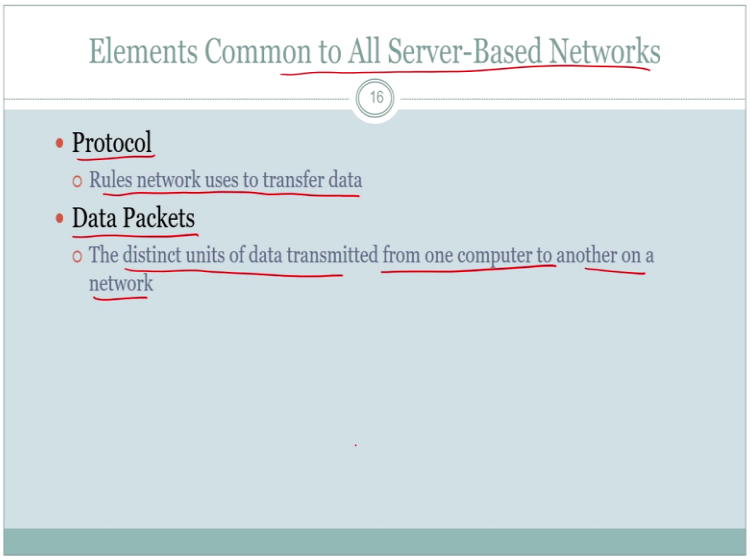

And then, there are two other things that you hear: the Protocol and the Data Packets. I think I used the word Data Packets a couple times in the lecture.

- So, the Protocol when somebody says I am using something specific. These are all common to all Server-based Networks. So, somebody says I am using a TCP IP Protocol, or this Protocol, or UDP Protocol, or whatever it is.
  - All the Protocol implies that these are the rules which the network uses to transfer the data. So, how the data is transferred from one computer to another whether the client to the server or server to the client or server to the printer, it does not matter, how the data is transferred from one node to another in the network, it is determined by the Protocol that the network follows and that is called a Protocol.
- Then, the second one is Data Packets. So, what are Data Packets?
  - The distinct units of data transmitted from one computer to another on a network. So, two computers are connected on a network and the distinct units of data that are transferred between these two computers from one network to another is what we call a Data Packet.

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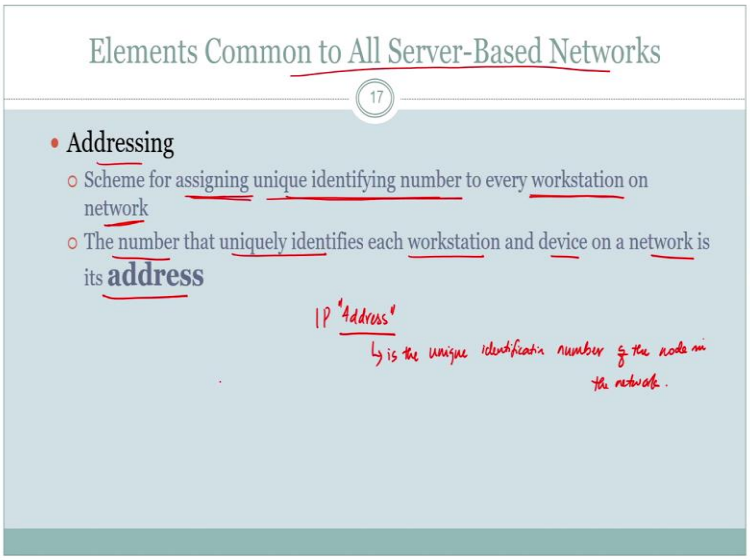

- Then, another element common to Server-based Networking is Addressing. So, what is the Addressing?
  - So, Addressing is the scheme for assigning a unique identifying number to every Workstation on the network. So, you want to identify a particular Workstation in a network and for that you need to assign a unique identifying number. Some unique number through which you can definitely identify that Workstation. So, that is called the Addressing. The addressing mechanism is the process of assigning, the scheme of assigning the unique identifying number.
  - So, this number that uniquely identifies each Workstation and device on a network, is known as its address. So, when somebody says IP address or something like that. This word address is the unique identification number of the node in the network. It can be a client, it can be a server, it can be a printer, it does not matter. That address is the unique identification number of that.

