CS 716: Introduction to communication networks

- 13th class; 9th Sept 2011

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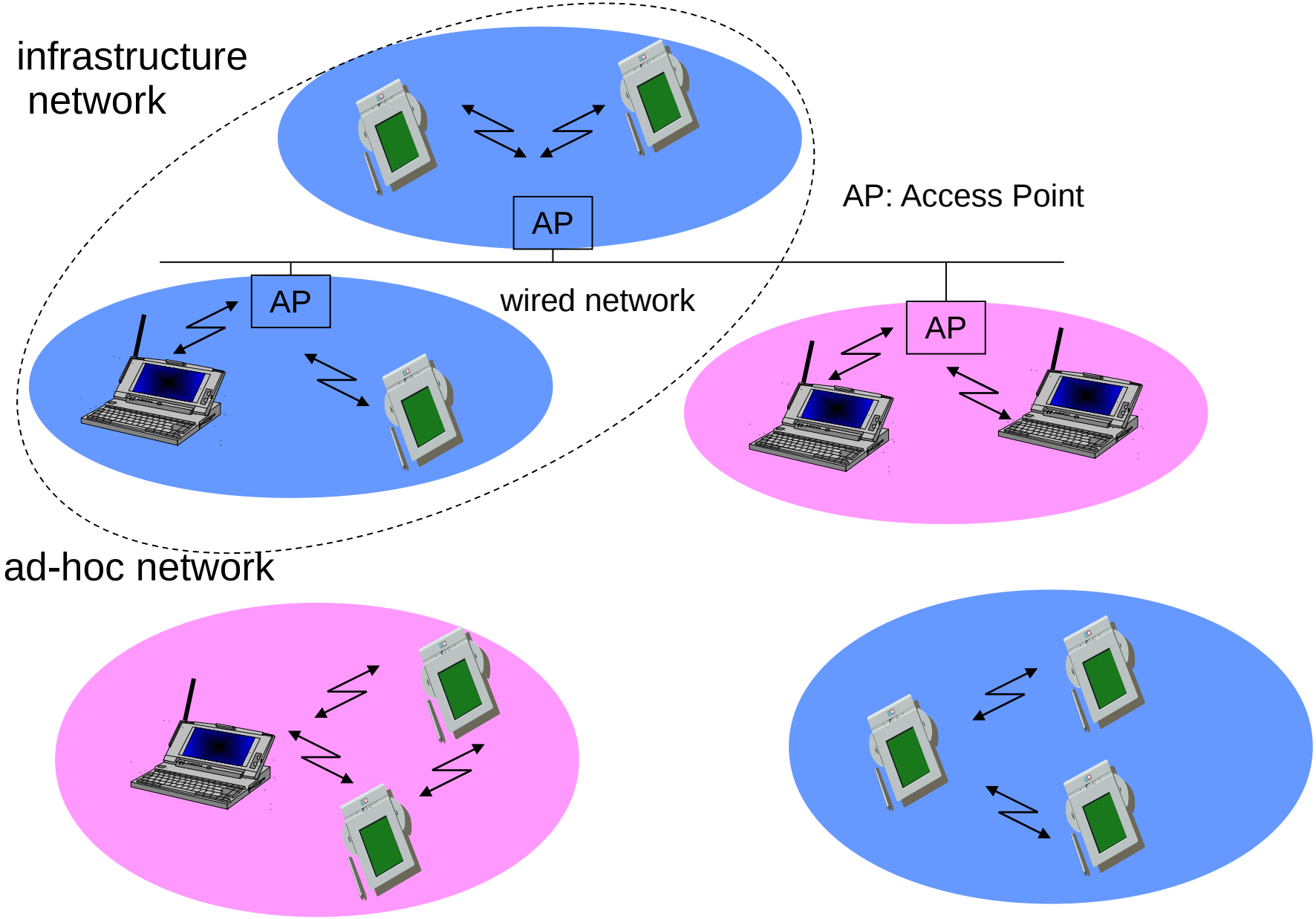
Recap of WiFi so far

