Digital Switching
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Lecture – 30

So, so far what we had done was lot of circuit switching, and then of course, lot of basics about the packet switching systems. So, basically the way I told was either you can use a cross bar and then you can build up a packet switch doing packet by packet scheduling or you can build up a distributed system which is basically based on the self routing matrix, okay, which is a banyan network technically. And you can use this to control routing, and that actually means whatever tag which you are going to insert in front of the packet will be dependent on the output port address, and it will be same on all input ports.

But if you are not using a banyan delta network, you are using some other configuration, then also on those banyan networks also it is feasible, but for the same output, the time value will keep on changing depending on the input; that will be the only condition, but it is technically feasible to make the things. Now I am coming back to the telephone, ultimately why we are actually doing all these switching. So, switches are technically built for two kind of systems. One is to create circuits or paths and then those are media transport over it. So, this is what was conventionally done in telephony. So, you actually create a path from source to destination and then the people talk.

Second is if I am going to build packet switch, I will frame packets data packet most likely that is the most common used. You will put a header, and from any source to destination you can do end to end pay load transport, but there is still something more which also goes once you build up a packet switching system. You can build actually in layered architecture, a complete communication infrastructure; that is what the internet actually does. So, packet switches are very simple thing in that. So, because that background is required and if you have not done earlier course on distill communication network, this suddenly will become something different. So, basically what I am trying is I am trying to start with I p telephony technically. So, you have to understand how the internet actually operates or t c p I p network how does it operate.
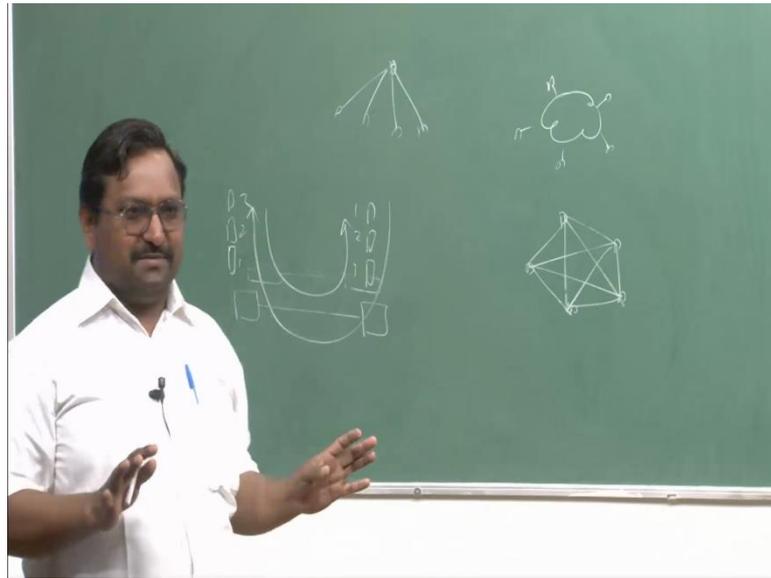
So, of course, the thing is pretty simple; you are going to have an abstraction of end to end. I am just doing a quick revision, and you will be transporting packets from source to destination; reverse also you will be doing if it is a bidirectional line. This can also be broadcast scenario one percent transmits the pay load; it is being received by everybody, and people can filter. Only thing is that these frames can be transported between two end points over a link, and these can be corrupted by noise sometimes. And if it is a wireless kind of field where everybody is using same channel, there can be chances of collision.

So, usually use an abstraction of media maxes control if it is a broadcast network, and on top of it, we take care of what we call the looses which happens because of the simultaneous transmissions. They somehow are coordinated or you can build up lot of other kind of excess mechanisms. We now do technically all broadcast all Mac protocols provide you nothing but an abstraction of end to end, point to point link between any two end points. So, broadcast network technically creates fully connected mesh.

Now over this link, so this actually takes care of this abstraction takes care even broadcast situation or a wireless medium or an Ethernet, whatever it is. Now you provide something call liability using what we call window flow controls. So, which actually means if you put lot of packets in the queue, they will be delivered in same order. So, it is one, two and three delivered one, two and three in the same sequence, and there is

going to be a parallel path in the reverse direction. In a broadcast network also, this is what is being as shown as an abstraction to the over data link layer.

But honestly speaking; only one of these can transmit at any point of time when you look at the broadcast medium, and this actually means the bandwidth of multiple links in a broadcast scenario will be multiple virtual links. So, you will be actually seeing for example, if there are five notes, the abstraction which you will get is this, this fully connected mash. I think yeah, this is the one; yeah, it is connected to everybody. So, this is the abstraction which you will actually create.

But then technically I have nothing, but they are all connected to a broadcast medium, but data link layer will see this; it will not see the broadcast scenario. So, that is the basically functionality of the medium access control. So, Ethernet protocol takes care of this. If it is a wireless, you can have all kind of variety of protocols, say, we have wi max, we have wi fi; all kind of things, they technically create this kind of scenario. If it is a wi max, you do not create this, you create a star. Everybody gets connected to a base station which will create this topology, and this controls. This wi max, GSM, all this will be this kind of structure.

