Computer Networks and Internet Protocol
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Lecture – 02
Protocol Stacks – OSI and TCP/IP

Hello so, we will continue our discussion on Computer Networks and Internet Protocol. So, today will be discussing on in this lecture Protocol Stack or overview of the protocol of stack OSI and TCP IP; this two protocol stack through will be primary following the TCP IP, but just will have a overview of the OSI. So before going into this protocol stack that overview of the protocol stacks, we what will try to look at that a quick we look at a quick quickly look at the history of this internet or internetworking; how it evolved over years type of things right.

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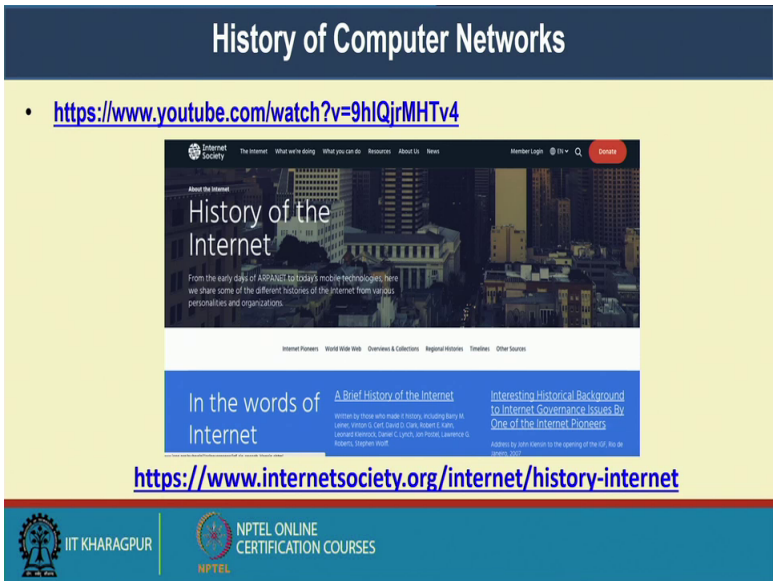

So, if you go to there are two interesting site one is a in a YouTube and also in another site where you get lot of history information, but if we try to correlate from different sources, if you see if you see that the history how this internet came into picture.

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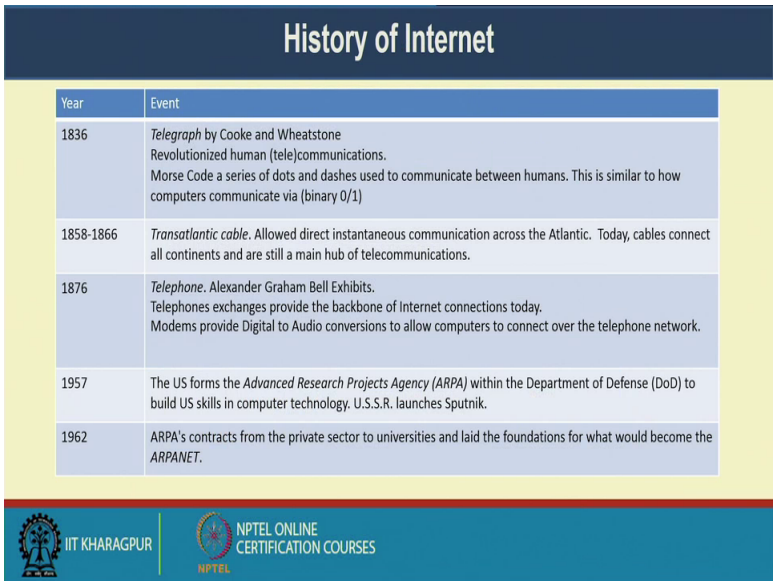

So, we start from 1836 when the telegraph fast telegram message was sent and it has been said that Morse Code, a series of dots and dashes which were used for communication and some what we find analogy with our today's binary 0 and 1. Then between somewhere between 58 and 1858 and 66 so, translating there is a part of trans Atlantic cable.

And if you see today also this huge sub submarine cables primarily forms the major backbone of the data communication part. And in then came telephone lines which revolution is our way of connecting things and if you see that our earlier network connection, these days also there are connections which pg back on this primarily used this telephone line as a physical layer. And then gradually somewhere in middle 1950's or 1950 around so, U.S. form that Advanced Research Project Agency or ARPA. So, this is one of the major state under department of defense which was there and there was a there was a parallel if means what I should know that is not on the network phone, but at the around that time USSR launched sputnik. So, some sort of a there are there are reports that there is a some counter or some parallel efforts was there.

Now in 1962 this ARPANET was found which primary aimed at finding a network which will allow some sort of a resilient and reliable connectivity during very extreme situations right. So, there is the major thing.

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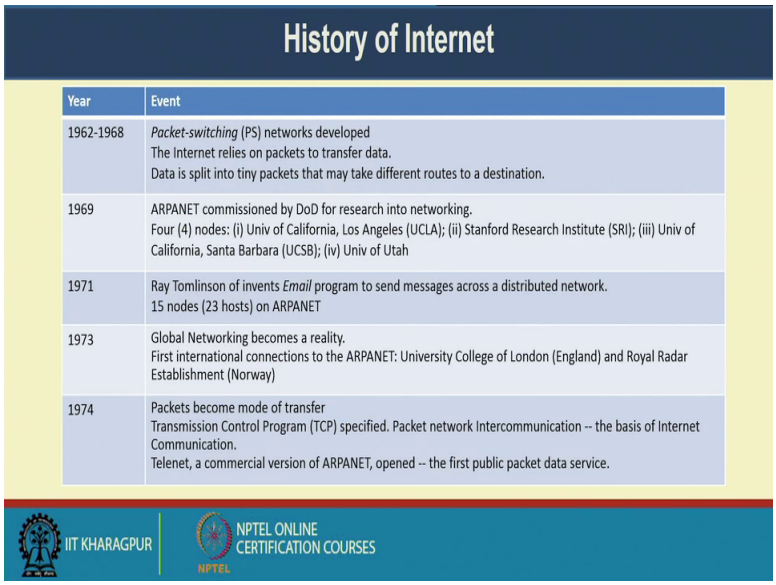

And we see that in around 60's early 60's the Packet-switching network develop. So, we will discuss about circuit switching and packet switching in our subsequent lectures. So, it was developed where did I split into small packets which may take different routes to the destination. So, the it will follow different routes to the destination, but data is more packet and that the union or the all this packets are primarily at the destination or intermediate things intermediate devices or product also will to continue.

In 69 ARPANET commissioned by DoD for research primarily what does research network where four major us university came into picture like university of California at Los Angeles like UCLA that is Stanford Research Institute and then UCSB and university of Utah.

So, this is the major four things came into play and it what we see it, it gets a open research motivation other things right. So, long it is under the department of defense, it is more of a what we say secured type of things, but here its gets a more university flavor where the number of research efforts were came into play right. And then what we see in 71 that first email program was transmitted, it seems that the first program was the first row of the alphabet in the typical QWERTY keyboard and with 15 nodes or with 35, 23 hosts on ARPANET.

Then in 73 global networking became some sort of reality connecting in England and Norway. So, it is some so as sort of across country or across continent.

In 74 this package become more mode of switching that there is evolution of transmission control protocol and other things came into play right.

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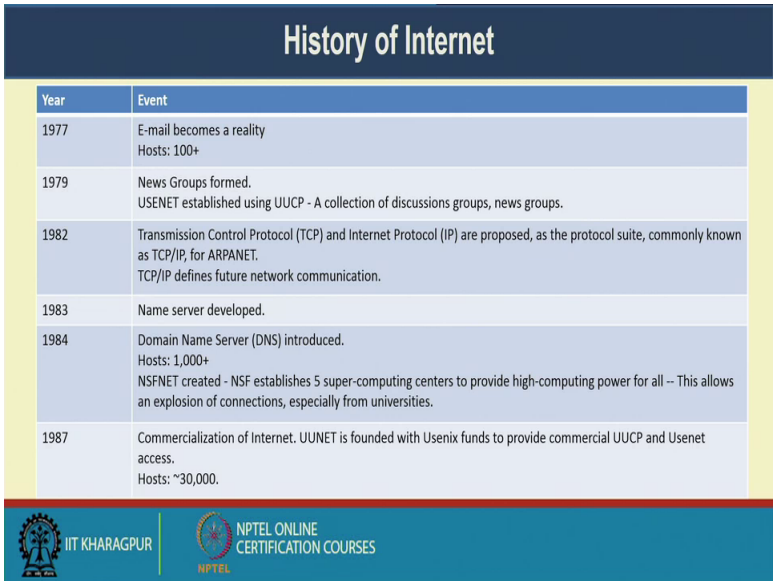

And 77, what we see that number of email hosts become email is really reality, there were host where 100 plus host were communicating and there was steep increase after that on overall efforts, 79 news groups are found. 82 TCP IP protocol was proposed for ARPANET. Then there is a major development in 83 when name servers are developed like it is it was becoming difficult to remember the IP in numbers and etcetera, so name servers develop. In 84 DNS came into play; number of host process 1000 by 87 it cross 30000.

