Computer Networks and Internet Protocol
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Lecture – 54
Wireless LANs

We are discussing on Computer Networks and Internet Protocol and as last couple of or last few lectures, we were discussing with layer 2 phenomena. So, what I thought that today will discuss overview of WLAN or wireless LAN. Though as many of you understand that wireless LAN or WLAN is a topic itself it is a separate course if not more than one course itself. And it has different consideration to be handled at the specially at the physical and layer 2 of the MAC layer or data link layer right. So, at the layer 2 and layer 1 there are separate consideration.

For enabling the wireless and to the rest of the things are may not be affected that much or are not affected that that way. So, so, that is why wireless LAN is a separate consideration, but nevertheless what we thought that a basic overview of this wireless LAN or WLAN at phenomena at data link layer. And also vis a vis little bit of physical layer may be good for the overall for the overall course structure, and specially those who are not exposed to this technologies or this particular well listen and phenomena will be it will be helpful for that right. With this motivation will be having a basic overview of wireless LAN phenomena at the layer 2 level right.

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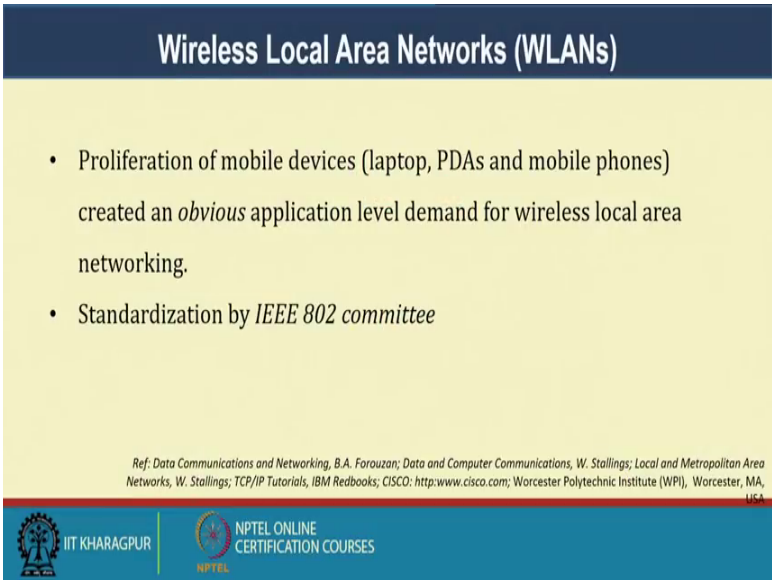

So, as we see that WLANs especially due to huge purification of our different mobile devices and obvious LAN mobile applications on those devices. So, there is a need for a omnipresent network to be there right. So, rather the if we look at that bandwidth availability with, in a wireless LAN network or data network par to say our mobile devices, it is increasing day by day right. And with technologies like 4G and 5G trying to become operational and it becomes a different ball game to handle those scenarios right.

So, not only that with easy availability of this band width at a lower cost, it also makes it more feasible to have a infrastructure with wireless LAN right. Even we are these days having a lab starting full working fully on wireless; like, what you require is only the power to power the systems, the network configuration is wireless. And it also is helping in reducing this overall cable infrastructure and management of the specific cable and type of things right. So, its becoming a de facto standard for operations and type of things. So, likewise if you want to in intraoperative wireless, similarly IEEE 802 standards come into play. And if we look at that different set of IEEE 802 standards it is not only wireless.

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So, specifically if you see 802 dot 11 is the wireless LAN working group right. So, there is a 802 dot 15 wireless personal wide PAN group and so on and so forth. So, there are if we see. So, there are lot of activities on the standardization point of view also right. And to be very specific so these are from that 802 standardization committee's recommendation and their documents.

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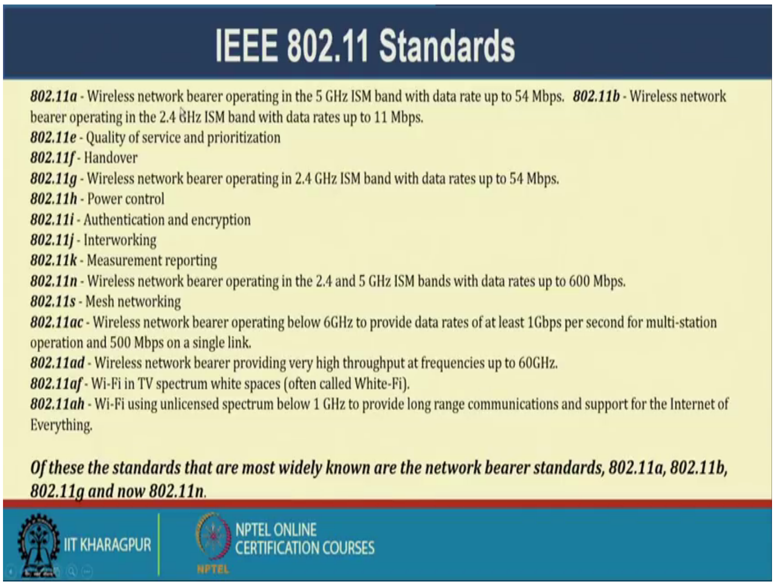

And if you look at the 802 standard part say, see we see a series of development came into play right. So, 802 dot 11 a wireless network bearer operating at 5 gigahertz ISM band up to 54 Mbps, 11 e quality of service and prioritization, 11 f handover, wireless network bearer operating in 2.5 gigahertz ISM data rates up to 54 Mbps g, and so and so forth right. And there are different standards which came up, though popular are a b g and n become more popular for practical deployment and type of things. So, what we try to look at, what we see that there is a lot of effort from the standardization which obviously, there is based on the demand of this type of deployment.

