Digital Video and Picture Communication

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Lecture - 40

4G Multimedia Conferencing

We were discussing about the Session Initiation Protocol the SIP and we had seen that SIP is a very effective signaling protocol for the IP domain. And now definitely if signaling protocol has to really succeed then one has to ensure that there is always an interworking which should be possible with the networks that is other than the IP; which means to say that essentially the ISDN, the PSDN and the IP they should be able to coexist in the SIP domain. Thus, today our topic is going to be the fourth generation 4G multimedia conferencing.

We can say multimedia conferencing or video conferencing. And essentially now we are trying to discuss that what future are we foreseeing for the Session Initiation Protocol and especially when we come to the fourth generation which is still in the formation stage, for the fourth generation it will be the mobile network which is going to be the future and there the network that one is going to use for the multimedia conferencing is the mobile ad hoc network Mobile Adhoc Network and in short form this is called as MANET.

So we are going to discuss that what is the philosophy of conferencing in the MANET environment and also we are going to see that how this MANET environment can coexist in the multimedia conferencing; how MANET can coexist with the legacy third generation network. So we are going to have 3G and MANET both working hand in hand so that it is possible that some of the conference participants could be in the third generation network and some of the conference participants could be in the MANET network and there must be full transparency that the location should not matter that whether a participant is in MANET or 3G they should get almost identical performance. So, MANET and especially the interworking between the 3G and the MANET is going to be the future of the video conferencing or multimedia conferencing.

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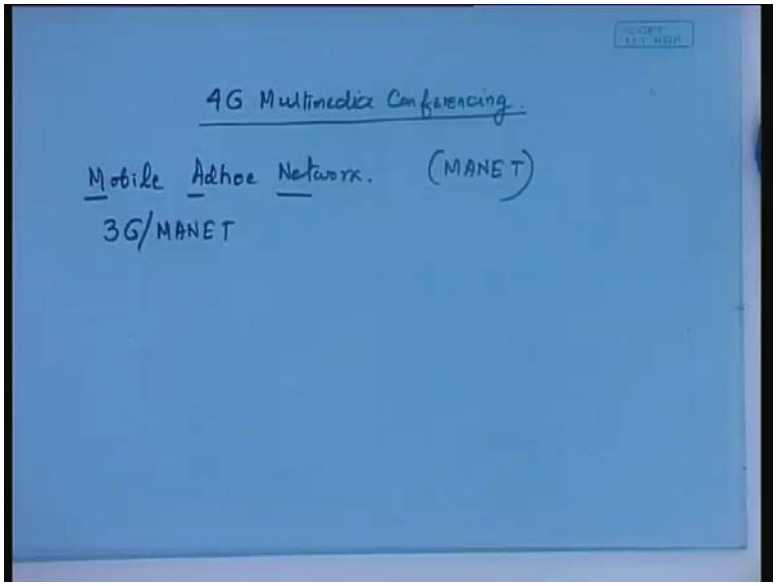

But before we go into that just a few aspects of SIP which I wanted to let you know. First is that as far as the multiparty sessions are concerned..... so regarding the multiparty sessions the SIP uses three different multiparty session architecture. So multiparty session architecture as supported by SIP these are..... first is what is commonly known as the full mesh architecture.

By full mesh architecture we mean that every participant builds up a signaling leg with every other conference participant. So they are in a fully connected mode that means to say that as far as the signaling is concerned they are fully connected; meaning that supposing we have like this (Refer Slide Time: 5:35) so there are four conference participants and every participant is connected to three other participants.

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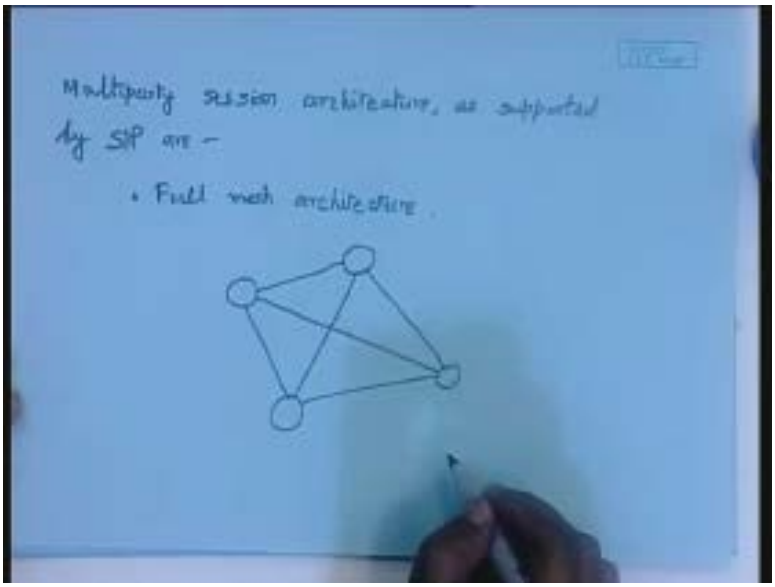

This is how one can realize a full mesh architecture but they are connected as far as the signaling is concerned. The signaling leg is there with every other participant and then how exactly the protocol is maintained. In fact, the protocol for the SIP signaling is maintained on a one-to-one basis in this case. That means to say that every participant has to initiate a signaling with the other participants. But naturally as you can very clearly realize that this is going to have its limitation or the bottleneck because for three participants or four participants it is okay, but certainly for a very large number of participants it leads to a very large amount of signaling overhead so naturally full mesh architecture though feasible has got limitations in terms of the number of participants.