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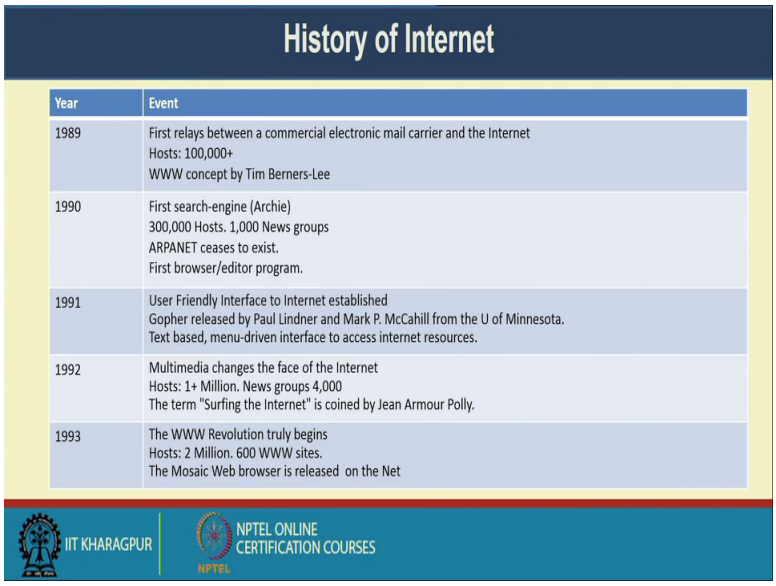

Then we see gradual increase 89, primary this is our omnipresent dub dub dub or WWW concept was coined by Tim Berners-Lee. So, in 90 what we see in first search engine what was proposed and number of host was 3 lakh plus around 1,000 newsgroups and at the same time ARPANET was cease to exist officially or it where it went to a distributed development mode and there is no practically that what we say existence of ARPANET it was not there. In 91 develop user friendly use interface for internet primarily go for some of you might have heard about it released by was released and text based, menu driven interface axis of internet resources was possible through go for.

Then 92 was a more multimedia came into much into play and so called quote on quote Surfing the net was term was coined. 93 onwards truly this WWW revolution begins number of host cross millions and Mosaic web browser on launched right. So, then onwards what we have seen as a phenomenal growth with different type of applications different type of content and so and so forth.

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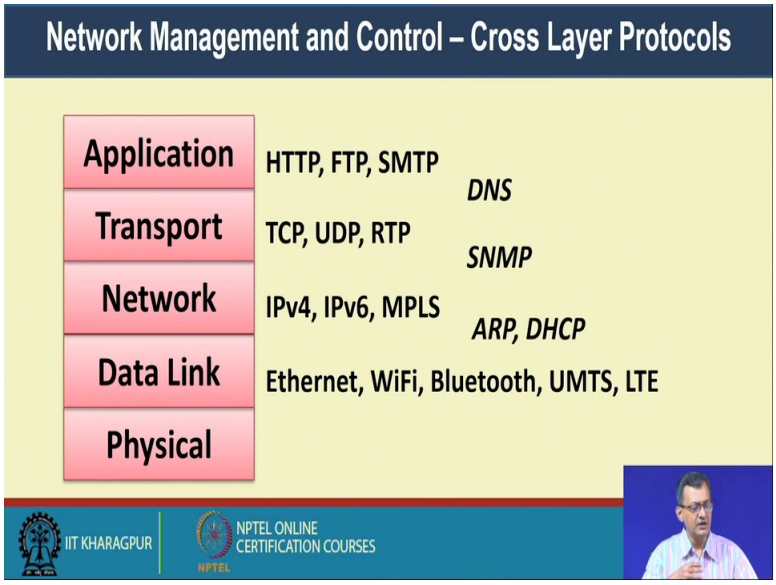

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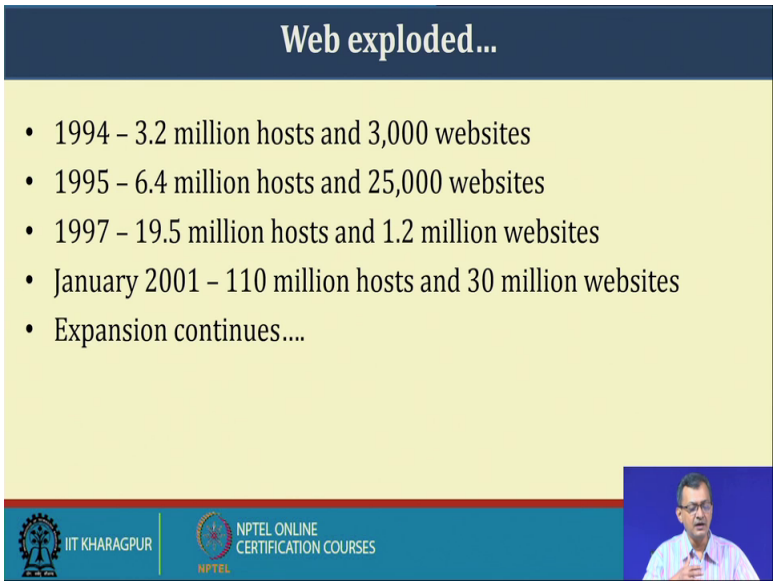

And if we look at some of the things like if we look at that is web explosion; say 84, 94 it was around 3.2 this are from different internet resources.

So, means I do not claim that all are pretty or authentic to the last bit of the number, but it shows that how things grows in a big way. In 95 it was 6.4 million, 97- 19.5 to in 2001 it is 110 million hosts over 30 million website and so on and so forth and this expansion continuous right. It is a expire it is a exponential or expensive.

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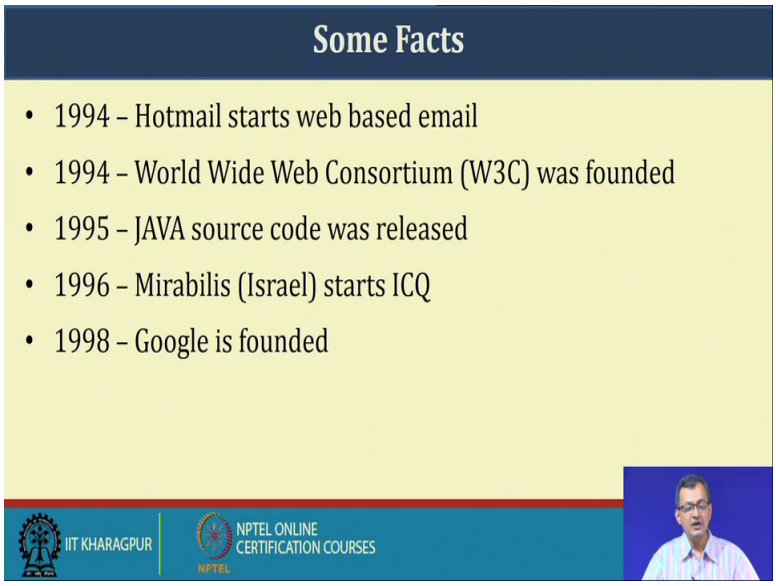

Also there are some other things like 94 hotmail came into picture W3C was founded in 1994. 95 JAVA source code was released and what we see that there are other stars ic ICQ or I seek you type of application in 96 by Israel and then 1998 Google was founded. So, these are some of the milestone we shows that that not only that growth of the things, the overall interest of the human community at large to us the to us the internet this internetworking.

So, we just try to come back where we started from. So, this is a brief after this very brief history that how things are there; what we see now it is a huge volume of applications right or huge volume of applications on the net. The some of the applications if you see they are pretty sensitive born error some of the applications are pretty sanative on time, some needs more data to be handled, some needs more accuracy and type of things and this application form anything and everything feasible for our from day to day life to scientific application and so and so forth right. Rather what you what we see for this typically for last one decade or so, with the different service services or internet bit services being enabled or whole scenario or information system design is moving towards is a moves towards a what we say service oriented architecture. This network became a major thing to be considered with cloud high performance computing coming into play so, there is overall backbone network plays important role.

This any interruption of the network will make the not only make us difficult to communicate, but several industry several industrial processes will come into a stand steel. So, it becomes a extremely it is extremely important to have these networking place.

So, as I was mentioning in our earlier lecture early lecture that we like to see that that what are the basic protocols, what are the basic processes, methodology, algorithms at the behind this overall networking right. The there is one of our there is a our major goal of the things.

Now if we just again recap from our earlier talk like we primarily have protocols stack right, we discuss about this will again little bit review on the whole thing. So, there is a physical layer, data link layer, network layer, transport layer, application layer right and it is not necessarily all devices should many faced all the layers right that also we have seen right.

So, in other sense the application layer at the top is basically the applications what we are working with. So, the application layer is the output of the so, called application layer is piggyback or became a payload of the transport layer. The output of the transport layer or will become a payload for the network layer and subsequently payload for the data link and then it is a physical layer and the physical layer takes care about the physical communication between two nodes right between the two nodes like. So, it can be somewhere where wireless and different type of technologies coming into play. So, that is that is the basic bottom line of the things.

And if you look that different type of services then the popular services; so to say HTTP, FTP and SMTP are the very popular services at the application layer, not only that if you look at our these days several web services this basically piggyback on this sort of services. So, this above application layer right. So, they use application layer like HTTP protocol is being used to carry some sets of messages or type of things right.

Similarly at the transport level we have TCP, UDP, RTP some are connection oriented, connection layers, real time protocols.

Then at the network layer we have different protocols like IPv4, IPv6, MPLS; these are the very prominent protocols. Data link layer, Ethernet is one of the major protocol Wi-

Fi, Bluetooth, UMTS and LTE and other protocols which are there and a physical layer is basically the physical connectivity and it goes on the communication system processes and methodology and technologies. There are some of the protocols has we discussed like DNS Domain Name System or SNMP for management protocol or ARP and DSCP for some of the anti-resolution protocols. So, these are the protocols which are somewhat cross layer protocol right. They exist between two layers. So, they basically interfaces between the two layers right.

So, will discuss this things in details in the subsequent lectures or some subsequent talks, but this is our all in campus a in compressor this things. So, we will be mostly hovering around the TCP; primarily looking outer this major protocols and of course, opening of that what are the other protocols and other things etcetera.

