COMPUTER COMMUNICATION NETWORK

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IEEE 802.11 MAC protocol

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Difference from 802.3

- For a wireless channel communication when multiple devices wants to send packets they need to be coordinated so that they do not fall on each other's slot.
- Retaining from transmission by sensing channel condition is possible which is called CSMA
- But CSMA / CD is not possible like Ethernet
- For CSMA / CD both transmission and reception need to be simultaneously
- Because the strength of the received signal is typically very small compared to the strength of the transmitted signal at the 802.11 adapter, it is costly to build hardware that can detect a collision

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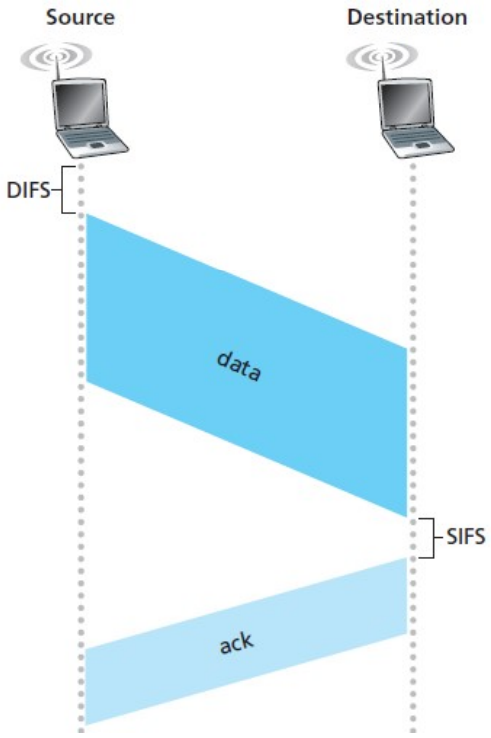
- Even if the adapter could transmit and listen at the same time, the adapter would still not be able to detect all collisions, due to the hidden terminal problem and fading
- Therefore for 802.11 wireless LANs the random access protocol is referred to as CSMA with collision avoidance, or more succinctly as CSMA/CA.
- Basic idea of the MAC protocol is to avoid chance of collision once the packet communication starts between two nodes
- Because of the relatively high bit error rates of wireless channels, 802.11 (unlike Ethernet) uses a link-layer acknowledgment/retransmission (ARQ) scheme

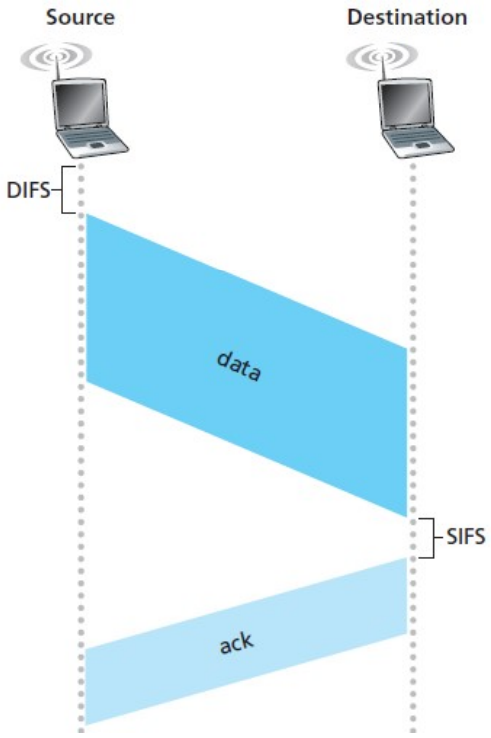
Basic Access Scheme

- If a station has a frame to transmit it will follow 802.11 procedure (CSMA/CA)
  - If initially the station senses the channel idle, it transmits its frame after a short period of time known as the Distributed Inter-frame Space (DIFS)
  - This is to give opportunity to other nodes who have already sensed channel and waiting for transmission
  - Otherwise, the station chooses a random backoff value using binary exponential backoff and counts down this value when the channel is sensed idle.
  - While the channel is sensed busy, the counter value remains frozen. Otherwise many device may land to zero while long transmission is going on