Then another architecture which the SIP supports is the mixer; mixer or bridge architecture whereby a centralized bridge as we also explained in the case of the ISDN video conferencing where there is a central controller or what we call as the multiparty control unit, the MCU. So basically there what happens is that every conference participant is connected to the MCU and the MCU takes care of the mixing; mixing in the sense that as I was discussing that when all the conference participants are sending their individual video streams they must be combined together into one frame wherein one frame in sub-partitions it will show all the conference participants together and it is that stream which will be transmitted to all the conference participant. Hence, this is a kind of mixer or bridge and there even the audio mixing also will be possible between the conference participants. So this is the second

architecture that is the mixer or bridge architecture and the third is what is called as the network layer multicast.

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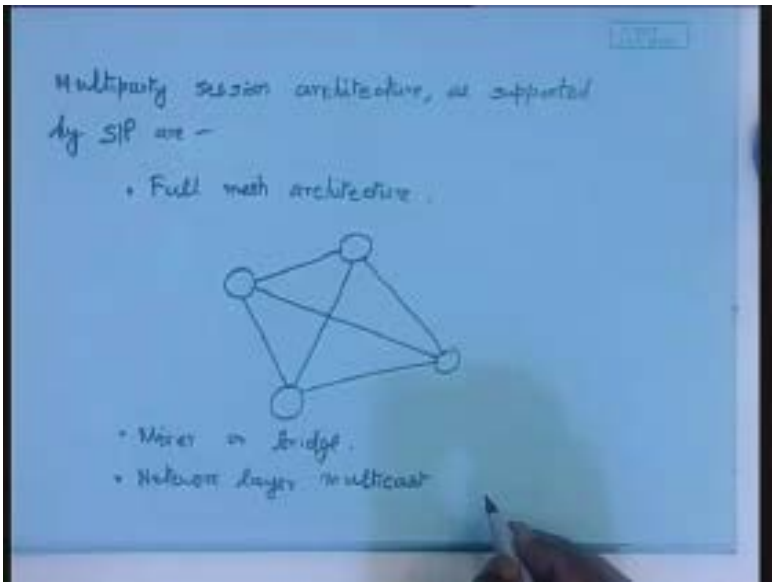

In this case in the case of network layer architecture one can still use a bridge to control the signaling but in order to multicast it can have a common network address common multicast address to which the conference participant can communicate and there it will be ultimately multicast to all the different participants by using a common address so this is through the network layer multicast.

And another aspect of SIP which I should discuss before formally closing the discussion on the SIP is that how SIP can coexist with the PSTN because as we had seen that it was easy for H dot 324 to coexist with the PSTN because H dot 324 indeed had included the signaling protocols in the PSTN domain. But likewise SIP as such does not support such kind of signaling protocol with the PSTN but it can be realized by using suitable gateways.

In fact, for PSTN and IP interworking we always need a gateway as we also explained that time that a common gateway is necessary and the gateway in fact lot of resources are required in that centralized or in that common gateway which is going to take care on the PSTN signaling on one end and IP signaling on the other end and that is the reason why we had argued that essentially that gateway can be sub-partitioned into the individual media

gateways because the gateway as such has to take care of the signaling aspect as well as the media stream transportations. So one can separate out the media stream transportation by using the media gateway and for the signaling one can use the signaling gateway and there could be a media gateway controller which is residing for the media gateway in a particular domain and the media gateway and the media gateway controller they can communicate with each other through the protocol which we had called as the Megaco or the H dot 248 this we had discussed few lectures back.

Now, a typical configuration that one can show is something like this that supposing we have some IP telephone installed in some residential building; let us say that this is a residential building and this is yet another residential building let us say and there is an IP phone which is available but what we want to work out is that this IP telephone should be able to take part in any conferencing with the legacy PSTN telephones as well; I mean, entering into an audio conferencing or video conferencing that should be possible.

So what we need to have in that architecture is that there should be an individual residential gateway. So, by RGW to say a residential gateway so there will be a residential gateway that will be connected to every such residential building so this is connected to one RGW and let us say that this IP telephone is connected to a second RGW and these individual residential gateways (Refer Slide Time: 12:59) they should be connected to one media gateway controller. these are Residential gateways are essentially the media gateways and they should be connected to the..... no this is not exactly media gateway this is a complete gateway but only taking care of this residence part. So this is the residential gateway and here we keep what is called as the call agent an MGC Media Gateway Controller and this Media Gateway Controller will act as a call agent as far as the SIP protocol is concerned.

So, MGC is connected to RGW and this has to use which protocol; this has to obviously use the MGCP or the Megaco protocol MGCP media gateway control protocol or the better version of this which is the Megaco protocol through which the gateways can communicate with the media gateway controller.

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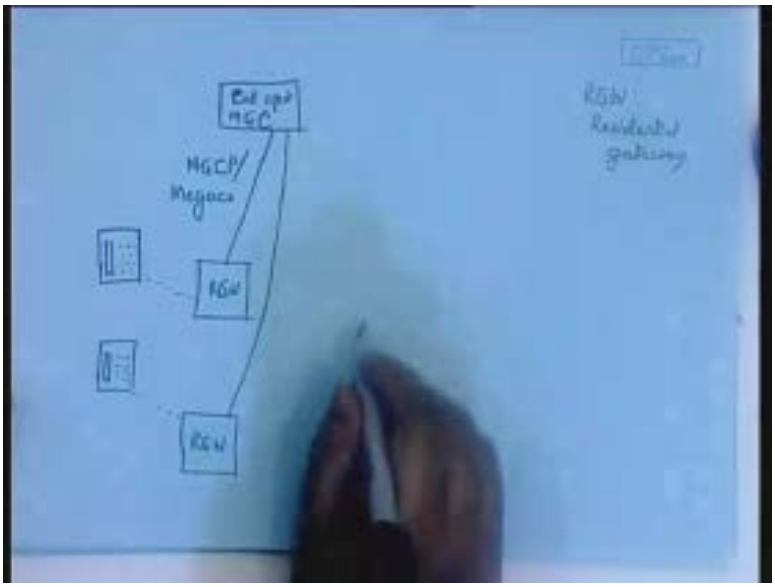

