Wireless Ad-Hoc and Sensor Networks
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Lecture – 07
MAC Protocols in MANET's Part-II

So we are now going to continue our discussions on MAC protocols for MANETs. So, we are in the second part of the lecture.

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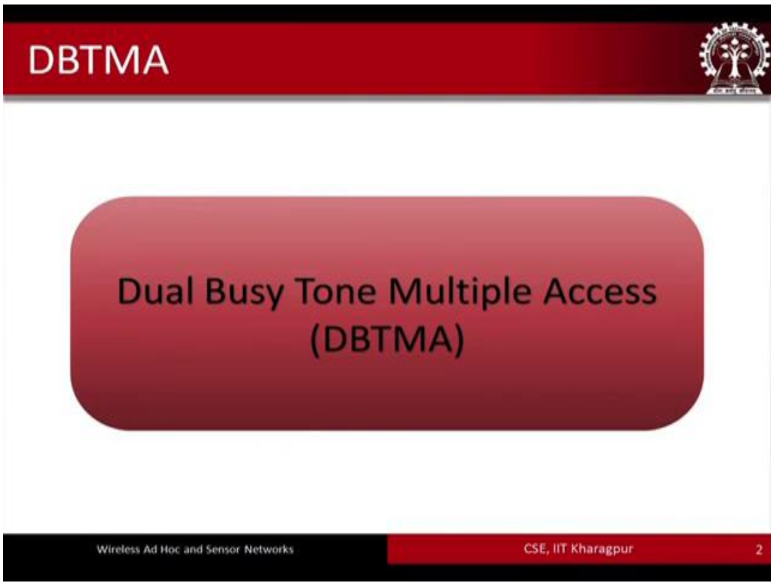

So, we have already discussed 2 well known protocols, which is the MAC protocol and the MACW protocol for use in MANETs. There is an another protocol which is called the DBTMA protocol which is also very popular. So, the MAC protocol or the MACW are single channel protocols; that means, that you know the entire bandwidth is treated as a single pipe.

So, DBTMA belongs to the multi channel plus of MAC protocol. So, in DBTMA what happens is the entire pipe the bandwidth is basically fragmented or split into multiple channels. Some of these channels are used for sending the control packets. Whereas, the other channels are used for actually sending the data packets out. So, this is how collision is reduced with the help of splitting of the channels into multiple sub channels.

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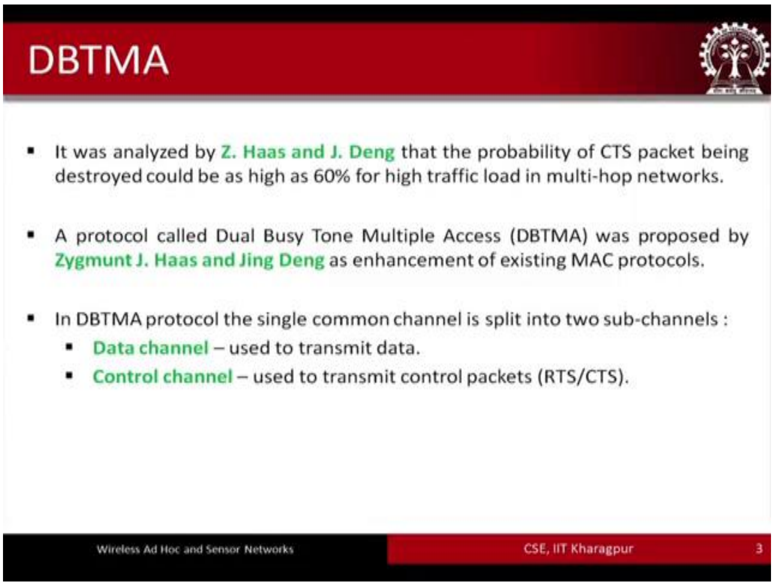

So, this now let us look at the different features of DBTMA. So, incidentally DBTMA was proposed by 2 to researchers Zygmunt Haas and Jing Deng at Cornell university and so what they have observed that the probability of CTS packet being destroyed would be as high as 60 percent for high traffic load in multi hop networks. So, this is why they have proposed the DBTMA protocol as an enhancement over the existing MAC protocol. So, as I told you at the very beginning. So, we have a common channel one single pipe that is split into different sub pipes or sub channels the data channel and control channel. The data channel as the name suggests is used to transmit data whereas, the control channel is used to transmit control packets like the RTC CTS frames.

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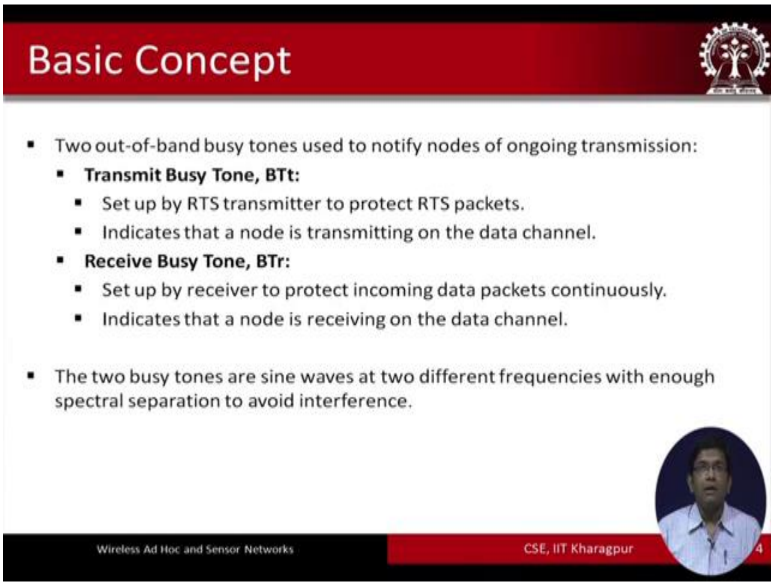

So, this should be called as frame. So, there are 2 out of band busy tones that are used to notify nodes of ongoing transmission. So, these are the 2, one is known as the transmit busy tone BTt the other one is known as the receive busy tone BTr.