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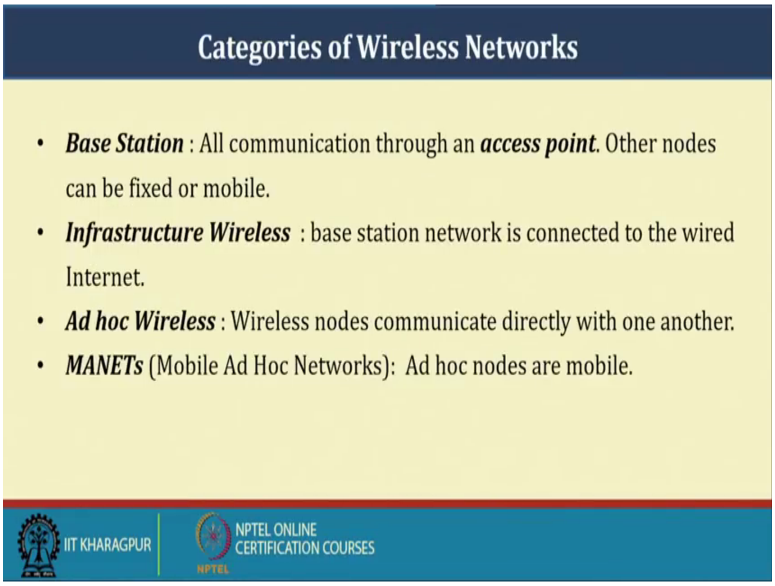

Now, if you see that wireless LAN that types of broad categories of wireless LAN. So, one is something base station batch right all communication through access point right. So, its a based station batch so, you have a access point and communicate, infrastructure wireless base station is connected to the wired back bone all right. So, its a more of a thing its a wired backbone and then infrastructure then base stations are connections. These are more controlled because I have that measure control over the wired back bone between the segments and etcetera and management is much better and so and so forth.

There is a Ad hoc connections where there is no per say there is no central AP sort of thing, but there is a connection which is Ad hoc and there is MANETs right mobile Ad hoc networks. So, Ad hoc network again on the movement and there are different variants of different types of networks which are coming a polarize of this like, one may be the when it declared Ad hoc network the network where the where the vehicles communicate each other in the things So, it says that there are these are major categories of the network, which where this wireless proliferations is there.

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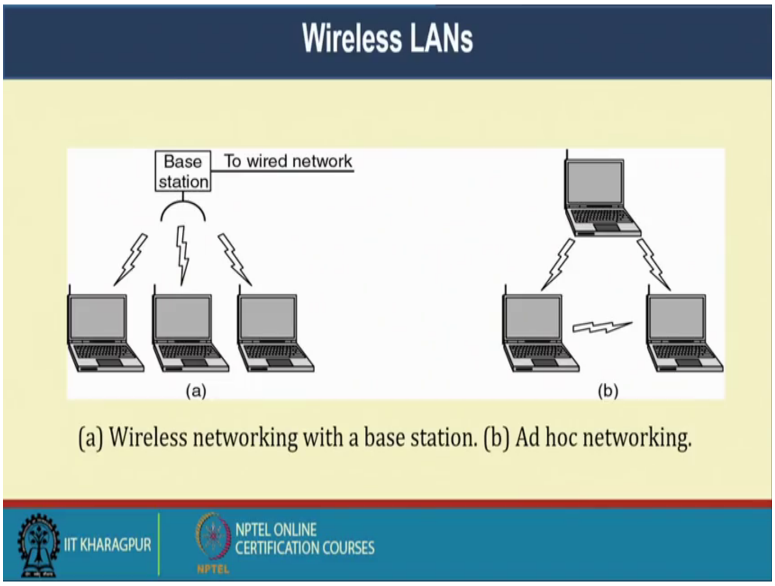

Now, so, to specifically one with the base station which is wired backbone, another is the Ad hoc may be the broad thing type of configurations what we are looking for.

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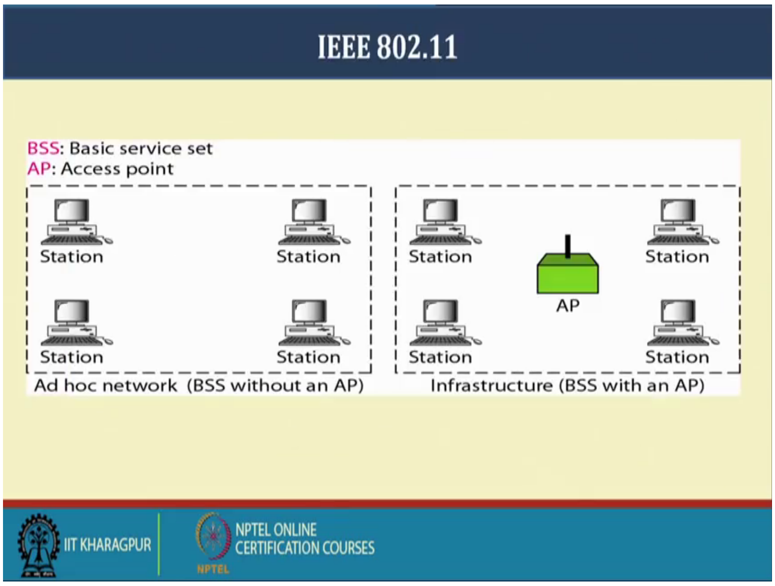

and if we look at that from other perspective so, there is a concept of BSS Basic Service Set, where within that particular basic service set the stations can be there they communicate with each other. Either on Ad hoc basis without any access point or there is a access point within the basic service set right. And there is a concept of extended service set, where the service set is extended to the other BSS through some access points.

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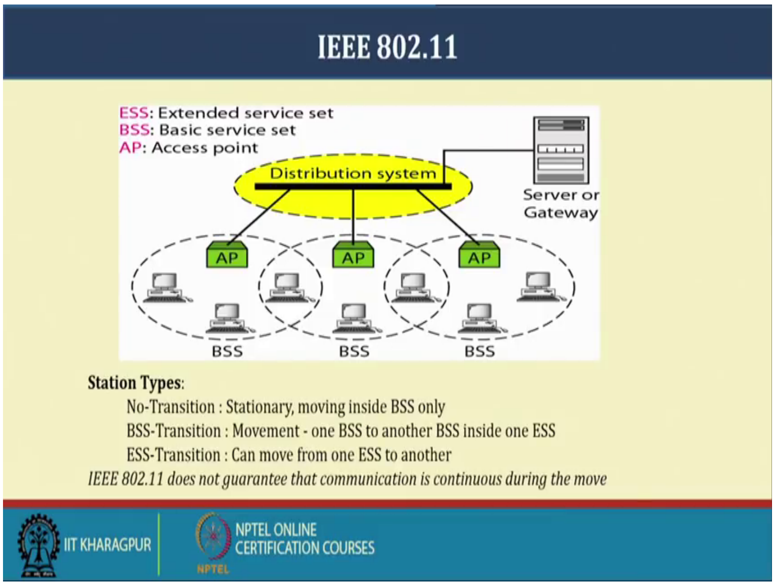

So, extended service set so, there are basic service set to access point they are extend they are into different BSS. So, there can be different the stations, this particular stations can be different type, one is it can be stationary that in other sense it is within the BSS only. Other is there may be movement of the things that is one BSS to another in side to another BSS.