- Difference between wired and wireless
- Licensed versus Unlicensed spectrum

- Hidden terminal problem
- CSMA/CA
- RTS-CTS-Data-Ack mechanism
- Binary exponential backoff

Infrastructure and Adhoc Networks



802.11 – Virtual Carrier Sensing

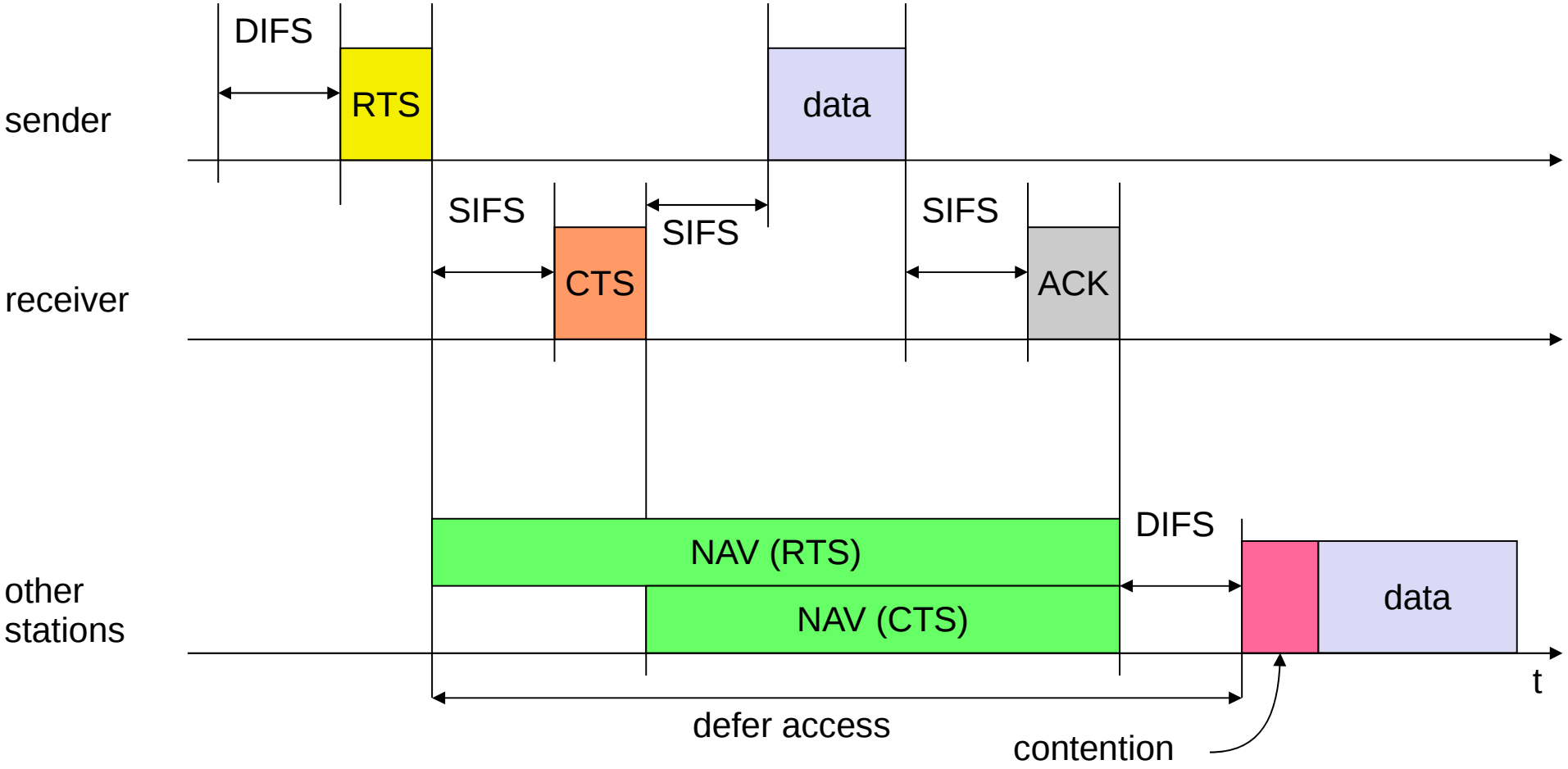
- In IEEE 802.11, carrier sensing is performed
  - at the air interface (*physical carrier sensing*), and
  - at the MAC layer (*virtual carrier sensing*)