So, ultimately, you will have end to end connectivity. Only problem with this, when you have this kind of scenario being abstracted into this form is the bandwidth which is available on all the links, total sum of it is actually constant. So, if this one is using the bandwidth, the bandwidth available for other links will become less, because total transmission bandwidth is common and shared by everybody; it is a shared channel system. Same is true here in GSM. It is like when already twenty calls are being made, you cannot have more calls, because may be all channels are busy at that point of time. So, more the channels are available, more bandwidth you can get actually. So, it is again a shared resource, and that is what also reduces the cost of the shared resource. So, once we have this abstraction, I get end to end reliable transport of packets in a packet switching system.
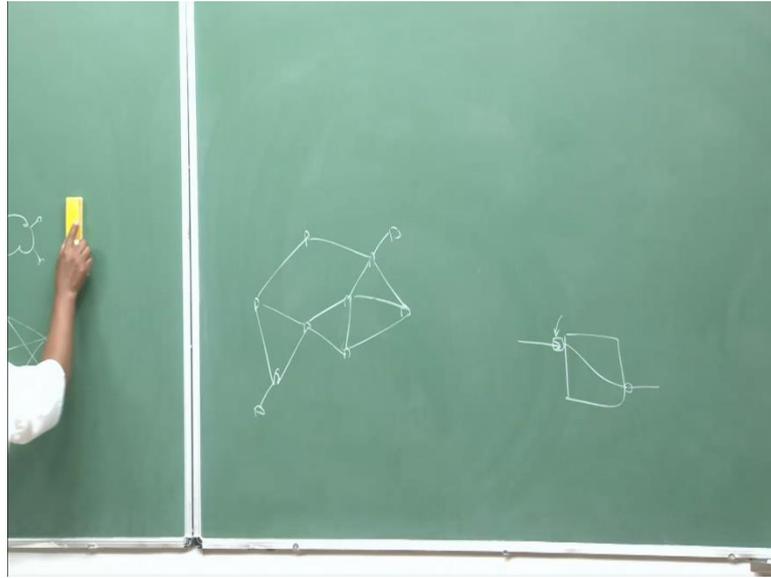
Next abstraction we always say is we can actually create out of this point to point links an abstraction of a network; any kind of topology can be created depending on how the people are reachable to each other. So, somebody wants to talk from here to here, he will actually do nothing but actually will form a packet and packet will contain a header. Header will contain the destination address, and this packet will simply be pumped. At every note that header will be analyzed, and packet will be forwarded, and ultimately, it will reach to the destination. There is no circuit being created here.

Circuit switching you are going to create the path first and then you keep on transporting your pay load or data whatever it is. There are other ways of also doing the things, but I am not worried about them actually as of now, okay. Now important thing is I want to do the voice transport. I have this packet switching system being created. If we already know, we can do this using your delta network kind of thing, okay, and the header will be analyzed. So, usually before you have a delta network when the packet comes in, there will be interface electronics which will actually understand the complete header. It will also have the routing table; based on that, it will decide on which outgoing port it has to go.

It will insert the tag. Packet will be routed there. Tag will be removed; because tag has already being used for its functionality of routing within the matrix and that will be going moving over to the next hub. So, it will move from here to here, here to here and so on.

So, important thing I need not do any signaling with the network. I have to just put the appropriate kind of header. Now I have to set up the calls; earlier days when it was circuits switching system same thing, if this would have been exchanged; I would have talk to this guy. Sir, I want to dial to this number; it would have reserved the resource. This must have talked to this person, reserve the resource.

The path once it is through till this particular point, it would have send a ringing current here, ringing tone coming back. And when this guy lifts and set ringing current and tone both are stopped, final path is set up, and they will start talking. At that point of time, billing will start; billing is depending on the duration. Now all that is gone. This guy is not talking just forming the packets and pumping it in, but the question is when you are going to hold a phone, you are connected here, and this is a wire, this a computer; this is fine, but with phones this cannot be done.

I can connect a phone here; tomorrow I would like to connect a phone here. I would like to have multiple phones connected at multiple places, and still I would like to make the call. So, how this will be done actually in I p network? Important thing is that the destination I p address and a port number are good enough to connect to a server. So, more details actually we will come; now let me give an example of how this kind of thing happens in a I p call actually, how you can set it up. Say pi will talk about later the actual stranded, but first of all the call set up procedure.