So, there can be movement from one BSS to another BSS or that can be ESS type of things right. So, move from one extended service to another. So, usually what happened? This AP's are connected on a distributed on a backbone, which is a distribution systems, which in turn connected to a server or gateway, which allows it to different type of services starting from different network level services right. So, this is the typical structure which make more practical and says that I have BSS different BSSs they are APs, APs as a backbone where we say distribution systems and go on other things.

So, this is the extended service set and there can be movement within the BSS, within two BSS, under the one ESS, or across ESS one ESS to another so these are all those things are possible. But however, 8 not 2 dot 11 does not guarantee that communication is continuous during the move right. So, the protocol does not guarantee that the communication will effect full during the overall movement.

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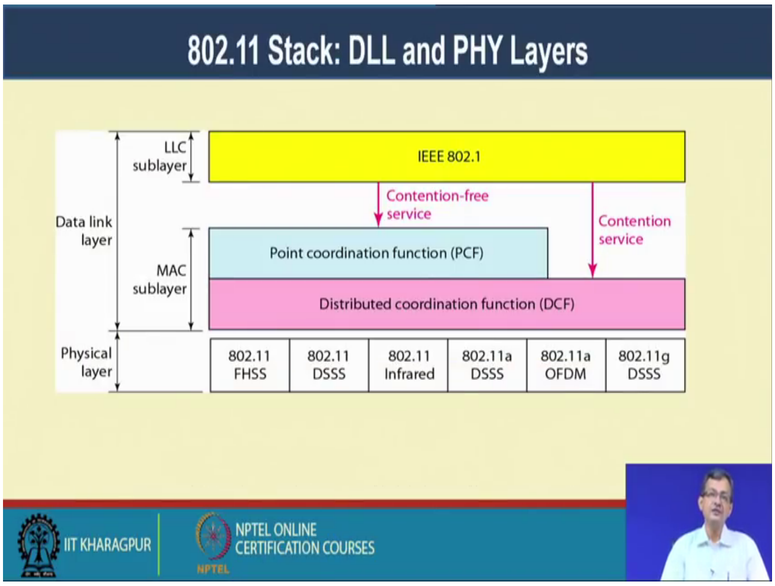

And if we look at the physical and data link layer structure of the whole stack. So, it is this there are at the bottom line there are several physical layer standards, over there, there is a distributed coordination function or DCF, over that the point coordination function PCF. And there is a there are issues of contention free service, contention services and over and above there are 802 dot 1 that is the LLC sub layer.

So, we have this sort of structure for the wireless or WLAN or more specifically 802 dot 11 standard, above this are network transport etcetera that remains same right. That whatever the standards or IP and other things whatever is working as in a same less fashion so, that the bottom lines are considered.

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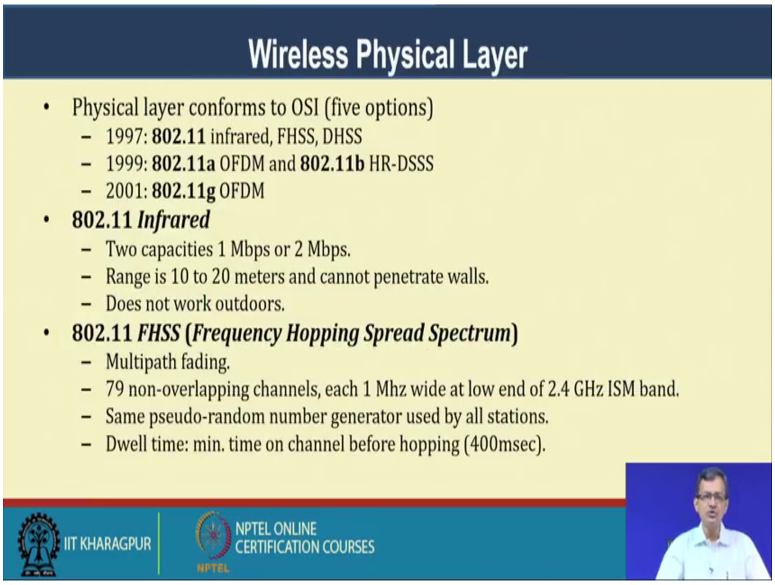

So, if you just go little look at little quickly at the different wireless physical layer consideration so, physical layer confirms to OSI. So, there are 8 naught dot 11 infrared FHSS, DHSS, 802 dot 11 a, OFDM. and 802 dot 11 b, HR-DSSS, and 802 dot 11 g, OFDM so, these are the different things. So, 802 dot 11 infrared 2 capacities 1 Mbps or 2 Mbps typically, range from 10 to 20 meters and cannot penetrate wall right. That is why infrared cannot penetrate typical wall and does not work out rows, but its can communicate with a low range thing right. And 802 dot 11 FHSS frequency hopping spread spectrum, again a physical layer consideration we will see some of the aspects of physical layer.

But may not in our subsequent lecture, but may not go deep into the physical layer consideration, these are more communication oriented phenomena. So, there is a multi path feeding, 89, 79 non overlapping channels and so and so forth and these are different characteristics of that. So, 802 dot 11 DSSS the direct sequence spread spectrum. So, spread signal over entire spectrum using pseudo random sequence and I have the bandwidth achieved is 1 or 2 Mbps. 802 dot 11 a OFDM orthogonal frequency division multiplexing so, comfortable with some European hyper LAN 2 can go for 254 Mbps with wider 5.5 gigahertz and these are the different consideration into the thing.

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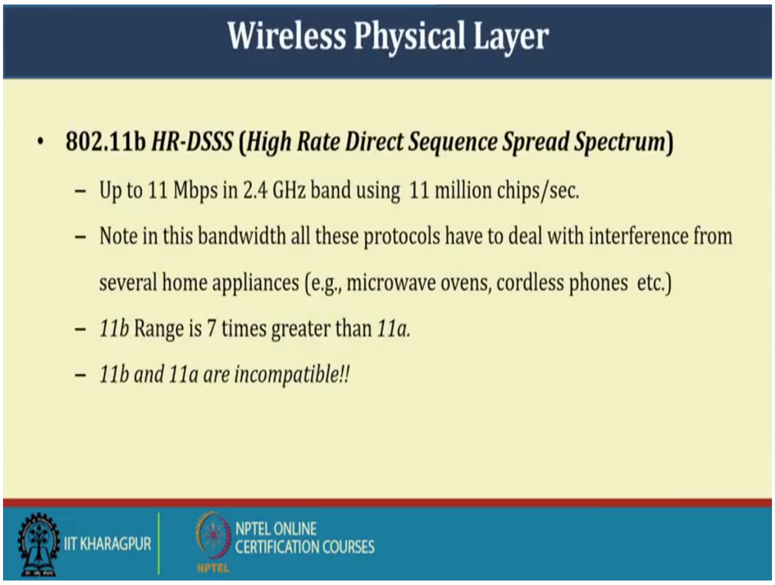

Then we have a variant of 802 dot 11 b, though there are incompatibility between 11 a and 11 b up to up to 11 Mbps for 2.4 gigahertz and with 11 million chips per second. The bandwidth of all this protocols updates with interference from the several other home appliances right like microwave oven etcetera. So, 11 b rangers much higher than the 11 a so, it can communicate to a higher range.

