Computer Networks and Internet Protocol
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Lecture – 52
ARP-RARP-BOOTP-DHCP (Contd.)

Let us continue our discussion on this Computer Networking Internet, we are discussing on layer two label or layer two protocols rather some of the protocols are companion for the higher level protocols namely ARP, RARP, BOOTP, DHCP right. So, already we had discussed in our last lecture about ARP and we will try to see other protocols that how it helps in this overall communication process.

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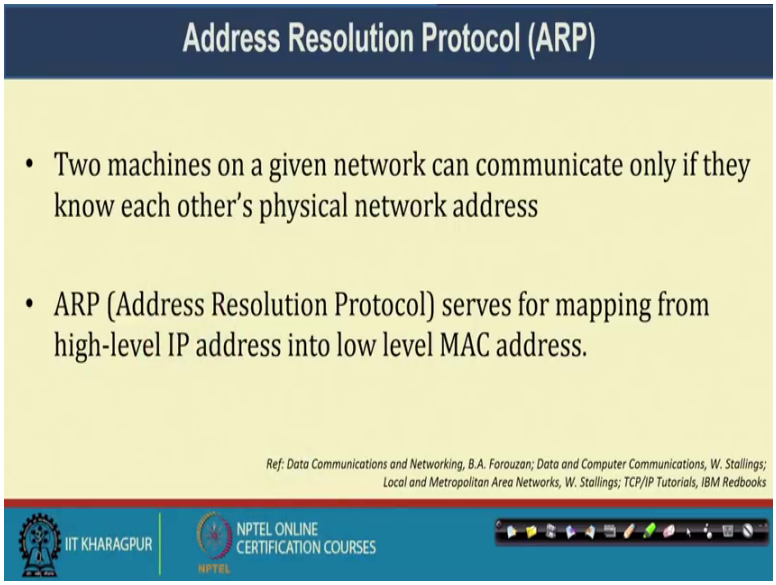

So, just to one or two slides on the recap that any two machines on the network can communicate only if each other physical address network address is known. So, unless you know the physical address the things cannot be communicated. So, there is a need to resolve the higher label IP, two way low level machine address or MAC address so that you know that the next of the next of things.

So, any transmission whether it is host to router, router to router, host to host, router to host what is required is it trans when the next stop things what is the hardware address of the MAC address of the things right; so, that exactly the job of the ARP or Address Resolution Protocol. Also we have discussed about some aspect of proxy ARP, the

different component of the ARP package that which makes is possible like. So, there is a need of cashing of those things so that the next request comes and can be addressed in a much easier fashion.

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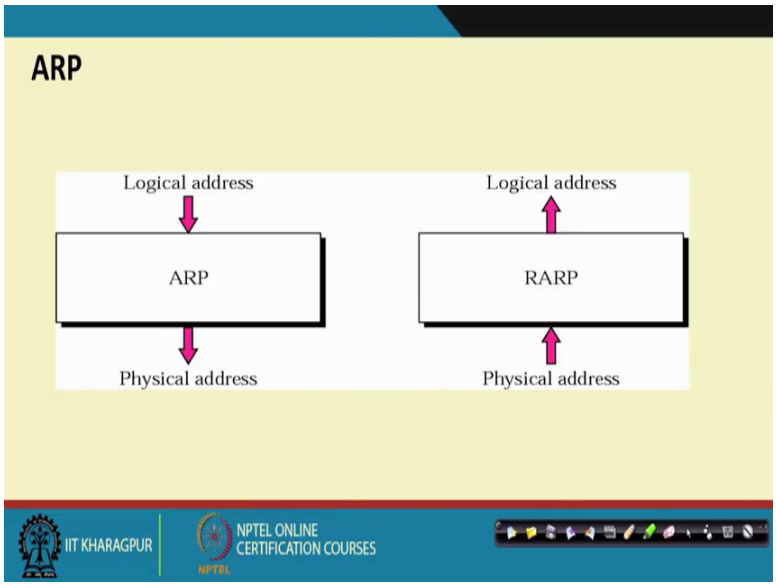

So, this is the very popular diagram. So, logical address or the IP address ARP to physical address, on the physical address RARP to the logical address. So, there is another companion protocol we or the other protocol means the, protocol with ARP is the RARP, Reverse ARP that is given the MAC address or given the physical address how I can resolve to the IP address.

So, where it may be possible requirement, we have seen that where things may be require, one of the major thing is that if I have a dum terminate wants to know what is the IP address during the boot time etcetera then there may be a reversed resolution. I may want to know that if I get a request of I want to do a rewards resolution and see that; what is the IP of the thing. So, in case of connecting other things like VPN or some other type of lines I want to there where the IP address need to be allocated based on the network address and so on and so forth.

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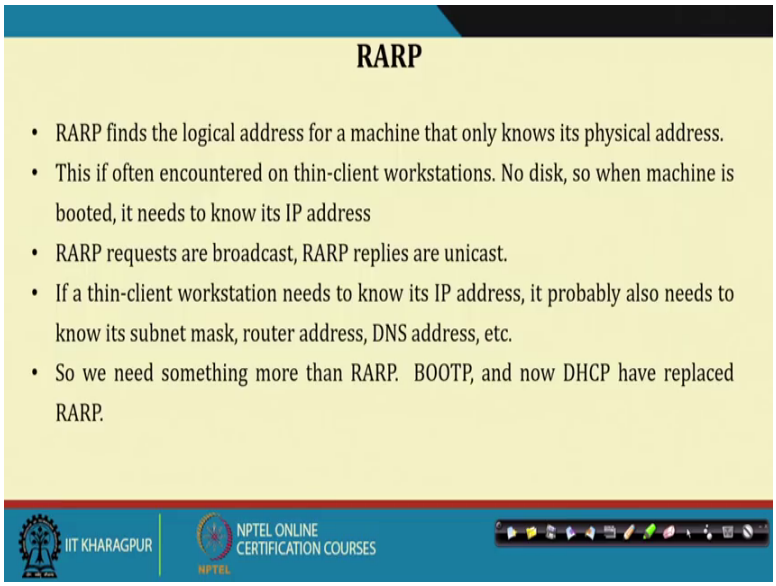

So, finds the logical address for a machine that only know this physical address; the physical address to the logical address mapping. This is of an encounter on thin client workstation, as we have seen thin client workstations no disk. So, when the machine is booted it needs to know its IP address.

