Computer Networks and Internet Protocol

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Lecture - 01
Introduction

Hello. So, welcome to these course on Computer Networks and Internet Protocols. So, this course we will be taking, I will be taking jointly with Dr Sandip Chakraborty of computer science and engineering of a of IIT Kharagpur. So, as the name suggest, we will be primarily looking around all sorts of aspects in compassing, computer network and internet protocols right.

So, though all of us are somewhat means rather everybody is a custom to it using computer network in some form of other and it has become a part and parcel of our life, right anywhere any disruption in the computer network is as he deserves a you know power or water supply like that, right everything moves around the networks. And with the more E enabled services like starting from banking to E marketing to any aspects, we talks about is so, these networks become all pervasive and we need to look into this means working principles of the network.

So, this course primarily aims at looking into that backbone or back ground the am what the what activities go out the back of the network which helps us in having a these whole internets works, right.

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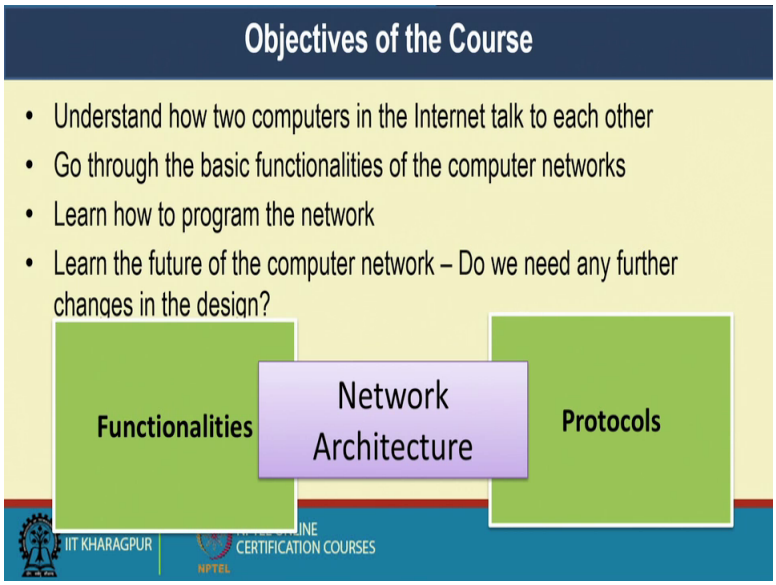

So, if we try to look at objective of this course. So, we try to understand how to computers in a network talks to each other, right like, if I say if I type www or if you type w w w i i t kgpse dot in. So, what are the activities goes on at the back ground that the page will get displayed, all, right. Or if I do a if I send a mail what it goes on type of things, right, we need to understand go through the, we like to go through the basic functionalities of the computer networks.

So, what are the various component learn about how to write my own application programs or on programs in a network and also try to look at the other aspects like what is what is in future, what we are looking for given our different aspects of with our needs and different prolification of several network enabled applications. So, what type of designs or what are the things what we need to look at.

So, what in other sense, what is the future of this computer network, we set to open up. These also may help you in some of you who are looking for some of the research activities around these may help you in finding out some research directions.

So, so what we look at we have a in a broadly, we have a set of functionalities one side and set of protocols, right. We will discuss about both of them in details in the subsequent lectures. But protocols, what do you mean by protocols ah? That is a in very flat terms or layman terms, it is a set of rules which allows me to execute something, right.

So, if I want to do something, so this is the protocol I want to follow. So, network also have a set of protocols. And using these protocols, I want to achieve some functionalities, right like I want to transfer a file given my under writing network. I want to these particular lecture is broadcasted or multi casted across different sender using these underlining networks, right.

So, there are functionalities I want to achieve from this network, right. The network as such the architecture of the network should be supportive for the things, right. Though there are general architecture back bone, I may look into some specialized things when I do some is (Refer Time: 04:31) it is like multimedia transmission may have little bit different requirement from say general textile machine or e mail services or internet services, right any way we will we will be looking at those different aspects when we go through the course. And in between two what this tie up these functionalities and these protocols is basically the network architecture. This is a very very brood view of the things we want to look into deep into the aspects.

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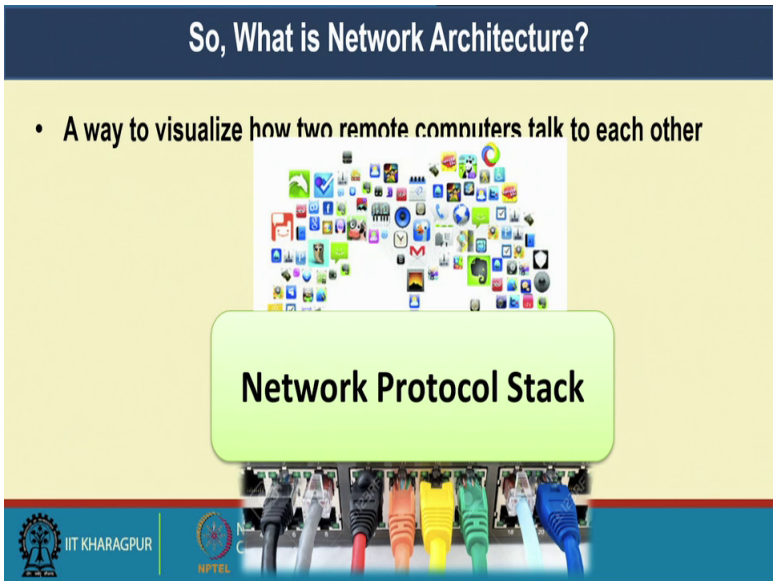

Now, so obviously, it comes that what is these network architecture.