So, this is basically almost similar to I do not know those of you who might have little bit of understanding about telephony applications. This basically this idea has resemblance to how the telephony applications work. So 2 types of tones transmit busy tone and the receive busy tone 2 of them are used. So, that BTt is set up by the RTS transmitter to protect the RTS packet. It indicates that a node is transmitting on the data channels. So, BTt right. So transmit right. So, transmit busy tone. So, it indicates that the node is transmitting and transmitting on the data channel. Receive busy tone is set up by the receiver to protect the incoming data packets continuously it indicates that a node is receiving on the data channel. So, BTr stands for r stands for receive and t stands for transmit, and both on the data channel. The too busy tones are sine waves at 2 different frequencies with enough spectral separation to take care of issues of interfere inter signal interference and so on.

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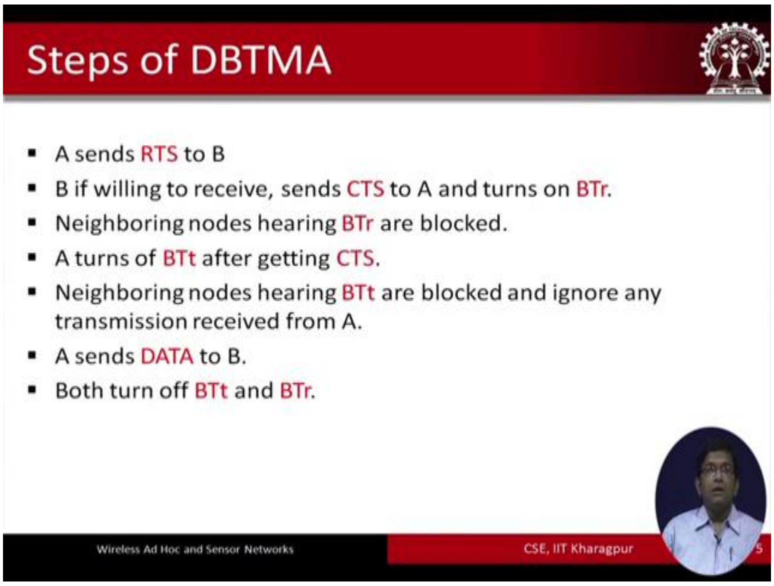

So, broadly these are the steps in DBTMA. So, we will look at the steps and we will look at the figure in the next slide.

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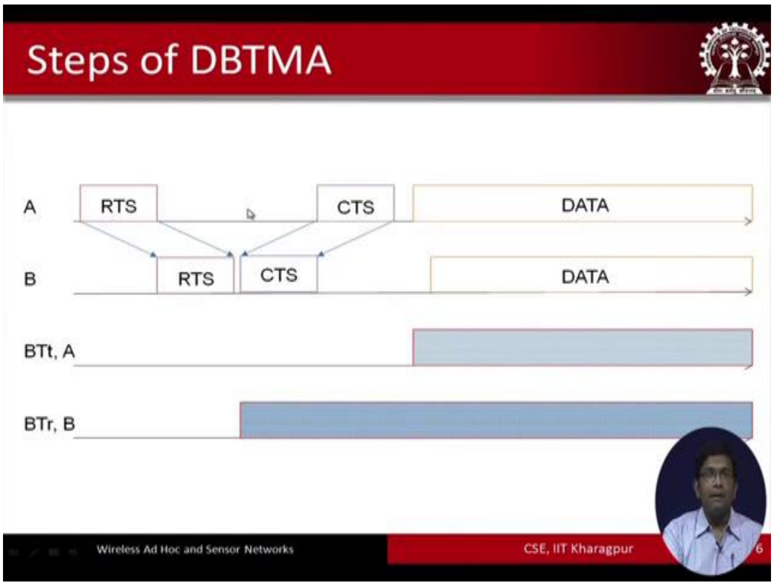

So, a sends and RTS to B A sends RTS to B. B if unwilling to receives sends CTS to A and turns on the BTr turns on the BTr. So, you see that this is how the BTt and BTr packet ex frame exchanges are depicted. So, B if unwilling to receive since the CTS to A and turns on the BTr. So, it is going to turn on the BTr as shown over here. The neighboring nodes on hearing the BTr are blocked. The neighboring nodes will be blocked on receiving the BTr. The node A which was the sender turns on the BTt after getting the CTS. The neighboring nodes hearing the BTt are blocked and they ignore any transmission received from A. A then sends the data to B and both turn off the BTt and BTr after the data exchange is over.

So, let us now look at the figure once again to convince ourselves the steps that we have just seen. So, node A sends RTS CTS back to A by turning on the BTr y node B. And then the data exchange takes place after a receives the copy of the frame. So, let us look at a little bit in more detail stepwise how this thing is going to function.

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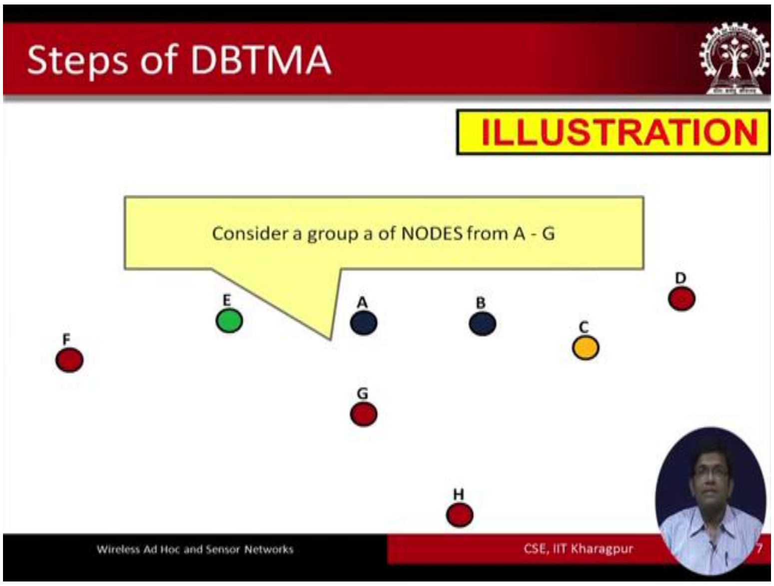

So, let us now look at let us now focus on the slide. So, let us consider that we have a group of nodes A B C D E F and G as shown in the slide.