Now here we can have the internet domain. This is the internet domain. RGW has got the interface with the internet domain and essentially what the RGW does is that it connects the SIP telephone to the internet and then we have another gateway which we call as the trunk gateway or trunking gateway or TGW so TGW this stands for trunking gateway. And for trunking gateway there will be another media gateway controller so there will be another media gateway controller to which the trunking gateway should be there; the trunking gateway should be connected to the internet and it should communicate with the internet via the RTP protocol and the trunking gateway would in turn be connected to the PSTN network.

This is the PSTN network (Refer Slide Time: 15:26) and supposing there are some typical PSTN users over here so one can use a one can have typical PSTN users who are connected to this PSTN network and PSTN should have..... in order that the signal control is achieved for PSTN you know that one of the signaling protocols that one can use is the SS7 protocol so there should be an SS7 gateway so we have an SS7 gateway and this should use a signaling protocol SS7 with the PSTN network and then these gateways and the MGCs they should enter into signaling with each other using the SIP protocol; I mean, either it can use SIP or one can use H dot 323. So SIP or H dot 323 will be the protocol that connects the..... (Refer Slide Time: 16:45) so this MGC also will act as call agent so these call agents and the gateway they are connected through the SIP protocol and this way one can facilitate the interworking between the SIP phone and the IP phones.

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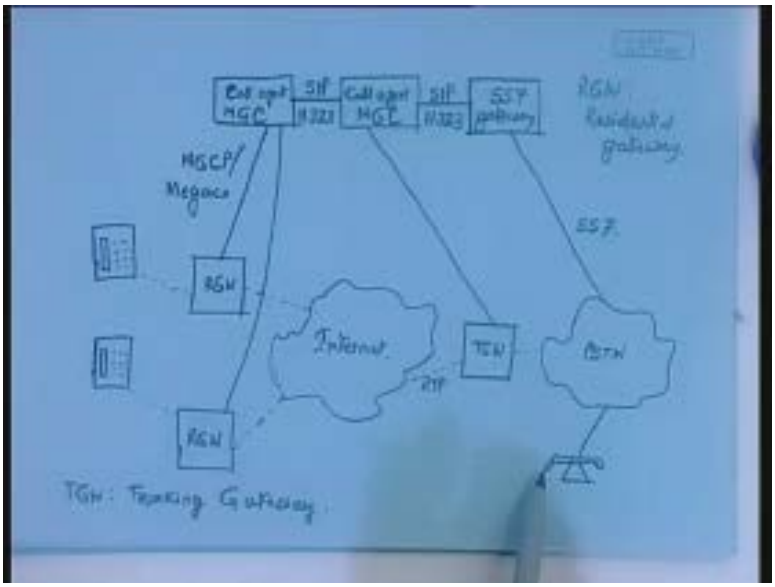

The thing is that in this case the use of SIP is actually restricted only within the IP domain whereas as far as the interfacing with the PSTN is concerned there a different signaling protocol is used but this way through this gateway configuration one can have a connectivity between the PSTN and the IP domain even if they use the SIP even though the SIP on its own is not supporting the interworking with the PSTN domain.

So the whole idea of showing this is that yes; you can realize that you cannot expect that it would be possible for all the users to come under one common umbrella of the networking environment; you can never achieve that, you can never say that everybody will be in the IP domain or everybody will be in the PSTN domain; yes, some will be in the PSTN, some will be in the IP and because of this reason this interworking is made and it is this interworking which has to be extended further when one goes in for the mobile networking configuration and this is what the 4G multimedia conferencing has to achieve.

Now before we go into this there is something that we would like to say about the different characteristics of the multimedia conferencing and then we will examine that which of these characteristics can be fulfilled by the MANET, which characteristics can be fulfilled by the 3G and then only it will be easier for us to think in terms of the interworking between the 3G and the fourth generation which is the MANET.

Now every multimedia conferencing as we had seen consists of two components. so multimedia conferencing has got two components: one is the signaling which we have discussed at length which is needed for the call setup, modify session modify, teardown, in other words, the session control: session initiation, session termination, session modification and then the actual media handling, the actual media handling deals with the transportation of the media and the management of the mixers; mixers and the media connector. So this is for the transportation of the media and the control and management of mixers and media connectors.

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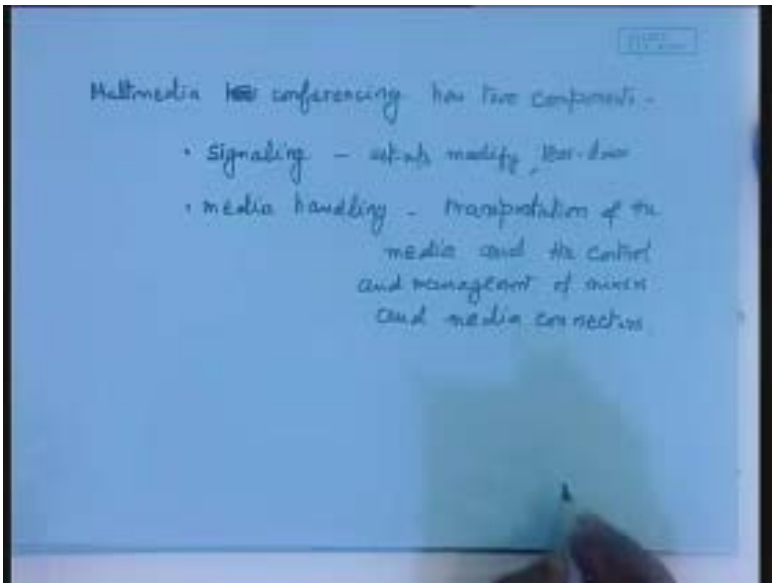