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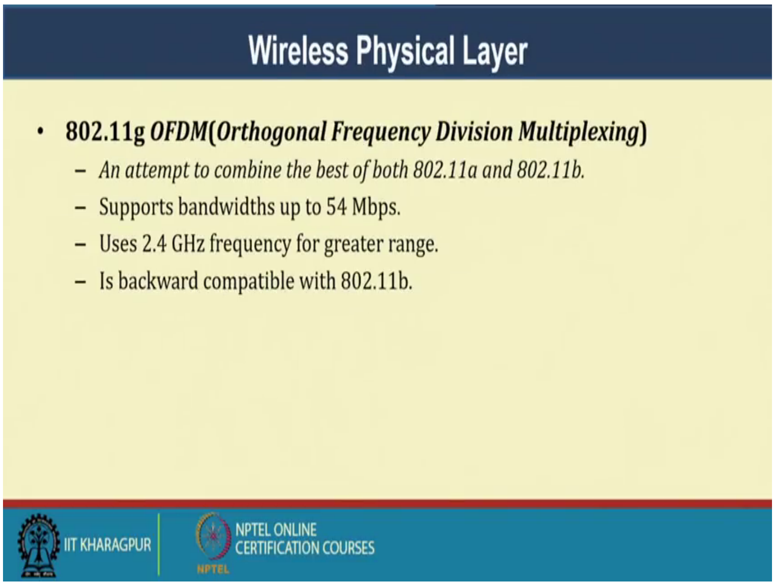

Then we have 11 802 dot 11 g orthogonal frequency division multiplexing, it is backward compatible with 802 dot 11 b. That is why in several devices you see that 802 dot 11 b slash g up to 54 Mbps uses 2.4 gigahertz frequency for greater range. So, this as sum of this physical consideration, this is primarily to have a idea that what are the technologies or what are the standards at the physical level.

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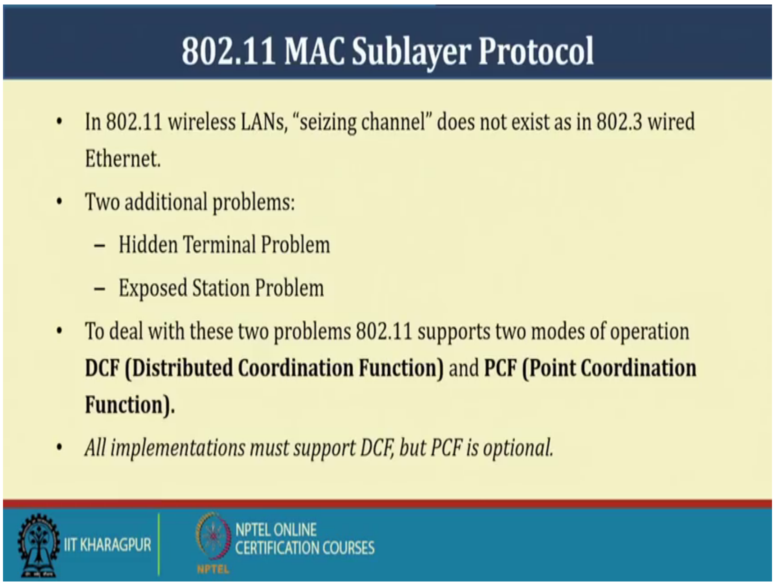

So, if we again come back to this 802 dot 11 Mac layer Mac sub layer protocol. So, that its not which we have a problem of this having this sizing the channel, which is not in the 8.3 dot wired network we will see that some of the things. Two major problem which comes up here is, the hidden terminal problem and exposed terminal problem. We will see that this is in channel problem will not come in a wired network where things are not like this.

So, to deal this two problems 802 dot 11 supports two operations; one is DCF or Distributed Coordinated Function and PCF Point Coordination Function. So, these are the two things which are supported by 802 dot 11 right. So, implementation of the PCF is optional, but DCF is there its all implemented and support DCF right another PCF is much more complicated to handle also.

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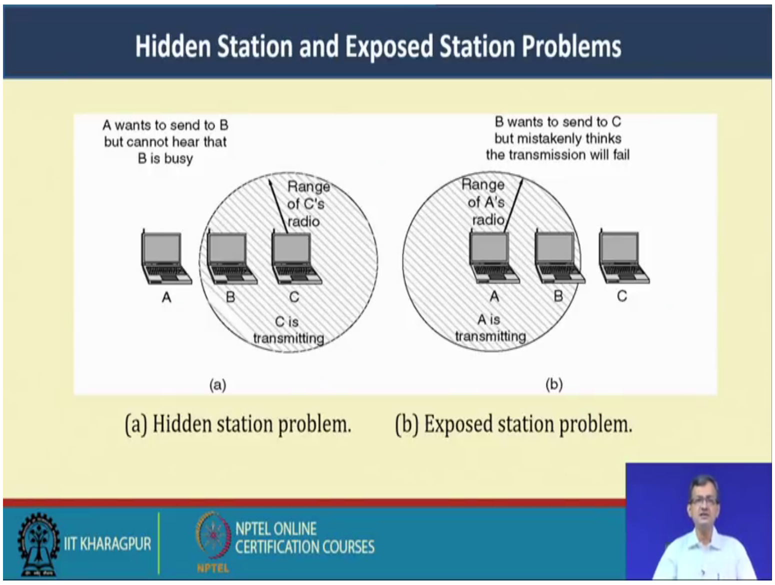

So, what is this hidden station and exposed station problem? We will presented in several literatures and internet resources. So, this is a hidden station problem on the A figure A and figure B is the expose station; A wants to send to B, but cannot hear that B is busy right. So, it is a hidden station problem there are range of C radio is not up to the A. But here B wants to sends to C, but mistakenly things that the transmission will fail right. So, because it is in the age range and it is exposed station problem right.