So, in case of a thin client workstation if machine wants to know that IP address to be getting connected with the network and so and so forth. RARP request are broadcast as we have seen in ARP, RARP replies are unicast because you now you know that where to send the reply. If a thin client workstation needs to know its IP address it is probably also needs to know it subnet mask, router address, DNS address etcetera right. So, if you just recollect or remember that if you want to do your IP configuration or so to say TCP IP configuration in your windows or Linux machine.

Some of the case, what are the different parameters you will be looking at? If we recollect or if you remember say one is that IP address right, IP address what it gives the logical address to the system, other than I what we require if the subnet mask right. Why we require this subnet mask? The subnet mask allows me to when I, allows me to find out that whether the other address is within the in my network or not. So, it is a subnet mask. So, there is a gate way address like if the thing is not within my distances within, not in within the network so what should be the next of gateways of that particular packet.

So, there is other of the DNS. So, if there is a domain and resolution is required then; where is the DNS server is located. So, there are DNS usually primary and secondary DNS. So, these are the things what we require in the thing. So, subnet mask or router or the gateway address and DNS address and etcetera.

So, when a system boots thin client boots which do not have the memory of memorizing the or remembering its configuration may wants to note that IP address, subnet mask, DNS addresses and type of things. If we need something more the RARP, other than only resolution there are other protocol call BOOTP will come to that, and also a the upgraded or variant of the things which is DHCP which have replace RARP. So, RARP from there we have BOOTP and type of things. So, all what it knows this physical address right from there it want to populate its network property stack. So, that it start communicated communication in the network.

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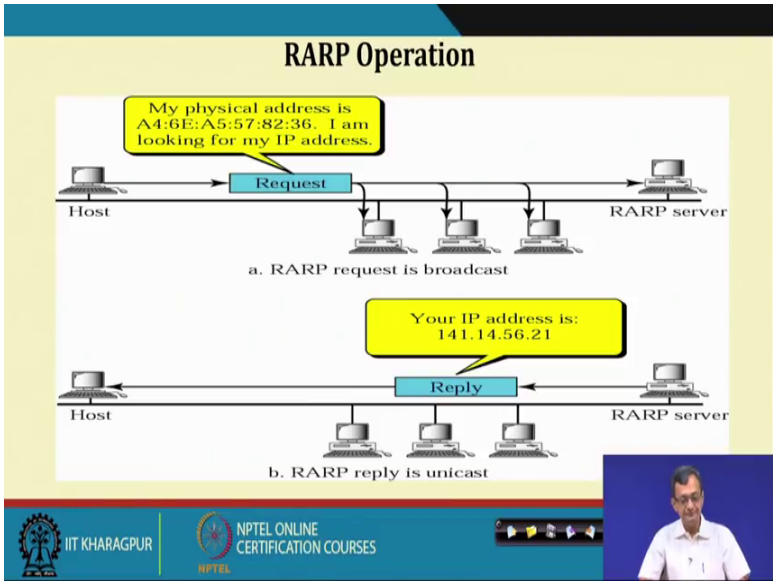

So, as we have seen in case of a ARP here also that with physical address it gives advertisement and the logical address is sent to the back to the host. So, there can be a RARP server or some of they will require means the host sends a request the RARP server sends the response of the on based on the request. If it is continuing that particular hardware address from the logical address can be derived.

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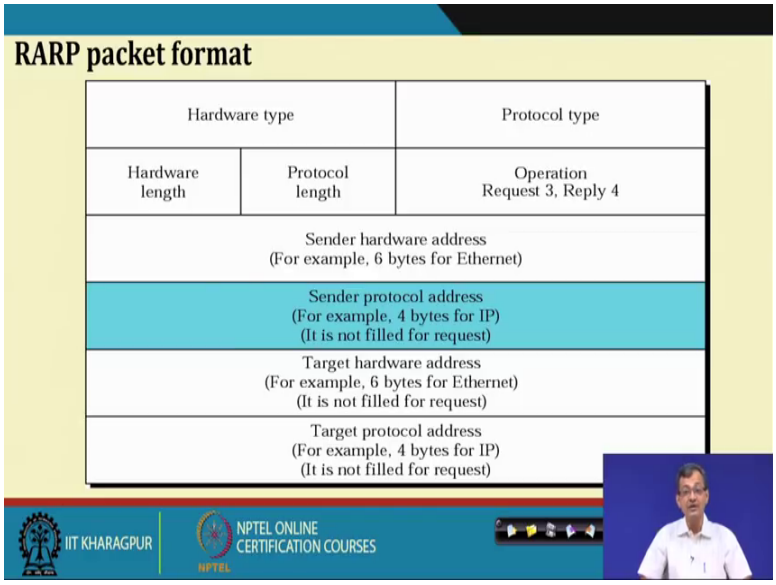

And if you look at the packet format it is somewhat similar with that ARP things, operations is 3 is request 4 is a response. And if you see here the sender hardware address is a known; hardware address is known, where as sender protocol address is unknown. So, because I the sender that is thin-client know that what is its hardware address, but the thin-client does not know where what is the IP address that is it is looking for.