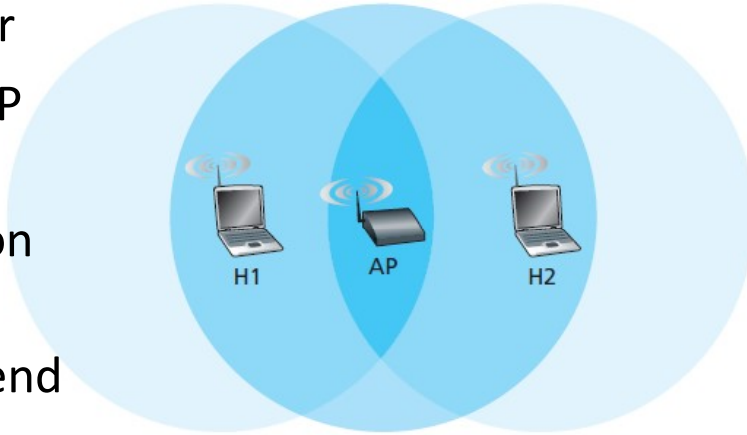
Basic Access Scheme

- As different device will choose different random backoff time none of the two will reach zero at any certain point
- When it reaches zero it also ensures that channel it idle
- When the counter reaches zero the station transmits the entire frame and then waits for an acknowledgment
- If the acknowledgment isn't received, the transmitter reenters the backoff phase If an ACK is received, the transmitter proceed with next frame following the protocol
- Gap between data reception and acknowledgment sending (SIFS) is kept less than DIFS so that no one else get access to the channel in between and data and acknowledgment can be completed continously



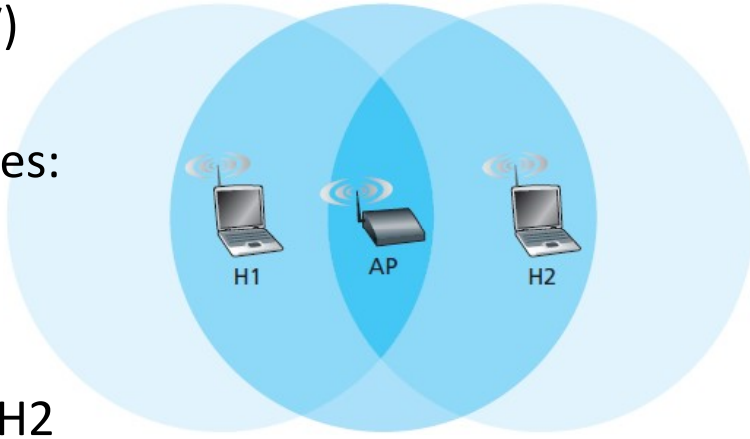
Distributed Coordination Function (DCF)

- CSMA/CA will fail if two nodes are hidden from each other
- H1 may find channel to be idle and start transmitting to AP whereas same thing is done by H2 and they collide at AP
- To avoid such situation 802.11 added two more transaction before the data transmission
- 802.11 protocol introduce two short frames Request to Send (RTS) and Clear to Send (CTS) to reserve access to the channel
- When sender wants to send DATA frame, it first send an RTS frame to the AP, indicating the total time required to transmit the DATA frame and the ACK frame



Distributed Coordination Function (DCF)

- This duration is known as Network Allocation Vector (NAV)
- When the AP receives the RTS frame, it responds by broadcasting a CTS frame. This CTS frame serves 2 purposes:
  - It gives the sender explicit permission to send
  - Instructs the other stations not to send for the reserved duration.
- RTS from H1 will not reach H2 but CTS from AP will reach H2
- H2 will not transmit for the NAV duration mentioned in CTS packet
- Also device surrounding H1 will not take place as they will find the channel as busy



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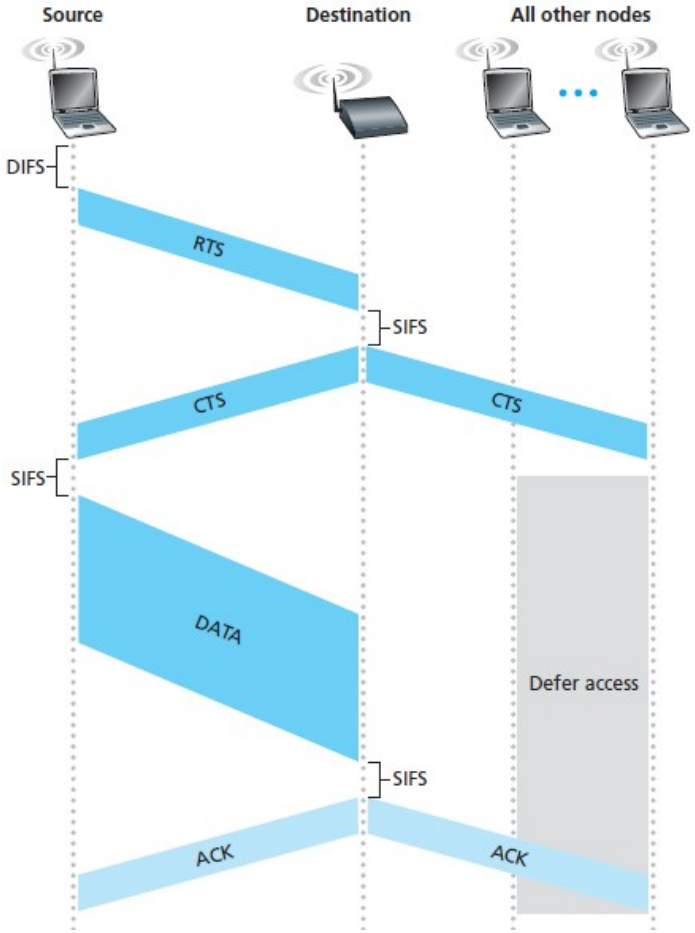