So, a way to visualize, how to remote computers talk to each other, right. So, it is gives me a way to visualize that how that underlining things will be there. I require some sort of a protocols tag to handle that, right. So, even if I look at our even not in case of the network, forget about the network if I want to communicate with somebody else at the

other things or some other party, I need to follow some I need to follow some set of protocols when I when I am delivering lectures I am following some protocols and type of things and there is a way of looking at it, right.

So, these protocols or the network protocols stack and having a underlining technology of the things provides me a way to communicate between to any systems whether it is in my same network or whether it is in the different network, right. One may be here I I T Kharagpur; one may be somewhere else in the world.

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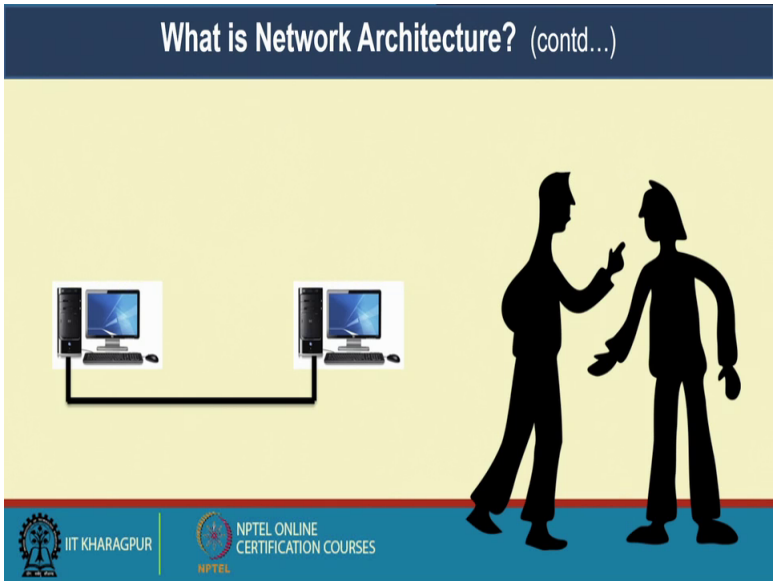

So, so, our basic objective is that two systems talking to each other, right these two systems can be vat connections, directly connections, we will see that whether it is possible or not and where these two systems can be some were at the different things. So, the basic venilla thing is that I have been two systems and some where I, I connect a wire between these two network interfaces like there may be some way of connecting them and then there is these two systems talks to each other, right. This can be two direct systems.

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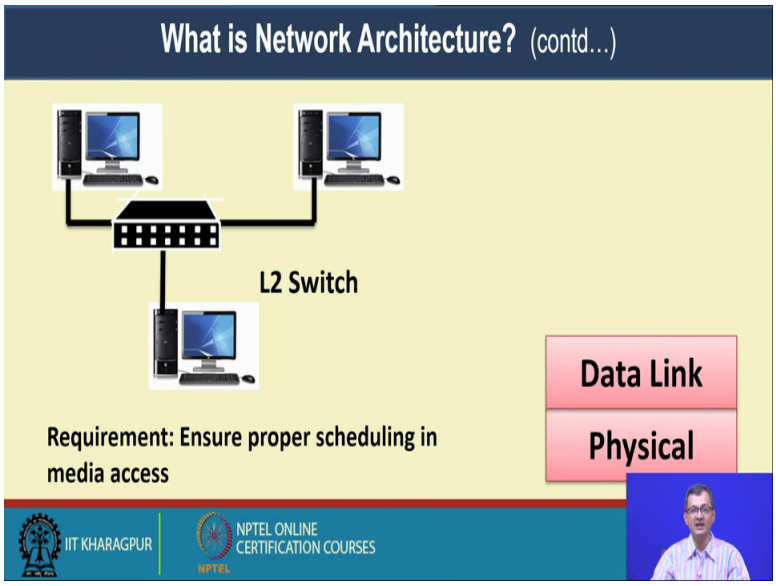

Or so, what we have for these, we require a need to convert this digital data to analog signal and vice versa, right.

So, when we connect by a wire, this is a physical connection, right. This is physically connected between the two systems. So, what I require a physical wire and as the signal transmuted by the typical wire say even if you consider our previous thing is to communicate through telephone lines and type of things or still we do in cases.

So, what is there, it basically converts this digital data of these generated by these computer systems to analog signal which is carried out by this wire, at the other end it is reconverted to digital data and placed it to the systems. So, I have two applications at two systems they are generating some data underlining network interface converting that to the analog signal being carried out things etcetera this basic communication part which allows things to communicate is the physical.

So, whatever may be the way of protocol etcetera follow at the high levels, I need to have some physical connection. It can be vat, it can be wireless all, right, it can be cabled it can be fibered, it can be normal, it can be Bluetooth, it can be Wi-Fi etcetera, but I require a physical connection, right. There should be a connectivity which carries the signal from one part to another, right.

