Computer Networks and Internet Protocol
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Lecture – 38
IP Routing-II (Intra-domain-Distence Vector, Link state)

Hello, welcome to this course. We will continue our discussion on Computer Networks and Internet Protocols. So, we are discussing on routing protocols right as we discussed over this lectures. So, one of the primary objective of this overall network is route a packet from one source one node to another node in the internet right. So, and it may go on over several routers right. So, there are two things which is important: one is that what is being routed right, the packet which is being routed.

Another is that how this routing is possible right, how this routing happens. So, in other sense if we see, if you recollect that what we have seen that every router or in intermediate or in the internet routers every routers maintain a routing table. So, what it says, that if the packet is for this particular destination then follow this particular interface of the router right.

So, in other sense what we see that our routing protocols primarily aims at updating this routing table or sometimes called forwarding table. So, if I get a get a packet with so, such destination, then I need to forward to this particular network; that is my objective. As we are referring to the analogy, like if I have a road network with different crossings, which acts as a forwarder or routers. Then, the person or the traffic person in the tossing may help you that you say that, if I want to go to that particular destination which path I need to follow or what should be my next stop to follow right.

So, this is this is the thing will do. So, what it needs to do that every this router or the traffic man needs to be updated or maintain a table or lookup table a forwarding table by which, if say if we looks that this is my destination, this should be the network right. So, the protocol across this overall internet working with helps in doing this forwarding or routing of packets are routing protocols.

Now, we will see subsequently there is a concept of autonomous systems. So that means, it is a good group of network or a portion of the whole network along with hosts and the

necessary things like their connectivity protocols and so on and so forth. It constitute a autonomous systems autonomous system. We will we will look into those things and these autonomous systems usually under one organizational or administrative control. Like IIT Kharagpur along with several networks, routers, hosts, protocols running, connectivity defined etcetera for can for may autonomous systems.

That means, it is inside the things it maintains as a autonomous system. So, overall inter networking or a overall internet is of this type of autonomous systems or popularly known as. So, every AS has a unique number right so that it is identified. Now, you see so, some of the packets need to be routed within the AS, some of the packets need to be routed outside the AS right. Suppose, you are said sending some source to destination. So, destination can be within that AS only or the source end source and the destination can be different AS.

So, for that we require something what we say intra domain routing sort of thing or inter domain route of things right, which is localized and which is more globalized right. So, conceptually you may say that the same algorithm may work across the thing absolutely no problem, but there are issues of scalability, there are issues of time complexity etcetera. So, based on managing a small network is much easier than managing the whole internet and type of things.

Secondly, that internet works most of the things works on a cooperating basis. You may not have control over whole internet working as such. So, you cannot you may not run the whole thing at a surfaces right. So, what will, what we have started from the last class, we will be continuing that we look at the intra domain routing like. Primarily, we today we would like to look at the intra domain routing which has two specific primary category of distance vector and link state type of protocol right.

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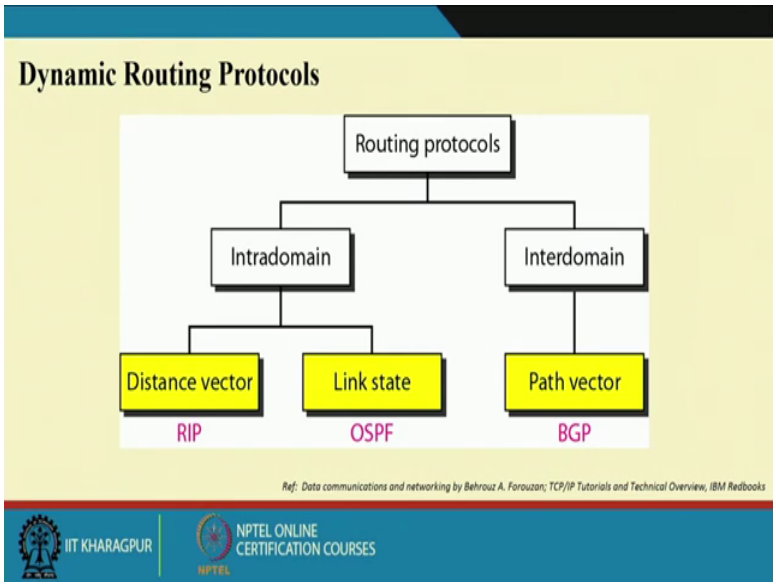

So, as we discuss if we look at the dynamic routing protocol. So, that is another concept of static routing; that means static routes as specified, but if we look at the dynamic routing protocols. So, we have intra domain or inter domain and inter domain has two things, that two the group of protocols. One is distance vector, another is link state protocol.

One a very popular protocol in distance vector is the RIP Routing Information Protocol or the in the Link state is the OSPF protocol for the in the link state whereas, in the inter domain we have a concept of Path vector routing. And, one of the very that major protocol will which predominates is the BGP or Border Gateway Protocol right. So, this way we segregate, we today's talk or today's discussion will be primarily hovering around distance vector and the link state protocol.