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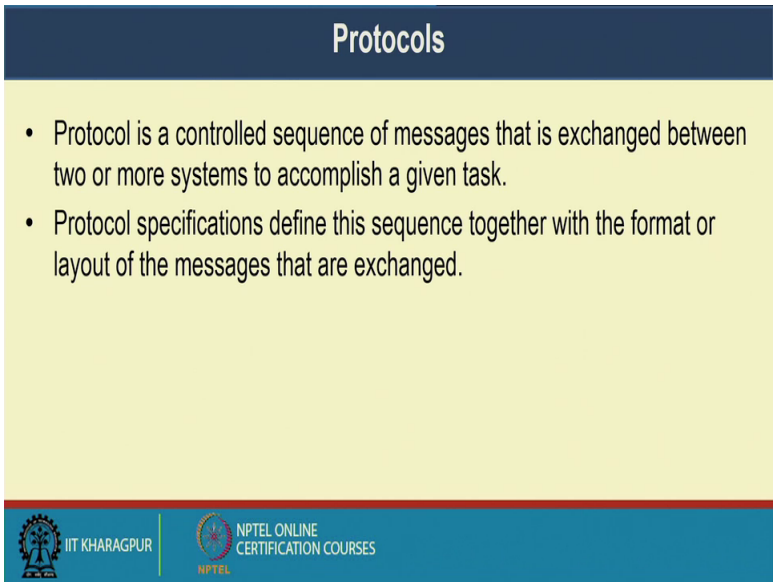

Now, if I as we are discussing about protocols; so what is the meaning of protocol right, what do you mean by when it is protocol it maybe for networking or any other aspects also we say that the protocol to be maintained at the set of audit. So, protocol is a controlled sequent of messages that is exchange between the two or more system to accomplish given task right. So, when I say that I do FTV communication, I do a SSH communication I do a STDP or a DNS system resolution DICP. So, I do a control setup messages right so, that where between two party or multiparty to accomplish given task

right; so, some maybe downloading some documents or some maybe resolving some network configuration IP address and so and so forth.

Protocols specifications define this sequence together with the format or layout of the message that are exchange right. So, the so one is that protocol is a set of messages to be exchange and there is a protocol specification that the what message, what is the specification, how many, what is the size, what are the different fields of the message those are specified define. So, define is the sequence define this sequence together with a format or layout of the message that are exchanged.

So, that the other party on receiving the message can basically receiver based on the specification of the message like I say if I send a particular a DCP packet, the DCP receiver can basically open the packet and it knows that these are the wait is sequence similarly for any other protocol. So, that that makes this what we say interoperate between variety of things like if I say that I am following so and so protocol, then I am done with the things that other things. So, I say I am following so and so protocol and then the other end basically only understand the specification no need of any understanding separately knowing that what is the format etcetera that is that that the that exactly tells to do.

So, this so, whole any this sort of distributed, loosely coupled and autonomous systems or autonomous systems and services when they communicate this protocols played a primarily a very important role.

So, in this is basically in this course we try to look at look whole thing in terms of different internetworking protocol which makes it possible to communicate between any two devices over the network.

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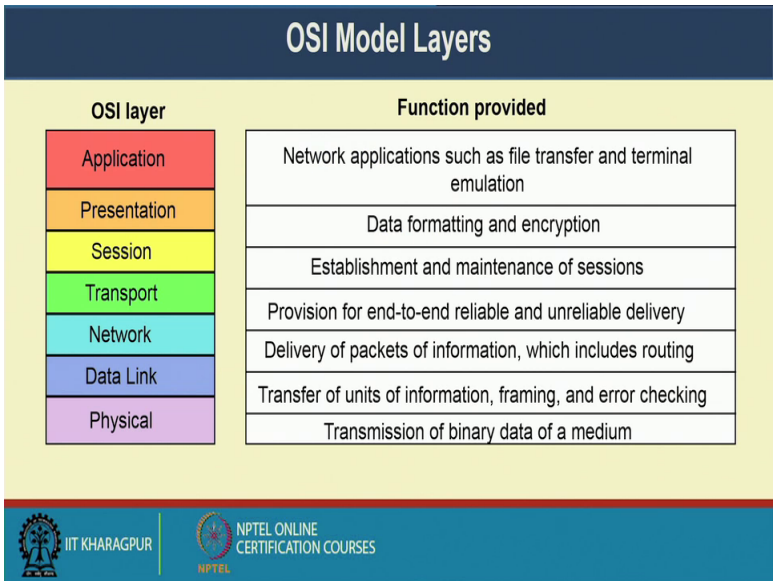

Now, one of the very measure effort was made to define the protocols in a bigger in a more specific way that is the what we say OSI model of model layers of the networking. Unlike our TCP IP things were which is a five-layer stake in some cases; there are they considered as a full layer stake will come to that, but never the less it is a five-layer stake, OSI is typically seven less ten right.

So, it is it has physical data link network transport session and presentation additional things what we see here and the application. In the TCP IP also this things are there, but they are marched with the other layers right. So, physically primarily has we are discussing transmission of binary data on a over a media right; so, this is a things. So, when I gets say digital or binary data which is carried over the media. Data link is a transfer of units of information, framing and error checking. So, this is the data link layer consideration, primarily one of the functions which it does.

Network layer primarily involved for delivery of packets of information which includes routing right rather what will see that network layer it is what we say it is not a reliable layer. So, it is a it delivers packet in a unreliable way means that is reliability is not guaranteed whereas transport is a provision of into and reliable and unreliable delivery both right. So, through transport they are 6 over network layer, it has the protocols supports to for a for giving a provision for end to end reliable service or in case of unreliable services right.

Session establishes and maintains session so this is a session layer which establishes and maintenance session presentation is data formatting an encryption if any. So, that it takes care application is network applications are just file transfer terminal emulation and so and so forth so all type of application at the application layer. So, this are the primarily this seven OSI, Open System Interconnection model for networking which takes care of every part of the things.

So, every network device will have all or some of this layers right. It is not necessary that all will be enabled like as you are talking that (Refer Time: 20:40) to switch is up to enable up to layer 2, l layer 3 switch is up to layer three and so and so forth so; that means, it is it is it can have one or more layers or all the layers in some cases. So; that means, it allows it to the things.

As we are discussing just discussing that packet of the application is piggyback is become a payload to the presentation which in terms become a payload to the session and so and so forth. Finally, can I get the physical layer to the other end.

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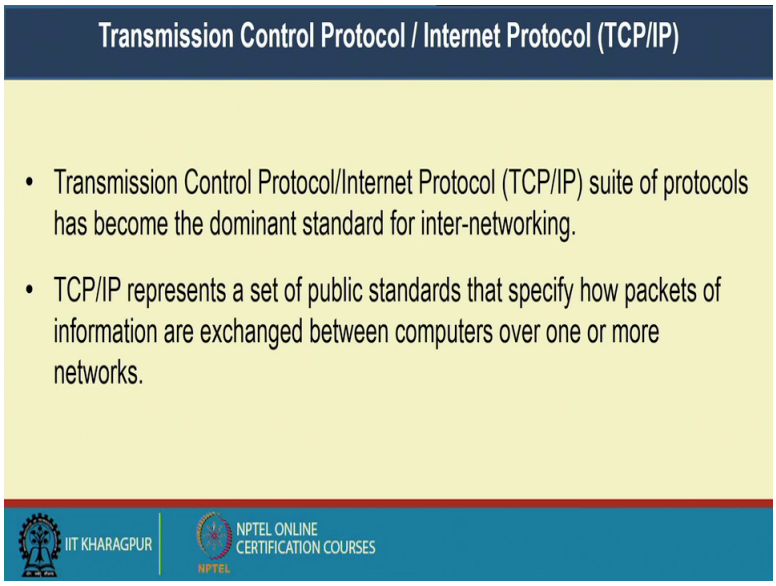

So, TCP IP on the other end is one of the very promenade protocol which is being started long back and being used or being followed in different in different type of network enabled devices. So, it is says suite it is a suite of protocols that become the dominant standard for internet working right. TCP IP present say set up public standard that specify how packets of information or exchange between the computer of one or more

networks right. It is not only confining the one network it can be between any two system in between any two network.

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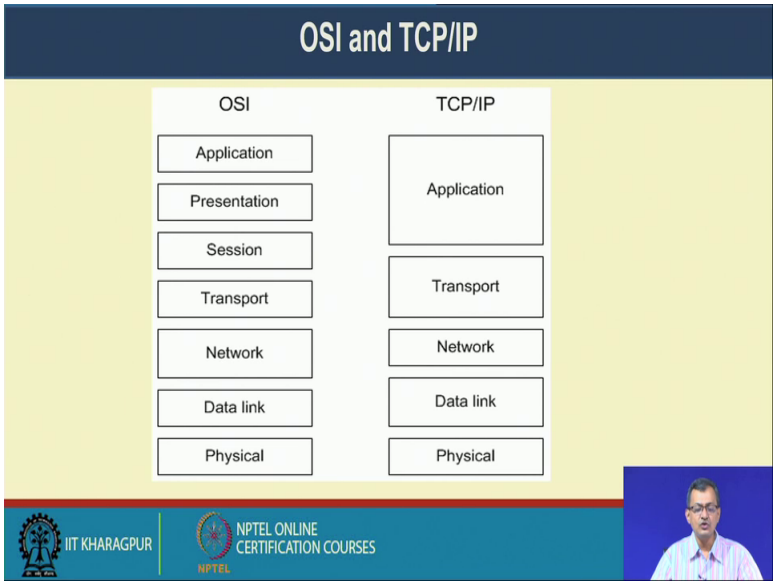

So, if we try to compare these TCP IP, so somewhere we try to match like this like physical data link networking etcetera whereas, transport of the TCP IP takes a little bit of the part of the session and the transport where as the application takes care presentation and the application and maybe little bit of the session layer. So, this is it is it is not like that something is left out or something new is there, but TCP IP is somewhere in between.