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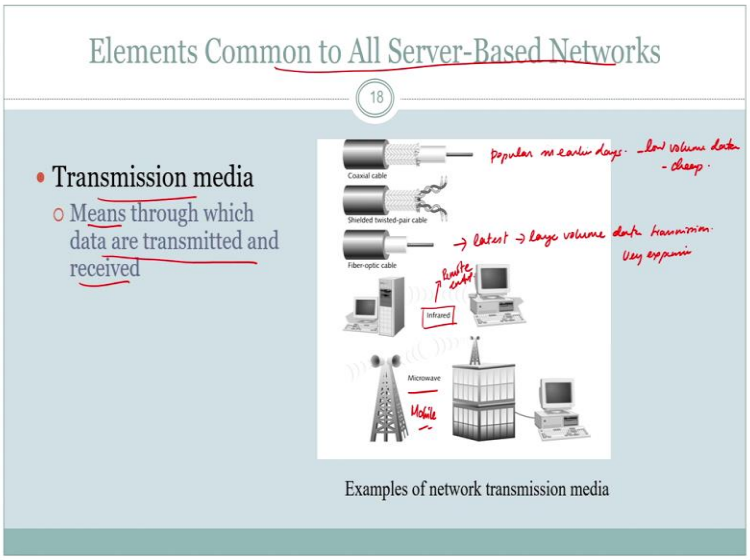

- So, there are some other things which are common to all of them and you need to remember this, common to all network-based systems, Transmission media or Transmission medium, whatever people call it.
- So, the infrastructure, it actually means infrastructure or the means through which the data are transmitted and received. What are the different approaches? There are so many options to this. I am not going to give you too many details, I'm going to give you a simple example.
  - i) The Coaxial Cable, as I showed you earlier. It is no longer very popular but it was popular in earlier days. Shielded Twisted Pair Cable, so, this is also sometimes we can call it Cat. Most of the time people call it Cat5 cable or something like that. So, that is a twisted pair in that regard.
  - ii) Then, Fiber Optics (FOG) somebody says FO (Fiber Optics) Cable. So, that is where it actually can transmit very large. This latest large volume data transmission is very expensive. This low volume data is cheap and think about it that.
  - iii) Then, computers can also transfer data or information through infrared. Like, you can see most of the time the easiest example of this is remote controls TV remotes, you point at the TV and click it. It is actually infrared which actually you can do.
  - iv) Then, you can have a microwave or you know, a tower through which you have your mobile communications etcetera are part of this example. And, these are without any wire you can communicate through radio signals or radio frequencies.

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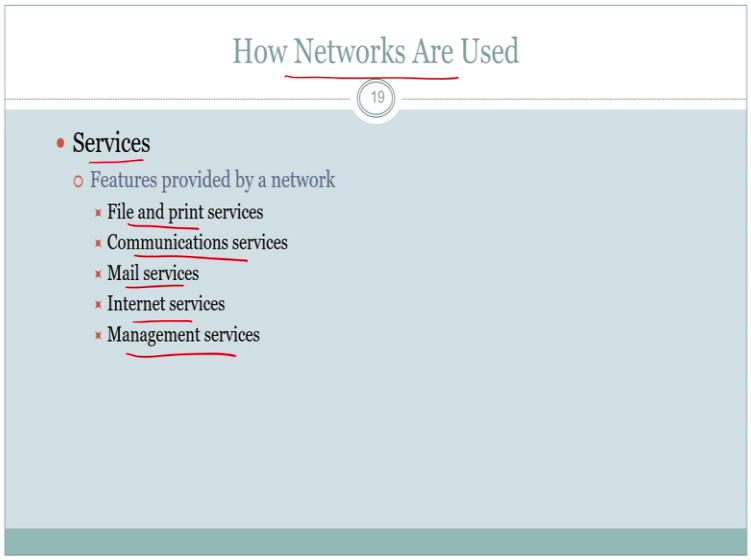