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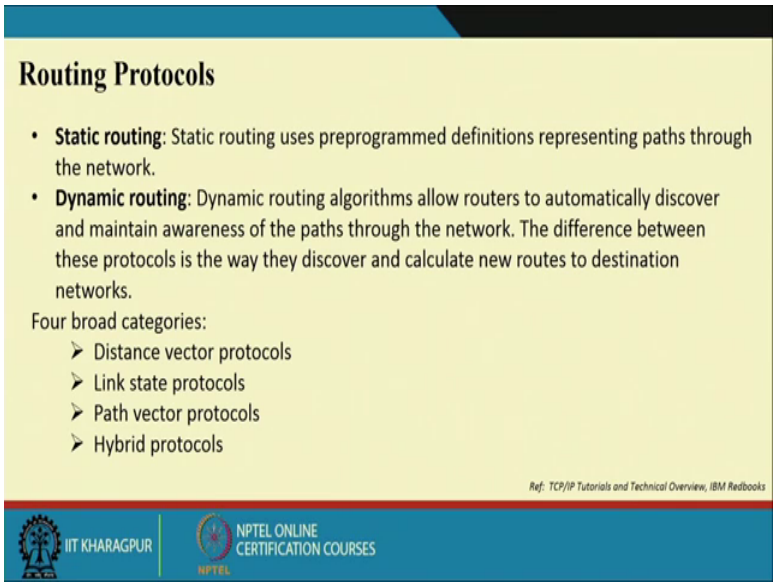

So, just to quick recap. So, if we have a routing protocol one can be a static route that the static route uses programmed definitions representing pass through the network. That means, already programmed or already defined routes or it can be a dynamic routes. Dynamic route algorithms allowed router to automatically discover and maintain the awareness of the past through the network right. The difference between these protocols is the way they discover and calculate the routes to the destination. So, everybody's objective is to update the routing table to a individual router, such that the packets are forwarded optimally.

The different routing protocols which they differ is primarily that in what sort of how they discover these routes. How they calculate the new routes etcetera. Why this is required? The, what we see that the internet is a dynamic phenomenon. The packet that there are means routes being added or deleted in dynamically right. And secondly, this is not under a single administrative control overall right. So, you need to have update you need to update individual or a router needs to update its routing table dynamically based on that how what frequency and other objectives are there.

So, to in order to maintain a appropriate routing things. Again, though there are predominantly distance vector and link state at the predominant protocol. There are sorry there are three distance vector link state as the inter domain. And, path vector protocol is the inter domain whereas, there is another protocol called hybrid. It is not a new

protocol, but mix of this sort of things that also people use. But, that is mostly used in some sort of a proprietary or more regulated scenario.

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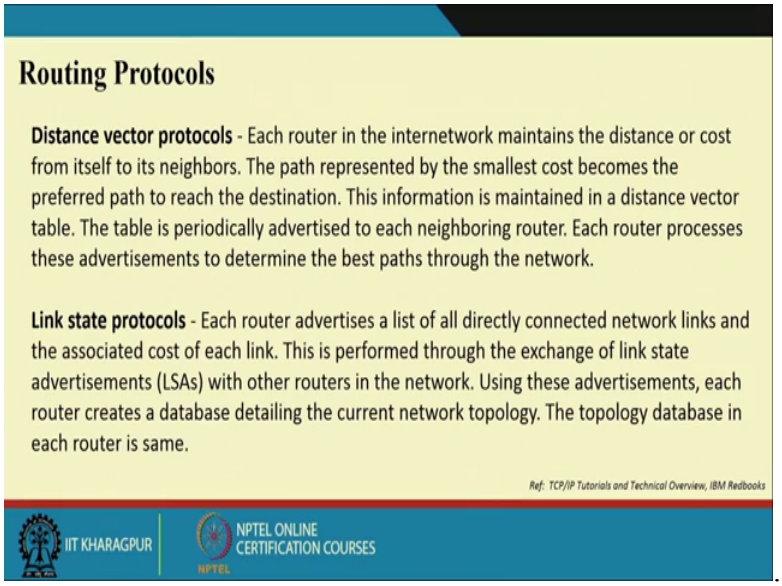

So, we will see that distance vector is router in the internode maintains a distance or cost from itself to its neighbor. So, it is more localized like a router only look at the look or maintains and share the information about the, its neighbors along with the cost. This or sometimes we call that distance of the things. The path represent as by the smallest cost become the preferred path to reach the destination right.

So, if there are more than one path for the destination the minimum cost path will be taken these information is maintained in a distance vector table right. The table is periodically advertised to each neighbor and each router processes this advertisement to determine the best paths. So, what happens that every router has a localized information about his neighbor and the cost and it goes on advertising right. And, the neighbors listens and go on updating the things.

So, there is a period of advertisement that is how periodically it is done, one maybe one is every 30 seconds and so. And, along with that there can be thing that, if there is any change the it will be advertised. Based on this input and the already packet available to a; already the table available to it the a particular router updates the routing table. And, in way it is some sort of a this sort of whispering goes on into the whole internet or whole I to say autonomous system or and then it goes on updating right.

Whereas, in link state each router advertises a list of all directly connected network and associated cost of the link. Or, it tries to look at the whole network or the portion of the network in the autonomous systems. And, it advertises the what is the link state it says right. This is performed through exchange of link state advertisements or popularly known as LSA's LSA with other routers in the network. Using these advertisement each router creates a database detailing the current network topology, the topology database in each router is same.

So, in other sense the e every router advertises the what way the networking overall network state or the picture is there to the rest and it goes on updating and, at any point of time ideally the routers have the same picture of the network under its under its domain or under its where in the region it is there. Like in the AS or the area in the AS, where it is there it has the whole picture. Based on the thing it calculates the how to go to the destinations. So, one is more localized only with the neighbor, here it has a global picture of the things.