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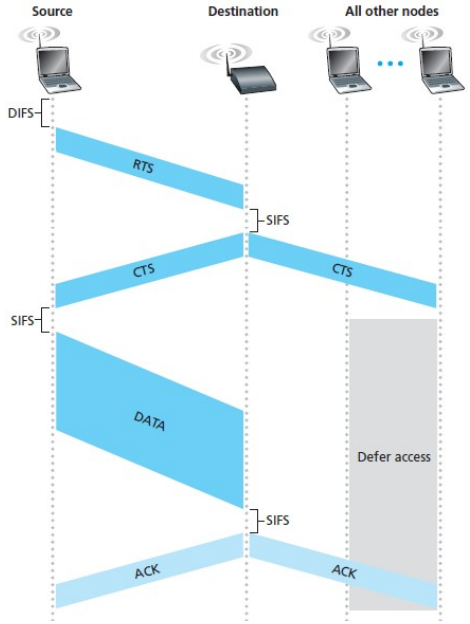
- As after initial DIFS all communication parts will be done with SIFS gap no one else will find channel to be idle and can not start any further communication
- Channel will remain exclusively for sender and receiver till they stop communication.
- When a node sends a RTS some other hidden node also may send RTS frame and they will collide.
- Receiver will not send CTS and hence communication will not start



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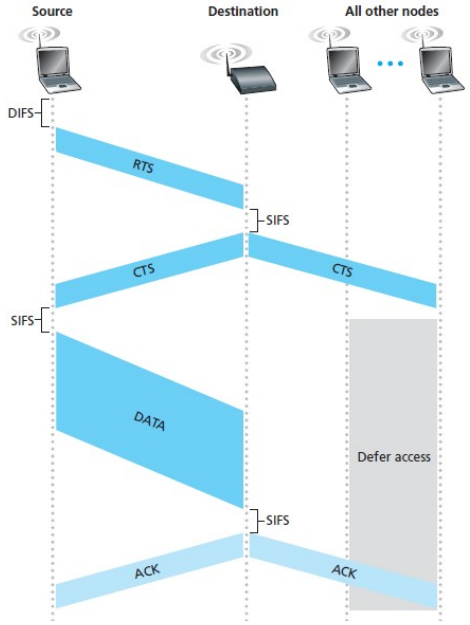
- Once communication starts channel will be exclusively for them
- As RTS and CTS are very small frame it is far better to have collision at RTS than big data packet which improves overall efficiency
- Although it reduces collisions, it also introduces delay and consumes channel resources
- For this reason, the RTS/CTS exchange is only used to reserve the channel for the transmission of a long DATA frame.



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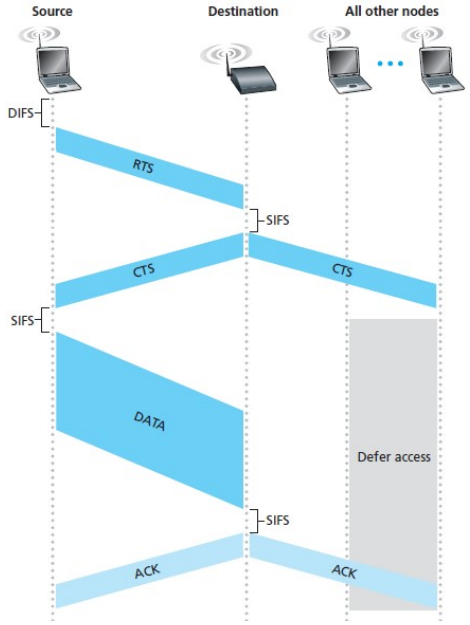
- In practice, each wireless station can set an RTS threshold such that the RTS/CTS sequence is used only when the frame is longer than the threshold.
- For many wireless stations, the default RTS threshold value is larger than the maximum frame length, so the RTS/CTS sequence is skipped for all DATA frames sent



THANK YOU

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