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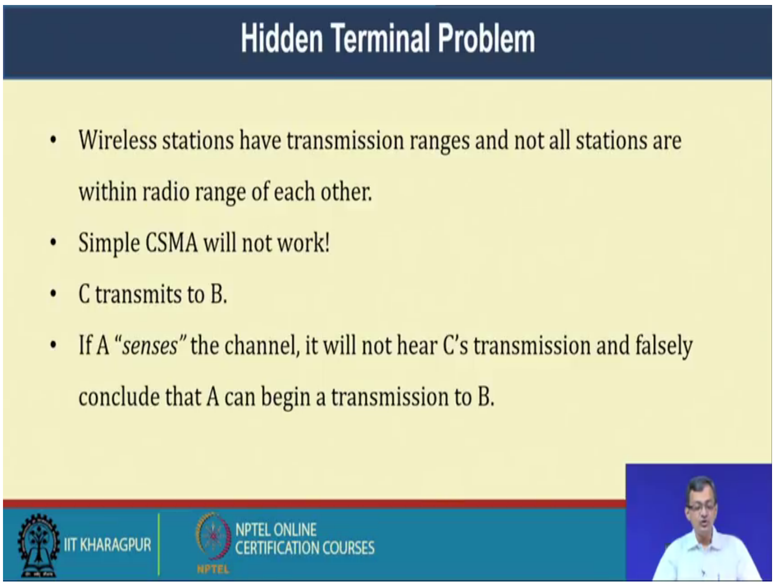

So, in hidden station problem wireless stations have transmission range, but not all stations are within the radio range like C that it is in the transmission range of B is in the C, but the A is not there. Simple CSMA will not work carrier sensing will not work, C transmit to B sorry. And A senses the channel it will not here transmission and falsely conclude A can begin the transmission to B right. So, A senses the channel and see that the communication to the B is free because it is not within the range of the C and it may begin transmission to B. So, this is the challenge with the hidden terminal problem were shown in the figure A.

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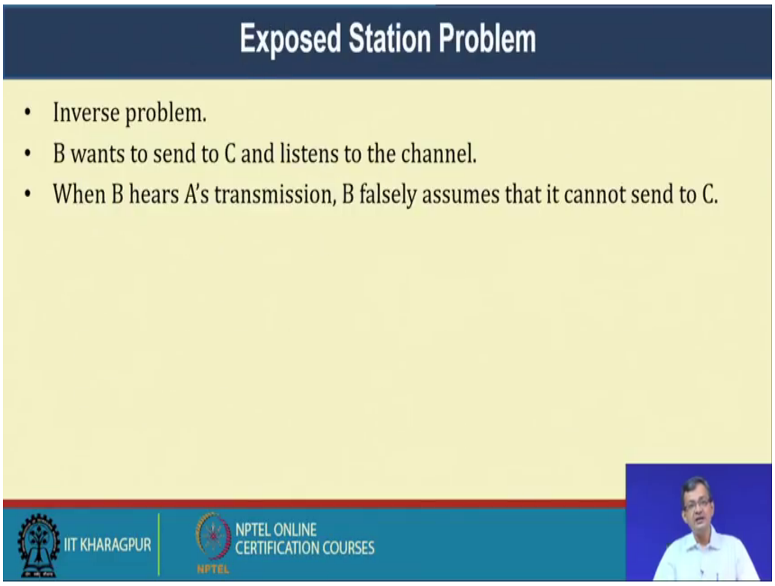

On the other hand on the flip side or the so to say on the inverse problem is the expose station problem, B wants to sends to C listens to the channel. B here is that A transmission B falsely assume that it cannot sends to C right. In this case B wants to sends to C and since the channel and what it sees that it assumes that here's A transmission. And because it is in the radio range of the thing and then it cannot sends to C so, this is a exposed station problem.

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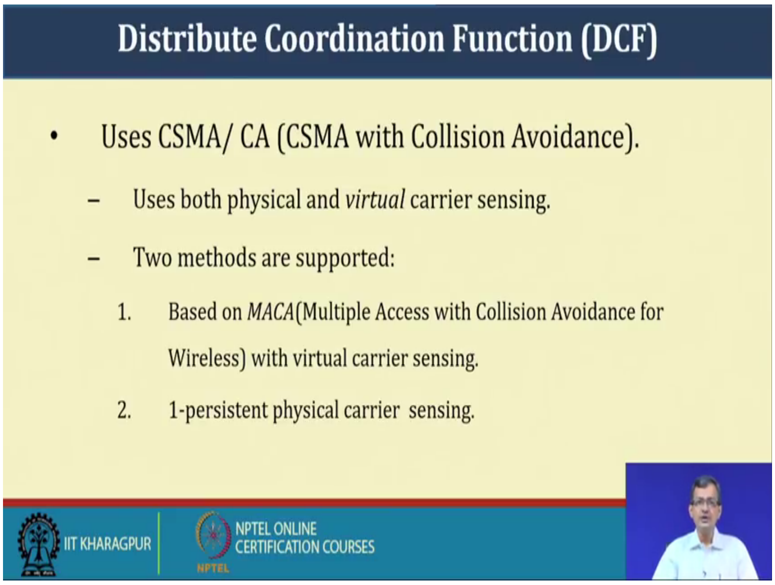

So, this are being tried to handle in the wireless scenario by to as we have been the two approaches or two functions. Like there is one distributed coordination function or DCF, uses CSMA CA, CSMA with collision avoidance, both physical and career sensing right. So, virtual carrier sensing so, it is not that we will see that how things it done. So, two methods are supported; one we have to say multiple access with collision avoidance with virtual carrier sensing and one persistent carrier physical carrier sensing so, we will just see that what it does.