So, what it says it sends request to that particular RARP server; the sever respond back if there can be more than RARP server, the server which is having this things that mapping of MAC address or the hardware address to the IP address respond responds back that sending the this is the IP address and gets populated to the sender. So, in the previous case it was there while sending the packet it is looking for that hardware address where the frame can be forwarded. In this case it want to know the network address so it gets connect can get connected to the network right.

So, if you look at sender's hardware address protocol address or IP address is not known in this IP b 4 for 4 bytes, whereas the target hardware address is known and the target protocol address is known. So, where the server is there it is known to the thing.

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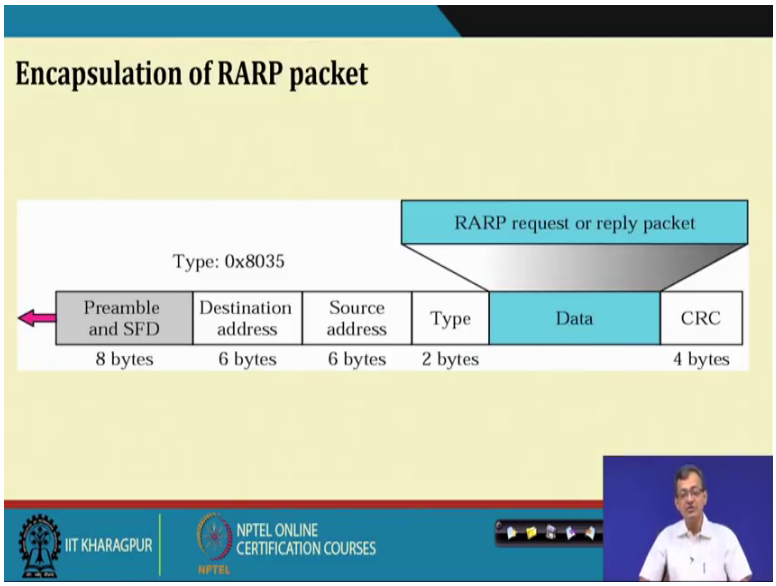

And also in case of Ethernet what we have that is goes payload to Ethernet over all is Ethernet format and Ethernet packet and Ethernet frame and it goes as a data that is whether is request of response in case of a RARP. So, what we say that the next step of on upgraded variant of RARP is the BOOTP.

So, which as we are discussing that not only the IP address there are other parameters which as equally important for the network. So, to say the parameters like IP your network mask gateway or router address, DNS addresses and these are equally important. So, that the server which is responding to this request should also should also send back this are the parameter. So, that the network stack of the originating missing or the thin-client gets populated so that it can connect to the network right. So, for that the BOOTP server should have this capability.

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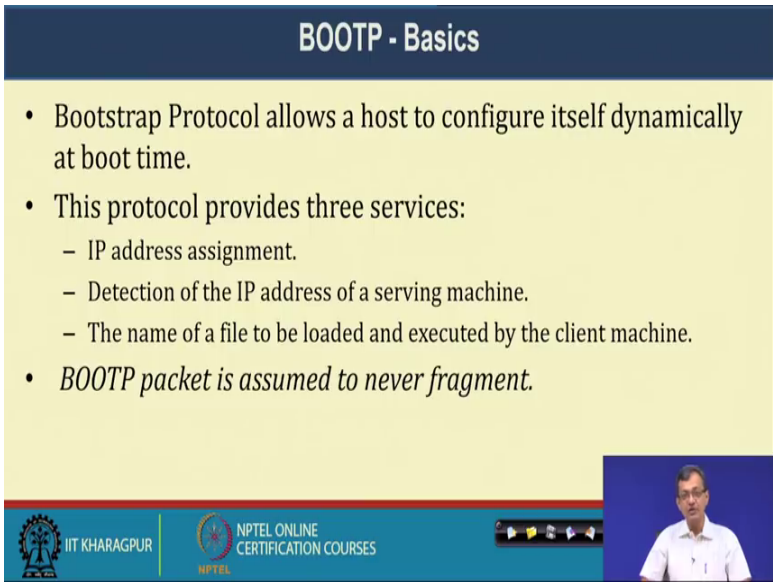

So, bootstrap host protocol allows a host configure itself dynamically at boot type. So, that is the basic philosophy where the BOOTP protocol allows a particular host like thin client and so, to configure itself dynamically at boot time. This protocol provides three services, one is IP address assignment as did in RARP detection of the IP address of serving machine right, it need to know that who will give the IP address and detect the thing, the name of the file to be loaded and executed at the client machine.

So, it its get loaded and that file to be executed. So, it gets populated by this it helps in populating the networks stack BOOTP protocol typically assumed to be never fragmented. That means you get the whole thing in a one unfragmented message. So, it is not fragmented. So, it is not like that two three and things are coming. So, this is BOOTP protocol is not fragmented.