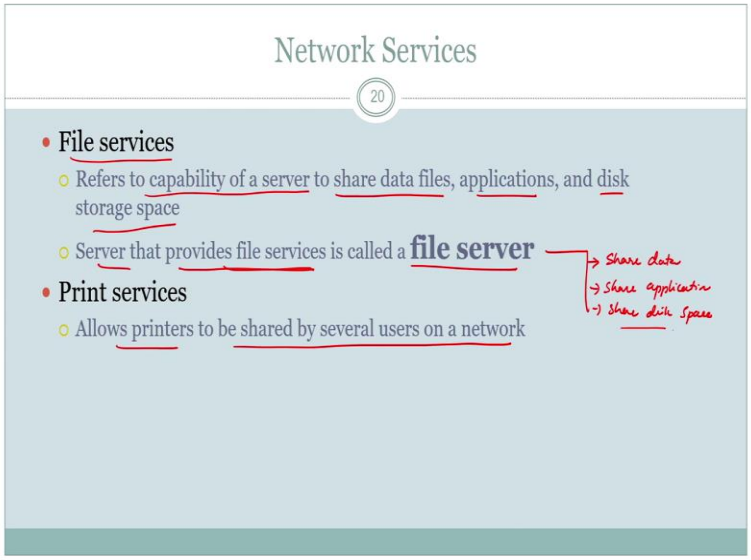

Now, how are networks used?

- And, the main aspect of this case is Services. So, networks as I said earlier, provide multiple services to the users. The main services are the,
- File and Print Services, it can share the file, print, documents, etcetera.
- Communication Services
- Mail Services
- Internet Services
- Management Services

These are the commonly used services as part of the network.

So, the Network Services now let us go through each one of these ones, one by one.

- So, the File Services, one of the major Network Services is File Services. If you see into this file and print services is one. So, what does this mean?
- When somebody says I am using the File Server or File Services, which means it is the capability of the server to share data, files application and disk storage space.
- So, the server, the computer that provides the File Services is known as a File Server. So, a File Server has the capability to provide. It can share data files, share applications, share disk space, or storage space. So, these kinds of capabilities, mostly these three capabilities are what we call the services provided by File Server. So, the File Services when somebody says I am using a File Server, that means the person is either sharing the data or sharing the application, or basically sharing the disk space or storage space.
- Second is the Print Services.
  - Print Services means printers to be shared by several users on a network. So, the server that actually allows for sharing the printer is sometimes called a Print Server. So, printers can be shared on the network.

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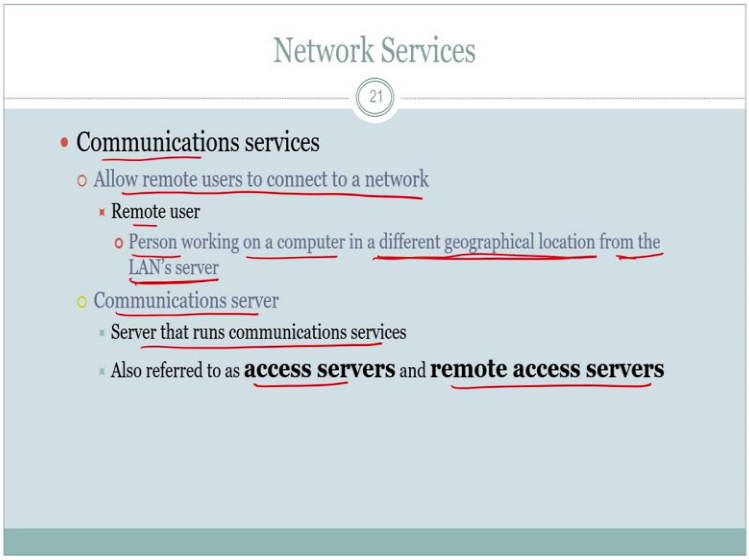

- Then, the second one that we talk about is the Communication Services as part of this, what are the major Communication Services provided?

- So, the main aspect is to allow Remote Users to connect to a network. We told you what the Remote User and what is the network, so, our Remote User is connected to the network.
    - So, what is the Remote User, again, A person working on a computer in a different geographical location from the LAN server. So, you have a LAN server, as I told you about a geographically restricted area, network within that, and the person is working on a computer in the LAN from a different location using another computer. So, that is called a Remote User.
- The Communication Server, the term Communication Server.
    - So, the server or the computer that runs the Communication Services is known as the Communication Server.
    - It is also known as Access Service or Remote Access Service. When somebody says I am using the Access Server or Remote Access Server or a Communication Server, all of them mean the same. The person is interacting with that computer in a different geographical location than that of the LAN server. And, they are using a Communication Server, or Access Server or Remote Access Server to do this work.