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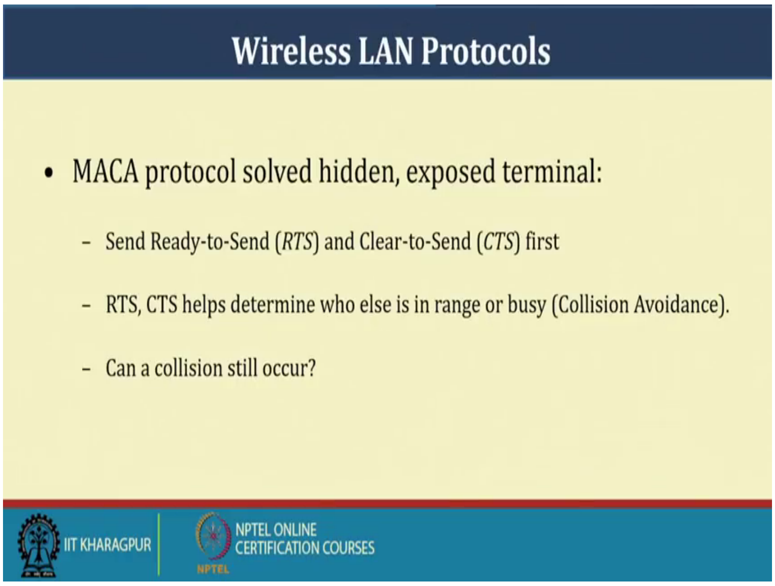

So, Multiple Access Collision Avoided on MACA for wireless has to solve the hidden exposed station problem or these two challenges by, two type of mechanisms; like one is ready to send and clear to send. So, before sending the things it says a RTS signal and waits for a CTS thing. So, RTS, CTS helps determine who else in the range or the busy are in the range or busy so, that it can avoid collision.

Now, we will see that detection collision it may not be false feasible here out here. Because this first of all this channels are pretty noisy, you need to have major resources and bandwidth to handle this sort of sensing. Because you are sensing and trying to transmit at the same time like. But whether still collision occurs yes, whether in spite of this collision occurs will see that in spite of this to may collision occurs. But nevertheless the based on that CTS or RTS not receiving the channel will go for again retransmission.

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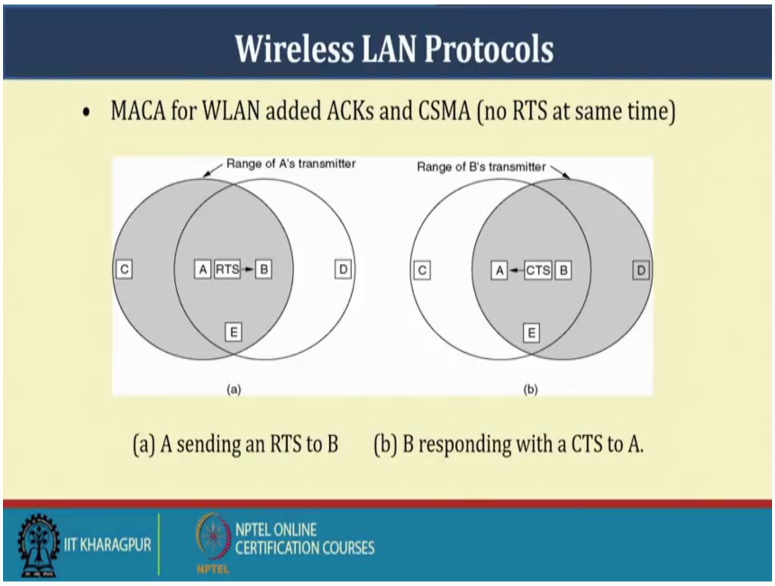

So, if we look at that MACA for WLAN added acknowledge and CSMA no RTS at the same time. So, this is A send a request to tell me to B and in the range of A so, B sends a CTS and responses CTS clear to transmission and transmits. So, it is really does not; it able to handle this hidden channel, both hidden channel, and exposed channel issues. So, we have a virtual sensing with CSMA CA like in the C in the range of A receives a RTS right.

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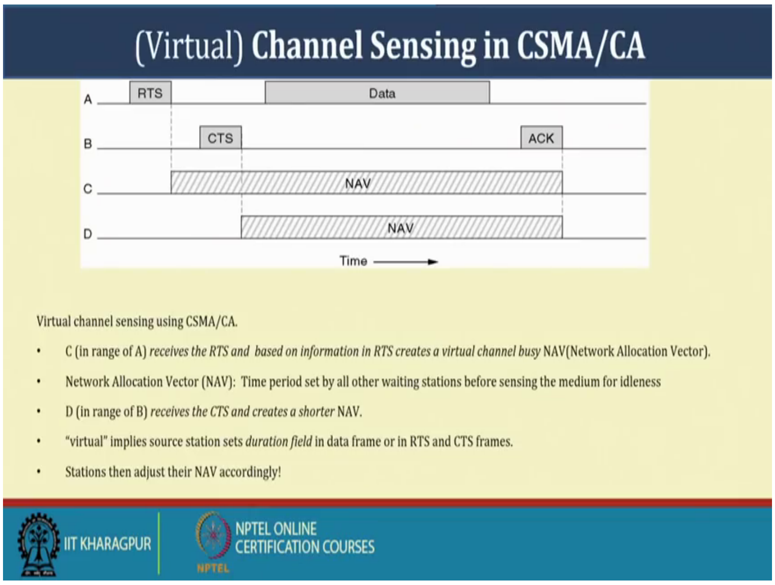

C in the range of A receives RTS and based on information in the RTS creates a virtual channel busy NAV right. So, what is a NAV? So, Network Allocation Vector; the time period set by all other waiting station before sensing the medium for idleness right. So, it is the time period like if it is A sends a RTS for B, then it is the other stations who are hearing this will wait for, will set there NAV that and it also in the RTS their information is there how much time it may required to transmit the data. So, for that time this a other stations who are hearing this, will wait for that and for that period before looking for the channel whether it is idle or not. So, D in the range of B receives the CTS and creates a shorter NAV right.

So, if D also in the range of B received the CTS and creates a shorter NAV. The virtual implies that is source stations sends duration field in the data frame of the RTS and CTS. So, and so that is why by reading those its creating a wet time, which is an sensing after some after that wet time by setting their own NAVs. So, it is creating some sort of a virtual science channel since sensing right. So, it is not sensing the channel based on this information wise is the RTS and CTS. Station, then adjust the NAV accordingly right so, the network allocation vector accordingly and wait for the things right.

So, let me repeat it when a channel wants to A wants to send to B it sends a RTS, the other channels we are listening to this RTS, the RTS also contains the information, how much time it required to sends the data. So, based on that sensing, the other channels way set their network allocation vector to that time period after which it will look that whether the channel is idle or not right.