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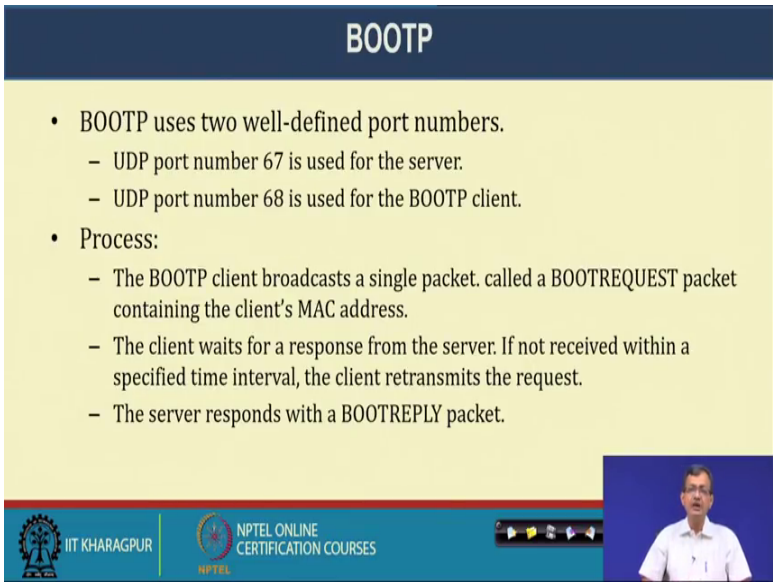

So, as we are requesting for a service it works on to very well known port, well defined port number one is for 67, where the server works and the port 68 where the BOOTP client works. So, that is a defined port.

Process; the BOOTP client broadcast a single packet call BOOTP request packet containing the max client MAC address the client waits for the response from the server, if not received within a specified time the client determines the request the server response with a BOOTP; BOOTREPLY right. So, it sends a boot request packet containing the MAC address clients MAC address that this is my MAC address you send me the other details, the client wait for the response from the server. If not received within a specified time period resends it, it is retransmitted the server responds with a BOOTREPLY packet.

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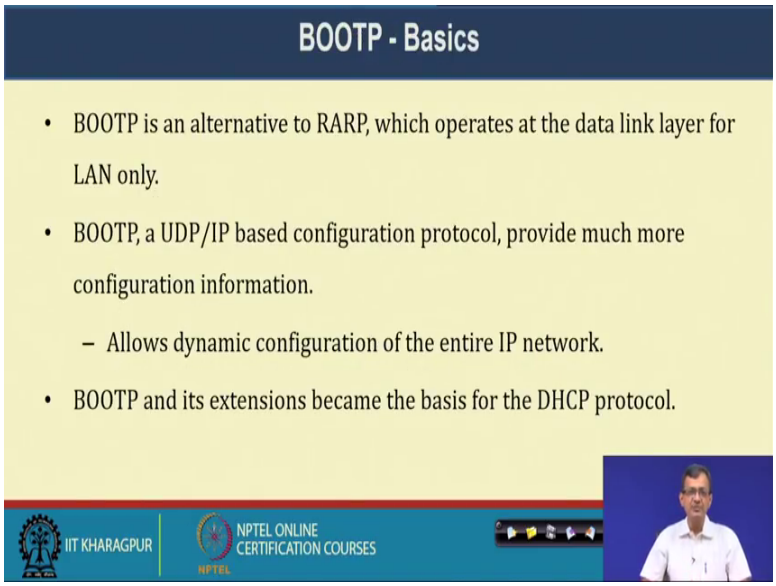

So, few more basics on BOOTP or few more things the points to note; BOOTP is alternative to RARP which operates at the data link layer for LAN only right. So, it is a alternative to RARP, BOOTP is a UDIP based configuration protocol provide much more configuration information allows dynamic configuration of the network IP network configuration.

So, if you see, these are different companion protocol which has upper layer linkages and also have needs to deal with the lower layer two level MAC address right. So, that is why we are trying to look at the when we are discussing this dll of the layer two level phenomenon right. So, this is one of the important aspects to be known, to be seen. So, BOOTP any extension become the basis for DHCP protocol right that will come to that next upgradation of the BOOTP the DHCP right, DHCP protocol.

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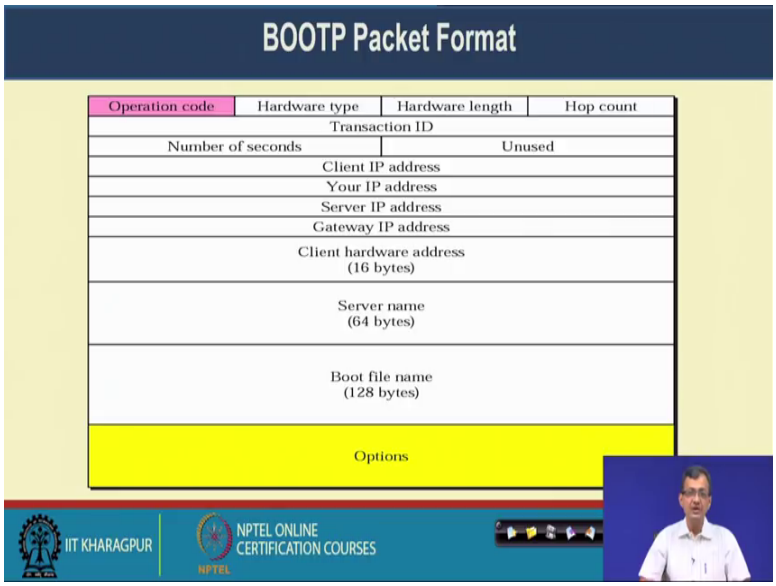

So, if you look at the BOOTP packet format it is much enrich than what we have seen in case of RARP.

So, operation code, hardware type, hardware length of account, transaction ID which requires where it is sending number of second part it is with some person is and use them is a client IP address, your IP address client server IP address, gateway IP address and then what we require that client hardware address server name and so and so forth. That means what we are and there is a boot filename. So that it is downloaded and executed during the bootstrap and their sum of (Refer Time: 13:41).