- **Physical carrier sensing**
  - detects presence of other users by analyzing all detected packets
  - Detects activity in the channel via relative signal strength from other sources

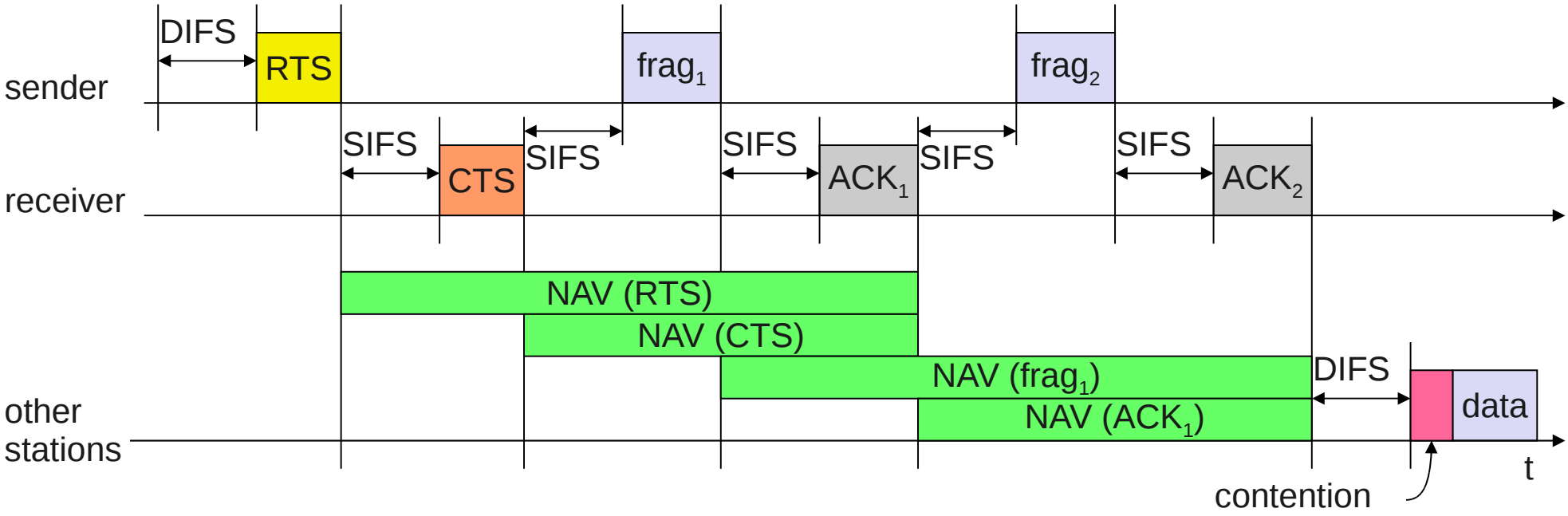
Virtual carrier sensing

- **Virtual carrier sensing** is done by sending MPDU duration information in the header of RTS/CTS and data frames
- Channel is busy if **either** mechanisms indicate it to be
  - Duration field indicates the amount of time (in microseconds) required to complete frame transmission
  - Stations in the BSS use the information in the duration field to adjust their network allocation vector (NAV)

802.11 –RTS/CTS



Thresholds and Fragmentation



- **RTS-Threshold:** Packet Size above which RTS-CTS will be used.
- **Fragmentation-Threshold:** Packet Size above which packets will be sent as fragments.

SIFS/DIFS - Group Activity 2

- What is the need for SIFS?
- What is the need for DIFS?

- Timings:
  - What should be the “slot time”?
  - What should be the SIFS time?
  - What should be the DIFS time?