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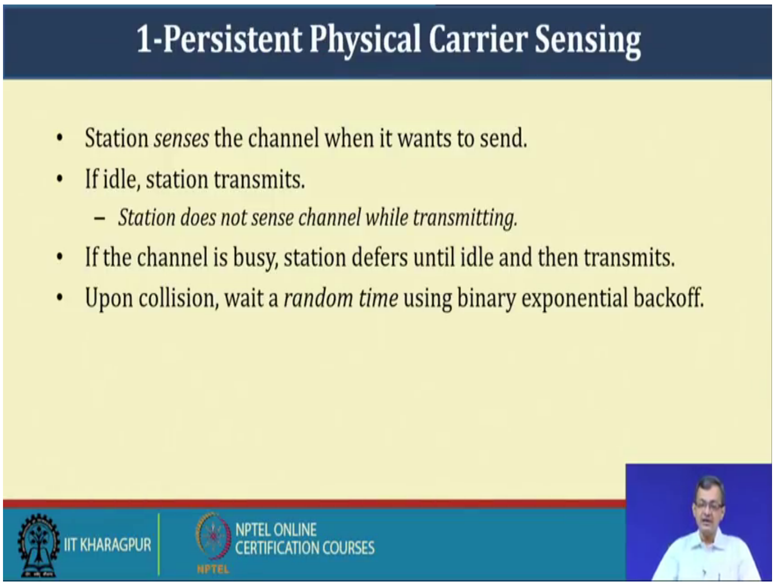

So, there is a another one persistent physical carrier sensing, the station senses the channel when it wants to send right. So, change the station senses the channel when it wants to send, if idles transtation transmits right. So, station does not sends channel while transmitting. If the channel is busy station defaults until idle and then transmits right, upon collision wait a random time using binary exponential back off. So, there is a one persistent physical sensing, in a previously it was there it is not physically sensing, but based on the information in the RTS CTS it is setting up that after what time it will again check the idleness of the thing.

But in one persistent physical carrier sensing, what it is doing that station senses the channel when it wants to send some data right. If it is idle that is the station transmits. So, if it finds the station it find the channel is idle that nobody is within that range because, the revaluation. So, there is no wired channel and then the station does not sense the channel while transmitting, while transmitting it will not sense the channel. It is go on sensing there, if the channel is busy that station defaults still the idle and then transmit. So, upon collision wait for a random time using binary exponential back off period right; so, this is the bottom line of this one persistent sensing.

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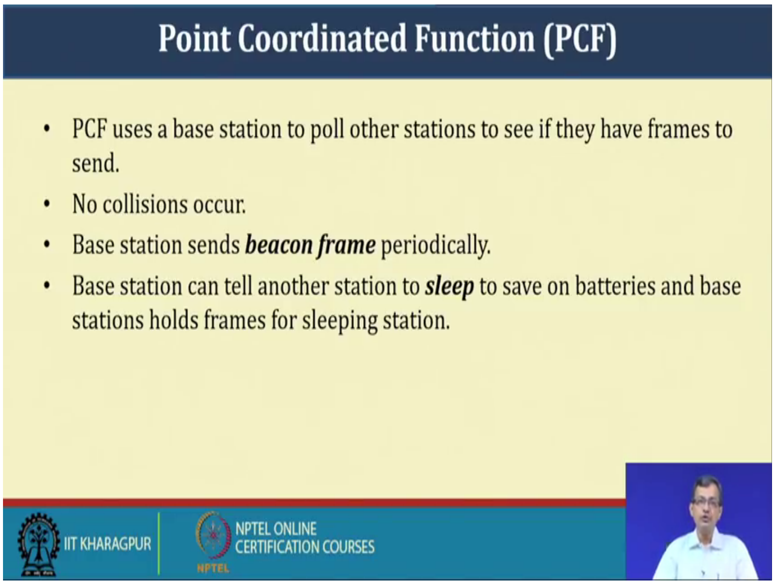

Now, point coordinated coordination function that PCF uses a base station to poll others station to see if there are frames to be sent. So, in this in PCF in this case it requires a base station to poll other station, to see that it is a polling operation goes on, if they have frames to send so, no collisions occurs per say right. So, there is no collision occurs. Base station sends beacon frame periodically. So, base station can tell other station to sleep, to save batteries and base station holds the frame for sleeping station right.

So, it is a more coordinated or point coordinated because they are the base station is polling and seeing that if they are frames to send. No collision occur, base station sends become frame periodically, base station can tell other station to sleep to save the batteries, and other and base station holds the frame. So, this is the point coordinated function little bit complicated and not over not it is optional for things that you may not fall. But DCF is considered mandatory for all communications with those features of RTS, CTS sort of things.

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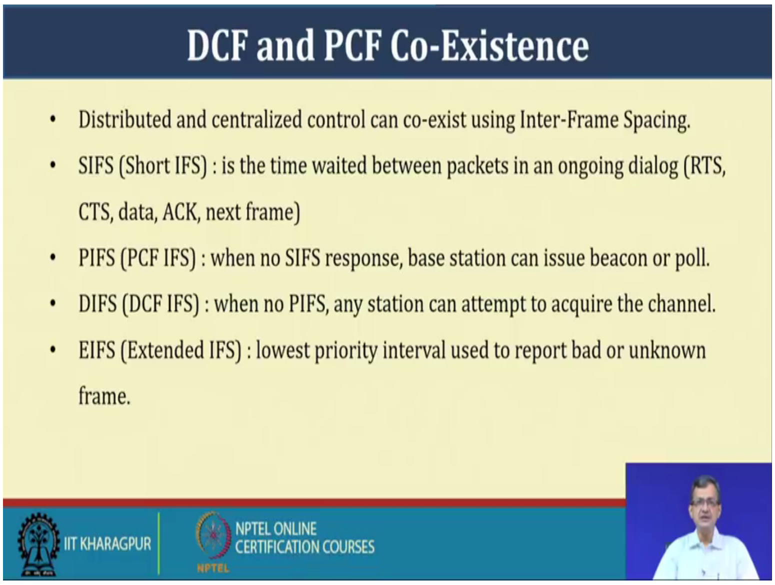

So, DCF, PCF coexistence distributed and centralised control can coexisting using inter frame spacing. Like there are three type of thing one is short IFS is the time waited between the packets of ongoing dialog like RTS, CTS, data, acknowledgement, next frame. So, this is the short IFS; so, some short intestine spacing and PIFS PCF IFS when no SIFS response the base station can issue a beacon or poll alright. So, for that it requires that is the PCF inter frame spacing. There is a DIFS that is DCF IFS when no PIFS any station can attempt to acquire the channel alright.

So, that is a distributed that is DC DCF, IFS and there is a extended IFS or EIFS lowest priority interval used to report bad and unknown frames right. So, that is a extended IFS or EIFS which has a much lower priority and it is primarily to report bad unknown frames. So, these are different inter frame spacing’s which are standardized, which are used for this communication.