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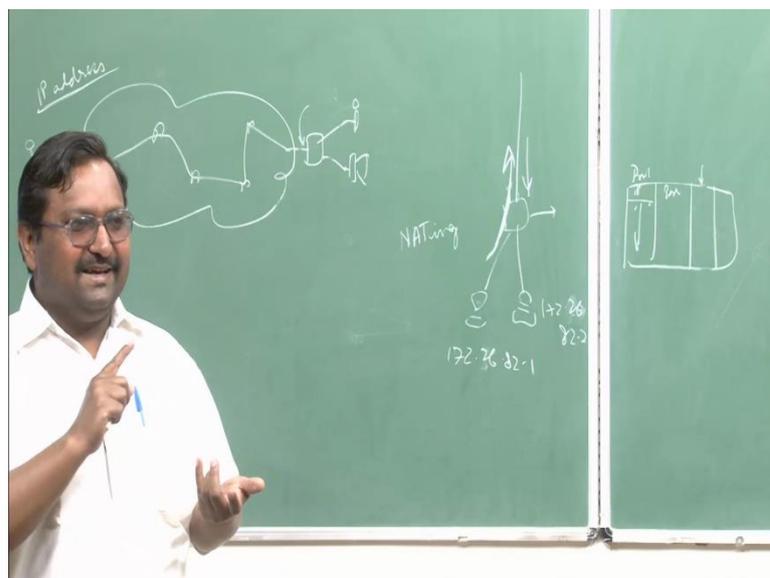
Similarly, one of the important thing is as all of you must be knowing, if you actually have a computer and if you have program running there which can capture your voice and which can play back the sound coming from the other end; you have started a program on a computer, okay. So, it is connected to a microphone; it is connected to also a speaker. So, whatever you are going to speak will be captured can be packetize and can be send to somebody and whatever is coming from somebody can be played back.

So, people thought of lot of things, and they said okay, if somehow I know the other persons machines, this address; this address will be an IP address; that is what is used in internet for addressing. And if I can run a small program here which is running on a certain port, okay, and then this is also connected to a microphone; this is also connected to a speaker; this is also connected on a certain port. So, in fact, if this person is initiating the connection, this port is immaterial. If this person is starting the connection, it will set up a TCP or UDP connections.

UDP is a packet by packets system. You send a UDP frame, you build it and you send it; even if it is lost, it is fine. We need not retransmit it, okay. TCP you make a connection. You keep on sending TCP frames; if they are lost, automatic retransmission will be happening after time out. TCP also does something nice that if the bandwidth available becomes very small, it will start transmitting at a smaller rate. There is a built-in congestion control which is not there in UDP. So, UDP is a datagram base system. TCP is a kind of a virtual circuit end to end built on top of a packets switching system, both of them, okay.

So, only this port number if it is known, this guy can set up a UDP connection all the way to this person. So, it will get UDP packets. So, I can put my all sounds here, packetize it, transmit over the network; these are all I p routers or switches whatever it is. Whatever is the shortest path, it will take that shortest path and will reach here, or whatever be the other policies, it may be dong routing on all other kind of methods. This end users are not bothered about. They just create UDP connection all the way from here to here. Audio is captured, packetize and sent all the way.

This is the received, and this guy can listen whatever this is person is telling, and similarly, this program can also run in a different way. So, that two channels you create in TCP, same way you can create to UDP also. This can also keep on sending UDP to

these, and this can keep on sending UDP to this guy. Usually, we will use UDP for most of the multimedia information which will be transmitted. Reason for that is if I am speaking and you are packetizing my voice, sampling in forming packets, sending it. If some few packets are lost, okay, and if you have not done complete compression of the audio, the other guy will still be able to make out.

See if I am speaking whole sentence, something is not recorded in between; still you will be able to make out sentence. We have lot of redundancy built inside the human construction of sentences. What electronic compression system actually do is they do not use that linguistic redundancy; they are not using that. They are only, for example, taking silence reduction; when I am silent that time they are not recording, okay, or they are kind of building a prediction, so that I require less number of bits. Only differential changes are being sent, but even if in a sentence, if you know the previous sentence; you know the few words in current sentence. You can build on the base of context what I must have spoken in the current sentence.

In fact, amazingly human mind is. So, we actually do not listen to each and every word very carefully in the sentence. In fact, when you are reading a book, we also do not read each and every word actually. If you are careful enough, we actually jump over the sentences. Sometimes you skip the words, and we make from this what we call very fast scan of the words, we just join them and build up the meaning out of it. So, sometimes you might have seen that you have missed a not written in text, then you actually build-up a meaning which was totally opposite than what was intended in the text.

So, I think this is also one of the difference when you read especially the research papers, this is something which you have to earn learned. So, reading a novel and reading a research paper is different because of this. When you read a research paper, you have to read word by word because it is go through so much of iteration, so much of compression that you cannot make out what is written in the research paper by doing this jumping through the words kind of method.

But in a novel this works perfectly well, and amazingly, if you read the novel second, time you will find out lot of things you missed out, because you were jumping earlier. So, now you will read a difference sequence of words. So, actually humans are much more intelligent in that sense. So, machines do not do this thing. So, that actually means

if I build up a TCP connection, my some voice is lost. I do a timeout, retransmit; there is already so much of delay which will happen in that process. And by that, time my other later on sentences already reached; you have already figured out the meaning, what is the use of retransmitting something which was lost.

So, anything which is delayed in real time multimedia is always useless. So, by in principle, most of the transmissions are done over UDP. We do not do retransmissions for any audio or video stuff, and mostly we are talking about audio video, but there will be lot of other media streams which can also exist for communication. This is a very simple system. Switching is still happening amazingly; switching is happening because I am now forming packets, and packets are being switched by the network.