A conference can be done with a floor control. What we mean by floor control is the control of the common workspace; like say for example, the audio channels. there may be restricted number of audio channels as compared to the number of participates and then how the audio channels will be allocated and managed that will be the job of the controller. So every conference every conference can be with or without a floor control. Then a conference arrangement that could be either a prearranged conference or it could be adhoc and there the conferences so prearranged conference means..... just excuse me..... prearranged pre-arranged conference that starts at a specific time and has got some and is participated by some specific parties.

This is obvious that what we mean by prearranged conference that supposing we decide, I mean, it need not be a video conferencing it could be our normal way of conferencing that supposing I call three or four of you that I say that okay come to me at 3:30 today so at 3:30 you come to my room and we will have a discussion on this topic so at 3:30 all of you come and then we have a discussion and then there may be some specified time when the conference ends. Supposing it is like a class or a lecture where there is a specific duration that it would be of 1 hour duration or it would be say some specific duration is there and it is being participated by some specific parties and it starts when all the parties are present.

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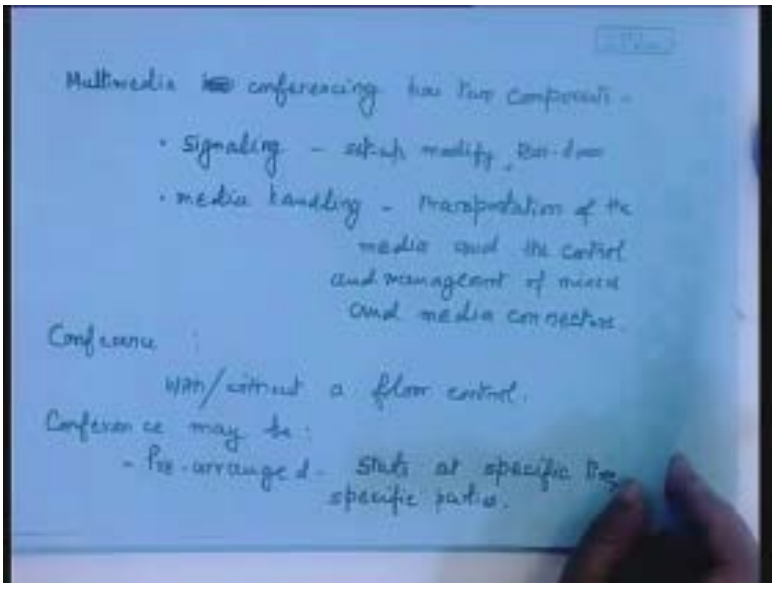

The other way of arranging the conference could be that instead of prearranged it could be an adhoc conference. By adhoc we mean to say that whenever first two parties are available a conference can start and then anybody ..... and by anybody we mean to say that anybody who is authorized in that conference group; again there also it could be a private conferencing, it could be a public conferencing I will come to that aspect little later but supposing it is a private conferencing there are some authorized participants but what happens is that when any two participants are there the conference can begin and then while the conference is going on other authorized participants can join in or the existing participants can leave and the conference ends when the last two parties who were present they leave the conferencing and then only it is going to end.

That means to say that it may begin with two persons and it may end with two other completely different persons. It is something like what happens in let us say a tea shop conference. What happens is that we take a cup of tea and our friend one friend of mine may be taking a cup of tea and we just come outside the tea room and we just get together and we start talking. So there a conferencing begins; maybe we talk on some topic we start our conversation and the conference begins. Now third friend of ours, a common friend of ours he comes and joins in, he takes a cup of tea and he is joining in the same conference so maybe that the discussion continues in the same topic, he also joins in, then another person comes and then the fourth person may join in; in the meantime the first person the first and the second person who are involved in the conversation one of them may be having some urgent work so the first person or the second person may say that okay now I have some work I have to leave so now the conference continues with first person, third person and fourth person.

So now the discussion which was initiated by the first and second person may now deviate because that may not be of interest to the third and fourth persons much so the conference topic can change and now first, third and fourth person begin on a different note and the first person again leaves in a short time, the first person also has finished his cup of tea and goes back and then some new participants begin and may be that ultimately the seventeenth participant and the twenty fourth participant they are the last people to talk and when they leave the conference ends and then with whatever topic the first and the second person had started the seventeenth and the twenty fourth person may be talking in a completely different topic. So this is a kind of an adhoc conferencing where anybody is free to join and free to leave during the session.

The conferences may also be either a public conference. So conferences may be public. In public conference anybody is free to join any time or free to leave any time. It is something like a public chat room you can say. Or it may be private so private is a closed conference this is closed and the public is what is described as the open.