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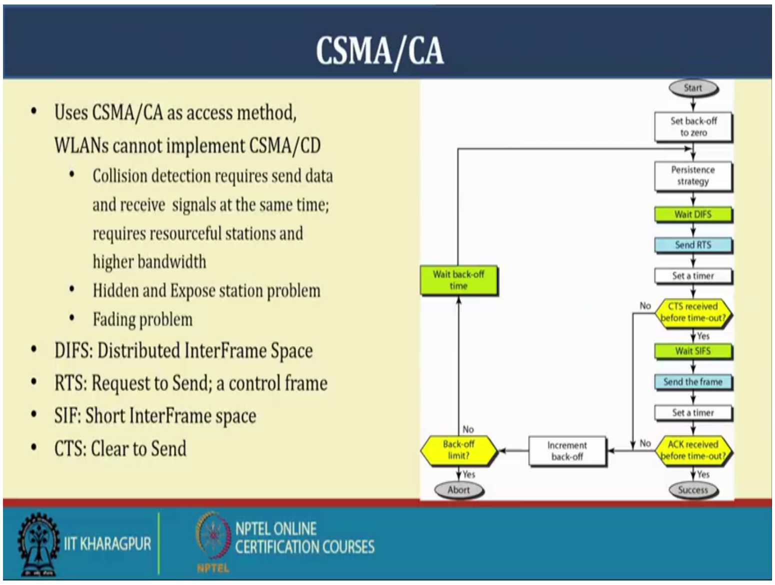

So, we come back to our CSMA CA. So, as we have discussed the WLAN can implementing CSMA CD there are lot of problems in case of WLAN. Collision detection requires send data and receive signal and the same time, required resource poll stations and higher bandwidth which is a difficult for several this type of mobile devices; which are communicating, which are not that resource poll both the in terms of application and other resources. And, there are issues of hidden and expose station problems alright.

So, if there are hidden and expose station problems which are things. And, in number of cases this channels are noisy, sometimes the devices which are communicating are far away which creates a problem of fading. So, the signal fades off or the signal strength comes down which makes this CSMA CD to implement much difficult right. So, as we have discussed we have DIFS: Distributed InterFrame Space, RTS: Request to Send; a control frame, SIF: Short FrameSpace, CTS: Clear to Send; with this thing if we just we look at the things.

So, at the start it is a send set the back off to 0, it sends the channel if it is not free some persistence strategy is deployed. So, wait for DIFS or Distributed InterFrame Space then the sense the. So, it is it waits for a time period and then it sends the RTS or a to request to send to its destination station. After that it after it sends a timer that so that it is looking that within that particular time period, the CTS should be reserved that is the clear to send signals, it should receive from the destination. If it is received yes, then wait for again for a short time period or SIFS and then send the frame.

Again set a timer so, long this acknowledgement is not received and if it is successful if it is acknowledgement received is success. So, sense the channel, wait for a persistence channel deploy a persistence strategy. If it is channel is busy wait for some time, wait for a distributed or DIFS, sends RTS, wait for CTS. If it is received within the time period, wait for a again small periods, set the send the frame it is on the sender to the CTS is received from the destination. And, then it sends the frame sorry, sends the frame set a timer if acknowledge is received is successful right.

On the other hand if you see, if there is no CTS that it does not depend with the things, it may increment the back off, back off time limit, wait for the back off time and go for the things. Again if acknowledgement is also so, if the CTS is not received within the time period or acknowledgement is not received the entrepreneur is goes for a back off time right so this way it goes on running.

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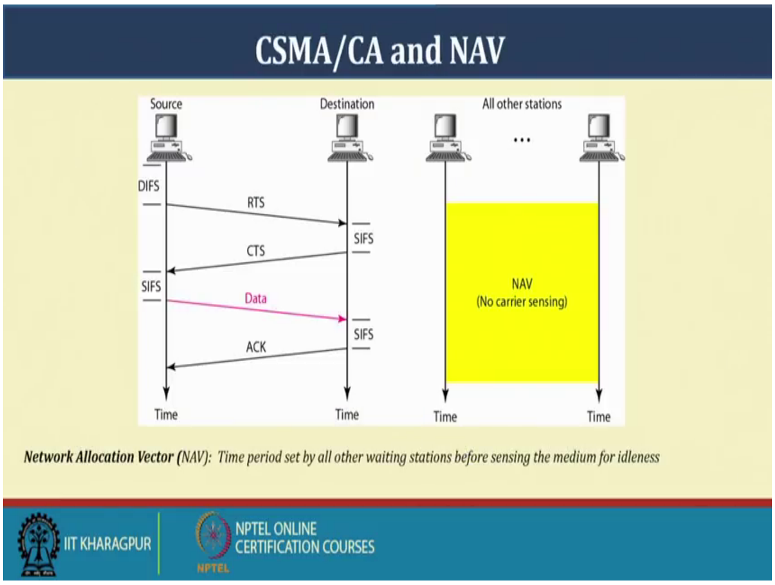

So, just to look at in the other perspective so, the source waiting for a DIFS sends a RTS waiting for a SIFS sends a the destination sends a CTS. And, it again waits for a SIFS sends the data or the information to the destination and this waits again for a SIFS and sends the acknowledgement. So, this is the whole process and there in that this phase there is a NAV or that is Network Allocation Vector which are set by the all the other station within the sensing zone. Like the wait they because this RTS, CTS have that thing that how much time they required to send the data. So, they have they wait for the other things before checking that whether this channel is idle or not. So, this way it handles the problem of this hidden station expose station problem.

Now, whether still collision not cannot happen or type of things, yes it may still happen right. Still happen there are this is a totally mobile, this is a wireless environment there are mobile devices etcetera. There are noisy channels these are channel so, though it may happen. If there is a things either the things will be lost RTS acknowledgement, CTS acknowledgement etcetera will be lost or corrupted. So, it is within the time period it is not reached it all goes for the back off things.

So, with this let us conclude our overview a short discussion of this how this wireless LAN or WLAN have there the phenomena works in the layer 2 or data link layer infrastructure right. Again as I mention that the wireless LAN is a separate topic or subject all together may be it requires couple of courses to handle the all aspects of wireless LAN. So, it is a basic overview of the wireless LAN with respect to the data link layer that what are the basic consideration following the 802 dot 11 standard.

So, we will continue our discussion on this overall networking topic in our subsequent lecture, let us conclude today.

Thank you.