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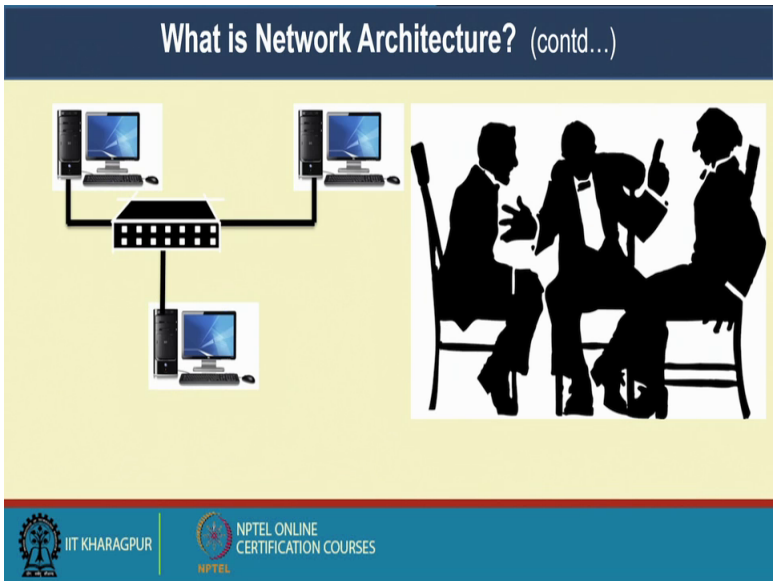

And then, if I have more than one, like only not two party more than more than two party are communication with each other like three systems are there, then I cannot connect this wire like these.

So, I require a somewhere concentrator, right about some what we say in our terms a concept of hub or switch in between where it has a multi-port things, I can connect to the things and then I communicate with the other three systems can communicate the property of these device is allows it to communicate to one other.

So, one way of looking them is that they when everyone talking to other, there is a there is a collision between things. So, what we say they are in the same collision domain, right. They can then they are in the same collision domain in the same physical network and or they one communicating others can listen or everybody can listen.

So, they are in the same broadcast domain either. So, this sort of things at a venilla things what we say that there is a say I can think there is a concentrator of these wires where we wire the wires basically terminates and allows to communicate to each other, right. So, another property usually these type of devices has is that they are more, they acts as an amplifier. So, if there is a degradation of the signal, they act as a amplifier. Sometimes, we call that at the physical layer they are hub or repeater. So, they repeats, they basically energizes the signal, right.

So, this physical layer, here the requirements is ensure proper scheduling in the media access, right. Now, the underlining media say like A communicates, A communicates with B, B communicates with C, A communicates with C. And so, there will be some collision. So, there should be some media access protocol need to be scheduled or need to be ensured that how this access will be there, otherwise what will happen there should be lot of retransmission.

So, if at the physical layer, if all things are connected at the first layer, then we have lot of retransmission. Whenever we retransmit, we lose bandwidth, right like 4 person taking or 3 person taking to each other and everybody wants to talk now body is waiting for others to the think. So, there will be lot of collision. If there are collision, then say I am one of the party I need to again tell my own story whatever I have told.

So that means, there is a retransmission and in doing. So, what I am doing I am losing that, I am taking more time that over all communication things is more time or in other sense, it is losing bandwidth of a communication it is becoming inefficient never the less we can communicate, right. Now, the next type of things what we have a layer 2 switch what we say where these communication are at a what we say data link layer, right where these collision domains are divided.

So, they though they listen to the same broadcast, but collisions are reduced. So, effectively, we increase the available bandwidth of the things. So, this layer 2 activity allows us to have a better bandwidth realization of the things. So, initially we are having a physical layer or layer one type of devices. Now, we are having layer 2 type of devices. So, it I can that that is that communication between A to B, B to C, C to D or D to E etcetera are not colliding.

So, the retransmission is lays and effectively we are getting much more bandwidth, what we say in network terms they are in different collision domain, but still in the same broadcast domain, listen to they are in the same broadcast domain, but they are in the different collision domain.

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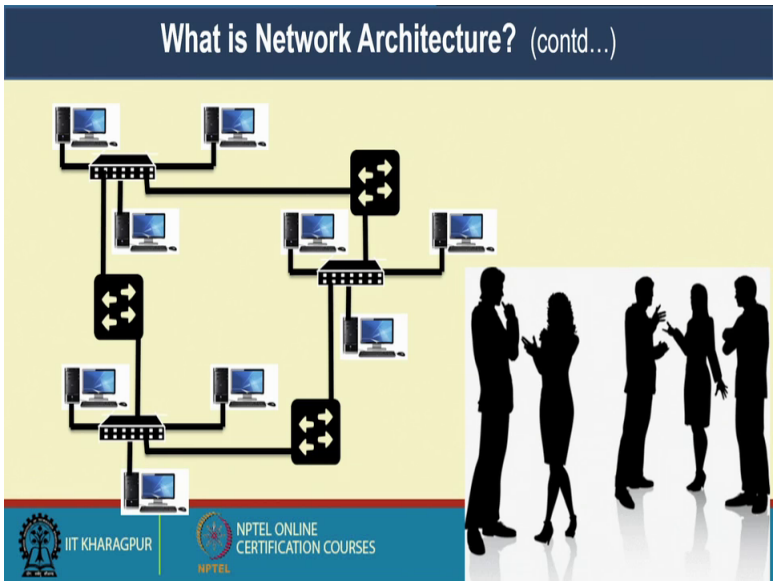

Now, it may so happen that I have number of things like consider your office or university institute a type of things.