Now you see what where it is in this cases is required is I, it required a BOOTP server which will respond to the things. So, the BOOTP server typically holds this MAC or the hardware address to IP address mapping. Or in other sense in some cases if we when you look at the DHCP will see it is has a pool of addresses from where the IP address being allocated right.

So, it is much more managed and this is well known phenomena what we see when we work; we when we work with thin-clients and the clients which do not have IP address attached to it right. So, during the boot time it gets the IP address and the configuration and start configuring. So, though there are in first chart we see that the challenges that is having a thin client and this thin client of this BOOTP clients may not have the initially the IP address, but you see there are if there is centrally manage things. So, the overall

management may be much better when we look at the things right so configuring the overall network will be much better.

In some scenario where you required is dynamic allocation of thing of network configuration files, this are pretty helpful or pretty much needed for this type of configurations.

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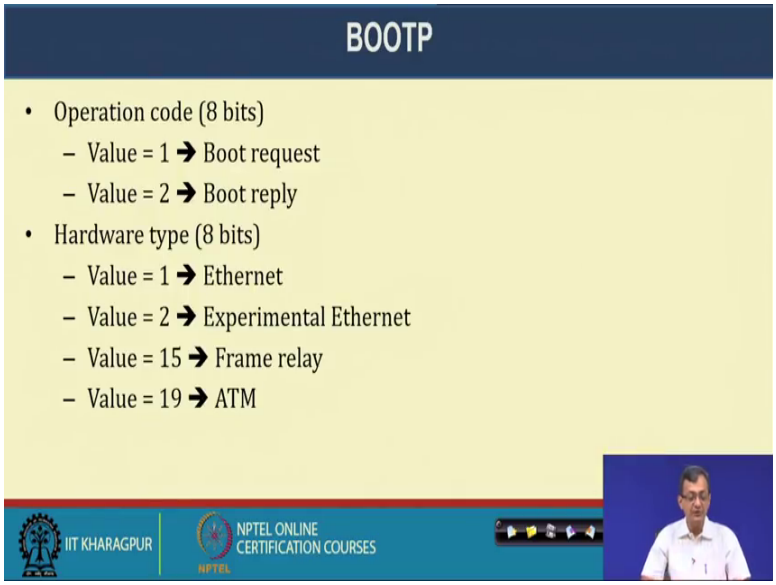

So, BOOTP if you see operational code the value is one for boot request and boot reply it is to that operation code, hardware type value may be a value is 1 Ethernet to experimental Ethernet, frame relay ATM it support a variety of layer to layer to level data driven level protocol like it can be Ethernet, it can be experimental Ethernet, frame relay, ATM and different type of flavors it support right, then if you look at the operation so these are the things; and if you look at the operations.

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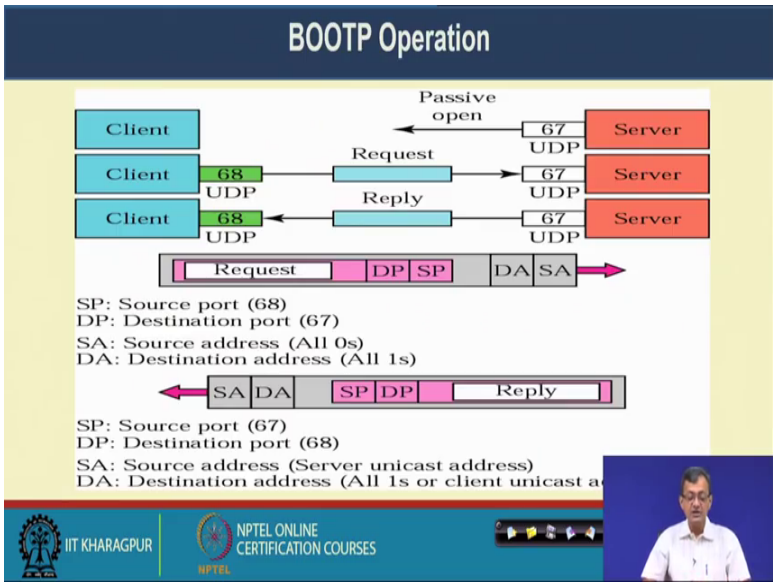

So, server at 67 port on UDP it keeps a passive open and when there is a request from the thing, from the client from port 68 it replies back with the with a UDP and means UDP and reply back UDP packet right. So, as if you see the request with a destination port means source port, destination ports, source at the destination port goes on and it gets replies back on those line, right. So, what we see that my source address may be initially not known, see if you see that if it is source code is 67, destination port is 68, source address is the server unicast address and destination address all 1.

So, the clients unicast address right. So this way it goes in to the things. So, it may be the client may not have any address or the client may be having a address that all are not that all you remember the previous address and try to conform that way the steel address it will continue with this address.