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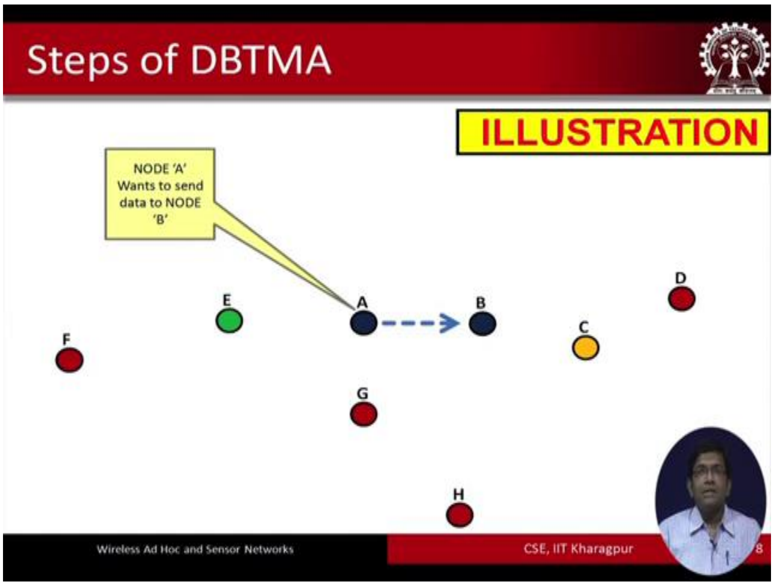

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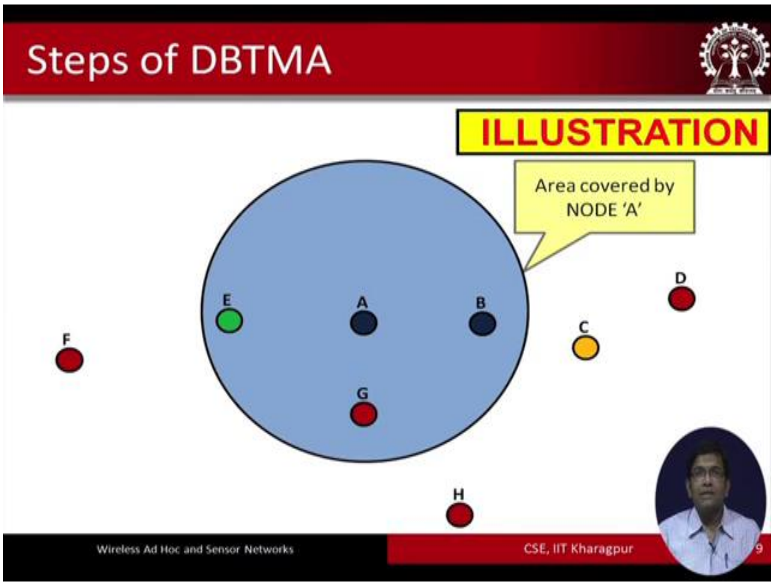

So, then let us assume that node A wants to send data to node B like this. So, the area covered by node A is depicted like this. The circle the blue colored circle that you can see; that means, that nodes e and g are in the transmission range of A. So, along with B these are also going to get a copy of the frame that are that that is sent by A to B.

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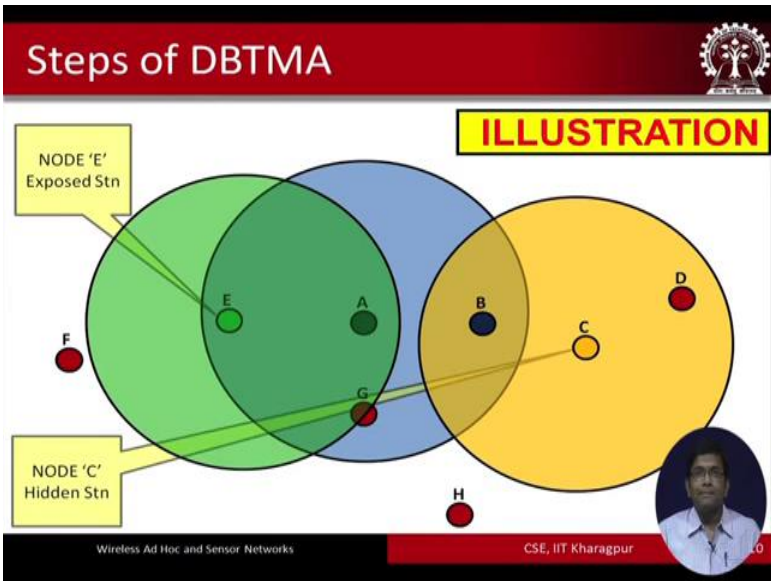

Node E in this case is the exposed station and node C is the hidden station; obviously, So, there is no doubt about it.

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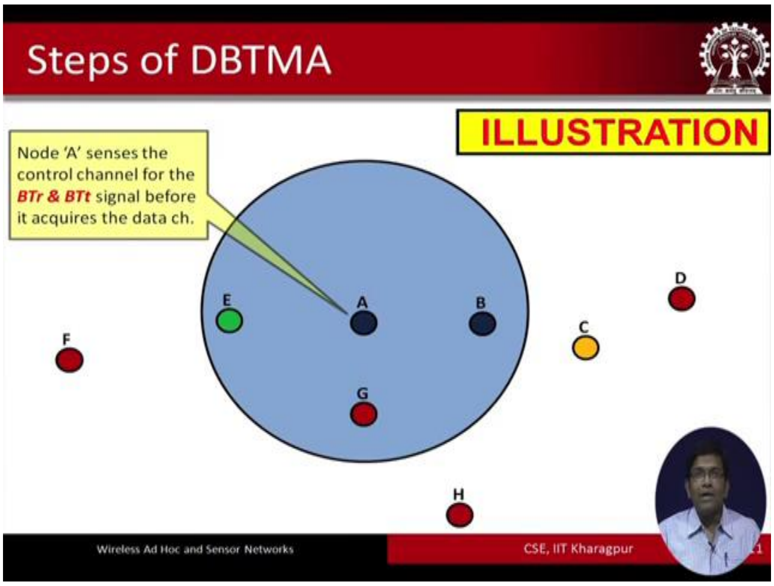

Node A senses the control channel node A, senses the control channel what BTr and BTt signals before this particular node equates the data channel. So, it senses the BTr and BTt signals the control channel for the BTr and BTt signals before actually sending the data channel data over the data channel like this.