So, there are several departments every departments has several labs, class room etcetera a different labs, etcetera which are having different set of computers and a we require. So, there are there are huge number of systems come into play and as such there may be two groups were talking, right. But they are talking among themselves, they are talking among themselves, but as such there is they are not this group is not talking with each other. In other sense, their conversation being heard by them or their conversation being heard by this group will create a collision or network congestion, right and it may lead to again bandwidth loss.

So, I need to so, if you look at a data link layer, so we could have avoided that collision domain. But even we listen to each other, right. So, they are in the same broadcast domain, right. So, though we could handle this collision, but they are in the same broadcast domain, right.

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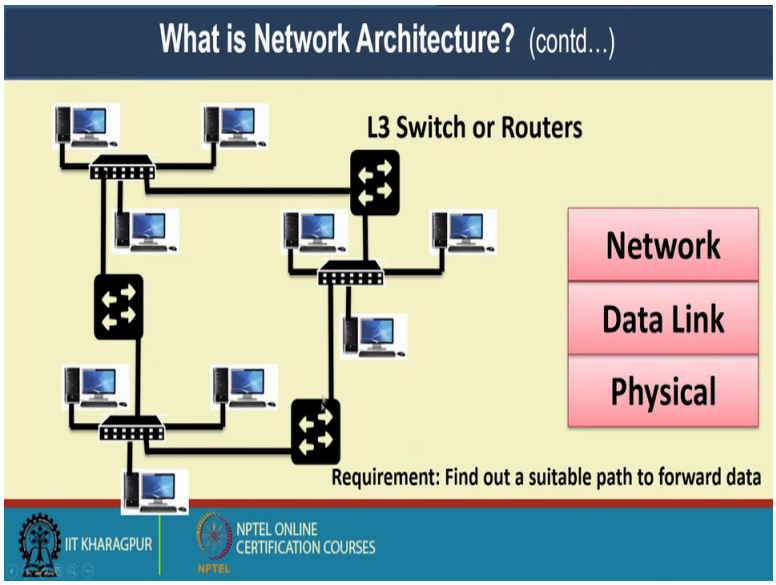

So, in order to handle this, so we need to find out a suitable way to forward this data from one to another, right and they are what we require a network layer. I, let us think of another case like here in a class room I am, we are discussing about the network computer network internet, internet protocols. In the next class room, there may be something going on say something on a class on economy. So, economics or a class on say chemical bonding, right. So, had it been a one class, say two parallel system in a large class.

So, they are in the same broadcast domain. So, my broadcast is hard there, but now if it is a different physically card. So, my broadcast is not going to there are other things, right in order to communicate now from here to here what I require, I require another way to go that I. I have to go out from the this particular gate or room catch hold of some person if somebody is there then tell that I need this communicated to be communicated to this. I require a pen from the other class room right. I need to communicate something, right.

So, I require so, this not only the collision domains are divided there the broadcast domains are there. So, I in networks terms we say these are two different network. In order to connect these two networks, I require a network level device which will allow me to connect, right. So, what we say this is a layer three or the network layer type of

things where routing is possible. So, one network is routed to the things and rather finding a suitable path to forward a data from one network to another, right.

So, we require a level 3 or network layer, right or mostly they are known as layer 3 switches or routers. So, whenever we have different networks like in this case if you see this is a network this forms a network, this forms a network, in order to communicate I require a yeah L 3 switch or routers. So, that routers can am communicate with this. In this case, then the picture it shows that two port that can be multi port typically routers are 4 port routers and type of things. So, there can be other networks connected from other ports etcetera. So, they can communicate with each other, right.

So, this is this way a I have a network layer type of things. So, what I what we try to see that initially from the physically we can connect, right; two things, they are in the same collision and domains etcetera in order to improve that situation, we have a data link layer or layer 2 type of switches where this though they are in the same broadcast collisions are divided now we divide both the things. So, they are separate networks in order to in order to connect them, we require a layer 3 switch or a router.

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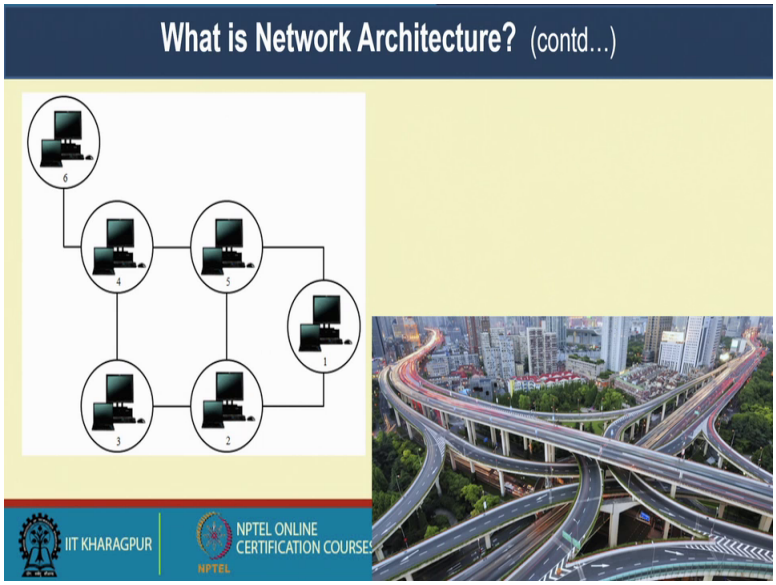

So, sorry, so if we try to see. So, there are different networks communicating to each other and there are some inter between links, right or what we say data links or this like the road networks, these are high speed connected links or gate way or data paths between the things. So, I have different networks across the world and they are

connected with different type of mechanisms and this routers across this world layer 3 or layer 3 plus switches distributed over the network allows this things to communicate with communicate anything to the anything.