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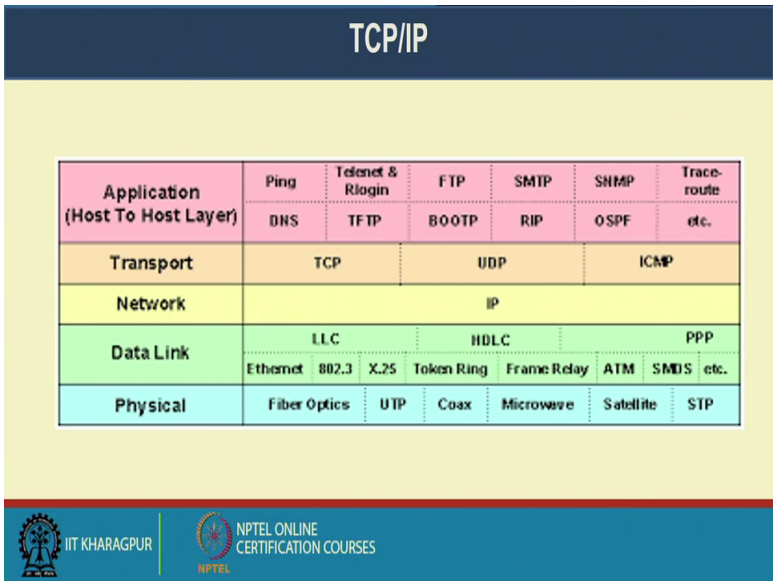

And if we look at the different type of protocols which are supported by different layer of TCP IP are verity protocol, these are some of the what we say standard or values protocol there can be other protocols at so and so, forth like data link layer that can be fiber optics it can be UTP, CAOX, microwave satellite STP and type of different type of links layer whereas data link layer there are there can be different other things like Ethernet which or (Refer Time: 23:01) 802.3 standard or X.25 token ring frame relay are different sort of protocols.

In networking with TCP IP the networking is over IP. So, it can be IPv4 or these days IPv6 transport TCP, UDP ICMP and this sort of protocol whereas application has a big bunch of protocols right it can be variety of protocols. There are issues of which are intermediate protocols were which are between the different cross layer protocols etcetera, but that is some views so of this TCP IP stack.

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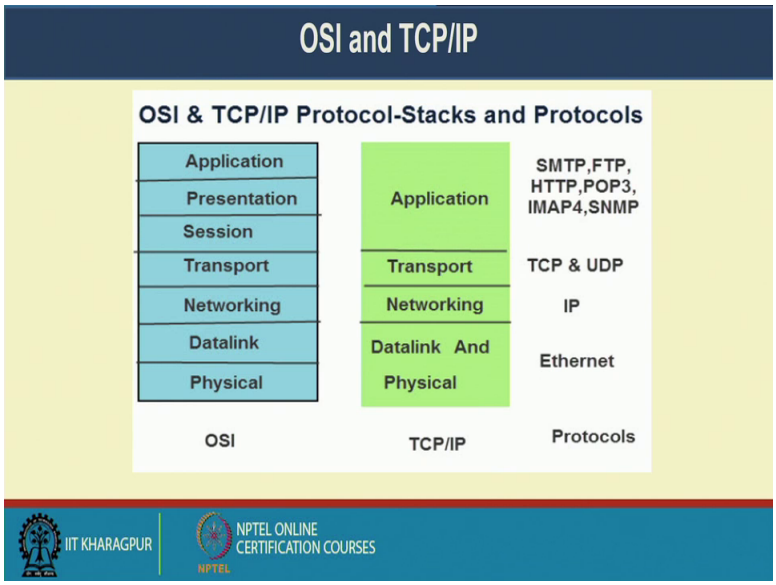

Similarly, if you try to look at some other way of looking at it like this is other way of as mentioning that some places it is considered as a four layer stack instead of data link and physical TCP IP considered as single layer stack.

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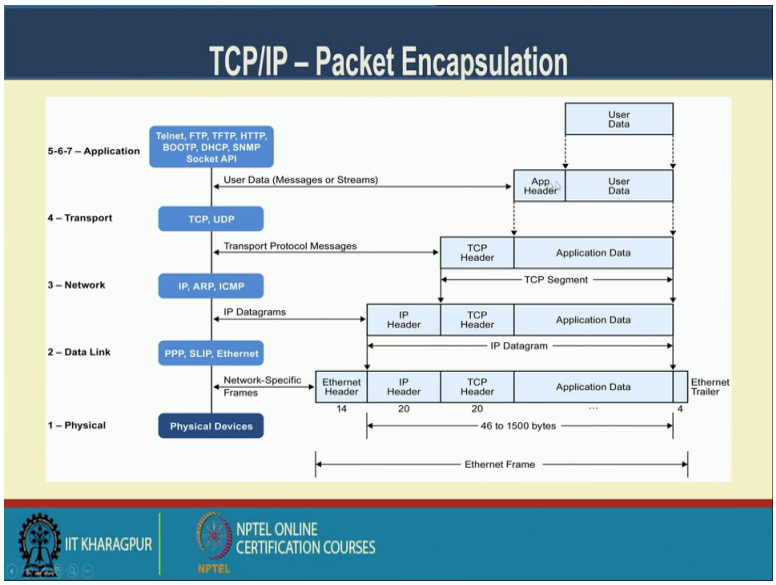

So, as we are mentioning that use at data at the top is became is becomes a payload for this next layer right and with the application header it is it becomes a application data which is a payroll for the next layer, which becomes a payload for the which in turn the whole thing become a payload for the next layer and so and so forth. Like at the physical

layer Physical level this whole data is transmitted through the underlining physical channel right.

So, we will try to see that different protocol structure and what it sizes including its payload wherever this it is applicable right in this particular lecture.

So, why different type of things what we are looking at because in different books different internet resources you will say that different representation. So, I thought that I will try to get will put some of the things; so, that we should not get much confused with the things.

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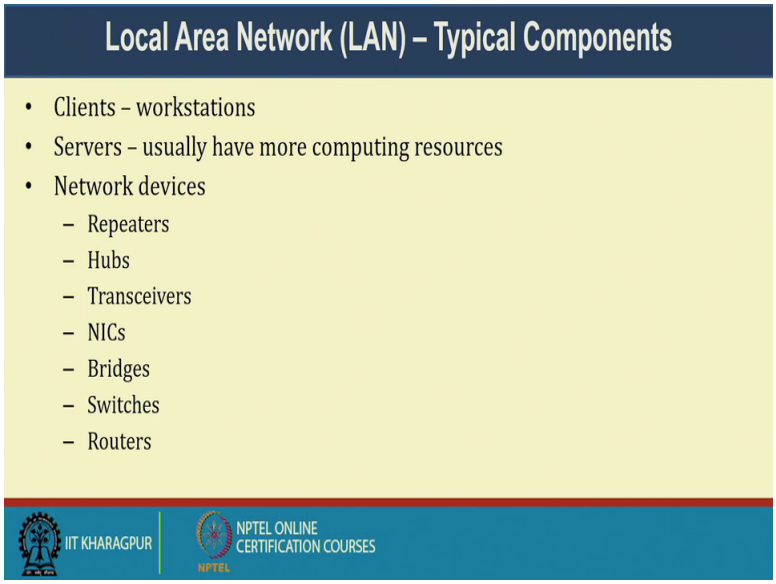

Now let us consider a typical local area network right. What are will be the typical component? There are clients, there are servers right. So, client is servers are severing for some application or something like there is a FTP server, FTP client; HTTP server or sometimes we say it should be demo it should be decline like what we use on the browser at my end is http server, if I accessing ITKGBSC dot in. So, it is a it should be server is there from I am http client, my browser is http client.

And if you look at the network devices, there are several devices repeaters, hubs, transceivers, NIC's, bridge, switches, routers; this are the different type of devices we have to see which are at different layers like repeaters and hubs primarily at the layer one whereas, when I see bridges layer to switches layer two and outer cense so forth.

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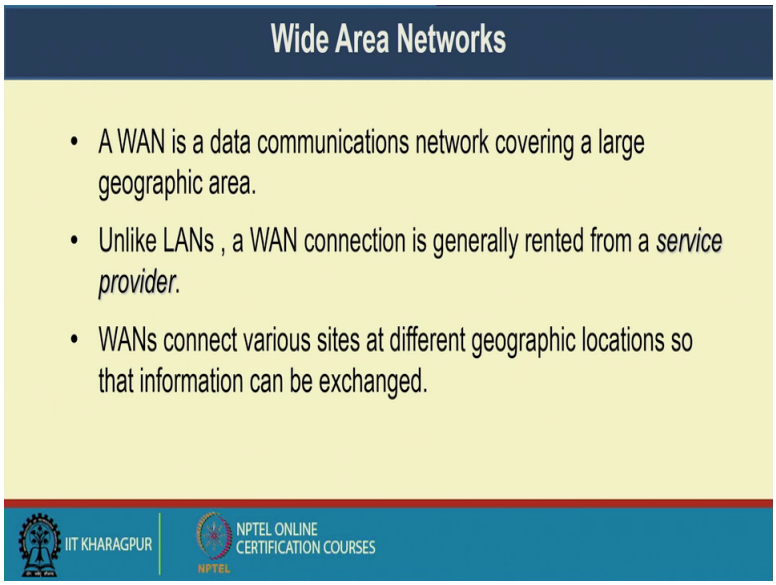

So, if I and there are there is a concept of Local Area Network, Wide Area Network we like to see look at it. So, a WAN is a data communication networking covering a large geographic area. Unlike LAN's a WAN connection is generally rented from a service provider so when you go for a WAN connection, it is from the service provider. WAN's connects a various sites at different geographic locations so that information can be exchanged.