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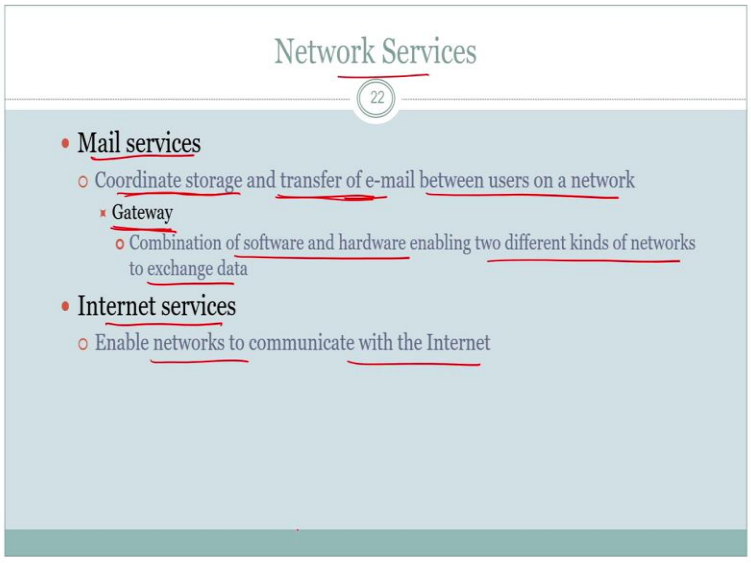

- Now comes, the Mail Services. So, we all know what an email is. So, that is also a critical aspect of a network.

- So, the Mail Services, it includes coordinating the storage and transfer of email between users on the network. So, in IITK, everybody who is a member of the IITK network, they all get an IITK email at the rate IITK.ac.in and that is provided by Mail Server that is in our computer center. So, if the Mail Server stores and transfers email between users in a network.

❖ Then, here is another term that you need to remember. Sometimes you will say Gateway, you will hear this term Gateway. So, the word Gateway intends it to be a combination of software and hardware, enabling two different type networks to exchange data. So, sometimes there is some form of a combination of a software and hardware that will allow two different kinds of networks to exchange data. There can be two different topologies, two different geographically located networks. So, the Gateway is something that will allow these two different networks to communicate.

➢ Then, what do we call the Internet Services?

- So, the Internet Services is something that enables networks to communicate with the internet, that is called the Internet Services.

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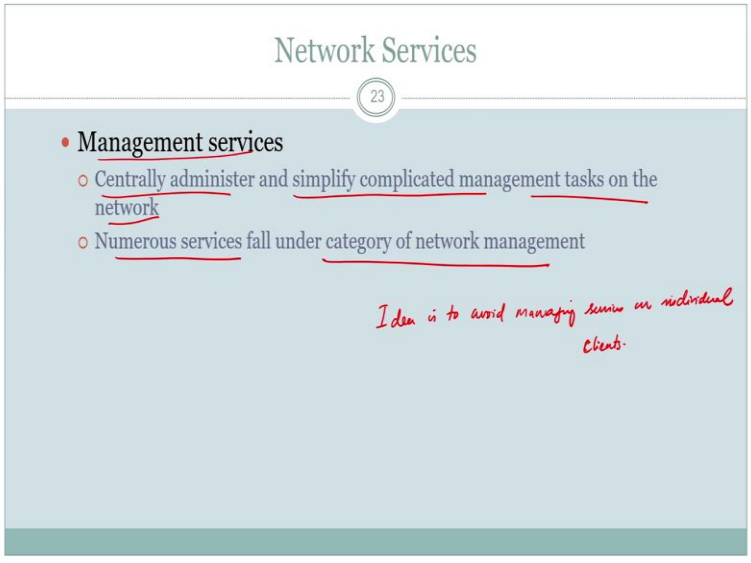

➢ Then, the last one is called Management Services and there are a lot of things that come into the Management Services and many of them are important to us. So, we will discuss some of those aspects quickly, so that you have a broader idea of things.

- So, the Management Services that are administered centrally or somebody does all of this centrally and it is to simplify the complicated management task on the network. So, the idea is to avoid managing services on individual clients. So, we have 1000 computers, there is no point in going to all the 1000 computers and doing it, instead of that, do it centrally. So, that is the Management Services.
- And, the Numerous Services fall under this category of Management Services many of them. So, we are only going to look into the important ones, we are not going to look into the other ones.