So, within the network, there are devices, right, there are several computers. So, one computer here wants to communicate to here, it needs to find the path; either this path or this path or this path. There may be multiple paths like in case of our road network. So, different cities, different regions are connected by this road networks. You can have multiple paths and you chose a optimum path, right based on your requirement, right. Here also, if the a particular path is chosen based on the base on the overall traffic flow management and other type of things, right. And if there is a interruption or, if there is a some congestion in the path. So, there some other paths can be chosen etcetera.

So, there are multiple paths and so and so forth. Rather, if you like to see that they are all somewhat independent things, they are there is this particular network at 4 or network at 2 one they do not, they do not control each other, right. So, they are distributed network autonomous systems or autonomous networks and still it can communicate because they follow a underlining protocol and there is a different network architecture for that. So, I can I can say this is the way I architect the internet, right or I anti[dent]- my network.

So, it can be at a small scale, right. It is in a department how you things make the networking things, it can be at a institute scale it can be as a region scale, it can be country it can be over it, right.

So, the core things which binds them is that agreed upon protocols, right. How they communicate is a agreed up on protocols and there should be a network architecture which may vary from installation to installation and even within a installation, we can have different type of reverse of the things, but never the less they allowed you they follow that standard protocols, right.

We see, we have seen this in a telecom scenarios also, a then we can communicate to anything to anything because they follow from protocol. Any way this days, segregating data voice and other thing are slowly becoming they are becoming converge networks and type of things they follow is becoming more what we say consolidated so to provide a better service.

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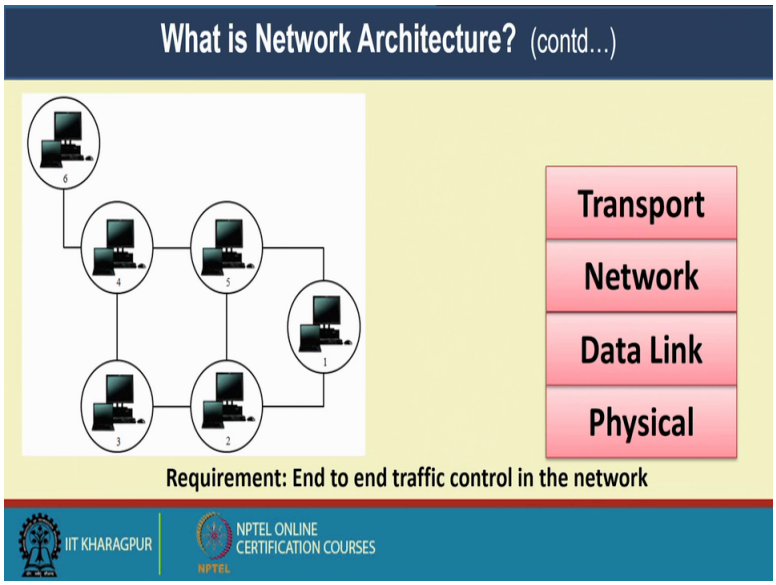

So, what we see that with this 3 layer, we try to have a end to end some network connectivity or some sort of a traffic control in the network, right. So, there should be some physical connection, there should be some data link for hub to hub connection and there should be a network layer to have a network to network connection, right. Over and above, we require a layer called transport, right or mostly what we say it is a process to process connection and it has lot of property error control, traffic management, traffic control and different other properties.

So, it is above the network layer, right. So, it gives a process to process communication. So, one is physical connectivity, one is hub to hub connectivity, one is network to net network even to system to system connectivity, but there can be multiple process in the system process to process communication is handled by this transport layer type of things, right.

So, we see that this different type of layers gradually will be dealing all of them in this particular course. We will be going details into the things, but we try to have a over view that these are the stacking of the layers which are there in our realization of a any computer network or internetworking or what you say data communication, the whatever way you try to put it. Whenever there is a there is a movement of a some data from one known to another known from other place, I require this type of things will be there.

But you see I may not require always all the things, right I. If I am my data is only transmitted in between and to the other point like in between router, may not want to open up to the transport layer, right. If there is a hub to hub connection, the data link layer may not require that needs to be open up to the, this up to the data link layer so, not even the network layer is not required.

So, sorry intermediate devices can act up to the level which connect it that, right.