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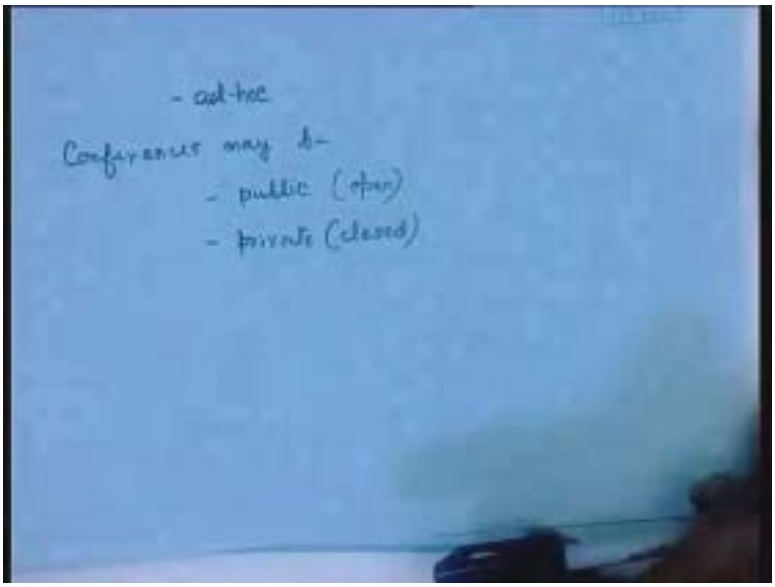

Now yet another scheme that is followed in conferencing is what is called as the subconferencing. In subconferencing we mean to say that may be that the conference is split into two different rooms. That means to say that some of the participants may be in conference room number 1, some of the participants may be in conference room number 2 so those who are in the conference room number 1 can only see, I mean, whomsoever are the participants in the conference room 1 and the participants in conference 2 sees only their things and may be that the leader of the conference room 1 and the leader of the conference room 2 they can have their own chat and that time they may be able to see the full conference full view of the conference room together. This mechanism is called as the subconferencing.

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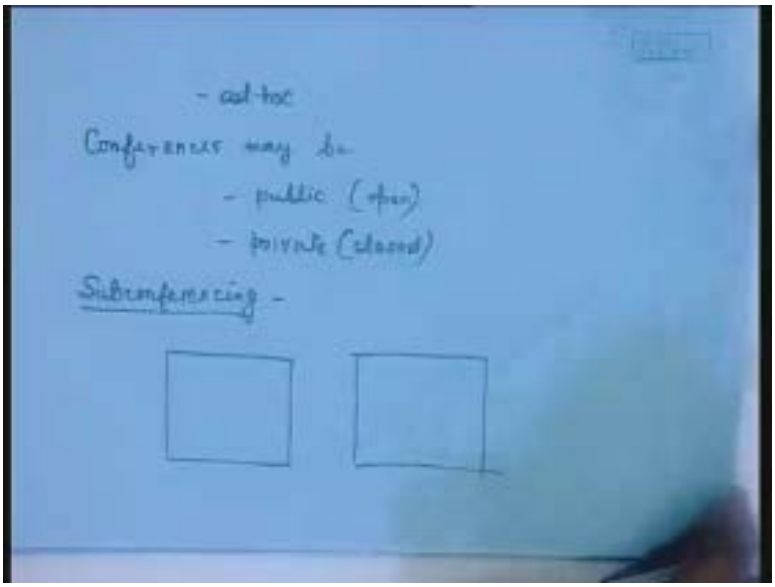

Now the thing is that yes, coming to the topologies of the conferencing it follows four different topologies three of which we already described in connection with the SIP just now. The topologies of conferencing could be either an end-system mixing. By end-system mixing we mean to say that one of the participants does all the mixing. We were saying that the mixing is done by the central controller or the bridge, the bridge does all the mixing but one can have bridge as a participant. All that I mean to say is that all the mixing jobs could be there with one of the participants; one of the end-systems itself could do the job of mixing may be that that participant is the conference leader so that the mixing will be done there and then the mixed streams will be distributed to the other participants or it may be the full mesh.

Now in the case of full mesh the mixing will be done by every participant. So every end-system does its own mixing or it could be in the multicast mode. In the case of multicast also every end-system does its own mixing but the packets are sent to a multicast address or the centralized topology where there is a conference bridge, so a conference bridge for mixing. Here the only requirement is that when there is a centralized topology then every participant has to enter into a call, has to call the centralized bridge in order to establish a connection with the other participants. That means to say that what happens is that the invitation will first go to the bridge and then bridge in turn will invite the other participants; that invite message forwarding that is what we discussed sometime back.

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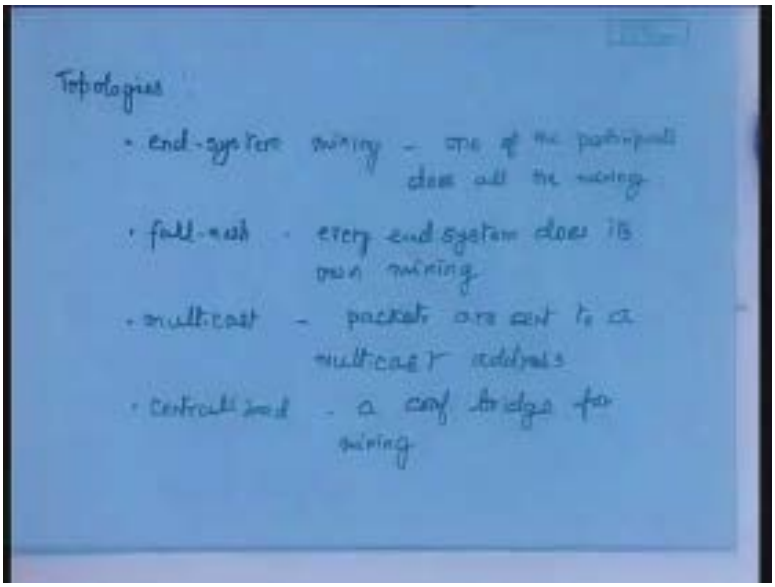

Now as in the case of the 3G conferencing what we have discussed so far is that the 3G conferencing definitely requires a centralized topology. So characteristics of 3G conference is that it uses a centralized topology means there is a central controller then it may be with or without floor control; it may be private or public, it may be adhoc or prearranged, it may be with or without subconferences. Now this is good for 3G conferencing. But certainly when we move from 3G to 4G and to the mobile adhoc network, there which one do you think is not permissible out of these listed five points.