So, what? So, there is a concept of wan and LAN primarily that way of handling will be different, but never the less the devices etcetera or the way the protocols works remains same.

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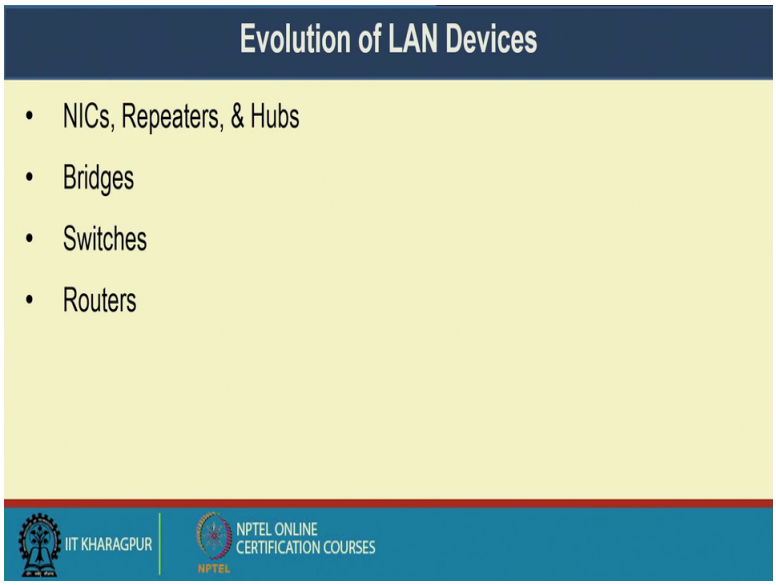

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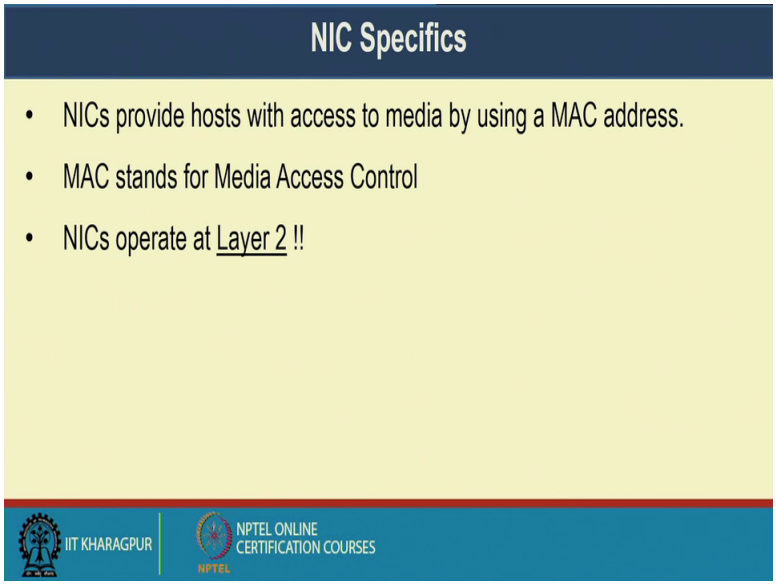

Now, if we that so it is a layer 1, layer 2, layer 3 and type of devices. So, let us see that what so, NIC typically the network interface card which what we are having in our all systems laptop, pc etcetera are basically having as a layer 2 device. So, it is having MAC address or sometimes call hardware address which is with that interface card right.

So, it is a unique address so called unique address which is given by the from the (Refer Time: 27:27) or the manufacturer right there you may there are way to spoof etcetera that

we are not going to those business, but we considered that MAC address is a unique address given by the hardware address given by the things will come to those things.

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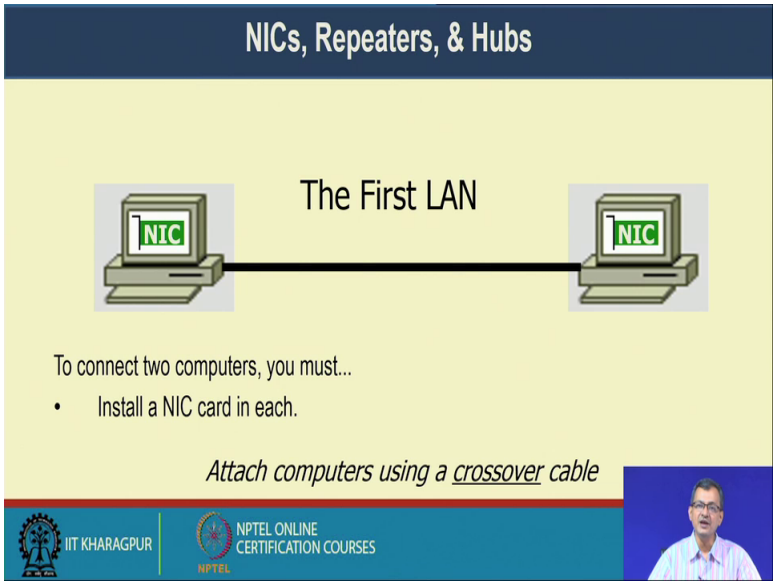

So, if I have two computers with NIC cards, the first LAN how to connect is connect to in kind of either cable; only thing that should be a crossover cable; that means, the transmitter or TX of one should go to the RX and RX of the others should go to that TX. So, it is a crossover cable or what sometimes what we say cross cables right.

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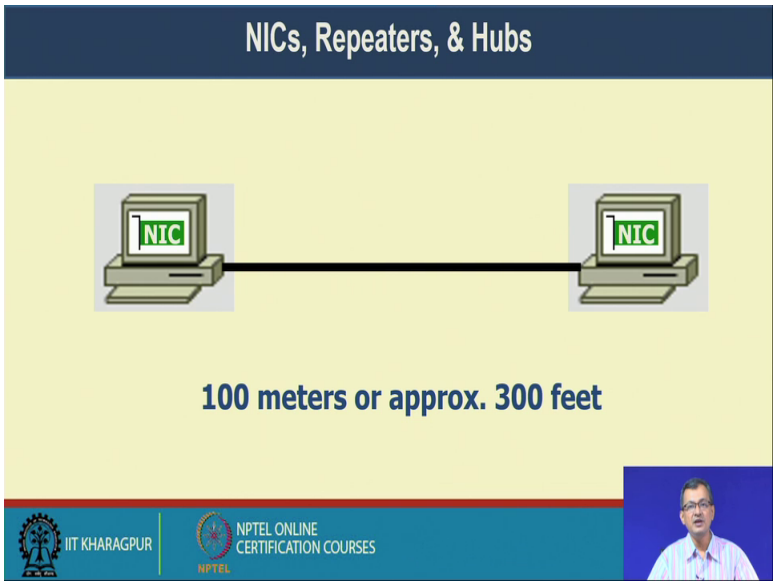

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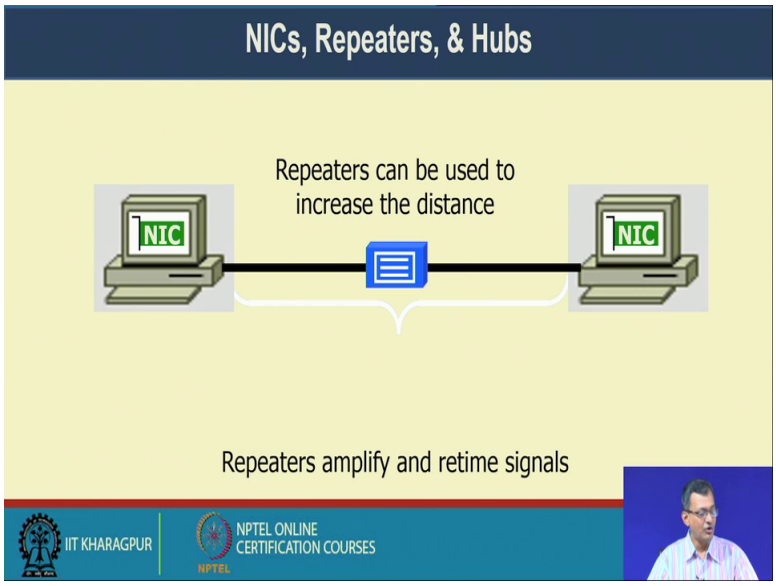

So, if it is typically can connect 100 meters things at a that maximum thing it maybe little less than that and if I have to go more than that I require a some repeater or which amplifies the signal right.

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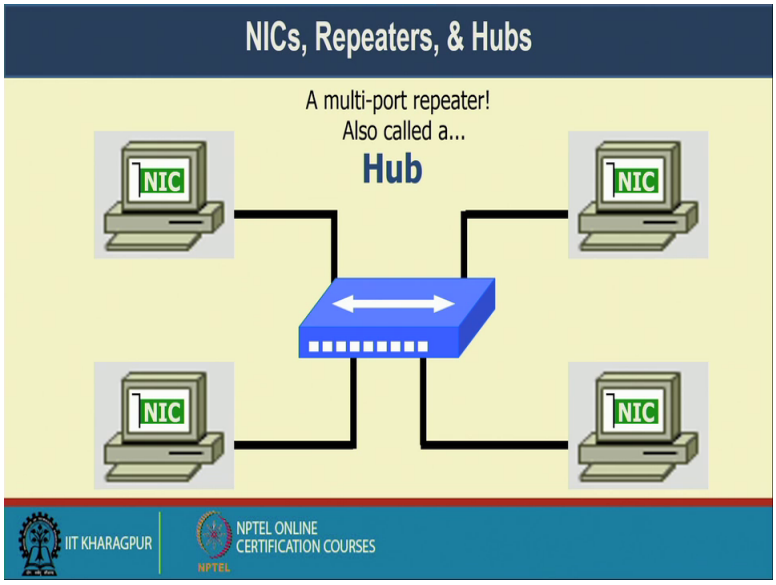

And if I want to connect more than two things, then I require a multiple repeater or popularly we called as a hub these are all layer one devices. So, it is only amplifying the signals and type of things right.