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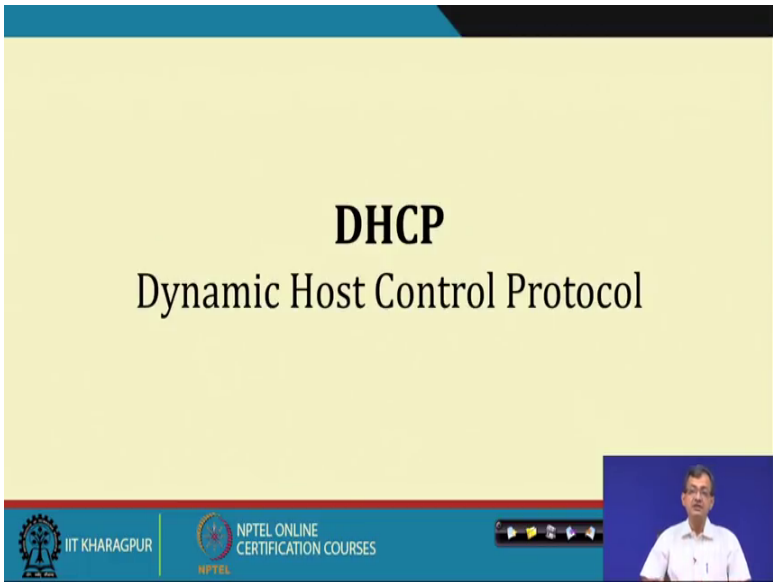

If we look at the next or the predominant variant of this MAC to IP configuration is a DHCP Dynamic Host Control Protocol. Now let us look at it, not as a MAC IP conversions only; it is basically meant for dynamically configuring the network stack of a particular host right. Being a particular host I want to dynamically configure the things.

So, this is not only required for a dom-terminal, but several other scenarios where this network configuration needs to be dynamic configure when the request come. So, there are scenarios where in several situations where it is DHCP configure. So, in the machine puts its requests for that keep me IP address and other configuration and it get the networks stack of the host gets configure and if you see in today's several organization. Even in our IIT Kharagpur network labs. And other places where number of systems there.

They are DHCP configured means while booting ideally they request for the DHCP server which is somewhere in the network and it gets that configuration to be loaded. As I was mentioning other than getting the IP address connected this gives a enormous control over that which IP range you want to allocate and what are the gateways you want to push through and it gives a lot of management related handles to this type of configurations. So, this is a now a very well known practice to have this sort of configuration in to this sort of structure in the start of a protocol or process into place. So, that way the system gat configure dynamically while booting.

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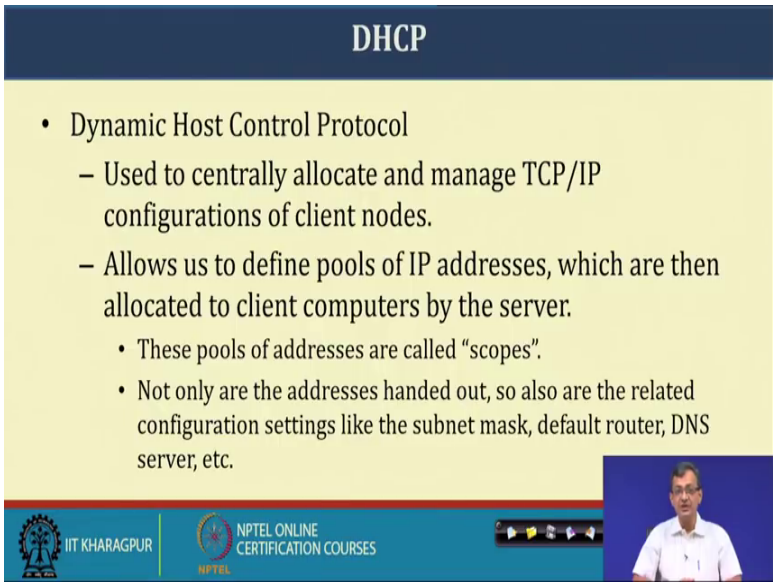

Now, it is used to allocate manage TCP IP configurations of the client notes as we have mentioning right. So, it is centrally allocated and managed TCP IP, allows a administrator to define pulls of IP address which are then allocated the client computers in the things. So, it can be pool of IP address says c s IIT Khargpur this pool is there from there the system can be allocated, this pool of addresses of often known as a DHCP scopes right, not all the addresses is handed out.

So also, the related configuration settings like subnet mask, default router of the gateway DNS server etcetera these are also can be configured. So, the DHCP server perceive contains those informations which can be let out to the things right. So, this is one way of looking at that DHCP server and it is a as I mentioning practice in several organization and installation to look at to for dynamic configuration of the network.

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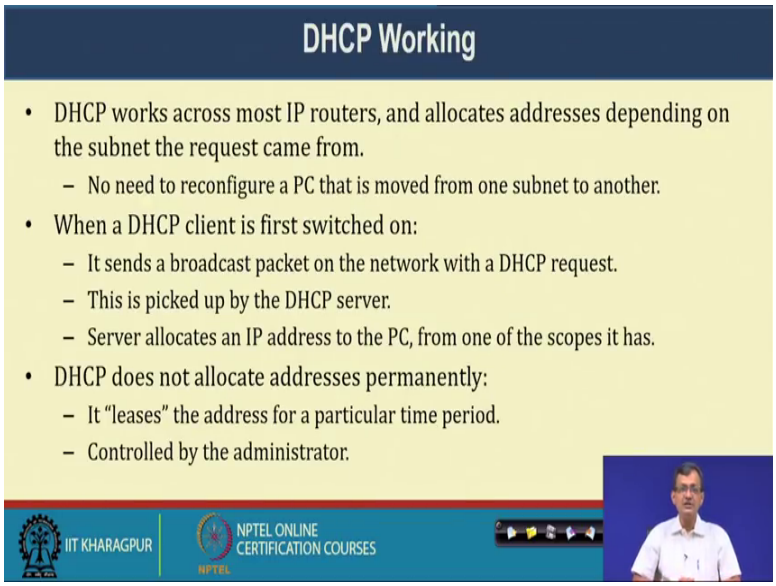

So, how it works? DHCP works across most IP routers, allocates IP address depending on the subnets and the request came from no need of configure of a PCs that is move from one subnet to another.