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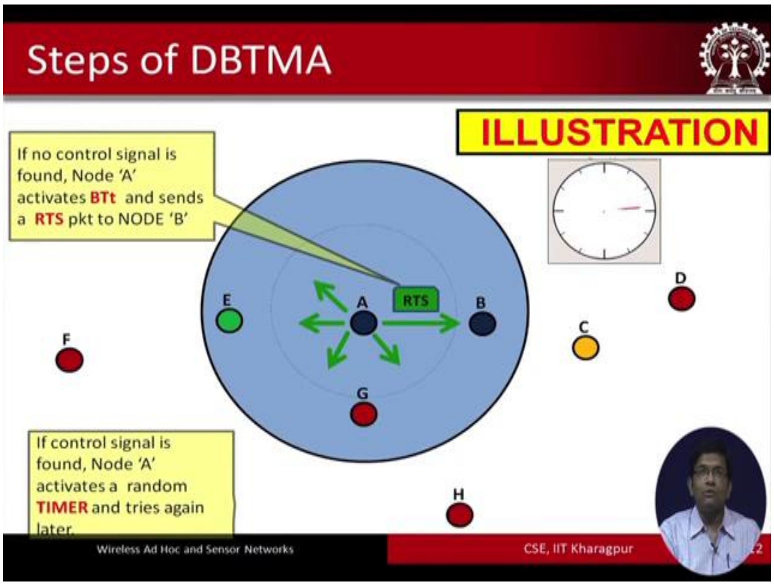

Then if no control signal is found node A activates the BTt and since a RTS packet to node B, like this. If control signal is found node A activates a random timer and try again later. As you can see the you know the timer is activated by node A, and then after the timeout it is going to attempt transmission once again.

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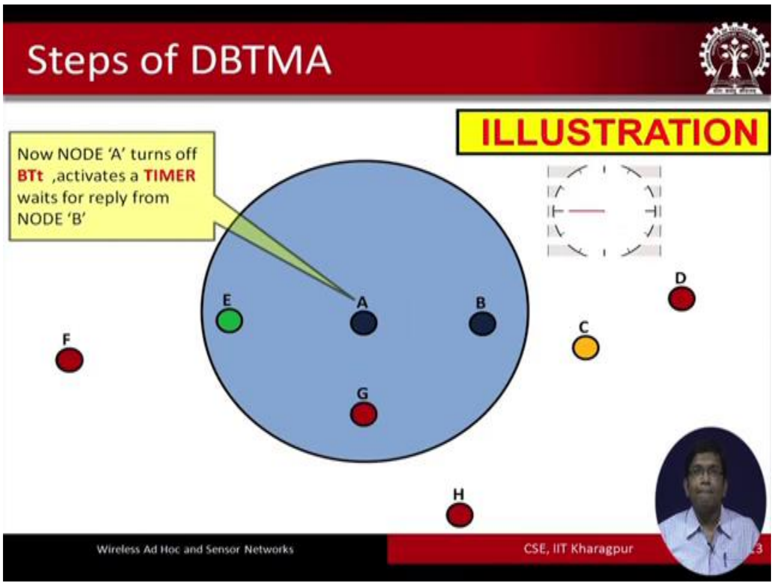

Now, node A turns off the BTt activates a timer and wait is for reply from node B clear.

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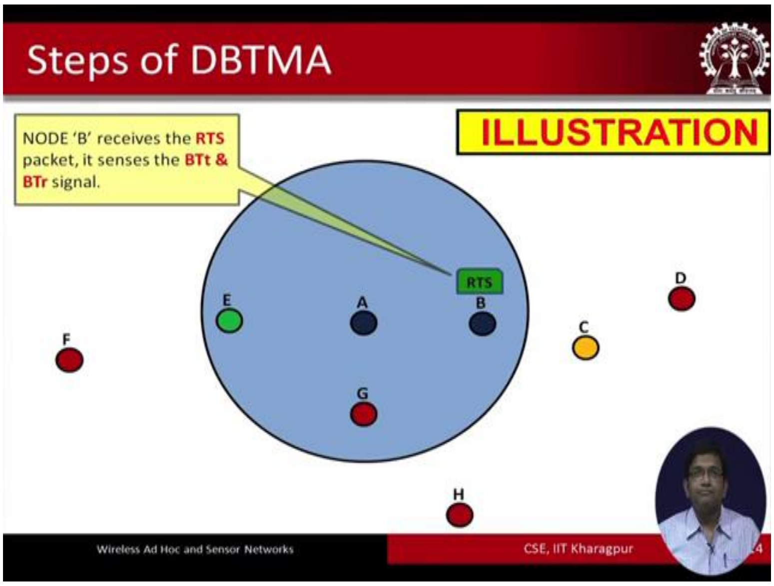

Now, node B receives the RTS packet it senses the BTt and BTr signals if no control signal is found node B turns on the BTr signal.

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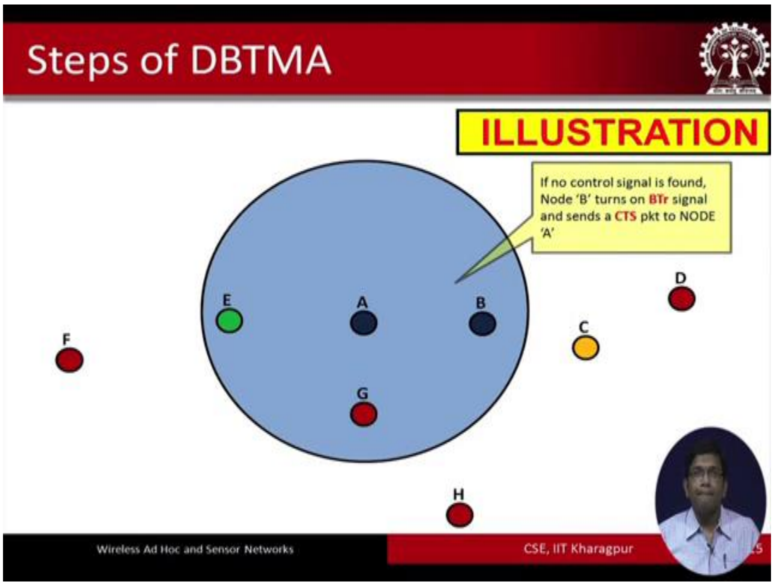

And sends the CTS to node A node A receives the CTS and turns on the BTt signal node A then starts sending the data packet.