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The first one that is to say the centralized topology because whenever we are in the MANET Mobile Adhoc Network there the participants are dynamically changing some are entering into the network some are leaving the network, the nodes are mobile nodes so some will be entering some will be leaving and there is no centralized node that is defined in in this case. Even if any centralized node is defined that may be defined only for a short time and that may be dynamically altered. so we will We will come to that but certainly in the case of MANET this centralized topology philosophy has to be dispensed has to be dispensed with.

And in a typical conferencing scenario in the future generation we may come across the following conference scenarios may be that we have all the participants in 3G all of them may be in the IP network to say or otherwise all may be in the mobile network so all participants in MANET or a combination that is to say some in some participants in 3G and some participants in MANETs.

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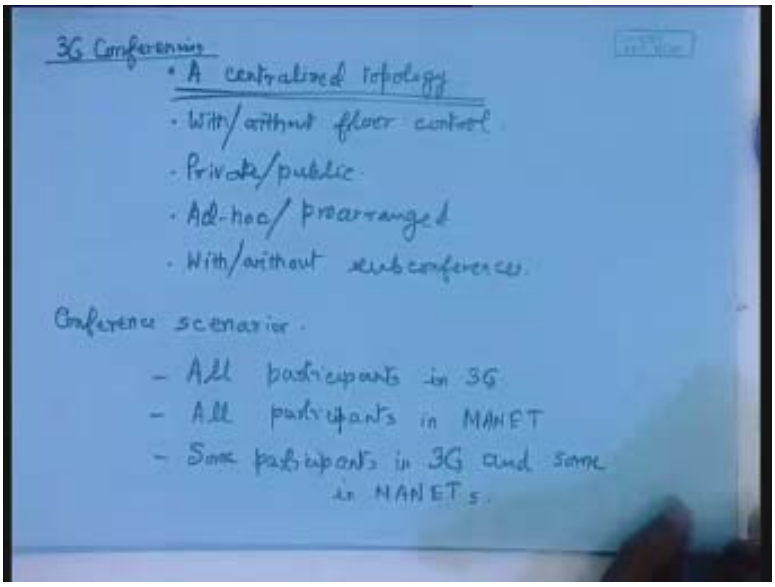

Now the requirements that one has to have in the 3G networks and MANETs so we should say that 3G and MANET requirements; first is that it should support all these three conference scenarios that may be exclusively 3G, may be exclusively MANET, may be a combination of 3G and MANET.

The other point the other requirement that it should fulfill is that there should be scalability in terms of the number of participants. This means to say that even if the number of participants becomes very large that should be accommodated or the signaling or the connectivity that should not be a bottleneck as far as the number of participants are concerned. And in the case of the 3G and the MANET both follow a definite signaling policy on its own. But whenever we are upgrading to a kind of interworking between this 3G and the MANET, there the signaling changes that one has to do should be minimal. So signaling change needed for MANET and 3G interworking that should be minimal and the performance should not depend upon whether the participant is in MANET or in 3G. A complete transparency should be there that one should not feel the MANET users are getting less performance or the 3G users are getting less performance.

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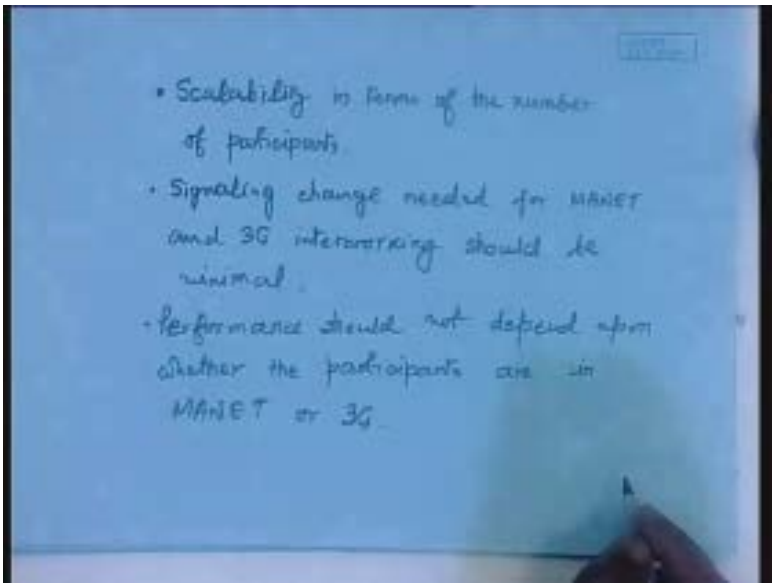

Now, before we go over to the interworking between the 3G and the MANET some typical signaling architecture that one can think of in the case of MANET is like this that the signaling architecture we are first talking of; in signaling architecture for MANET we talk of first a full mesh signaling architecture. When we have a full mesh signaling architecture there what we have is that these are the calling agents; one can say these are individually the mobile nodes because all of them are in the MANET and out of the participating nodes one is declared as the leader.

One of the participating nodes is declared as the leader and there is a full mesh connectivity for signaling that has to be realized. Yeah, so this is the full mesh connectivity with this as the leader.