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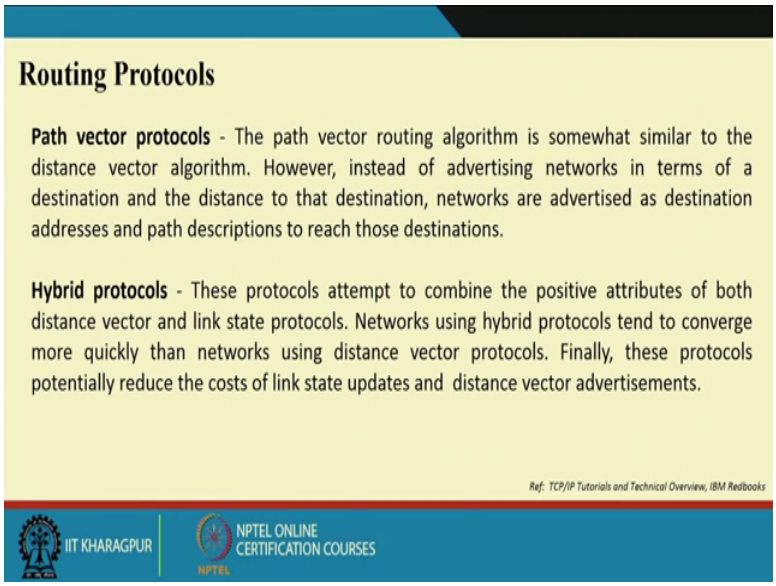

And, in case of a path vector it somewhat somewhere in some of the literature say it is somewhat similar to distance vector, but not exactly. But, there is a thing instead in case in path vector we have destination distance to the destination. And the that what is the path to reach the destinations right. So, it is not the which is the net networks, but what is the path in the rest of the to reach the destination.

Or later we will see that we need to talk about BGP BJ BGP and all those things then you will see that the it says that this that the ordered set of autonomous systems which the router need to pass to reach to that particular destination, if it is a inter domain routing. And finally, the hybrid protocol this protocol attempt to combine the positive attributes of both distance vector and link state. So, networks using hybrid protocol tend to cover more converge more quickly and so and so forth. But, most of the cases it has be it has been seen that in order to maintain these both this type of things you require some more I should say hardware or resource support.

And, in most of the cases if you have a more controlled environment or what we say proprietary environment that is this may be much useful. But, but in number of cases we do have those type of things. So, this can be followed. So, these protocols potentially reduce the cost of link state updates and distance vector advertisement and try to have a optimized path along the things.

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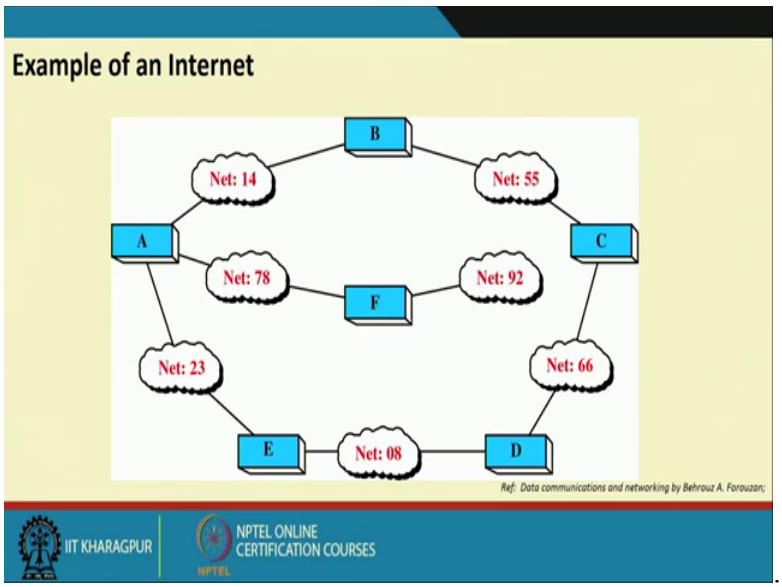

Now, so if we have a is typically a scenario like this where there are different networks connected by different routers A B C D like that.

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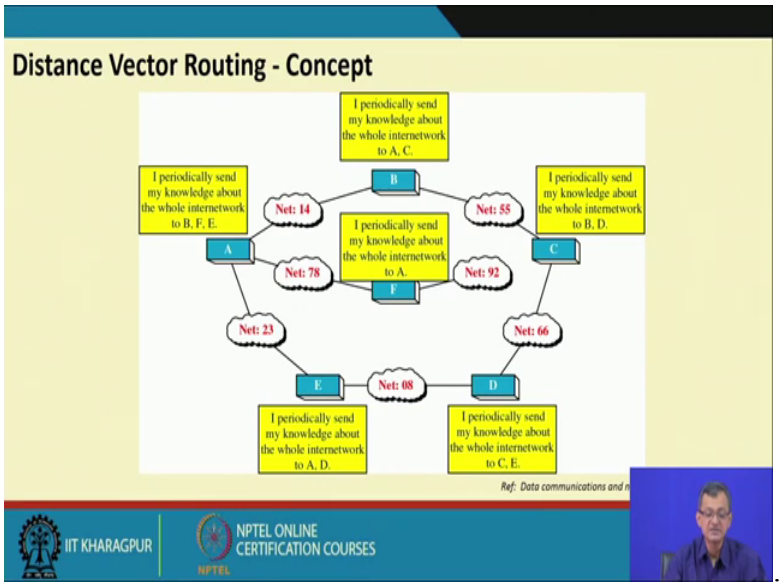

And then so, if we look at the distance vector what we have discussed so, A says that periodically says the knowledge about the about the whole network to B E F. So, whatever it has in having the knowledge its send is to B E F to its neighbor. Similarly, in case of B periodically send my knowledge about the whole network to A and C.

So, whatever it is having the knowledge about the whole network it share with its neighbor. So, some sort of a whispering with its neighbor right. It goes on doing that and in order to do that it attempts to converge right.