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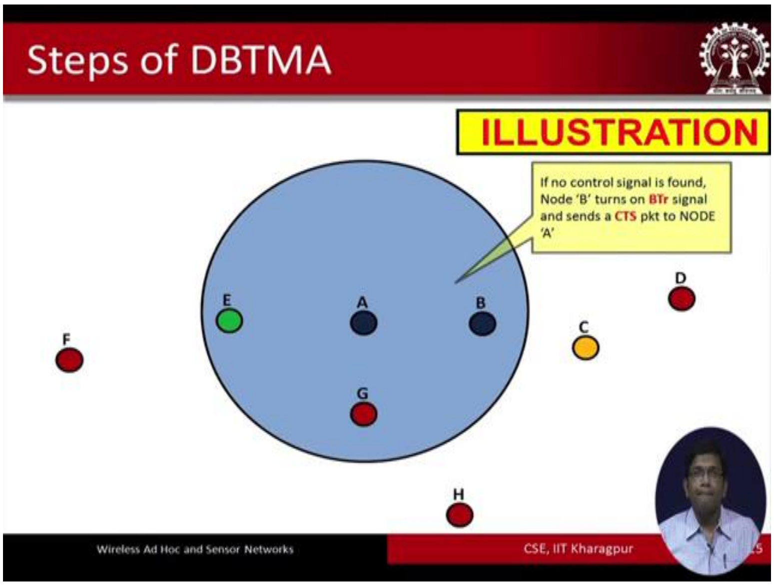

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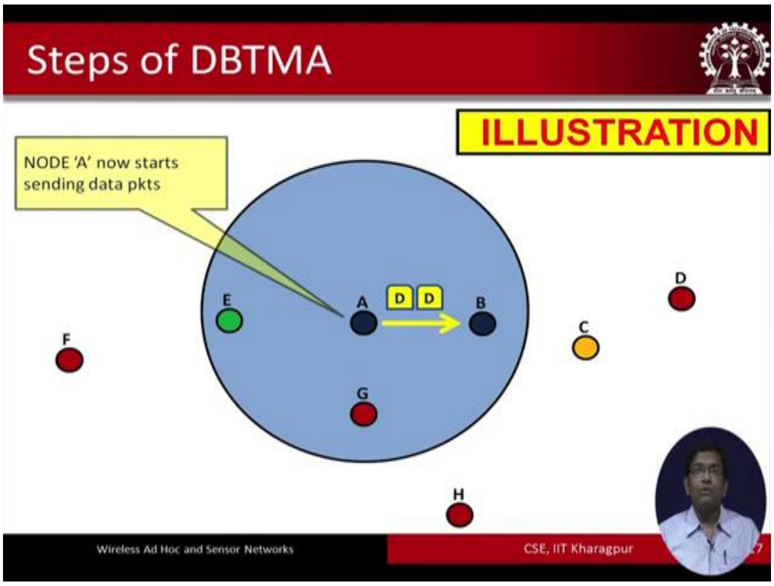

So, basically it is the introduction of the BTr and BTt, and complicating the control phase instead of sending simple RTS CTS complicating it little further. We ensure that there is lesser number of collisions chances of collisions that can take place by using the previous MAC protocols.

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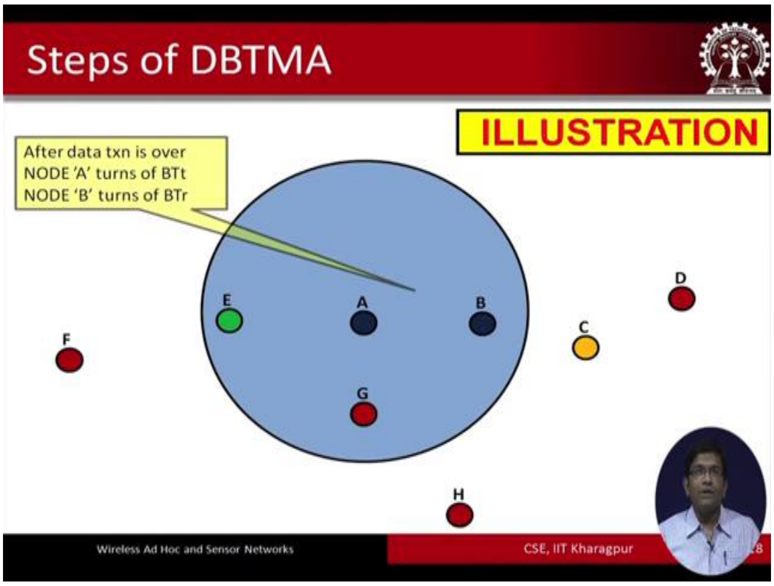

So, after that data transmission is over node A turns off the BTt and node B then turns off the BTr, it turns off the BTt and node B is a receiver. So, it turns off the BTr so; that means, that you are gracefully you know turning off the control signal that where activated before after the successful transmission of data like this.

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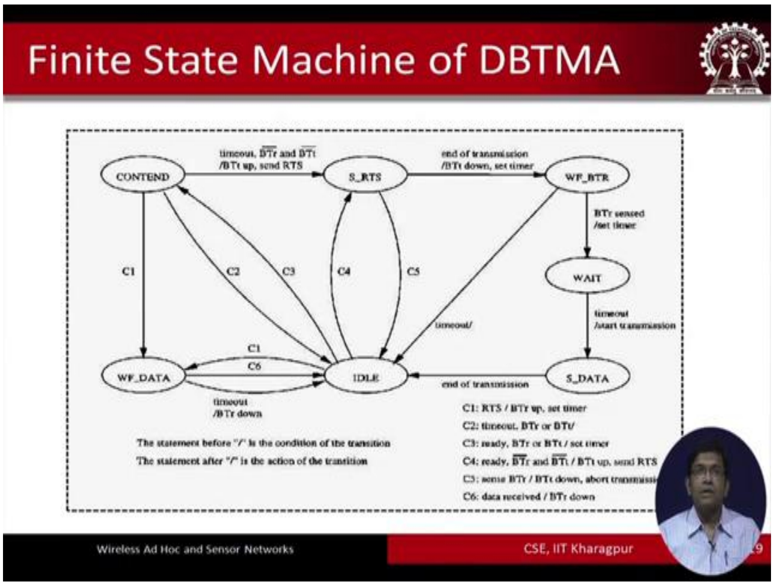

So, what we see over here is the you know the state chart of the DBTMA protocol. So, the ellipse is basically denote the different states in which the protocol is going to be a different instance of time, and the transitions are sole in the form of directed errors. So, these are the different states of operation of DBTMA.