So, it is it event across the thing. So, we when there are concept of DHCP release if it is not within the DHCP server within the network it goes across the there are DHCP release which can send the request across to some other network. When a DHCP client is first switched on it sends a broadcast packet to the network with a DHCP we request, there is a picked up by a DHCP server. If there are more than DHCP server that will picked up to the DHCP server and server allocates an IP address to the PC for one of scope it has. So, what you say that it is some sort of discovering a server and then getting bind with that with that particular IP and other configuration of the server it is having. Now DHCP per say do not allocate a address or addresses permanently.

So, it leases the address for a particular time period control by administrator right. So, this for a particular time period and controlled address by a administrator right. So, it is that how much leasing etcetera is there. So, this is give lot of manageability in to the things like if you want a particular sector of the things you put a configuration for a particular set of systems. Then once that time period goes up you can basically take out those IP out of the things goes the system goes out of the network right or it next day you can put them on next instant, you can put them separate bundle of IP address blocks. So,

this gives a better manageability of the thing that over all that how you handle and manage the your internal system within the network and so and so forth.

So, DHCP packet as like we have seen in the BOOTP also contained several similar fields there may be some one or two changes, but there is mostly same type of fields and what we see if we look at the configuration of the things.

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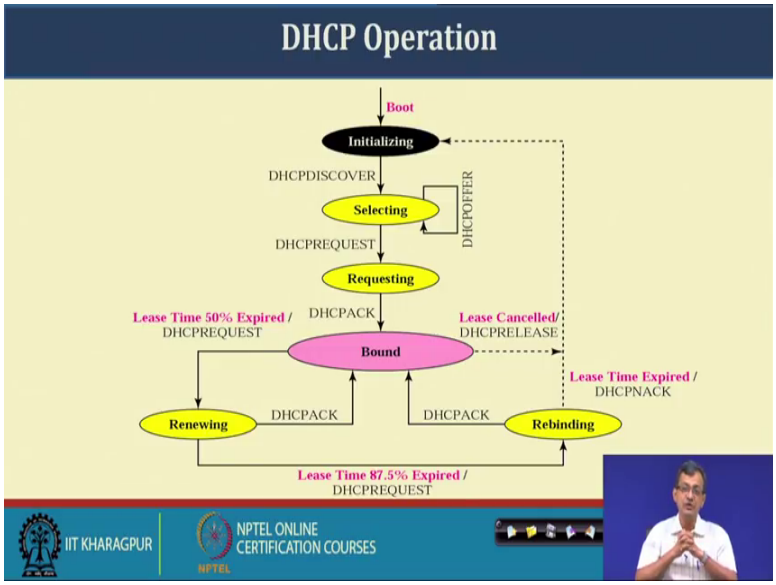

That initially as we are discussing in that over all operation, it that initially when it system boots it sends a some sort of a broadcast massage to there to find out that whether any server are there and not. As I was mentioning that if it is the server is not within the network there is process of relaying the request to the other network there may the DHCP server.

So, it is DHCP discover is the process which goes on, then several server can offer that I am I am ready to serve, I have a IP address that ready to serve more than one server is there. So, ideally DHCP things selects one of the server and it goes of a DHCP request, that requesting to give the IP address and other network configuration. So, that is one of the aspects and on receiving the request DHCP server; the request the DHCP server allocate IP and other configuration files right. So, it is DHCP acknowledge, once that is there it goes on bind with that particular configurations right. So, this is if you look at this process. So, this is the process of getting and gets configured into the things right.

So, it initializes has to repeat it sends a discover message the potential server sends a discover DHCP offer and DHCP request and requesting and DHCP acknowledge and it sends a once that one of the server things are there acknowledge and it sends a DHCP acknowledge and bound to that particular configurations one it is there it is attached with that particular DHCP server. So, once it is attached to the DHCP server now the next things come in to the play as we were discussing that it is not a permanent allocation of IP address right. So, the IP address or the other configurations are not primarily allocated. So, in other terms it is a lease to the system, lease to that particular requester of the host.

Now once that is lease to the things so after the expiry of the lease period things will be recovered or it need to return the things, but there are two situation the DHCP may request for a renewal of the lease right. So, it may request for a renewal of lease, when it can (Refer Time: 26:12)? When there is a lease time 50 percent expired, it sends a typically sends or it at any point of time its can send, but it typically send other DHCP request so renewing of the things. So, there may be two operations that is either it is acknowledge, that is renewed and it is gets to bind. So; that means, it sends a after 50 percent DHCP request it for the renewing it acknowledges as a positive acknowledge and it goes to the binds and the new time starts right.

So, this is may be the one thing and if it not acknowledged positively in a that if DHCPACK it is not received the lease time 87.5 percent was expired then there is a another DHCP request right. So, request of DHCP. So, it is rebinding goes in to play right DHCP acknowledge and again bind into the thing right. So, see two aspects are there, one is after 50 percent it sends a request gets a acknowledge rewind or rebound to the particular a stack does not have to new IP and the and the things works on a smooth vessel and that can be the thing that it may not be renewing that, may not receive the DHCPACK.

Then it gets a after 87.5 percent it sends a fresh request, then again the rebinding operation goes on. If there is positive acknowledgement it gets again bind to the thing with the thing and goes on. If it is still not acknowledge that means it is DHCPNACK. So to say, that is the DHCP the lease is not been increased by the server then it goes for the again initial stage right. So, if it is again requested goes for the initial stage, again request for the fresh allocation and the process continues right.