So, the distance switching is still happening; my voice is still being transported, but I think we will not be happy with this kind of system. I have to always either make a separate mobile call and find out what is your code number on which we can talk and then set up the same thing in my software; you will set up in your software or we have to at least know each other's I p address, and these I p addresses are not fixed for the users. When you are connecting at your home using an ADSL, every time you will get a different IP address, and this IP address has to be uniquely routable in the internet; if it is a private IP base system, then it cannot be.

Most of the time in your houses, you will actually have a telephone line coming, an ADSL modem. This will acting like what we call network address translation router, netting router, okay. Actually I am assuming lot of understanding in terms of networking, but if you do not understand the term, ask me. I will explain that, because I think all of you have not done the earlier course. I have also not explained everything in the earlier course, okay. So, usually address which is assigned to the machine here behind the netting router is a private IP block address which is assigned by this machine. So, when the packets are moving out, the source I p address is not this one, but this interface address. And it maintains the table that this was received from this one, and outgoing port number also will get modified. So, usually this will maintain netting table.

So, there is a private IP, and private port number here. And for the outgoing side, there is one public IP or maybe few set up public IP's depending on how the netting is configured. So, usually in household, this will be only one single which will be used; in

institutions, sometimes we use more than one. So, because now here the range of IP addresses which can be put in the table is much larger. So, I can use less number of ports. I will use less number of IP addresses which are available on this. These are unique IP address across the globe, okay; at any point of time, only one machine can use that IP address.

So, for example, 202 141 40.215 which we are using for our Brihaspati server is a unique IP address; nobody else in the world is going to have this IP address. So, that is the way they have been arranged in the internet. So, we will keep on using those IP addresses here, but they are less in number may be only one. But I would like to do a TCP connection for a telnet; I would like to do a voice over IP call, I would like to do a browsing. So, so many ports will be open, say, five ports. There can be another machine here sitting in your house, and there also somebody is doing voice over IP and whatever it is. They might be actually doing the same IP address, same port number was also may be used with different I p address.

Say, for example, this might be using 172.26.82.1; this might be using 172.26.82.2. So, here the browser might be using same, say, 16536 number port; this is also 16536 port. So, when this guy is going to send the same packet out, it will use same IP address, but these two connections have to be identified. So, port numbers which will be used will be different actually for the outgoing side. This will be source I p address and source port number will be modified when the packet is going out, okay.

So, Google or whoever sever whichever server you are going to use will be not seeing your IP address; this private IP block they would not see. They will see the IP address which is here, because if they start seeing this IP address, in the reverse they cannot send the packet, because those packets will be dropped. So, thumb rule is if in internet any router if it sees a packet containing in the destination address a private I p block an I p address from that range, it will simply block drop the packet; it will not route I g t. So, reverse when the packets will come, they will come for this IP address. So, again the same table can be looked in destination IP address and port number can be updated or modified and then packets will be routing appropriately to different machines.

So, you can do in multiple machines band and netting router because of this. In IP v 6, even actually this is not required; each one of them can have globally routable IP v 6

addresses possible. So, there the address is special huge; so it is the only problem in v 4, okay. V 6 you actually get slash 64 address for everybody which is a huge number, okay. So, first 64 beta out of 128 are going to be used for network address, and you can have 2 raise to the power 64 host sitting in your subnet in your house.

So, your phone, your TV, your remote, whatever you have, your watch, everything can have an IP v 6 address, and all of them can be routed through one single router. So, that is kind of capability which has been built, okay. So, now there is publicly routable address publicly routable address, somehow it has been managed; call setup based line issue, I have to do that. So, what could be the idea? You have to tell me what will be the logical approach for you. Telephones are numbers are always unique; your mobile number remains the same wherever you go, because that number is your identity.

So, one thing which is sure I certainly cannot put this I p address as an identity of the person; that is not possible, because if I am connected over a wi fi, I might latch onto another wi fi. If I am actually using GPRS or some other thing or a 3G connectivity or wi max, I might me moving in a train and may be attaching to something else; I might get a different I p address allocated. So, there is a mobility thing aspect; you may actually go from this room to another room and connect a phone there. So, this will not work, but you can always check your emails wherever you move, how that happens. Your email has what kind of address; it is always some user at the rate, some domain name. So, maybe I can use something very similar.

Student: That needs particular server that space we use?

Yes. So, that actually means we require some server and I have to tell I am so and so person and I am here as of now.

So, when this you are touching your phone here, I need some kind of a server running which should be known to this person; everybody knows where is Google. So, you can always check your email; you should run your mail client. You are always writing on that in the thunderbird you will be writing your for example, I map dot Google mail dot com or I map dot Gmail dot com. That kind of thing you must be writing; that is a I map server, and that uniquely result to an IP address. So, in fact, there is another thing something called domain name system, but in internet as far as actual communication happens, this happens on the base of IP addresses.

Either 128 bit IP v 6 address or 32 bit I p v 4 address, but humans cannot remember those numbers. So, we usually go for domain names. So, every machine is going to have a name, and it is registered under certain domain. So, the mastered or route domain is route which is known as dot; under that, then there are many domains which have been created.