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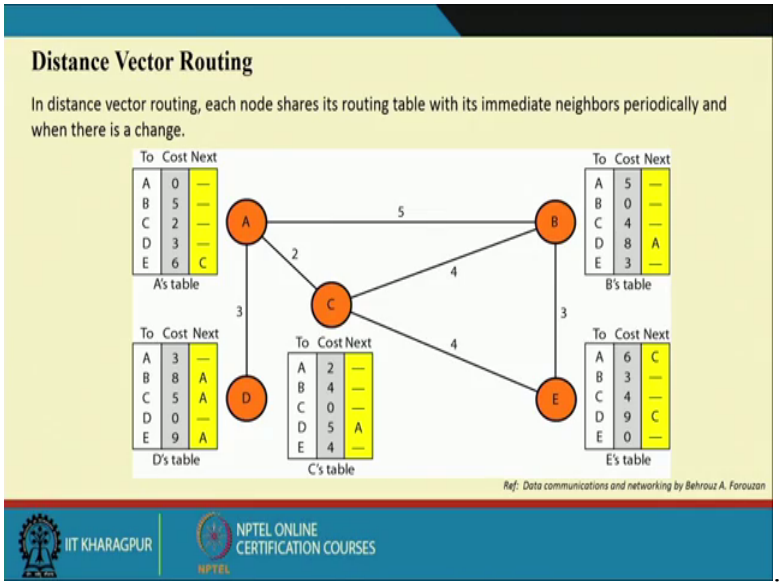

Look at another example like in a distance vector each node share its routing table; that means, the knowledge about the network with its in immediate neighbors periodically and when there is a change. So, it is either it will be a periodically; that means, every say time period t and when there is a change. So, if there is a change, then it also exchange the thing, like A B C D etcetera.

So, A have the knowledge that from A to A the cost is 0, A to B is 5, A to C is 2, A this is the first table is the A's table right, A to D is 3 and A to E is 6. Now, A to E is 6 via C. So, the next stop is C. This blank means the next stop is the immediate either itself or its immediate neighbor. Similarly, if you see the cost of D you can deduce that A directly to A as 3, but to B it has to go via A.

But, to so, it next stop is A then B, but it could have been A C B also based on the costing. Like from for C it has to go via A and then C, similarly for E it has to go A then C then A. So, A to D to A is 3, but for going to A to E is via C is 6. So, overall costing is 9.

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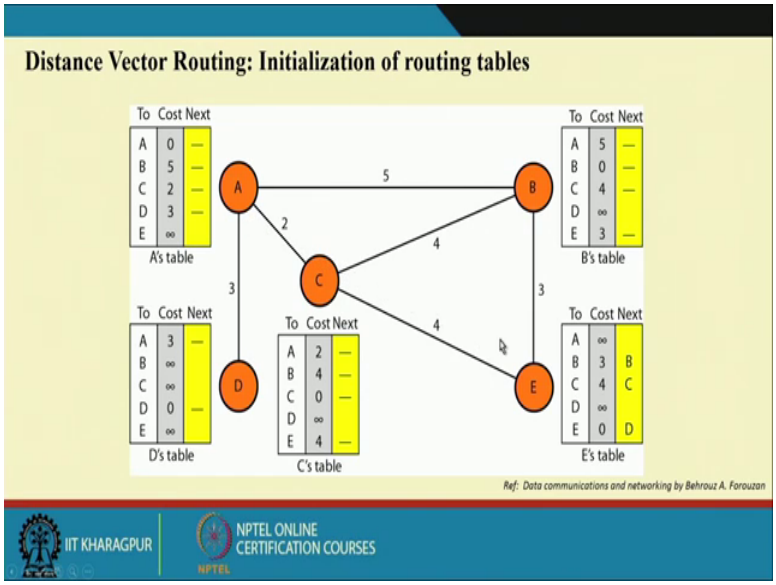

So, initially so, if we look at initially, what is happening? Initially, if you look at A for A it what is see that to itself is 0 A's table, to B is 5 because, that is directly connected. To C is 2, to B is 3 and to E is infinity, because it know does not have any information about E that is not directly connected.

So, this when the router say time t equal to 0, it has these are the instances. Similarly, for B is like this, for B is something like this, C for C is something like this, D is only it is connected to A. So, D knows that to reach itself is 0, reaching to A is 3, it is direct connected. But however, going to any other network or any other routers it is the infinity.

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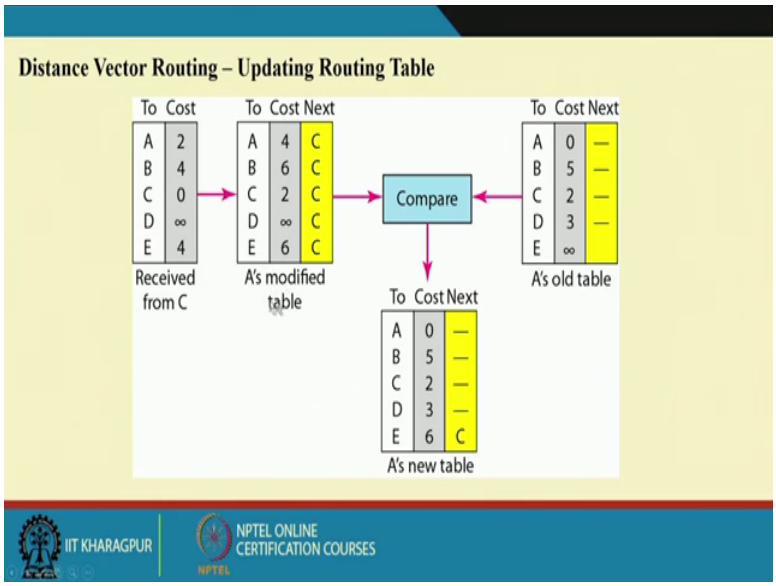

Now, we need advertise say we look at the A's table right. So, A receives A instance also C from C what it is receive, it to for C to go to A is 2 B 4 C 0 D infinity E 4 because, it does not have any knowledge about the D initially right. So, A receive say information from C, similarly it receives information from B also right at periodic information right.