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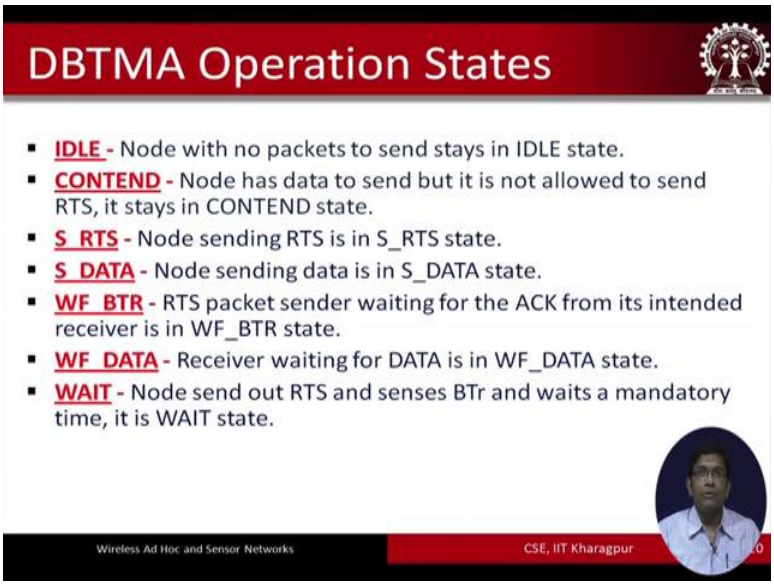

So, it is either going to be in the idle state, when the node with no packets to send stays this is called the idle state. And then or it can be in the content state where the node has data to send, but it is not allowed to send in the RTS. So, it stays in the content state or it can be in the S RTS. So, the node sending the RTS is in the S RTS states S data node sending the data is in the S data state WF BTr WF data and wait state. So, these are all different types of states the 7 different states in which the protocols the DBTMA protocol can operate.

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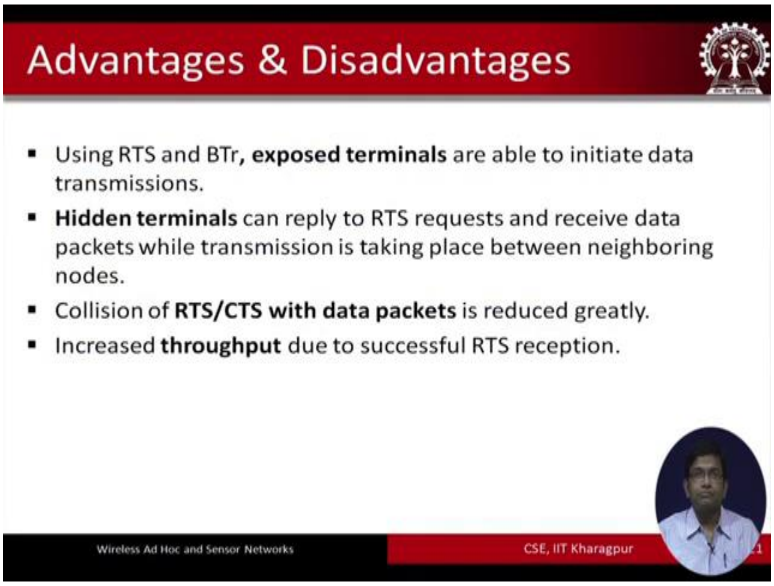

The protocol; obviously, has different you know advantages and disadvantages. So, although some of these hidden terminal and exposed terminal problems are solved, but still there are you know issues such as you know with respect to the overall performance we had used in more number of packets etcetera.

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So, these different issues still remain and the overhead the control overhead basically increases in the network. So, there are some problems the problems is that there is requirement of additional hardware to generate and receive busy tones and the bandwidth consumption as I said this few minutes back of the busy tones is not negligible practically. So, you know. So, the overhead is going to increase.

So, next protocol that we are going to discuss, it is known as the March protocol it stands for multiple access with reduced handshake.

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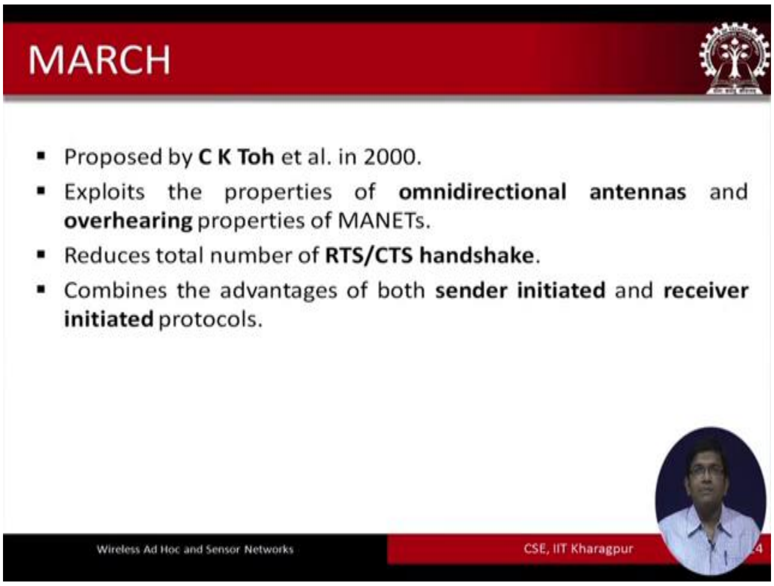

It was proposed by C K Toh in 2000. It exploit is the properties of the omnidirectional antennas and overhearing properties of MANETs. It reduces the total number of RTS CTS handshakes and combines the advantages of both the sender initiated and receiver initiates protocol. So, earlier we have seen both the types of different types of protocols the sender initiated protocols and receiver initiated protocols which is kind of a hybrid between the sender initiated and the receiver initiated protocol.