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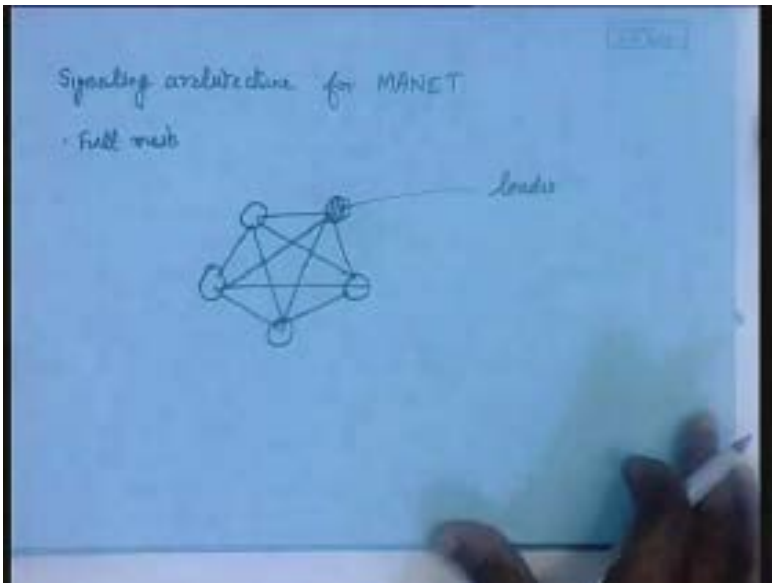

Now the difficulty about this is that such a kind of architecture is not scalable. Because if more number of nodes have to join in into this mesh obviously the signaling complexity will be very high because with more nodes joining in then it is not a scalable architecture anymore and in order to ensure scalability what we have is a kind of clustering architecture.

In the case clustering architecture we have it like this that there the mobile networks are divided into different clusters. Let us say that we have some clusters like this (Refer Slide Time: 42:42 – 43:15) so these are the four clusters. So in this example we have shown that there are four clusters and each cluster has to elect a leader. These are the cluster leaders or what is called as the super member. These are the leaders or also referred to as the super members and what is indicated by the non-hashed circles these are the normal members.

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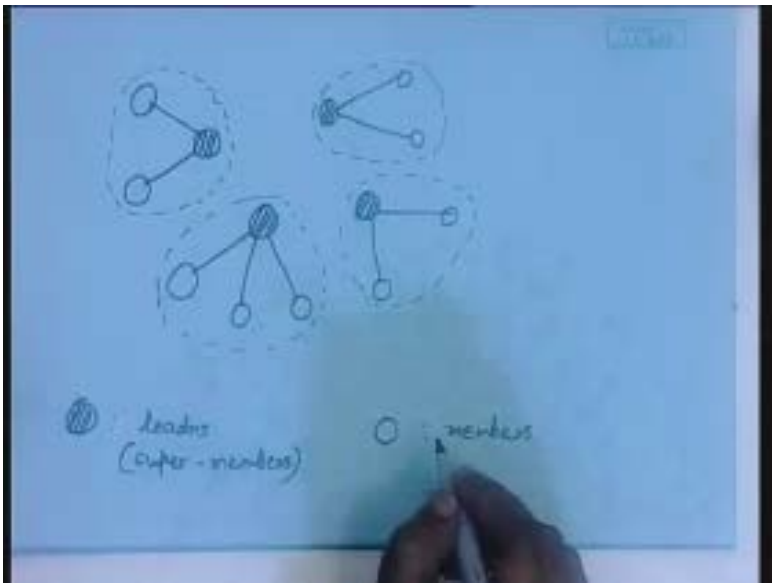

Now the normal members as well as the leaders they are acting as the signaling agent. So both this and this they act as signaling agent and the connection topology is that all the members in a cluster they are tree connected to the leader and the leaders themselves are full mesh inter-connected. This is a kind of connectivity that one can have but mind you this sort of a connectivity we can imagine only at a given instant because with time with the mobility of the agents the cluster configuration may change. Some clusters may be void that if all the members leave then a cluster becomes void and some clusters may be newly formed because some of the agents might have joined in an area and there a new cluster is formed or there may be a kind of a regrouping or reclustering. Two clusters may merge into one; one cluster may split into two; like that different scenarios would be permissible because everything is mobile.

One can say that even the leaders, the leaders are also mobile because it is not that we are going to have a fixed leader in every cluster because the leader is also on the move and whenever any leader leaves a cluster then one has to go through a new leader election algorithm to elect a leader for the newly defined cluster that is formed and then to that leader all other members would be directly connected.

So when a participant, say this participant (Refer Slide Time: 46:27) wants to communicate with this one then it has to call the leader, the leader has to find out the cluster to which the

ultimate end user may belong and then the invitation can go from this node to this node to enter into a conference. This is a typical MANET scenario so this is a clustering architecture. This architecture is called as the clustering architecture. So unlike the full mesh the clustering architecture can permit a better scalability. It has got a better scalability because in this case one can have larger number of nodes who can join to a cluster but only thing is that the number of clusters gets restricted because the cluster leaders are getting fully meshed connectivity. But at least the scalability aspect in terms of the conference participants is much better.

Now we see a scenario that how the MANET and the 3G network they can coexist together. In fact, they can coexist in order that they coexist there has to be a conference gateway that has to be used.

So a typical integrated conferencing architecture, so integrated we can say integrated 3G oblique MANET architecture would look like this that we should have a conference gateway and to one of the conference gateways the 3G network has to be connected and on the other side the adhoc network has to be connected the MANET. So let us say that on the adhoc network side we have say two clusters.