Now, on receiving say we consider only one that C, subsequently it will come same type of activity will go for what it this is from B. Now, on receiving it compares that so, in for if it goes via C reaching A will be 4. That means, it says that A to C is 2, C to A is 2 right 4, but wherever it has a better hosting thing like A to A is 0 it is having. So, it updates is A 0 with no hop. See in order to reach B C says that it has a thing called 4.

So, what he it C is that in order to reach A to C is 2 and C to B is 4. So, in order via C if it goes reaching B is 6. It has a better advantage out here reaching B is 6, it maintains at 5 right. Similarly, going to C via C it has 2 and now here also 2 so, it keeps that for D C do not does not have any information because C is not having any information. So, but A already having that ridging C is the it maintains that. For E, C says that via C that it is a

there is it can go by 6 whereas, A's initial table says it was the infinity. So, it updates as the thing.

So, the C is so, the A's table A's routing table after receiving the information from C it becomes like this right. Now, similarly it will receive the information from B also. So, that updated table can be compared with the B, it can be before or after. Nevertheless, what you what we see it finally converges to the things. But, if it is very dynamic or in some typical cases there may be situations where you may end up in, what we say non desirable states right which you do not want to be there right.

So, what I encourage those who are landing this thing in for the first time or not very much accustomed with this try to find out these tables yourself right. What will be the updated table for B from the initially or E and how it goes on right. It is easy if you do it we I also tried that all references along with the things you can consult those books and type of things.

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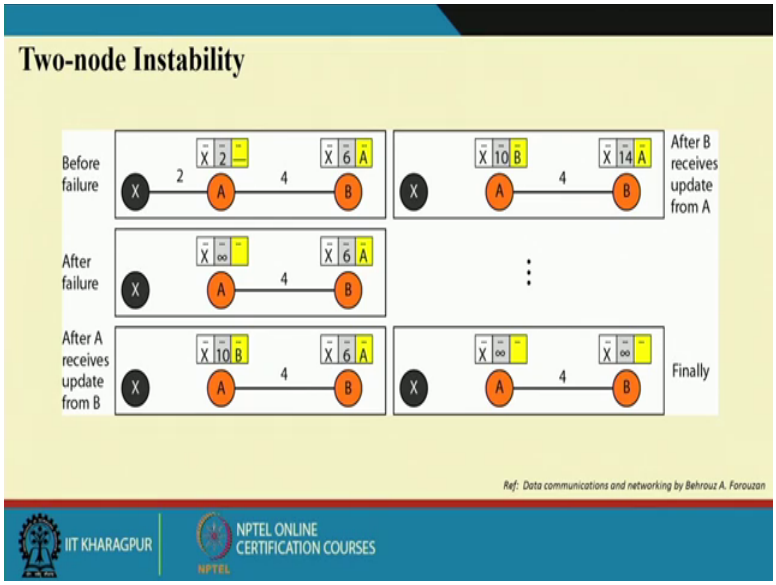

Now, there may be some problems right. Like let us see that there is one is two node instability problem right. Why, what is happening? Now, see if this is the network or portion of the network right, let us consider this is the our networking consideration. So, A for A table reaching X was 2 and it is directly connected alright. Reaching B for B in stable reaching X was 6 and it is via A and nevertheless it is other things are there. So,

dot dot dot that means, it has other information we have only, we are only considering these three nodes.

Now, after failure that means, there is a link failure between A and X. So, what A updates that reaching X via A is infinity right. So, there is no connection. However, still there is a B is still get yet to get the update from the thing right. So, if it A receives a update from B during that time. So, what it does? It sees that though there is no path for 2 X directly, but there is a it seems a there is a path from A to via B. So, it updates so, A to B is 4 and B by virtue of these says that in order to reach X it is still having that 6 entry right.

So, what it does? It goes on X to it says that it you can reach X via B by 4 plus 6 10 right. And, though only looking at the three nodes may be little, you may be little confused that why what is the big problem. But, if you look at the whole internetworking situation or a large network so, this can very much happen based on than when you are receiving this beckoning or the messages etcetera.

Now, subsequently A B updates through A and find that it is 10 plus 4, 14 and goes on. So, long they do not end up in a infinity; that means, non reachability finally, it goes on the things. So, these goes on a two node level instability. So, this is a typical situation which may arise in this sort of scenarios.

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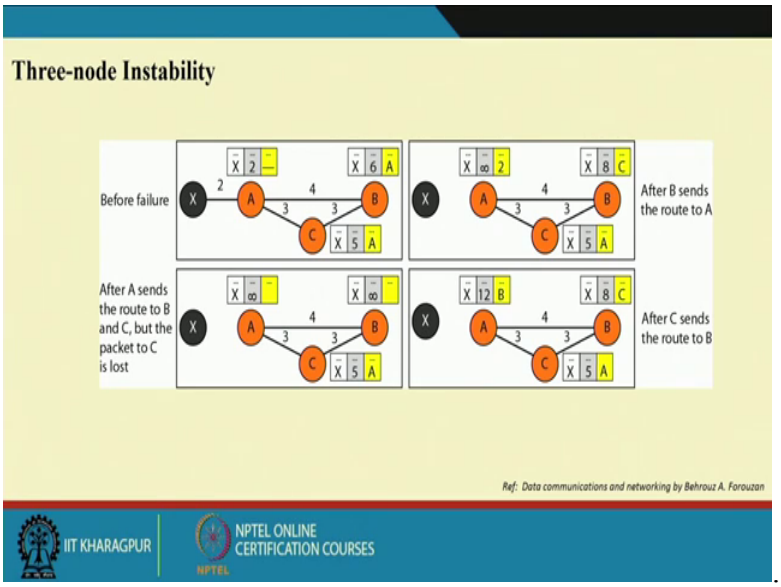

There can be a option of a problem of what we say three node instability right. So, there are three node A B C, A is same thing A is connected to X via with a link of 2. Then what we see after A sends the route to B and C, but the packet to C is lost right. So, what is that there is a failure out here, A gets to infinity and A updates the thing. So, B also gets the infinity, but somehow the packet to C is lost you know.