So, this is the way, but there is another connection if you see. If after the binding so there is the client can release it DHCP release work is over release it or leases cancelled mid way. So, that can be may happen, the lease is cancelled mid way in that case also it goes to the initialization state right. So, that again this recovery its discovery of the DHCP server getting some offer and go and so forth. So, there is one process or it can other process, should see if we look at this whole flow diagram it is s interesting to see that the IP configuration is leased to this client.

So, it can be any client right, any serves right like as a mentioning most of the systems in IIT Kharagpur network are on DHCP lease right. So, they request once boot the request for the IP; IP is allocated and it goes on IP another configuration is you know and those lease period after the period defined period goes on reactivity right.

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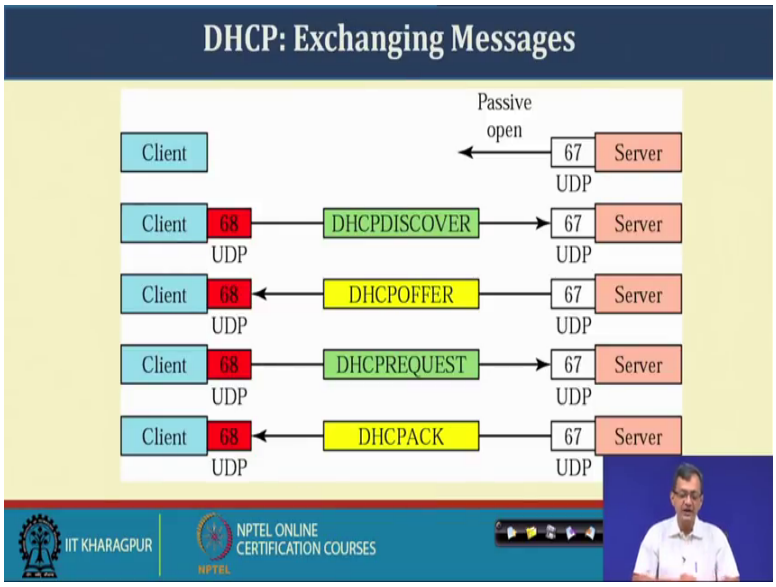

So with this, if we look at again that thing; so, the DHCP server again 6 port 67 with UDP passive open so, that the DHCP discovery as we have seen here, the process come in to play and it offer reply with DHCP offer; again if you look at it is offer then DHCP request. And this a DHCP positive acknowledgement or acknowledgement to accept the things and go in that particular accepting the IPN other configuration at gets bind with that particular thing.

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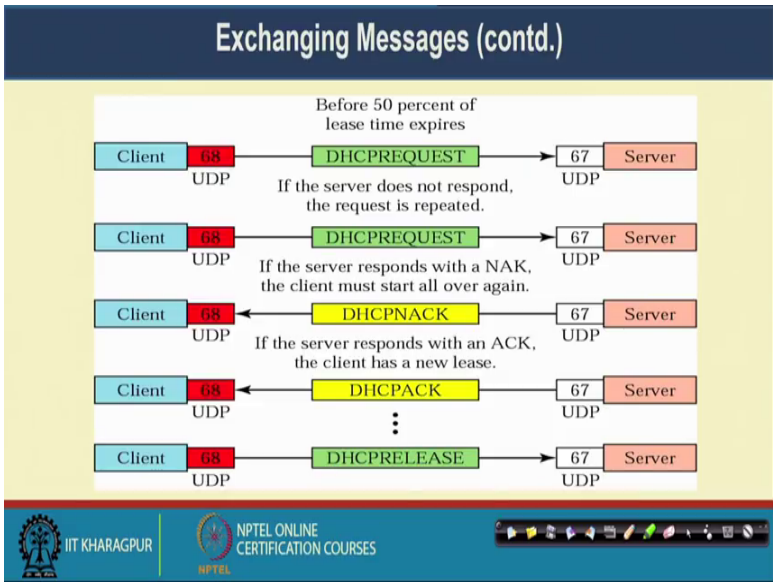

Now, after 50 percent of the time a lapse time expires the DHCP request. If the server does not respond the request is repeated after sometime that is the 87.5 percent time expire, then it goes for a DHCP request if the server respond with the NACK that is not acknowledgement negative acknowledgement then the client must start all over again that goes for the initialization and so and so forth the DHCPNACK.

So, if the server response with an acknowledgement and the kind as new lease that is the new lease of the thing and so and so forth. So, there are other options we have seen in here DHCP release and lease cancelled stuff where it is again goes to the that machine the DHCP list is released or that for things.

So, what we see in this protocols like from ARP RARP BOOTP or DHCP protocol what we see these are the protocols which allows this data link layer to have the say so to say at the connectivity level how things works right given a IP how a hardware address can be resolved and proved given hardware address I can get the IP configuration. So, it can be connected to the network. So, there is more of a configuring the network aspects of the thing which come in the play.

So, these are all important protocol and these are some of what we say border level protocol or transition things where which connects that that other part the IP networks and others with the data link layer helps in forwarding the packets right. In some of the literature they kept is in the IP layer itself some of the things you will get in the border,

but nevertheless it involve both IP and the MAC things and rather more of IP a if you look at the RARP BOOTP and DHCP it requires IP level configurations and the hardware address things I means from which it can be requested and populated. So, these aspects are as important as we have seen error control and flow control in data link layer.

So, with this let us conclude our lecture today. We will continue our discussion with other aspects of layer two, and also will finally we look at some aspects of layer one or the physical layer considerations.

Thank you.