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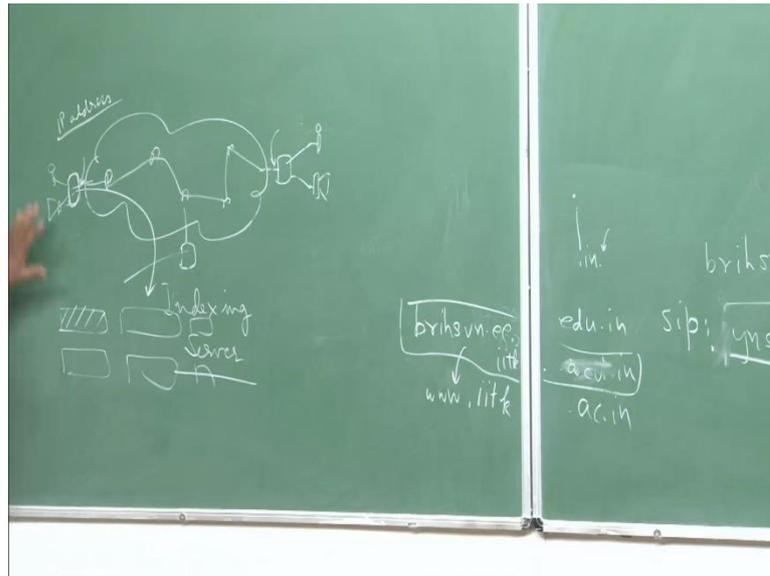
So, India is using dot in domain. So, last dot if you write, it is fine; if you do not write, then also it is fine. So, it is under root; within that then we have e d u dot in, wave e r net dot in, wave a c dot in. So, in fact, a c dot in is what Iit k is using. Our servers for Brihaspati and Brihaspati are using e r net dot in. Then within that we have IIT, Kanpur, IIT K, then I can use machine names. So, when I use www dot Iit k dot a c dot in; this is actually the machine name. So, when I resolve this query.

So, you can actually go into a Linux box and you can use either NS lookup which is old utility or use DIG D I G, and give this name; you will get a corresponding what is IP address allocated or you can also go to www dot trace route dot org, give this name. And the machine server there will identify what is the corresponding IP address. IP address will always be a 32 bit; the names can very long, okay.

So, we have been using, for example, Brihas v n dot e e dot Iit k dot e r net dot in. So, this is when you are within IIT, Kanpur; sorry a c dot in here. When you are outside IIT, Kanpur, I have been using Iit k dot e r net dot in. In fact, there should be a final dot is

directly an entry under the root, and worldwide there is certain number of routes server which are running which runs all the time. It is run by various governments, and they always synchronize; those are dot servers, route servers. And route server entries are always there in your slash e t c directory; you can actually get the file in your Linux box where you will see the listing of all these route servers, okay.

So, it actually comes in the configuration of the name d; name d is the utility which is used for this purpose DNS. So, you can run even your own DNS. Ac is the domain name. Under in India this is also e r net is also registered as a domain name. So, all the machines which are part of e r net are going to. So, whatever the IP address allocation for e r net has been gives is given there. So, e r net runs their own DNS server. So, how it happens? I want to search for this particular IP address for this machine. So, I know this is a machine for which I am looking.

So, I will go for an entry for I would like to find out if I know the DNS of Iit k dot e r net dot in if I do not know what I will do. I will I have my own local name server; everybody will be having local name server which everybody configures. So, all of you also have configured 172.31.1.1 in IIT, Kanpur and 1.130; there are two name servers which everybody configures. So, your machine actually talks to that machine [FL], can you give me the IP address of this particular name. It will say what is my domain name; this particular sever are responsible for Iit k dot a c dot in domain.

So, when you ask for this, you can actually access this from your machine. So, it will find out that Iit k dot e r net in, I am not for that. So, I have to search for e r net dot in entry. So, that server 1 dot 130 will talk to e r net dot in corresponding DNS for that, okay. So, one of the ways is it can directly go to the route, find out what is the dot in server; dot in is common. So, it will go to dot in server, find out what is the corresponding DNS for e r net dot in. Talk to him; find out what is a going to be Iit k dot e r net dot in DNS server. This is also running in IIT, Kanpur. So, we have done a short circuiting.

So, you already told that Iit k dot a c dot in server; for Iit k dot e r net dot in, this is the server. So, it actually miss sends the request there which then intern tells what is IP address for this Brihsvn. This we do not manage; this is managed by e r net team. So, when we wanted to put our 202.141.40.215 entry there we have requested them and they

have put the entry. For this one for electrical engineering all machine names. This is the v actually maintained, but we have informed that Iit k dot a c dot in domain server that for any name which contains e, you have to contact me.

So, it keeps on fetching entries from my side. If you do not know anything, just simply connect to a route server, and route server will tell this domain. Then from there you will get this domain, this domain and this domain, so on, and you can ultimately get the IP address of the machine. Now these are very important concept, and that is what we are going to use.

Student: Sir, is this hierarchical?

These are all hierarchical, but there will be all distributed system. It is a distributed database technically.

You can do DIG. D is a command which can actually even tell you the complete chain of events. There are two ways you can directly connect to the route or you can ask your name server; in that that name server will contact his further parent domain, and he can contact his further parent domain till they get the address. Addresses are flashed back and then you can get; that is one way of doing it. Secondly, you ask this guy. This guy says I do not know, but my parent is this, you talk to him; I can talk to the parent. So, I can keep on talking till I get the IP address.