So, C its still keep that X 5 A right. So, and based on that in the next round getting the advertisement from C, the other tries to update. B updates as 8 right, getting a update from the B A finds that there is a path to X via B right with a 8 plus 4 12 and it goes on increasing like this right.

So, this is another problem of three node level instability right. So, there are issues which need to be addressed when we look at the this sort of link state type of scenarios. Sorry, this distance vector type of scenario. So, these are what we are discussing about distance vector routing, where it whispers to the neighbors.

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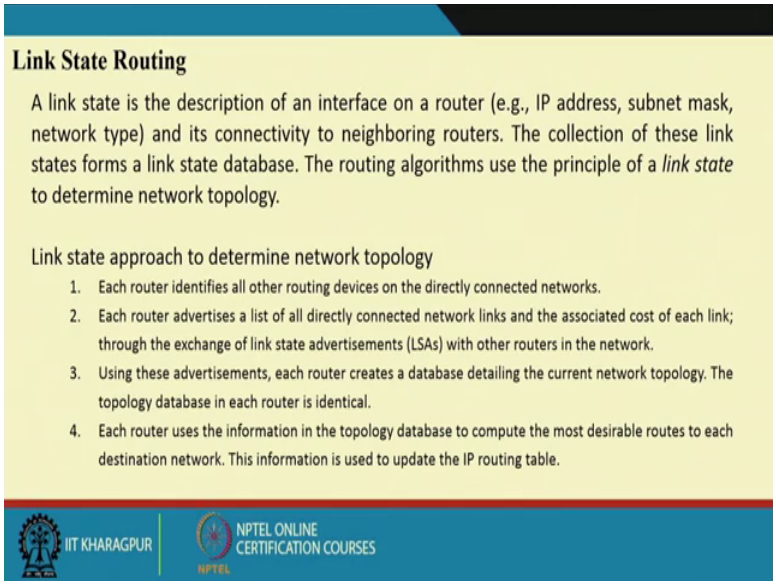

Now, a another routing protocol where which take which keep the inter first of all intra domain routing protocol, which keeps the track of the which keeps the track or which keep the state of the whole network is link state routing right. So, the basic philosophy is a link state is a description of a interface of a router; that means, IP address may be subnet mask, network type and so on and so forth and is connectivity to the neighboring

routers. Or in other sense I so, we can look at that it keeps a network graph in a sense right.

The collection of these links link states for may link state database. The routing algorithms use this principle of link state to determine the network topology. So, in other sense the every router keep track of the topology of the whole network right. So, link state approach to determine network topology, if we look at; each router identifies all routing devices on the directly connected network right that is easy.

So, whatever the it is directly connected. Easy router advertises a list of directly connected network links and is associated cost links; through a exchange of link state advertisements of la LSAs right with other network right. So, it has a each router advised the LSAs. Why in this advertisement each router creates a database detailing the current network topology. So, by looking at this advertisement or receiving this or using this advertisement, it makes the network topology.

The network topology in each router is typically or ideally should be same right, each router should be same. Each router uses the information in the topology database to compute the most desirable routes to the each destination. So, in other sense it goes on advertising these link states that whatever the connectivity information is there. So, each router gives the information and make the network topology of its own.

And, they using this database being state database of the topology it constitute or it finds out that what is the optimal path or optimal route to the destination network right. And, this information is used to update the routing table finally, it updates the routing table and it goes on that, if this is the destination this is the route and this is the interface to be used of the router. So, that is the routing table update because, when the packet comes it gets stored and forwarded based on the routing table.

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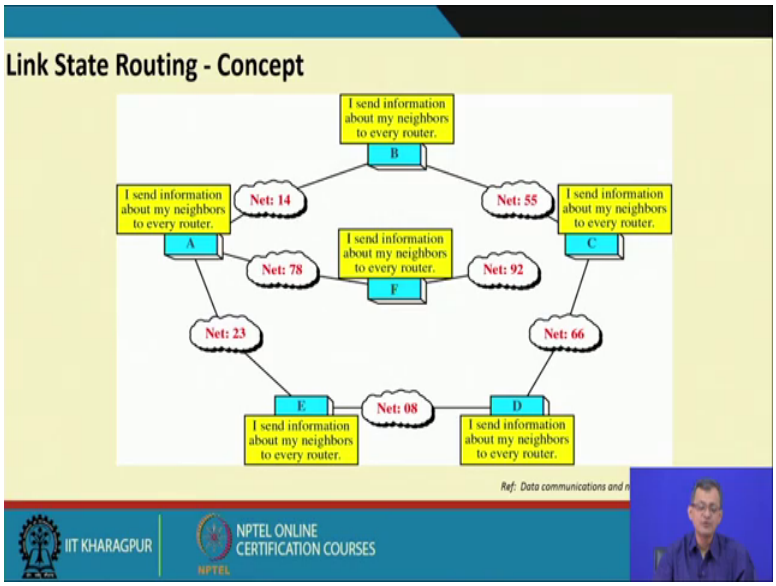

So, in the same way if we look at that same type of network. So, what it says that I send information about my neighbors to every router. I send information about my neighbors service so, everybody sends information and other things and every individual nodes that the router constitute this. Or update it things state database and realize the network topology and find the base path based on this topology.