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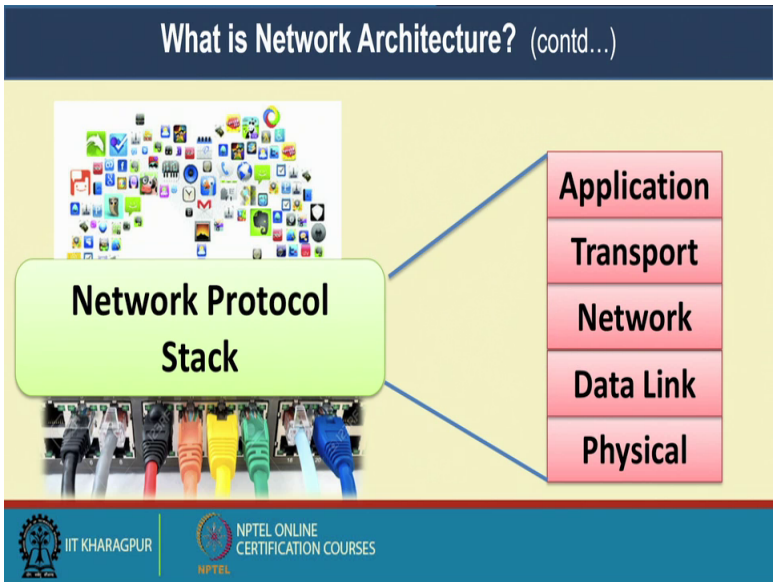

So, finally, what we looking for, end user is the application, right. So, end of the day I am looking for if I am a having a mail application, I am looking for the mail application that in turn uses some transport layer that, in turns uses some network layer; in turn data link and physical all stack is there, but the at the top it is the application layer. This is the, this is the typical protocol stack popularly referred at TCP IP protocols stack which are which is the predominant protocol across this over all over inter network, right.

So, this stack is the what we will try to look into the things, right into one by one into the all the aspects of this particular protocols stack in this particular course.

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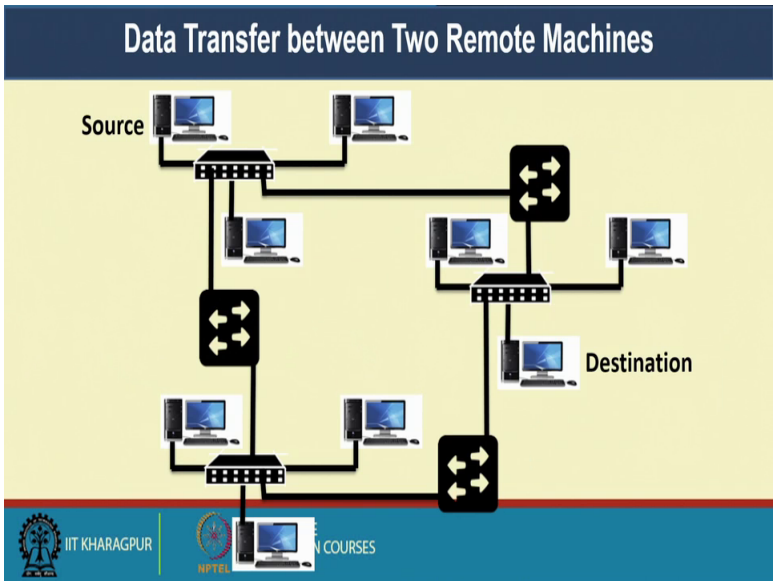

So, what we try to do now, the if there is a source and the destination of somewhere in the network, then somewhere other a path should be established between the source and destination and the communication should go on into the this paths, right. So, there can be we will see that what are the subsequently the Nitty gritty of these having these paths to the things, but never the lays I require a path to communicate from the source to destination, right and this overall different layer of structure.

So, at the source and destination, what the things are going on? These are basically applications what the user is using primarily, right like I say www i i t k g p s e dot in. So, what I am doing? I am opening up a browser it can be a say some some browser like this fire fox or chrome or internet explorer explorer and then that is a client thing and the other is somewhere server is their i i t k g p e server is there. So, he treats to the things.

So, the applications things are going on are, but it is taking it is using this intermediate layer to communicate, right. That will we will look into these aspects.

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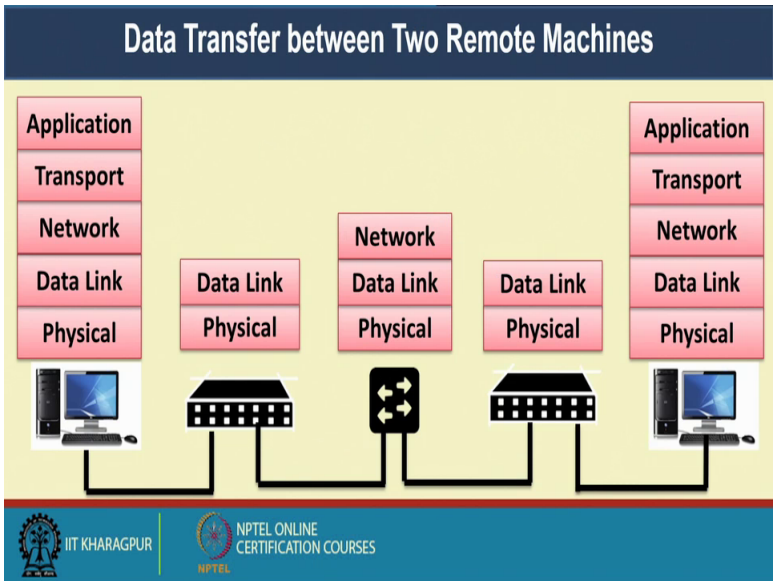

So, what we will see, if we look at from this picture to this picture. So, it is a this is a application style where this is the whole protocol stack down there to application is talking to the application it is reduce to the transport, network, data link, physical, then it go on in the in between there is a layer 2 switch. If there is layer 2 switch, it can open the packet up to the data link layer, right. Rest of the things is a pay load for the data link layer, then it goes this some routing device and it have a up to the network layer.