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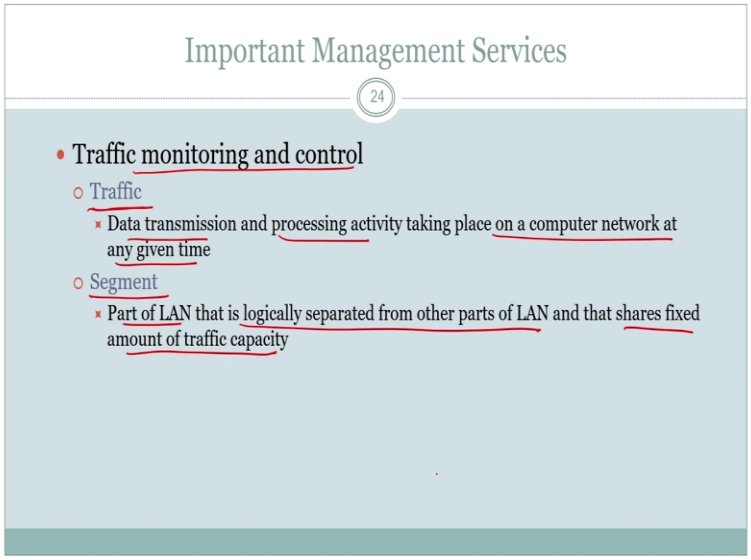

- So, Important Management Services, Traffic monitoring and Control. This is one important aspect to the Management Services.
  - So, when said traffic, it is not the road traffic, it is data traffic.
    - So, the data transmission and processing activity taking place on a computer network at any given time. So, traffic management means to make sure that everybody can communicate data to the server or within themselves without choking because every network interconnection where it is a coaxial cable or a twisted pair or fiber optics, there is a limit to how much data can be transmitted. So, how to manage that, so that data transmission never gets choked, and the

network continues to function smoothly. That is part of the traffic monitoring and control.

- Then, there is something called a Segment.
  - Another term that you will come across and segment ideally is a part of the LAN. That is logically separated from the other parts of LAN, that shares a fixed amount of traffic capability or capacity. So, certain times you would say I want these particular few sections of it to be geographically located separately or it can be separated not just geography, some logic, we are kind of keeping these computers separate out, and they have a fixed amount of traffic capacity, we do not want them to deal with other things. So, those kinds of things are called a Network Segment. Many times, segments are used to manage computers that are meant for.

So, let us say that you have a large network in an office and a small set of computers are there to just do video editing. So then, you can say that they are going to do video editing and they are going to transmit large files and nothing else. So, they are interconnected, they are part of this particular segment of the network. And, this is the data connection capability and that is it. So, although they are originally part of the entire IITK network, they are also a small segment of it.

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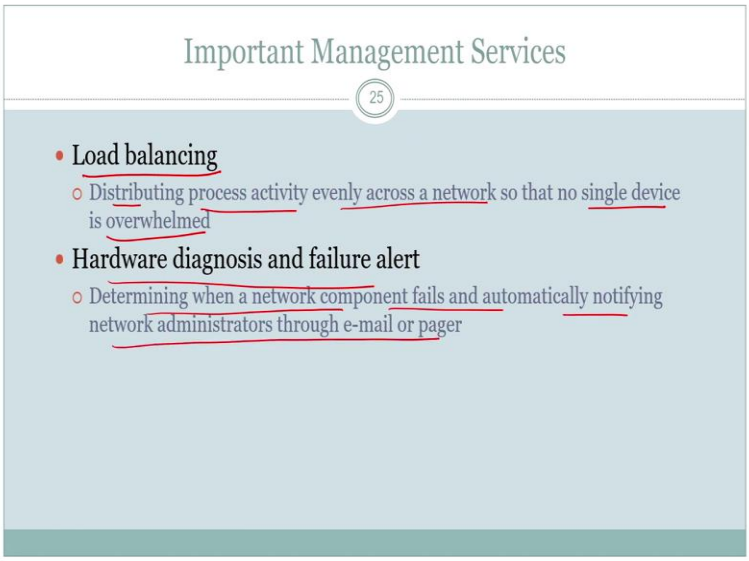

- Then, another Management Service is Load Balancing. Load Balancing is an important service purely because of the aim here is that.