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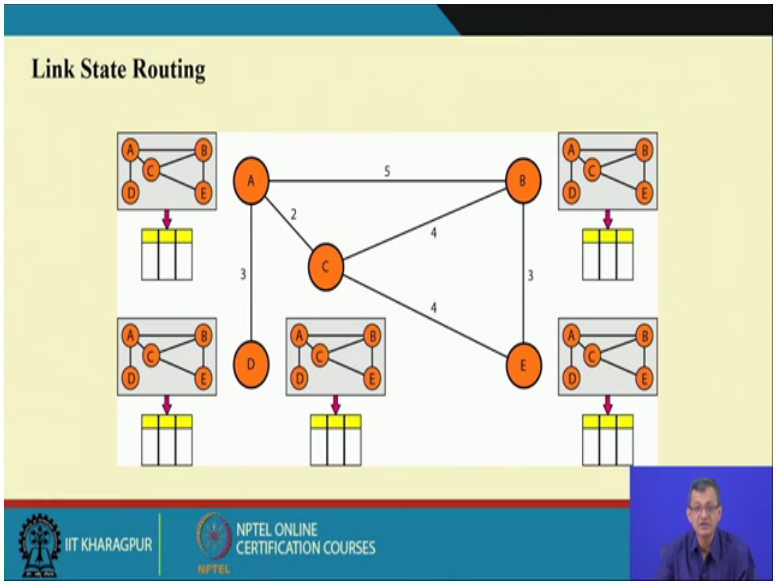

So, similarly leak like what you are seeing the link state things. So, individual router has this sort of instances of the network right, at a particular time. And, then a they take a call

based on this topology. Find out the best possible path and update this routing table which is used by the packet forwarding.

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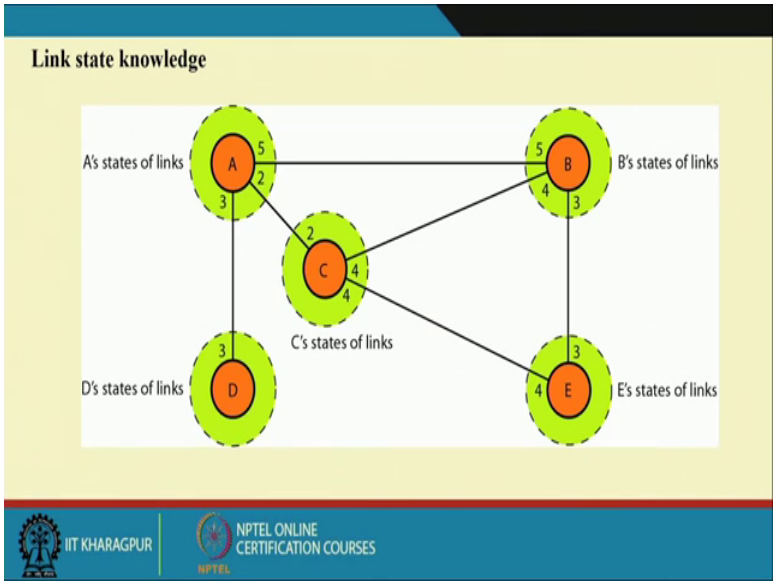

So, same thing link state knowledge as states of the links that how that connectivity and type of things are there. These are the different link state knowledge of the individual routers.

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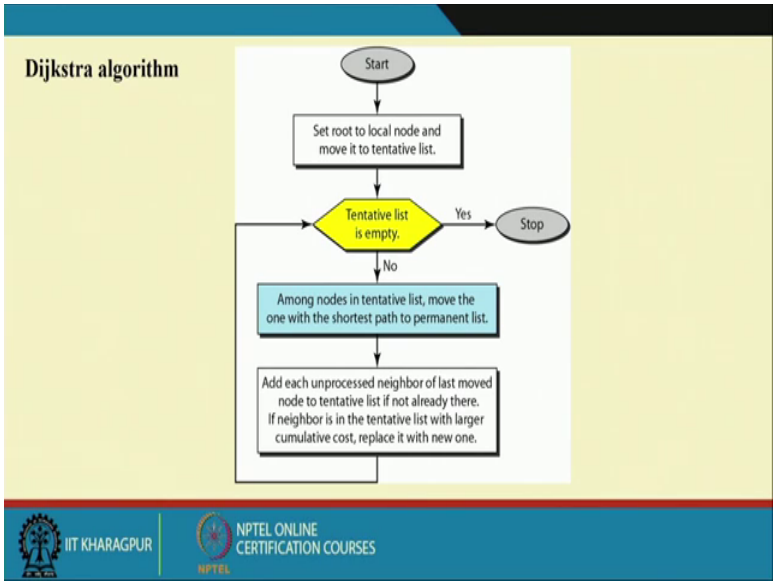

And, then it can use some sort of spot algorithm, the popular algorithm like extra algorithm can be used. So, like the this already we know that how this algorithm was.

Now, once for this algorithm to work and find out the that optimal path or the shortest path, we need to have the whole instance of the network. So, said route to the local node and move it to the tentative things.

And, this is the, and if we have the tentative list is empty then stop. So, long then as is not empty, it goes on iterate like this; like among the node in the tentative list move the one which is the shortest path to the permanent list. Add each unprocessed node in the last move node to tentative list, if not already present. If the neighbor is in the tentative list with in the tentative list means larger cumulative cost, replace with new one right.