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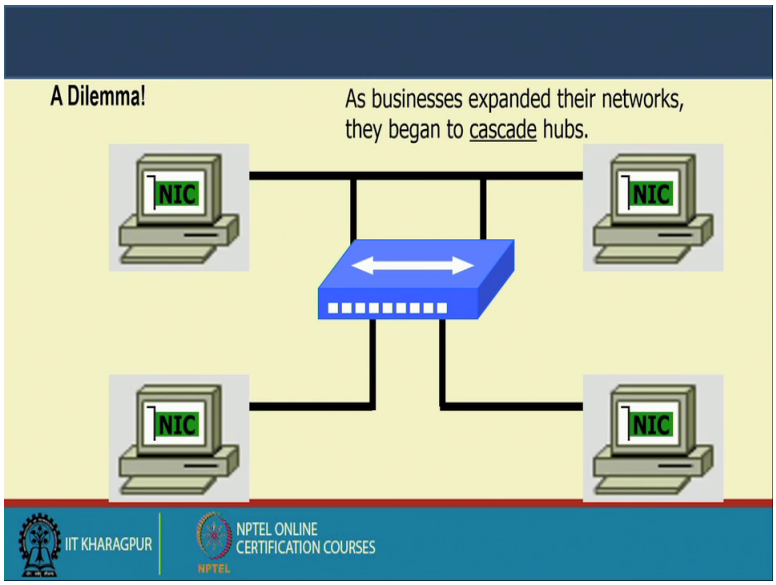

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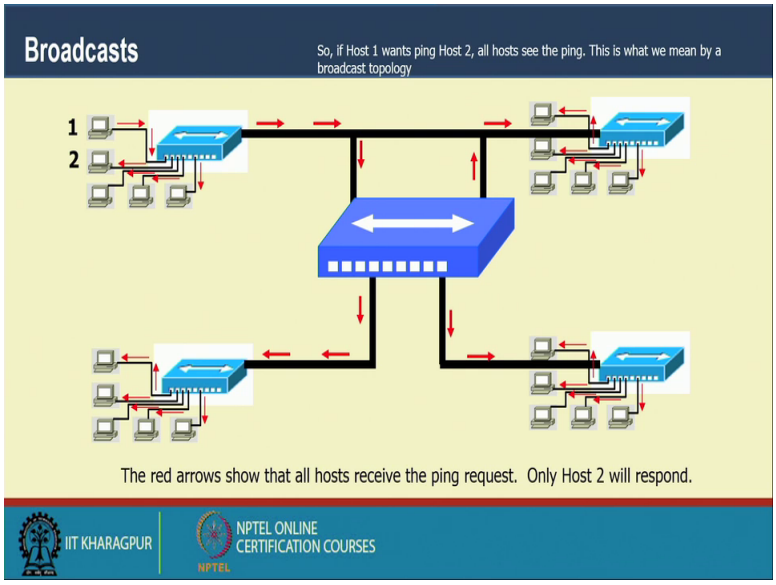

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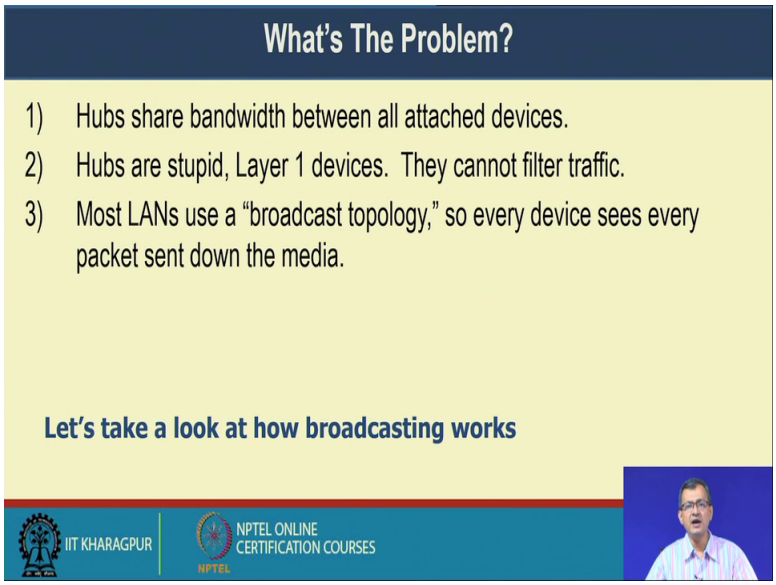

And if the business expends and I have cascade of things right; so, one repeater another half again half and go on expanding. So, what it happened that the problem is that the hubs share bandwidth between all attached devices like typically if we say if it is a set 10 mbps hub with 8 pores. So, effective bandwidth stand by 8 right. So, it is what we say that what scenario will come like that. So, hubs are layer 1 devices cannot filter traffic most LAN's use broadcast topology. So, every device sees everyone and is like if there is a communication is there so it is everywhere the things are there. So, there are lot of pollution and there are lot of things though only one is sending to two only two should expand, but all will getting the pollution things.

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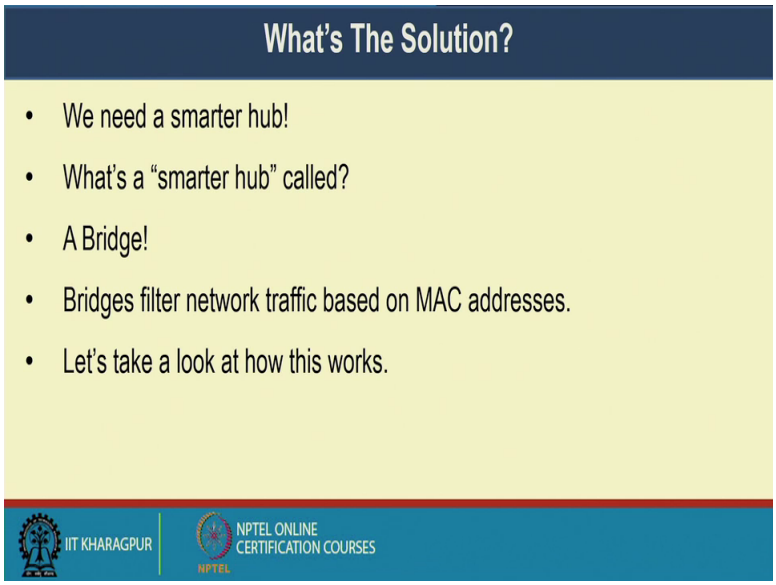

So, the solution is whether we can have a smarter hub or bridge. So, bridge filter traffic based on the MAC address; that means, as every NIC have a unique MAC address or every system has a unique MAC address. So, they filter traffic based on the MAC address. So, how it looks like?

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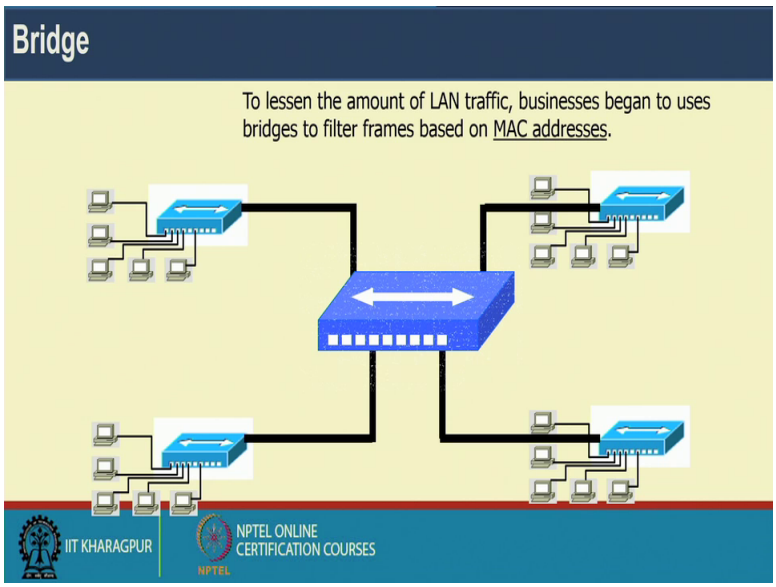

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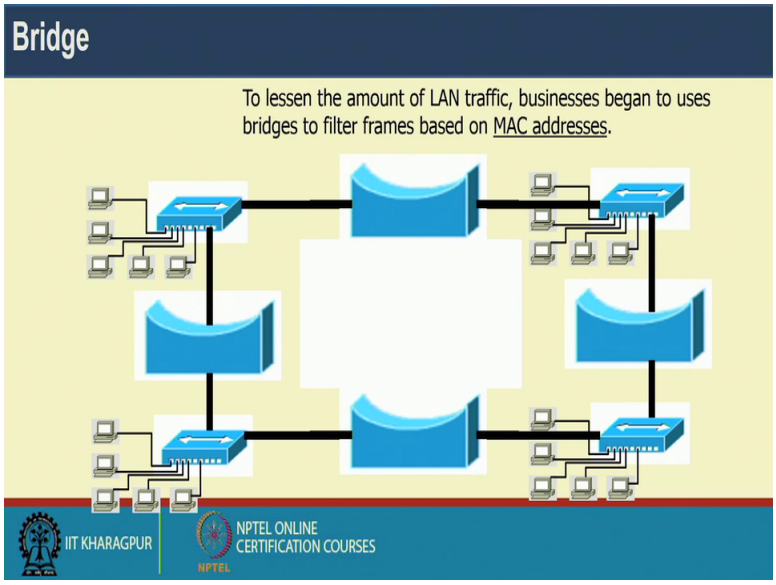