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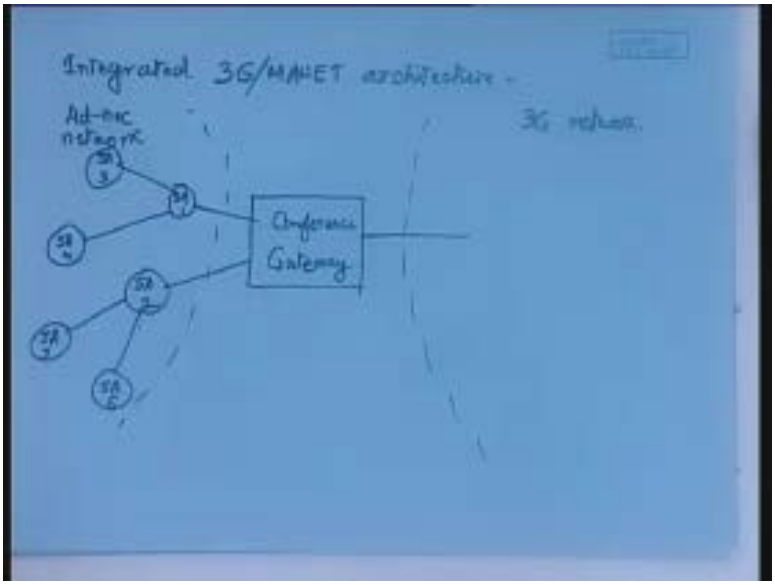

Now this SAs they are These are the connection agents and on the other side we have the conference focus, 3G network and this is actually this MRFC this stands for the Media Resource Function Controller Media Resource Function Controller or what is called as the MRFC and AS that stands for the Application Server; AS is the Application Server and in the adhoc network site this SAs what I am talking of this SAs are the Signaling Agents. So we have shown that there are two different clusters. So we have assumed a cluster topology so that this is say one cluster and this is another or the second cluster (Refer Slide Time: 51:19).

Now this is the cluster leader so SA1 in this case and SA2 in this case they are the leaders of the clusters connected to the conference gateway and these are the conference focus or the controller of the 3G network which is the Media Resource Function Controller which allocates the common resources and then to this all the signaling agents are connected; signaling agents in the 3G network. So we can now call those signaling agents by a different number, we have already covered up to SA6 so we can have SA7, SA8, SA9 and SA10 so all these things connected to the main conference focus that is to say the MRFC.

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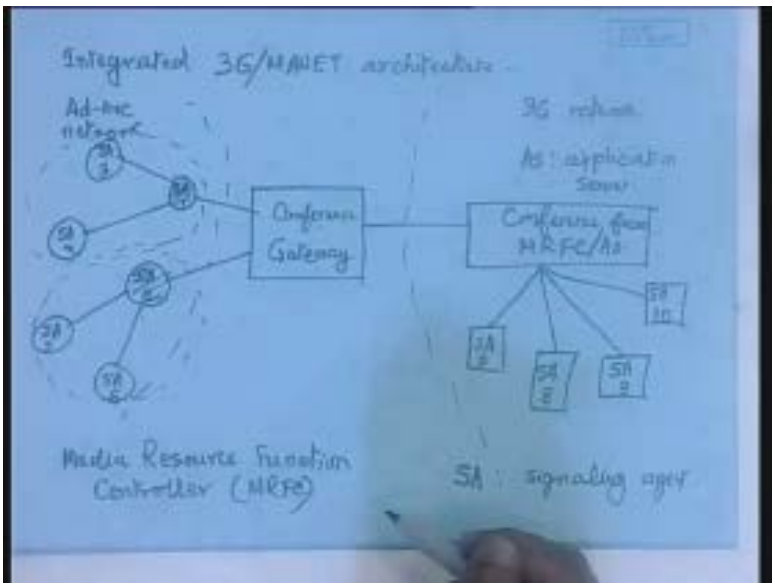

Now MRFC is actually joined to the conference gateway. So ultimately the conference gateway has to connect the signaling agents which are acting as the leaders of the cluster and the central controller for the 3G network. And if they are connected like this to the conference gateway then one can have..... the ultimate conferencing realization should be

there between any agents in the adhoc network with any agent in the 3G network. Actually this is a kind of a scheme, this is a scheme that has been worked out but the protocol and the interworking aspects the details of the interworking aspects of these schemes are still in the formative stage. So this in the development process and it will take another couple of years before the standards become available and the 3G and MANET multimedia conferencing in an integrated manner that becomes the ultimate reality.

But one paper which I would like all of you to go through is; it is a very recent paper; in fact, it appeared in the IEEE Communications Magazine of August 2006 so it is a very recent issue and the authors of this paper are C. Fu, F. Khendek and R. Glitho they are the team from Concordia University and it is “Signaling for Multimedia Conferencing in 4G” "Signaling for Multimedia Conferencing in 4G: The case of integrated 3G/MANETs" and this has appeared in IEEE Communications Magazine August 2006, page numbers 90 to 98, some more detailed concepts about what I talked of in a nutshell will be available in this reference so please refer to this and all that I want to say is that the voice the digital voice and the digital picture the way the technology is moving today has definitely a very strong potential because we have not only created the digital the media in a compressed digital format be it the speech or the audio or the video but also we have worked out the effective methodology in order that several participants may exchange the voice and video and there medium could be either a PSTN, the medium could be an IP, the medium could be the mobile network as of in the future so this is going to achieve these technologies are going to achieve further maturity. So with this we come to the end of the course and we see a very bright future for Digital Voice and Picture Communication, thank you.