Student: Sir, it is the same query or?

Every time we make a separate query till it gets resolved.

See sometimes when you do ping or TELNET, it will not work, because your machine has fired a DNS query, and it has timed out. Result has not happened, but that DNS meanwhile actually it is already filed up another query. So, next time when he will do the same ping, you will immediately get an IP address because each one of them also maintains a local cache. So, some DNS query is not being used for a long time, it is automatically flushed out from the cache; otherwise, it is captain cache.

Student: Sir, how we decide how to split up the split up and then how to distribute it?

For your domain, you are responsible; how you manage, it is your domain administrator will take care of this. So, for all IIT, Kanpur machines Iit k dot a c dot in, its computer center takes care of that responsibility. Within electrical engineering all machines, I take care of that responsibility or my lab people will take care of that responsibility. So, if you want to actually have your own name. So, you have a machine in for example, say, 305; you are working on that. You say I am fed up whenever I do telnet; I have to remember by IP address. Can I use something called my name itself instead of that thing? So, you can always say I would like to put my machine same as Rameshwar Rameshwar dot e dot Iit k dot a c dot in.

So, I will take your I p address and your name and I will put in my DNS entry of e e d. D is DNS; I will make an entry there.

Student: Local mapping?

I will create an entry because I am the admin for that, and that it will peculate all the way to the Iit k domain also. So, anybody can connect to you, but unfortunately, we are using private I p block. This entry is never propagated outside Iit k, but within Iit k, we are peculating all the entries. We are taking entries from outside world if you are not using proxy. So, remember if you are using netting router, we have to use 172.31.1.130 which is netting which is the DNS which is running outside. When you are inside, you are not using that one actually, and you cannot get IP address of Gmail dot com, unless you put that as a DNS, because that is an outside Iit k. So, that is how the netting will work because you require an IP address of Gmail in that case.

So, now what we have to do is we have a put a server here, indexing server we call it; that is a term which is used. Usually, they will not be one but there will be multiple of them. I am first of all talking about a principle, okay, of how this can be done. Now these both guys know about this indexing server, what this guy will do? It is a directory. The way we have a DNS, it is a directory system. You want to make a phone call, you can always keep a phone number, what is the corresponding IP address, phone number, corresponding I p address and port number, maintain a list.

So, when I want to make to a certain call to somebody, I will just make a query here; I want to talk to this particular phone number, what is his current I p address and port

number on which he is listening. Once I get that number here, I can just make a TCP connection or UDP connection to that guy and start talking.

Student: That goes with current IP address?

Hmm.

Student: Now this server register.

Yeah, that is next question which I am coming to. I am building upon this, okay. So, indexing server kind of resolve this particular issue of mobility; so, if I am moving my IP address whenever my IP address changes, I can have some mechanism to talk to this guy, talk to this server and update my entry. And this entry has to be updated, say, every thirty minutes; if it is not updated, I will remove the entry. Probably you are not alive; your battery is down or you are disconnected. You have to periodically keep on updating.

Our mobile phones actually do that; every six hours they reregister periodically. If your mobile phone does not get an opportunity to actually turn off the registration, you just take the battery out. So, your what we call indexing server which is maintaining, GSM will maintain the mobile phones entry still, because mobile phone is purely passive; it is not communication back periodically. It is only communicating every six hours or whenever the local area identifier LAI changes; it is the mobility handling technically. So, location area is they are multiple b t s, they will have one particular I d. So, they have one common location area identifier.

So far I am within that b t s's range; I need not transmit back. If that LAI changes, then I figure out my early LAI changes, location area identifier has changed. I will again send a request and update my new location area to the server indexing server of GSM as a different name is actually given to that, okay; we do not call it indexing server there, okay. So, this is I think known as home location register HLR, okay; it is a home location register there.

So, remember the same functionality and different people will use different different terms. Skype uses altogether different term; Google uses a different term, say, p is going to use a different term for this. They call it registrar in sip, okay. In Skype I think calls it as there is a different term master. There is a master; it is not a proxy actually. They use

some other term. For different different actually there are lot of systems which have been built around this mechanism, okay. So, this guy will essentially talks to him, keep on updating; that is very important.

So, all numbers will keep on updating, and why to use the numbers? Numbers in numeric coding is a legacy of telephony. Why we have telephone numbers? Because that time it was required; there was no other way a port or a device could have been identified. So, just to be backward compatible, I am talking about numbers here, but I need not have numbers. If I can use email ids for talking, now that is pretty common. We all do messaging over emails; that is an email id. A Google id, lot of you has been over Google messaging system. So, why to even making a phone call, do I require that I do not know; on Skype, I do not use phone numbers.

I still use that Skype id, a Google chat, voice video chat I use a Google id; you do not require numbers. I can directly use names; I only require an identification, who is this guy an unique id. And why your id cannot be used by somebody else on Gmail, because there is domain which is identified Gmail dot com; within that, if I use Y N Singh 69 that Y N Singh 69 will not be given to anybody else. That is taken care of when somebody tries to choose a new name at that point of time. You cannot even create that thing as an alias, servers has to ensure that.