- It distributes the processing activity evenly across the network, so that no single device is overwhelmed. So, let us say you have to do so many things using the network. So, the Load Balancing says okay I have this much computation to do and I have 20 nodes. So, instead of giving all of this job to one computer, it will distribute it among the 20 computers, so that no one resource overwhelms us within the network.

➢ Hardware Diagnostics and Failure Alert is another aspect which means when you have multiple components in a network, you need to know whether everything is connected working or something is bad. So, what does it do?

- It determines on a network whether the component has failed and automatically notifies the network administrator through email or pager. So, it says this particular desktop or a particular node is no longer communicated to us. So, either the network cable has gone bad or the computer itself is gone bad. So, that type of information is given to the network administrator.

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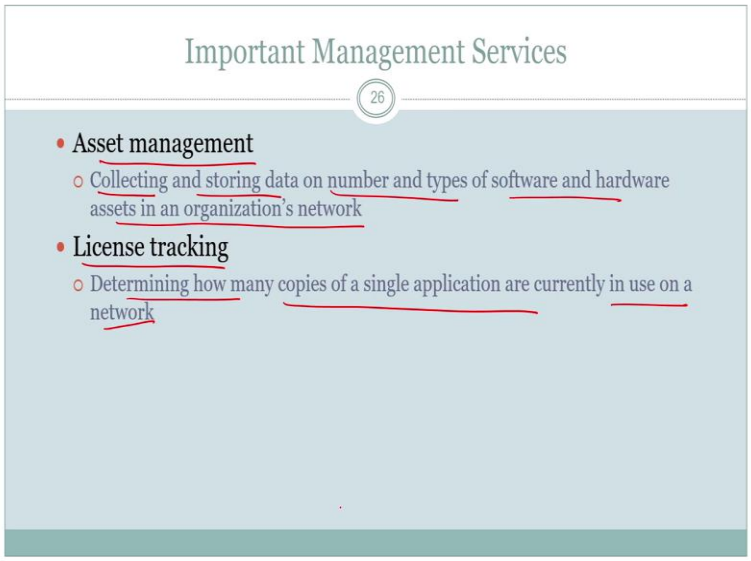

And, then comes Asset Management and License Tracking.

➢ So, Asset Management means that this collects and stores data on numbers and types of software and hardware in an organization network. So, let us say you have this particular type of server, many desktops, many licensed office software, this much of Database

Management System, etcetera. These many printers, these many scanners, this many fax machines, all those things, details of software and hardware, of assets in their organization network. So, it could be a LAN, it could be a WAN, it could be a MAN, it could be a Star, Bus Topologies, it does not matter how you do that, whatever be the organization network, this hardware and software, the types of them, and the details of it, that is kept centrally and then managed. That is called Asset Management.

- Then, the other one is License Tracking.
    - Determining how many copies of a single application are currently in use in a network. So, many of the software has a particular thing called license associated with it. And, these software licenses are expensive and are paid for. And hence, you need to find out how many licenses are being used. So, let us say somebody has created a license of an analytic MATLAB, there are only 15 licenses available. So, we need to know how many users are using it. And, at any point of time 15 users are finished and the 16 people we want to use MATLAB will be told the maximum number of users are reached. And, hence, you please wait until somebody stops using MATLAB. So, that service is also part of the License Tracing.

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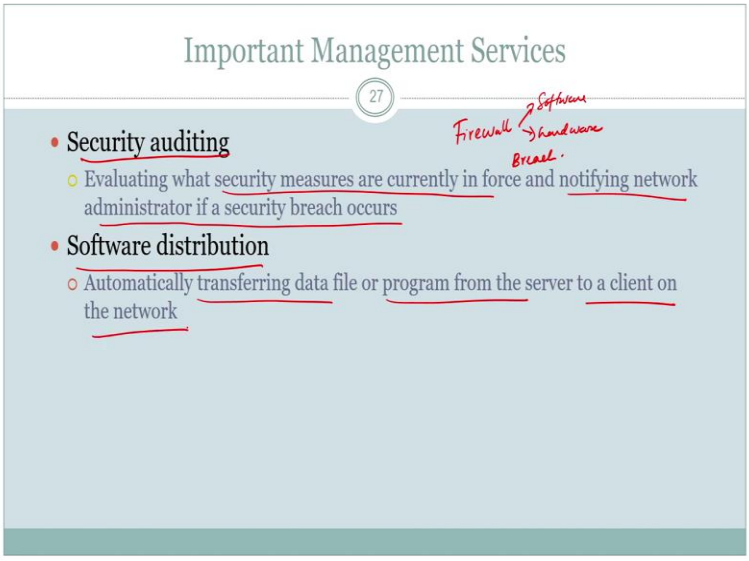

And last, but not the least, you have Security Auditing and Software Distribution.