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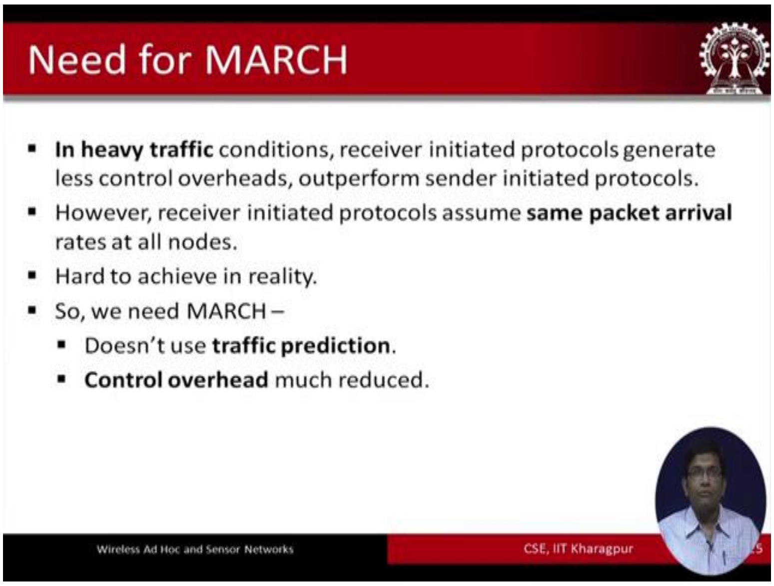

So, we are going to not go over the requirements for March, but let us understand few basic concepts before actually going through the different steps of execution of this protocol.

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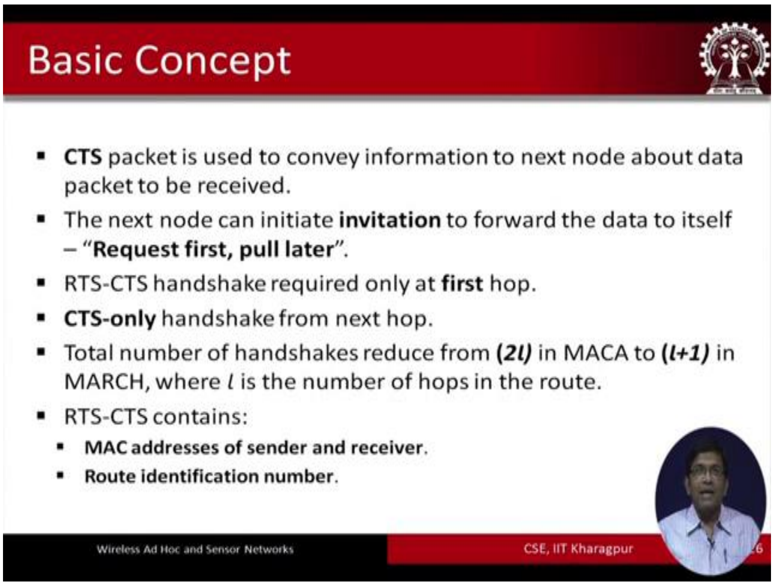

So, the CTS packet is used to convey information to the next node A bout data packet to be received the next node can initiate invitation to forward the data to itself. So, it is request first and then pull later kind of mechanism the RTS CTS handshake is required only at the first hop the CTS only handshake from the next hop the total number of handshakes reduced from 2 l in MACA to l plus 1. In March where l is the number of hops in the route. So, this is an improvement the match has improvement over MACA in terms of reduction in the total number of handshakes that are required. So, MACA required 2 l number of handshakes where as much requires only l plus 1 and; obviously, you know. So, much basically reduces the number of handshakes that are required RTS CTS is basically contains MAC addresses of the sender and receiver and the route identification number.

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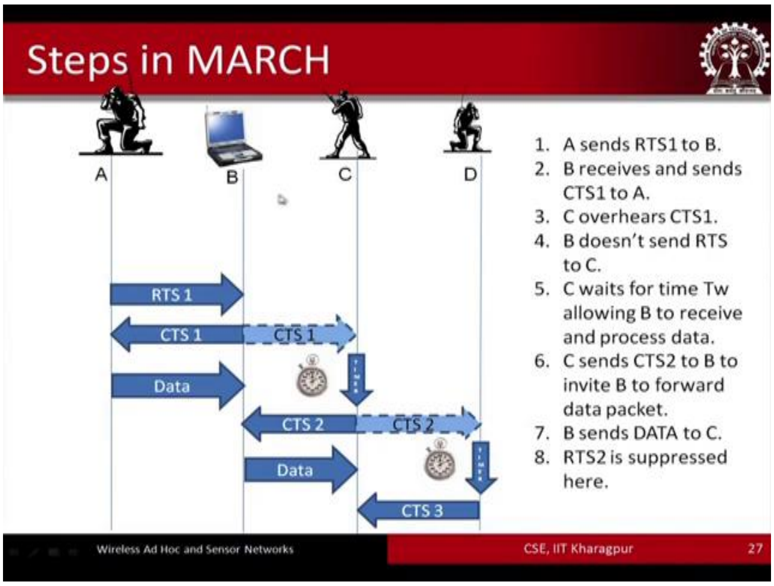

So, let us now look at this time line diagram. So, we have 4 different nodes A B C and D. Let us look at this scenario of transmission and the steps that are there in much. So, let us follow the different steps. So, let us assume that A, the node A; that means, this particular node since the first RTS, RTS 1 to node B. B, so it is like this a sends first RTS to B. B receives and sends the CTS to A, B receives and set the send CTS to a C note C basically gets a copy of it over here sit. So, CTS 1 was sent to A, but C is in the direct transmission range of B. So, it basically gets a copy of the frame.

So, B see over here CTS 1 B does not send the RTS to C, C wait is for the time Tw allowing B to receive and process the data C sent CTS 2 to be to invite B to forward the data packet p sends the data to C and RTS to is then suppressed here. So, B sends. So, as you can see over here that these timers 2 different timers are used and after that basically the corresponding CTS S are initiated. So it is not like you know. So, we had the CTS 1 that was sent from B which was overhead over here and the CTS 2 was again sent by this overhearing node and the copy of it again was received at D CTS 2 and after the sedan's transmission of the data. So, the CTS 3 is initiated from this over hearing node D.