So, here if I am going to put numbers, you can eventually choose a number and register here, how that will be stopped; mobile phones use a very different technique actually for avoiding this, but still this can be done using same cloning. It is possible to actually have same number running simultaneously on two different sim's handsets, but only problem is when both of them will try to register, only the entry corresponding to the latest one will be there; when other guy will try to register, it will overwrite the earlier entry.

So, when the sim is cloned and somebody is trying to make a call, you might end up in calling the wrong guy who has got the cloned sim, but both of them will never get the phone calls simultaneously; unless, there is only one situation. What is that situation? They both are in same location area which is going to be a rare thing to happen actually. So, again number itself is not good enough. I need to even identify this server, and we need not have only one server across the world; we can require multiple of them. So, we

have to come with the concept of domain name; your emails are always as for example, my email is this. I can use this domain as the domain of the server.

So, this is a service provider which is going to be there. Almost a Skype is only one single service provider all across the world. So, we do not have domain name is not listed there. Gmail also similarly domain name is not listed, but think of a situation when you are using your Gmail id Google chat and you will be able to connect to a Skype chat Skype clients for somebody. Then I will call the guy who is on the Skype. You simply cannot use his Skype id; you have to say whatever is the id at the rate Skype dot com, domain has to be specified.

In fact, internet relay chat system IRC chat system; this is what actually is being used. So, there is generic chat clients which are available which can most of the chat protocols are in open. So, we have to specify even domain name. So, this is what is going to be your URI, and depending on what kind of signaling you are using, you have to specify that, okay. So, chip thing when chip is going to be used, it will be chipped colon as this. This will be the domain kind of thing, but anyway that is a different thing now coming to the basic concept not to the tail of chip. Can anybody connect keep on updating this entry? No, I think they should never be permitted.

If I am the guy who actually is going to have a certain number or certain name is only I who should be able to update this entry, and for the time being, all of you have been assuming that only one device should be able to make the update in this entry. And this entry simply says for this particular user, this is the corresponding IP address. This is slightly old thought in telephony, because that is the way telephones actually have grown, but think of a situation my home phone, my mobile phone, maybe two or three mobile phones, my PC, my office phone; all of them are registered, all of them actually will do keep on updating this entry.

So, this guy can have for this user, entry number one, entry number two, entry number three, entry number four; I can have multiple entries, and all these devices will keep on updating. And it is possible that when somebody wants to make a call, he will come to this person will get the indexing entry and he will get so many I p addresses. And then he can try one by one all of them; he can try all of them simultaneously. One of them he picks up, he dissolves everything else, and we accept the communication.

So, all your phone will ring simultaneously or there can be priority, but who is now setting up the priority is this client. Now this actually design somehow I am not very happy. I should be very simple; I should talk to only one person. So, can there be abstraction of representation of this user which can have multiple instances running and only one single abstraction which is available to somebody who wants to make up a call. So, this actually can be done, and that is what exactly ship design actually has done. This is we are making nothing but rise star; I can build something like a proxy.

So, this actually does happen in Skype if you carefully observe; if you actually have you ever run Skype client or Google clients multiple of them simultaneously and then try to send up a call to this guy who is logged in at multiple places. The line actually rings at all the places simultaneously; well, that is by default design. They do not have a configuration thing to setup the priorities or ring for five rings and then actually move to next one. There is no ringing current in tones usually speaking in this scenario. I do not need to keep on transmitting my ringing current being packetized and transported as voice packets all the way to other end. So, they all generate their local stuff, and they locally shut it down; only for the voice thing they transport the packets.

So, now one thing which is very clear is that these clients will register with the registrar, and usually, this client will also register with this same registrar. So, far what we were doing is each guy was searching only for the entry, finding out the other thing, then directly talking with him, setting up the call, and once the call has been setup, they were talking, but there is lot of problems in this. Somebody can easily change the personality. I can always spoof as somebody else very easily in this kind of scenario; security is not there. So, how to maintain the security is an issue.

I should never ever tell this guy unless I authenticate him or anybody who wants to actually make a phone call to me. I should not permit anybody else to get the IP address. Somebody from the public should not be able to get my IP address and connect to him, because he can tell whatever he wants. I never will be able to identify him; there is no caller id and calls need to be indentified from where they are coming. So, the only way I can solve this problem is if I restrict only calling between all the guys who have registered only on this system, then only it is possible.

Student: It is not a good security?

Yeah, it is not.

You can actually tell all these configuration to the registrar. Registrar can maintain; at least before a call comes in, you can always verify about this person from here what is his identity.

Student: Sir, this is already implemented in ship.

Professor: No, ship does not work this way; ship is different. See I am evolving still I am side with the fundamental problem. I am evolving a system.

Student: Sir basic conduct, who will own the responsibility sir?

Professor: Yeah that is the question. So, ships server I call it now the telecom operators is essentially have to run this server.