- So, Security Auditing means the security measures that are enforced in the network. And, whether there is any security breach that occurs whether we talk about terms like firewall, there are two types: software and hardware firewalls. Then, you can also call data breaches or cyberattacks, etcetera, all these kinds of things. Those stuff are all managing, hacking attempts etcetera, are all part of this Security Auditing.
- Whereas Software Distribution is automatically transferring data files or programs from the server to a client network. So, let us say there is somebody who wants to run a MATLAB on a client machine. So, say I want to run MATLAB, so then, the MATLAB files get transferred to that server, no to the server to the client. And, the client runs the MATLAB and everything, once it is done, the files and everything gets sent back to the client as part of finally after that.

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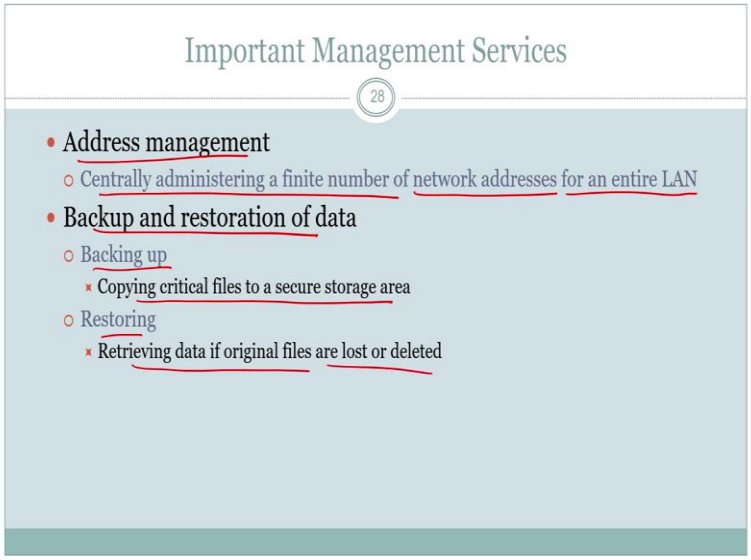

- And then, the other one we want to talk about is Address Management.
    - I told you what an address is. Address means it is each asset of the network that is on each computer, or each node on the network, or the LAN has a unique number through which you can address it, and how to manage that centrally administer that finite number of addresses that are available for a lab is what we calls as the Address Management.
- And then, the Backup and Restoration of Data.

- Many times, your data is also very critical. So, you need to backup data. Backup data means copying critical files to a secure storage area. So, it is creating. So, you have certain secure files in a computer and you are copying that and keeping it in a secure location that is called as the backing up.
- And, restoring means at some point of time, a file is deleted or retrieved or lost, Then, you can go to the backup and retrieve the data that is lost or deleted from the client and bring it back to the backup location. All these are important Management Services.

So, I only covered a few managements or reasons. So, the reason you go with a Client-server architecture is all the client-server architecture allows us to do all these things in a centrally administered fashion. So, as long as you can manage the server, things actually are much easier.

So, when you have a very large organization, let us say Infosys or TCS or something, which has a worldwide presence. It is easier and better to go with the Server-based Decision Support System or Server-based Approach in handling these things than going through something else.

So, with that, we come to the end of this lecture. And, I think we have this course that has helped you and understand the basics of Web-based Decision Support System, why we follow this Client-server architecture, the DBMS and etcetera and stuff like that.

We also have looked into what they call Big Data and why it is called Big Data and what are some of the fallacies of Big Data and stuff like that. And then, Professor Amandeep Singh has taught you other aspects of it. Hope you all had a fun time learning this course. And, in part two of this course we will deal with Advanced Modeling and other aspects of the course using more complicated aspects like Python etcetera. Thank you very much for your patience listening. Thank you.