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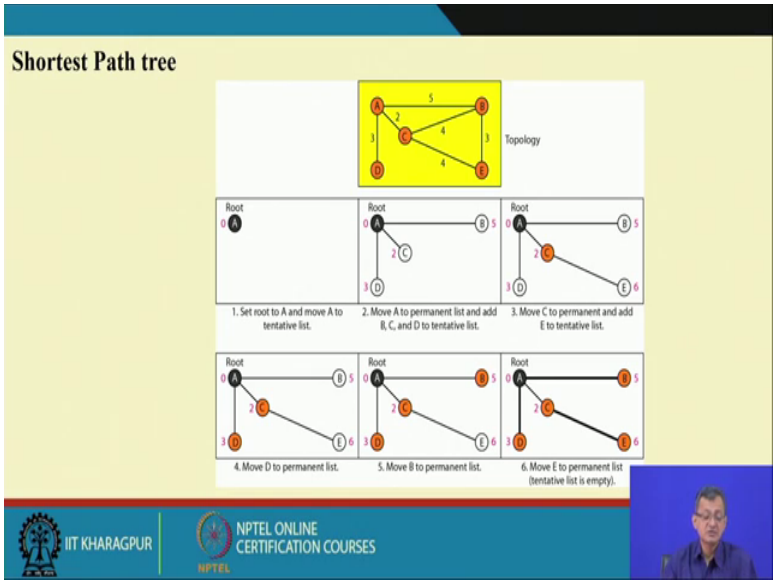

So, this is the standard way of looking at it and if we construct that shortest path tree per say. So, the tree will look like this one right. Initially, the topology is like that initially the said the route to A and move to tentative list; move A to permanently list and add C these. Then, if move C to the permanent list because, it is the least path from the A and so and so forth.

And, finally, we end up in the position 6, where our tentative your list is empty and as the algo says it stops. So, it find out the who are all 3 and this can be used for updating the routing table or the service forwarding the packets to the next destination or rather next stop to reach the destination.

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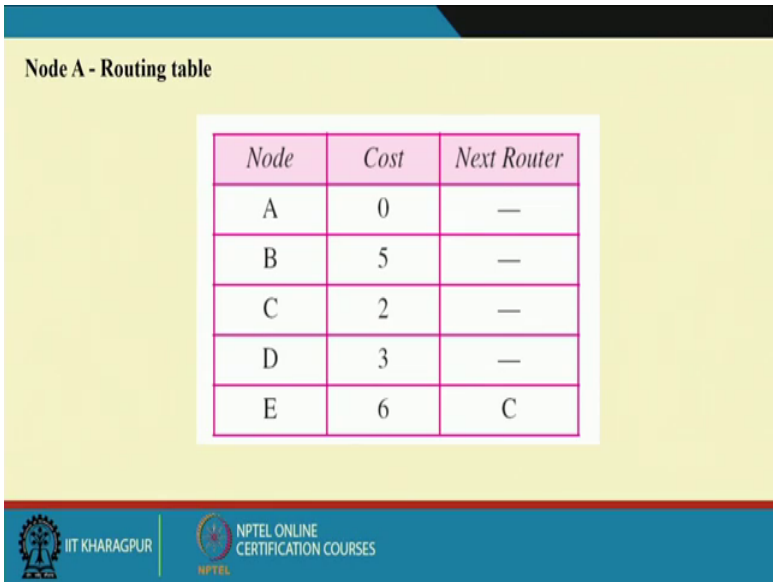

So, in doing so, if we see the routing table of A's routing table. So, no reaching node A is called 0, B is 5, C is 2, D is 3 and E is 6 via C right. So, this is the table which is being constructed from the, from using those information. And this the updated table can be used for forwarding the packets.

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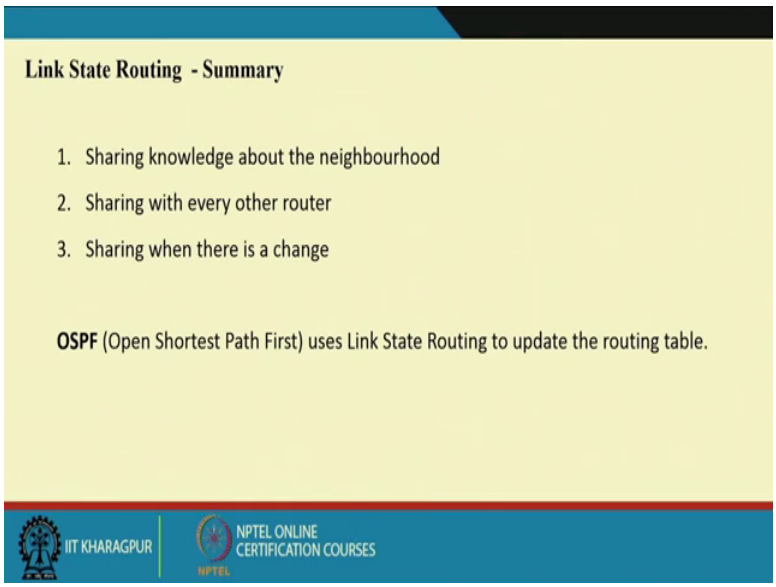

So, if we try to summarize this link states. So, share knowledge about the neighbor neighborhood, share with every other router, share sharing when there is a change right. So, one of the popular link step of routing protocol is the OSPF: Open Shortest Path

First, which uses is in state protocol to update table. And, OSPF if you see that it is a in a we will see later on. It is the popular protocol or inter domain routing protocol, which is used in as for intra domain routing in the in within the A's or a with in the areas in the A's right.

So, this follows the link state routing. So, what we I have seen that the broad way of how this distance vector and instead works. And, the popular protocol for your distance vector is RIP and whereas, this in case of a link state it is OSPF. So, with this let us conclude our lecture. We will be continuing our discussion with this intra domain and subsequently inter domain in some (Refer Time: 32:45) subsequent lectures of this particular course.

Thank you.