Currently, they run HLR, and you only buy the sim, and you authenticate with them. Same way you will buy an identity from them, and you will be registering with your registrar server or whoever is your service provider, but if there is going to be only one server and only one service provider within India, I think that is not okay all across the globe. So, in Skype of example is one single service provider all across the globe; you do not figure where his server is indexing server; that is a different question.

It is maintaining a distributed server cluster of servers all across the world. You always authenticate how do you know that when you are clicking on Y N Singh which is coming on Skype id, and I am actually Y N Singh. How you are so confident that the message which you are writing is going to the right person or it is going Google chat when you do. It is going to the right guy how do you know? Because id s is unique, and there is only one service provider unless service provider does a problem, somebody there actually tempers with the security; security is going to be maintained.

So, this is by restricting the domain, but voice telephony cannot be implemented that way in IP. I need to handle, and multiple operators should be possible. Why I have to only always have one client of Skype and one client of Google chat or Google voice? Why that has to be done? Why I cannot have a single client? I am talking with Skype, but I can still talk with somebody with Google, and how this pairing will be done? The

Google and Skype have to talk to each other, and as of now, they do not use chip; they are based on the proprietary signaling format.

Student: Sir, there is a separate number portability; we have to use a single number or multiple?

No, that is not possible; that is unfortunate thing. That is not possible; because you are ideas will be something like this.

You are saying I am going to still maintain Y N Singh at Iit k dot a c dot in, and this email id I should be able to work even with Gmail. Now there is way to workout actually. They will create another email id, and this will be at the last, but earlier domain also it is going to be locked. So, either that domain should also be owned by Gmail. So, lots of academic students do create their mail accounts in that fashion.

So, they are actually mail accounts for the whole academic students running on Gmail only, but their email ids are for example, in IIT, Rajasthan; that is the way it has been done. It is Iit j dot a c dot in, but it is running the whole mail system runs on Gmail, because Gmail provides for free for academic institutes.

Student: Sir, we are using a single client.

And the way it actually works is very simple is that Iit j dot a c dot in; there is mail like MX record mail exchange record in the DNS server. So, DNS server of Iit j dot a c dot in, MX entry actually is pointing to a server which is there in at Gmail. And Gmail maintains this whole thing, user at the rate domain as the complete user id. I think that is what is actually being done. But usually at the rate cannot be used as user id. So, they must be replacing at dynamically there, but MX record entry has to be changed. But Gmail can also do it for you by creating its registering your own domain; they are also are the domain registrars, okay.

So, now let us see where we have reached. So, we have come to the concept of registrar; we are trying to look at security but restricted only have to one single domain. Now we actually have realized that we require multiple domains; single domain will not work, and we need to still ask the security. So, we have to build now from here onward to what we call the telephony system which will work over IP. So, what I will do is because more

or less systems are very similar. I will once in a while I will come to the Brihaspati sync design, because that also conceptually works in a very similar way, okay. But we do not use; we use an indexing server which is our Brihaspati three server only.

So, all your id is that email id and passwords have the same thing which are there indexed; so, whenever I will announce a live session; those live sessions gets indexed here. So, those are also indexing server entries. Now those are a different kind of system; I have not talking about telephony, I am talking about the conferencing system. So, now that was something which was very bad in the earlier design; earlier telephony was very restrictive. So, as far as the session management and creation and holding is concerned, we do not worry about whether its IP telephony or whether is a conferencing or it is a multiparty video game or its some other kind of thing, it does not matter.

So, far I can create a session of any number of users. So, how to set it up that is the question basically, and it is with proper authorization and proper authentication. So, if you join a session and if you say I am x y z, you should be x y z, and you should be permitted to participate in that session. They are two things which are very important, okay. So, this is what basically has to be done by everybody. And since you are going to have multiple operators now connecting, they also have to pair with each other for and securely not insecurely; they have do it in a secure fashion, and how security will be identified? The key thing is security certificates.

How I know that you are so and so? You can always show me your id card which is signed by the director, and I now remember the director's signature. So, if they match, you must be so and so.

Student: You are talking about SSL certificates?

Security certificates, right, not as a SSL secure socket layer which uses a security certificate, but security certificates are different, okay. X dot 509 certificates we call them I think.

But these people can also do paring with each other. See, because whenever I want to talk, I am in domain of Iit k dot a c dot in. So, very soon you will be actually having similar structure in Iit k also. So, slowly you will do away with the phone numbers; it will come with unified system where your email itself can be used for doing even

interaction over a phone call. So, there will be phone handsets usually will be like computer, and then two three month down the line, they will be all deployed.

Student: When we have a single client with multiple operators, we are using single client only.

You are using single client; you can only connect with one operator with one id not with multiple of that.

Student: Sir, my question is when we have a single client, then we have the safe security pole c with same multiple operator?

You only connect with one operator; other operator will not recognize you.

Student: When busy?

[FL] Even at other times unless you register with them, you pay them or get your separate certificate.

There is procedure for that. The way you get your sim cards which are there for authentication, similarly, you will be issued security certificate by that agencies. Let me come to how the Skype actually works, then you will understand. Skype use I think very similar thing. This is the guess; I have not seen the Skype documentation or design, but we have been using similar concept for our peer to peer systems. So, I will continue with the same thing tomorrow morning.