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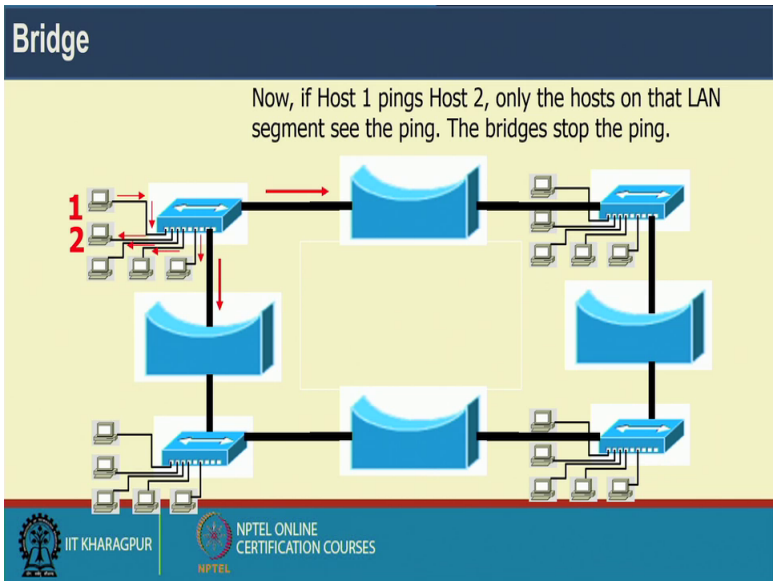

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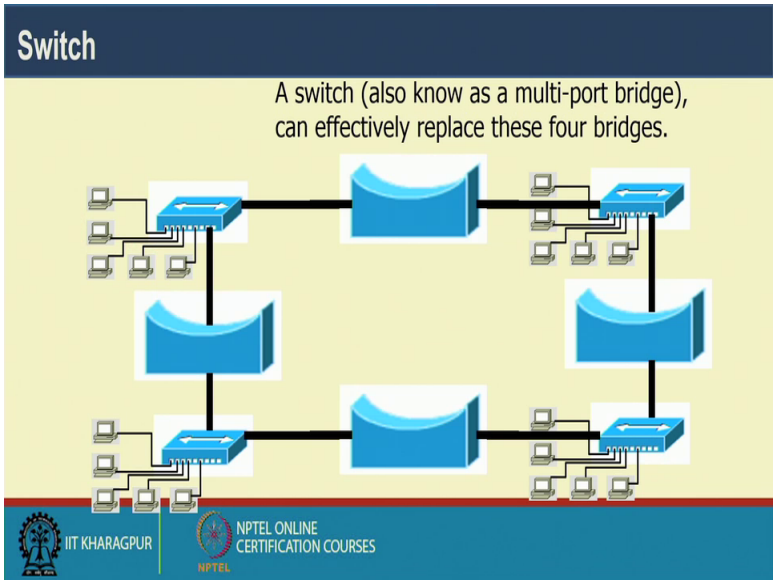

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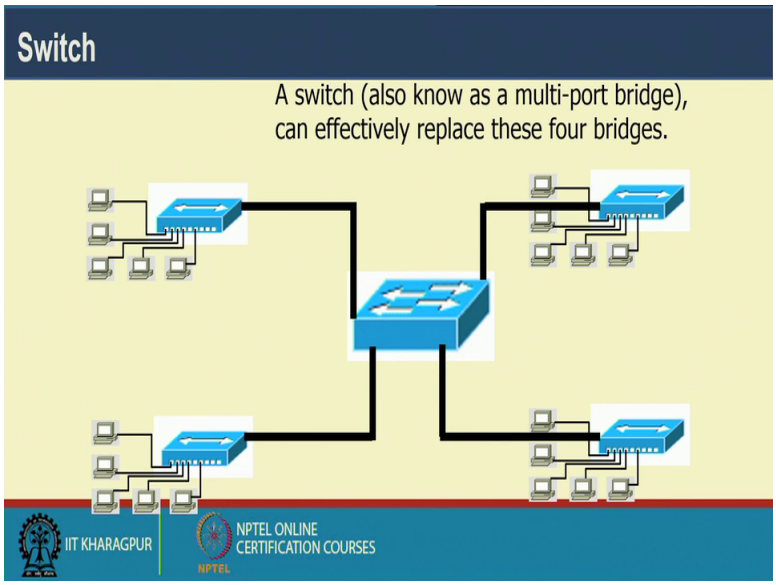

So, if I send instead that bridges then the traffic are localized so localized. So, it the traffic will not cross these thing. So, that the other parts are bandwidth are not wasted. So, if it is if there is a multiport bridge we primary we say that is a switch or more precisely is a layer two switch. So, that can be layer two switch where it connects etcetera it can have a connection to the cloud. In this case the cloud is internet cloud what we made and that is a I can have we can have the sort of connectivity with the cloud right.

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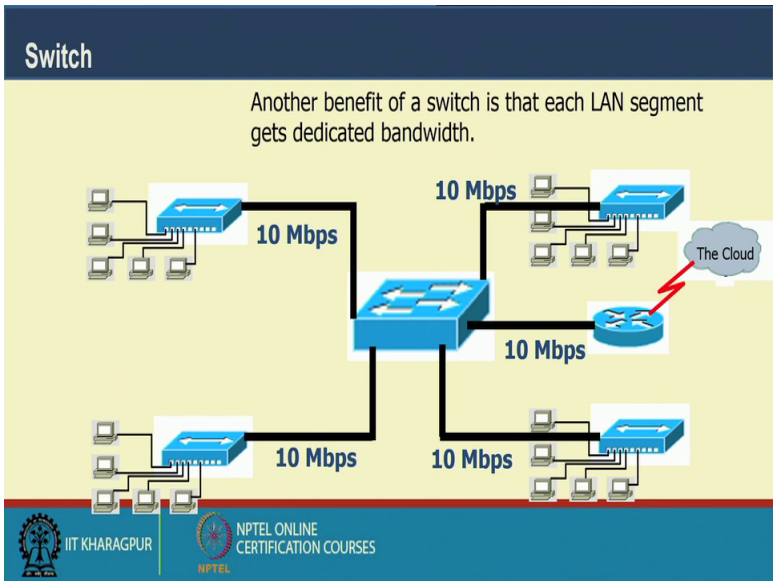

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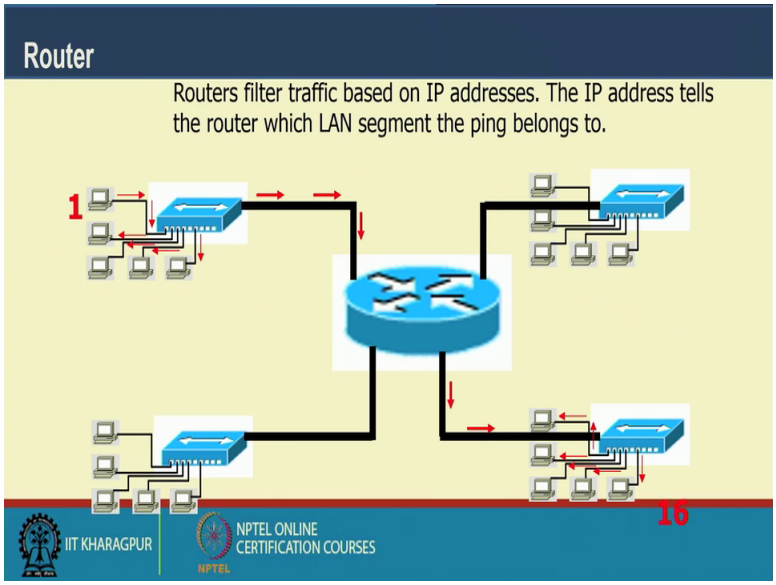

So, and then comes the router if the two networks are different router filter traffic based on IP address. The IP address tells the router which LAN segment and segment can ping the ping belong in other sense where you can have the things. So, this two networks are different networks. So, one is machine one is one network, the machine two is in other network this router finds the path from this to this. So, in other sense it is not only filters, the collision it not only divides the collision domain, it also divide the broadcast domains so, that it is it is only allowed filter the traffic those traffics to the other things.

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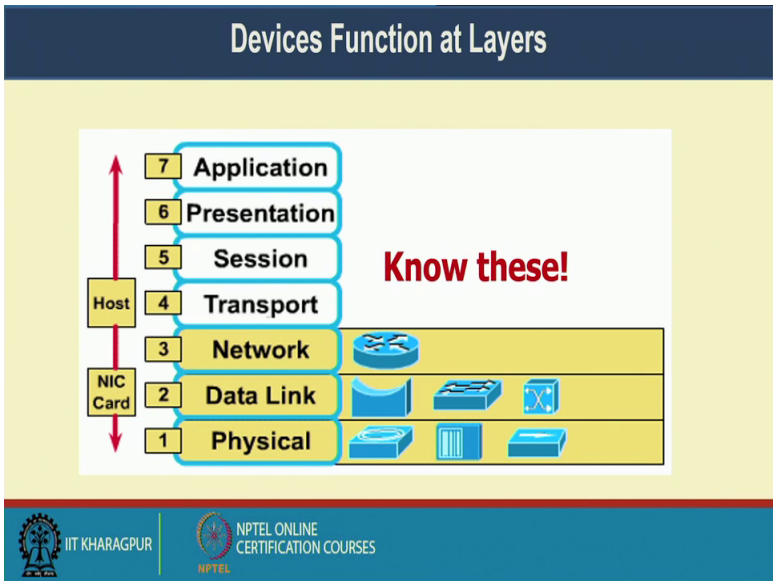

So, what we look at it? So, there are devices the different level. Typically layer outers layer 3, these are layer two switches, there are layer 1 devices and also each device works its layer, but all the things where is outer as the property of data link and also physical.