So, it network layer means, it can see this by which network it transmits and find out the path. Then it can go to another layer 2 switch and finally, hits to this server or means to other party A and B, right. And similarly, one packet moves from here to here, other packet moves from here to here and things goes on into in the communication the communication, but the inter mediate devices can open the packets up to the things which is which it can handle, right rest is a pay load for the things, right. Had it been there is a hub so, it could have open only up to the physical layer, rest are is a pay load of the things.

So, you see though these devices can be from different sources etcetera that we can still handle a communication between source and destination, right.

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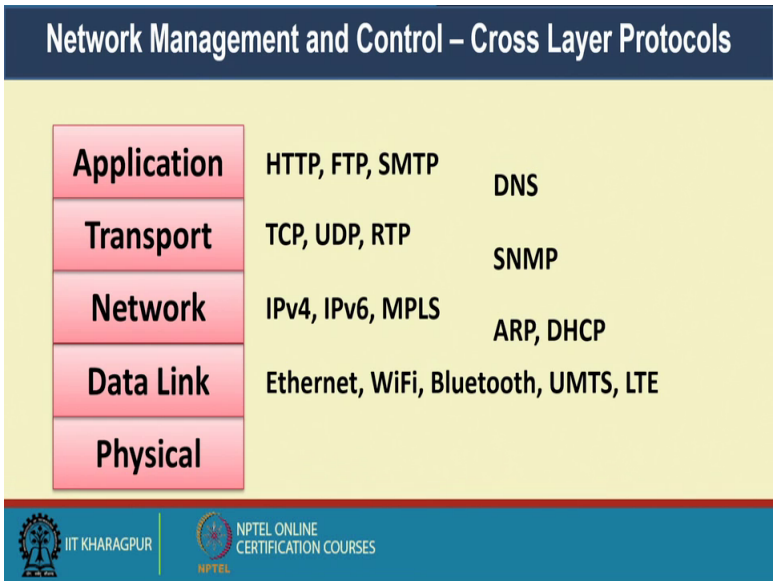

So, protocols at different layers if we try to see or what we are looking at is more popular protocols at different layer; if we look at the application layer, the popular protocol is HTTP for what by which we access web pages etcetera that is the predominant protocol, there are protocol for FP file transfer protocol and there is a pre dominant protocol for SMTP simple mail transfer protocol, right.

So, there are TCP, UDP, RTP and these are the predominant protocol in the transport layer, right. We will see that some are connection oriented, some are connection less, some are real time protocol and so and so forth. Similarly, at network layer we have IP, they what say we call it also IP layer different protocol like IPV4, IPV6, MPLS and so and so forth. Similarly, data link layer Ethernet, Wi-Fi, Bluetooth, UTMS, UMTS and LTE type of things different set of protocols. Major predominant protocol definitely is Ethernet and Wi-Fi, but we have other protocols to communicate at physical layer is more of the physical connectivity is mostly the physical characteristics of the things, whether it is wired wireless, if it is wire or set of wiring and type of things.

So, there are standards for, there are well defined standard for their communications or what we say signal and data communications that which are use by the things, right. So, if you there are some of the what we say protocols or which are which we do not we cannot place in a particular layer rather like if you talk about DNS, it is somewhere between application and transport SNMP, this is between transport and network, ARP,

DHCP, these are again between their some in some reference they are considered at in say network layer ARP and so and so forth.

But never the less, they use the cross layer phenomenal. So, these are what we say cross layer protocols, they connect between two layers, right.

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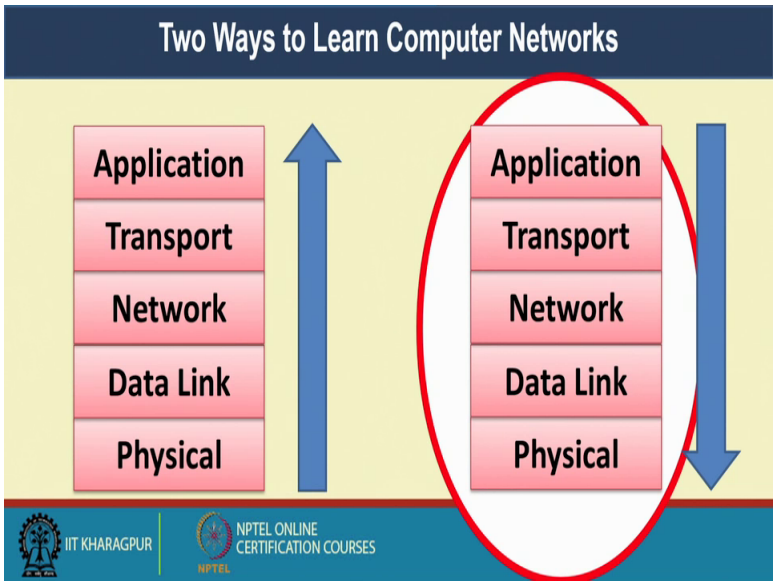

So, what if you want to look at computer network, there can be two way of looking at it like if I want to study things, one is going from physical data link transport application etcetera, other is going on the from the top to bottom. So, one is bottom up approach or is the top down approach.

So, both are fine, both are accepted and type of things. In this particular course, we will be taking this top down approach we will start from application transport network and goes to the physical layer type of things. So, we will be going in this means bottom means um, top down approach, right. From the top we will start and then go on the down, right.

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So, we will come to this history of networks subsequently, I will just give you some.