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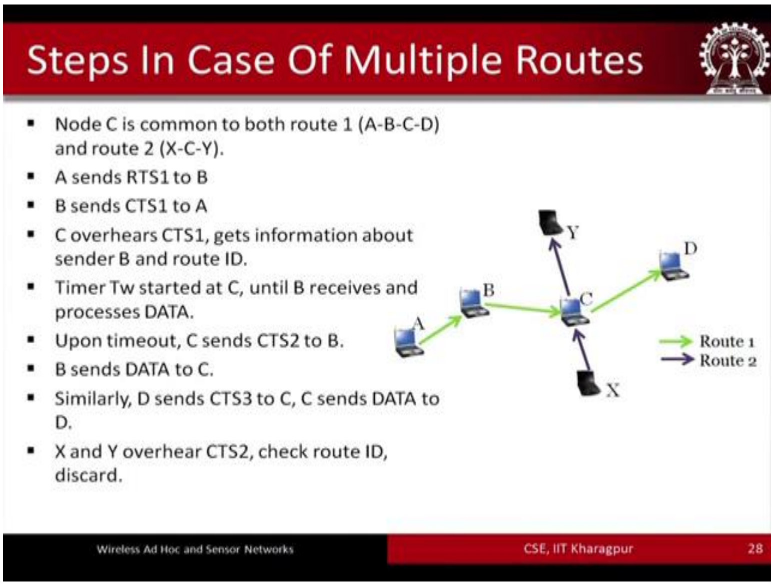

So, if there are multiple routes which is quite common in Ad-Hoc network. So, this is what is going to happen. Node C in this particular exam. So, he here what we have we have a scenario of you know A B C D and 2 routes A B C and D, this is one route, route 1 which is shown in the green color and the other one is X C Y which is black colored route that we can see in this photo, so 2 different routes overlapping routes in the case of this particular network.

So, node C in this particular case is common to both route 1; that means, A B C D and X C Y route 2, A sends RTS 1 to be a sends RTS 1 to B, B sends CTS 1 to A, C over here is the CTS 1. So, it is something that we have seen in the previous slide itself. So, that not new. So, far. So, C over here is the CTS 1 gets the information about the sender B and the route id. The timer Tw is started at C until B receives and processes the data. So, this timer is initiated initially at C upon time out C basically sends the CTS 2 to B, B sends the data to C. Similarly, D sends CTS 3 to C, C sends data to D and these CTS packets are overheard CTS 2 packets are overheard by A and D we check the route ID and the discard this overheard packets is an overhead frames or facility.

So, this is how these 2 different multihop routes with common nodes are basically this is how it is handled in in the case using the March protocol.

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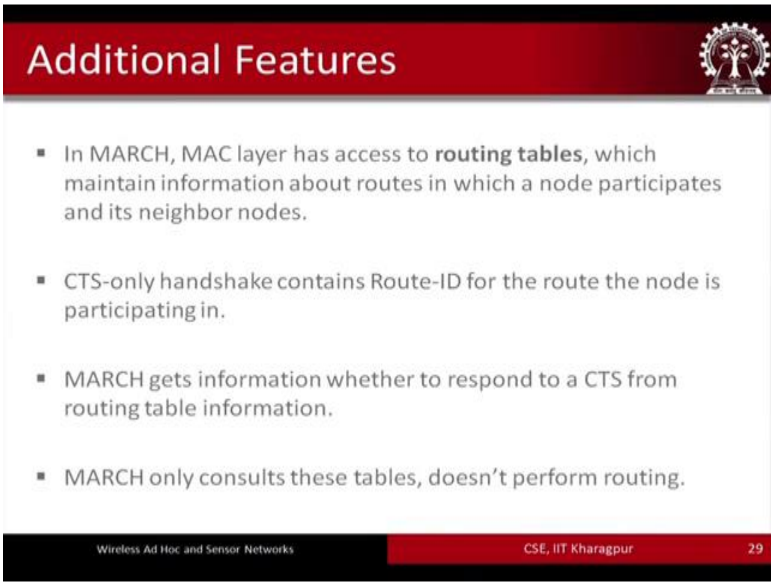

So, it also has some additional features. So, in March the MAC layer has access to the routing table. So, it is a cost layering kind of approach which maintains information about the routes in which a node participates, and it is neighbor knows because it is essential as we have seen in the previous case we have multiple overlapping routes. So, that routing information has to be routing table information has to be made available at the MAC layer right.

So, it is a cross layering approach then the CTS only handshake contains route ID for the route the node is participating in March gates information for the to the respond to a CTS from the routing table information. March only consults these tables and does not perform routing. So, March basically is a MAC layer protocol. So, it is it only gives access to the routing table information, from the network layer, but it actually does not March does not take care of routing specifically. So, we have solved the advantages you know.

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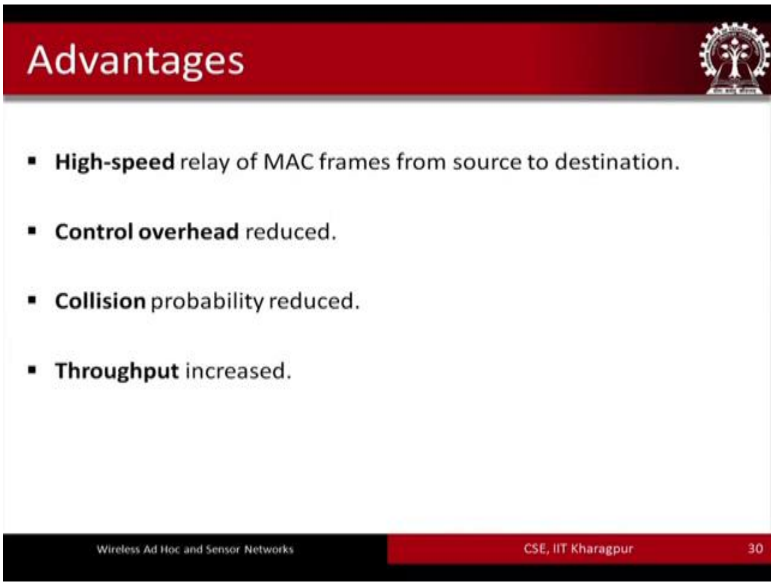

So; obviously, the throughput is increased the control overhead is reduced over the MAC protocol and the primitive other types of you know MAC protocols for MANETs.

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So, these are the references again like as we have seen C K Tohs book as well as this particular guide to Ad-Hoc networks the space springer this are quite widely available and these books can be consulted for this part of the lecture. And additionally the DBTMA protocol you know it was published in the I triple e trans and so on communication in 2002, if you want to understand this protocol in detail you need to get a copy of this particular paper and the March protocol was published in Milcom by this 2 title in 2000, so these are the 2, 2 protocols that we have discussed in this part of in the second part of the network MAC protocols for Ad-Hoc network lecture.

Thank you.