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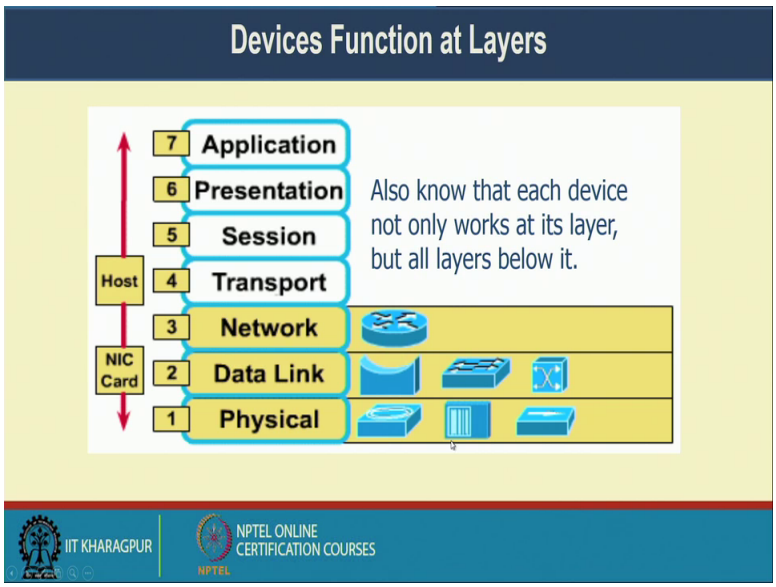

So, any higher layer as all the properties of the lower layer thing so, if you have a outer it as all the other properties. So, we; that means, it can basically do data link layer filtering

also can communicate and all those things right. So, as that layer 3 device but also uses MAC layer and so and so forth right.

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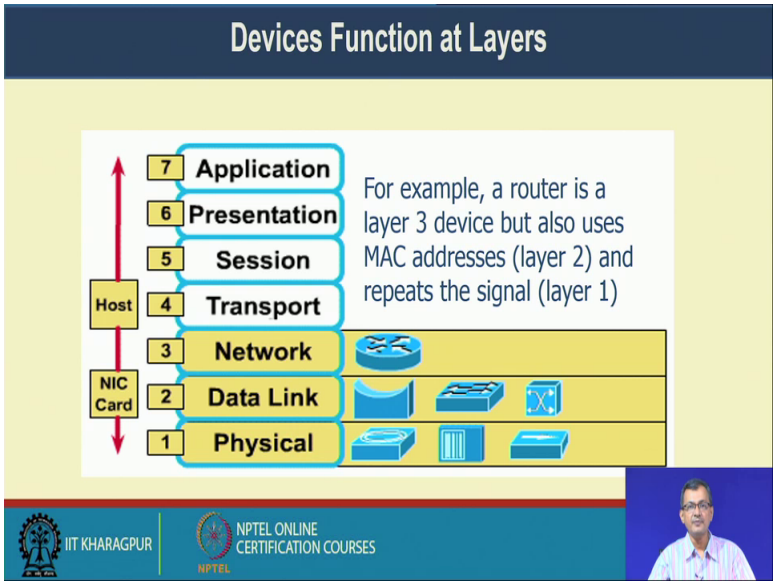

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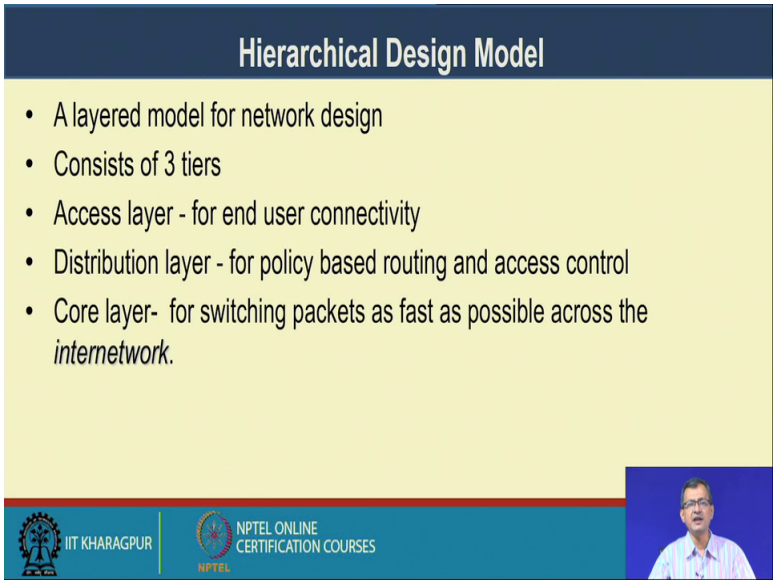

So, and typically when will comes to those things later on it is a what we look at the hierarchical design of network where we have a that core at the things, then distribution than the access right. So, the core is very past the distribution is more of policy and the access is the n mile type of solution.

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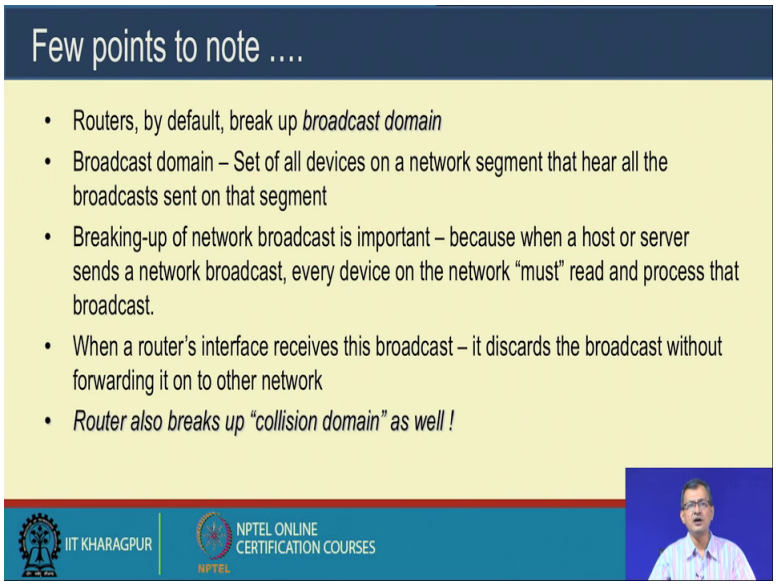

Let us say quickly few points and before we conclude. So, routers by default breaks up broadcast domain broadcast domain set of all devices on a network segment that here all the broadcast send to the segment. Breaking up the network boxes important because when the host and the servers sends network broadcast every device on the must read and process that broadcast right. It may reject or accept based on whether is meant for that. When a router interface receive the broadcast discuss the broadcast without forwarding to the network, routers also breaks up collision domain right.

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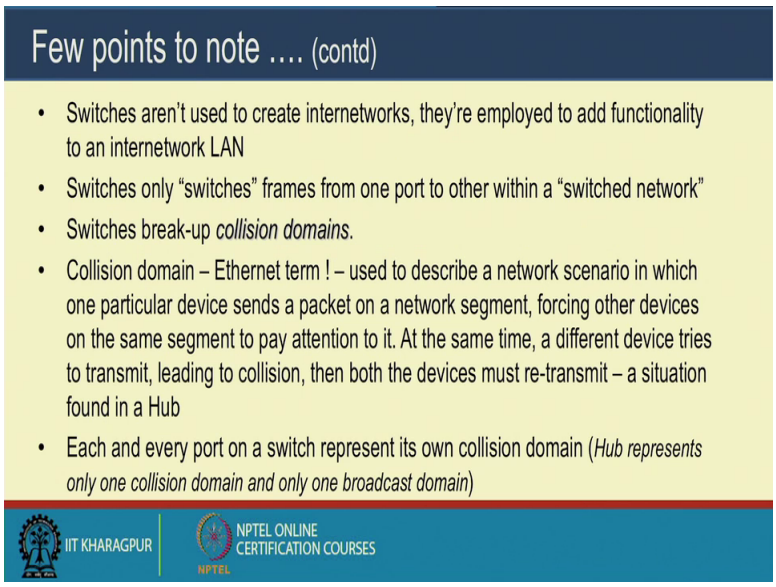

Switches are not used to create internetworking so, that is for router. They are employed to add functionality to the internet LAN. So, switches breaks up collision domain. It switches frame from one part to the other part in a switch network so to say that is why the switch.

So, again collision domain in internet term used to described a network scenario in which one particular device sends a packet to the network segment, forcing other devices in the same segment to pay attention to it. At the same time with different device there will be collision, loss of data and re-transmission and loss of (Refer Time: 33:36) in typically found in layer one and half. So, each and every port on a switch is own collision domain collision domain and half represent one collision domain so far.

So, what we try to say that this different layer of the things has different level of functionalities right. One is basically that different like at the physical layer is more of the physical transmission of the things whereas data link layer takes care of the filtering and the MAC layer level. And also communicate between so that it is filtered and the collision domain are divide and routers typically layer three device connects to two devices on the network; more precisely if we see that it helps in internetworking.

If we go to the transport it connects two processes into machines in the internetwork. So, that is process to process communication is visible by this transport and the applications what we are interested in what the inducer is interested in where the inducer basically use this different applications like what we use in internetworking and type of things and also we have seen that every layer processes and piggy bag make is payload and from the things.

So, let us conclude here we will continue our discussion on the things as we mentioned that will go on a top down approach so will go from application to transport and so and so forth ok. So, we will let us stop here.

Thank you.