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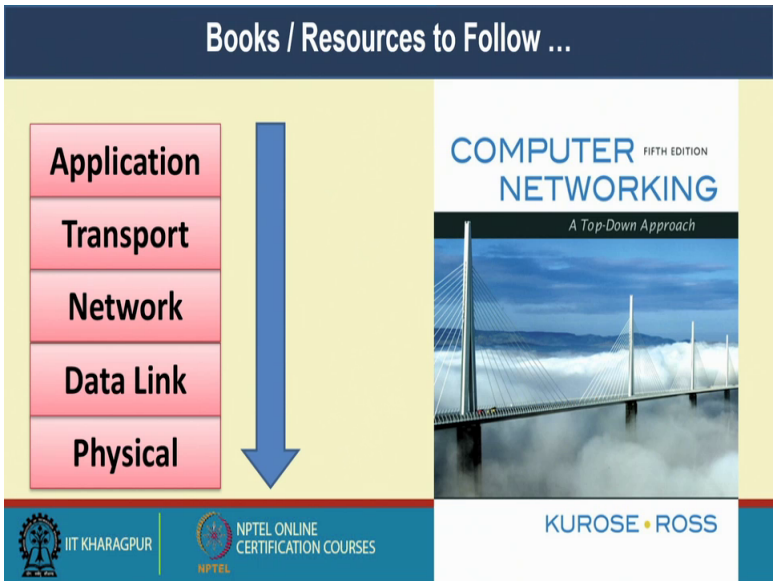

References which will be good for you to refer like one book is by Kurose and Ross, computer network.

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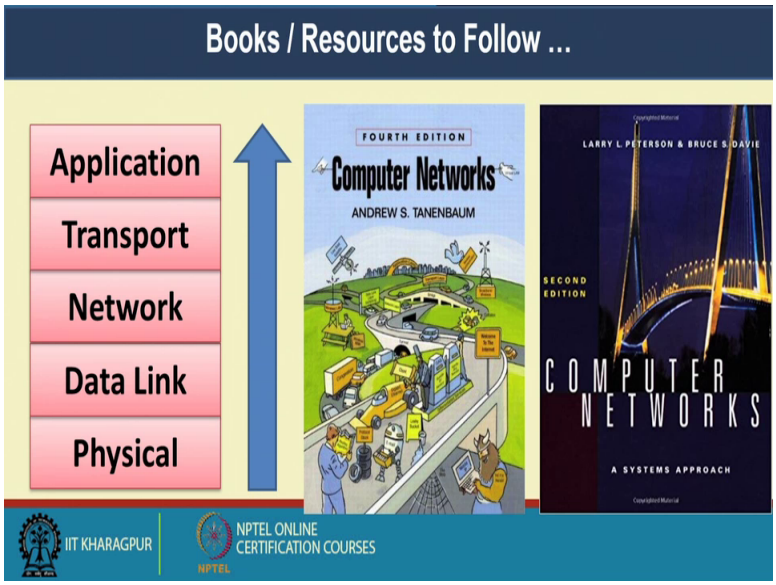

There are, this is primarily having the way we will follow that is top down. There are bottom up they primarily follow this bottom up, but never the less it really hardly matters that which book you prefer computer networks.

So, this is with Tanenbaum and the computer networks, there is a system approach by Peterson.

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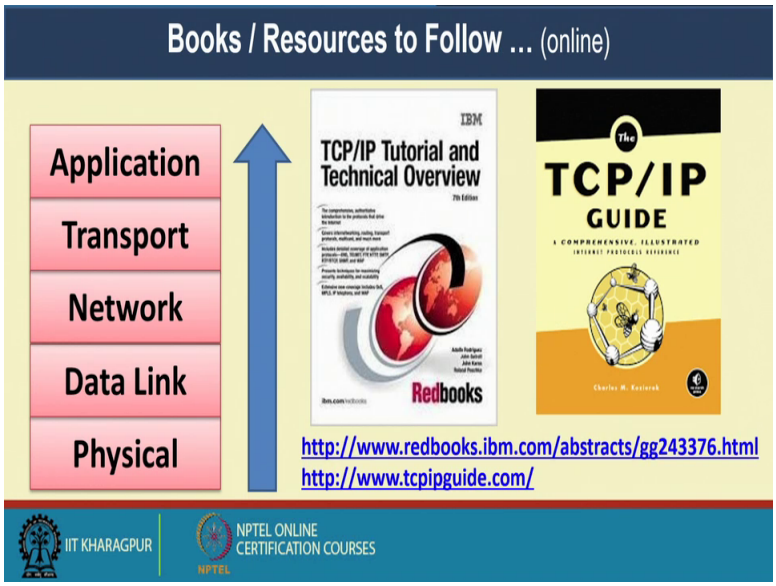

And there are different sources; one good source is IBM Redbook, there is a nice reference which is on the internet. Again you can refer TCP, IP guide this is also available online. So, this will be some of the books.

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And there are several internet sources like one is IETF is one of the major source, there are RFCS related to this network protocol requests for comments.

So, it will be nice to look at those sides like internet engineering transports. I think it is from 1986 or so. It is it has been establish and there are several resources which give you keeps you a things that how this protocols are developed what new things are coming up and so and so forth. So, with this, let us compute our this first introduced lecture. We will be continuing with the subsequent lectures on those on the on this internet and internet technology.

Thank you.