- Discuss in your groups and as a class.

Key points: SlotTime and SIFS

- SlotTime is: CCATime + RxTxTurnaroundTime + AirPropagationTime + MACProcessingDelay
  - CCATime: Clear Channel Assessment
  - ~ (14+5+1+0) = 20 µs for DSSS PHY
- SIFSTime is: RxRFDelay + RxPLCPDelay + MACProcessingDelay + RxTxTurnaroundTime.
  - RxRFDelay - Time between the end of a symbol at the air interface to the notification to PHY processing module.
  - PLCP: Physical Layer Convergence Protocol.
  - ~ (2+1+1+5) = ~10 µs for DSSS PHY

Key points: SIFS and DIFS

- SIFS (Short Inter Frame Spacing):
  - highest priority, for ACK, CTS, polling response
- DIFS (DCF IFS)
  - lowest priority, for asynchronous data service
  - DIFSTime = SIFSTime + 2xSlotTime
- **Question: Why 2xSlotTime?**

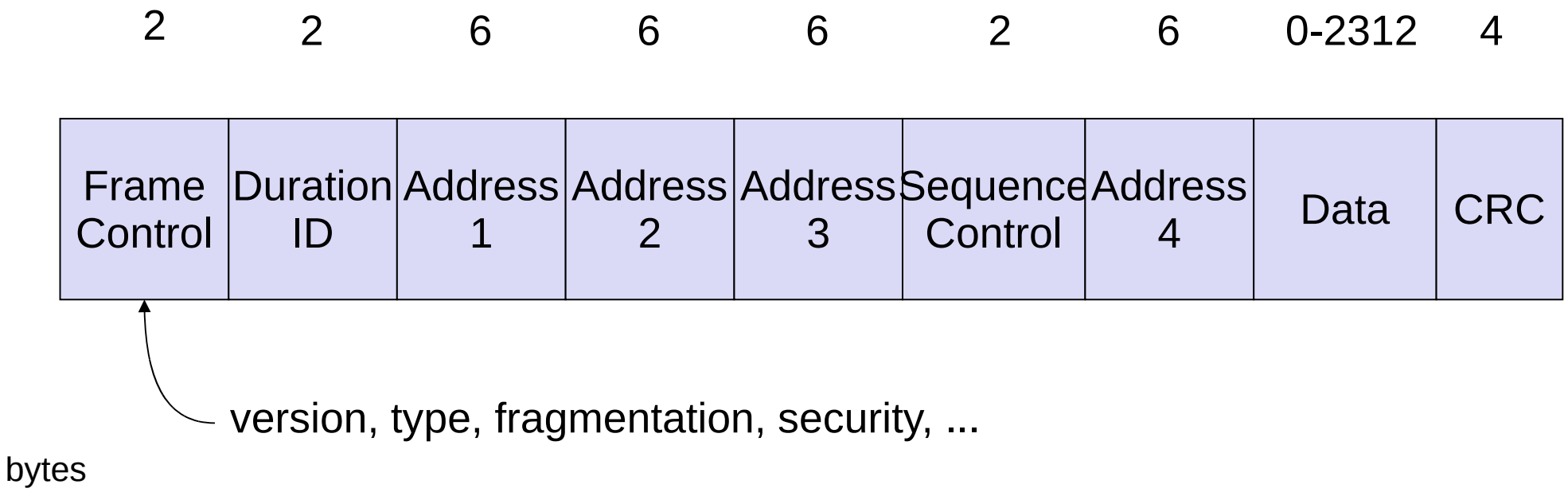
Practice Problem: Do it yourself

- Consider a 802.11 BSS with three stations (ST A1 to STA3), all within range of each other and operating in DCF mode. Data frames of various sizes arrive for transmission at the respective MAC layers as follows:

Time	MSDU (Data bytes)	Source	Destination
t=0	500	STA1	STA3
t + 120μs	1400	STA2	STA1
t + 250μs	500	STA3	STA2

- Compute the earliest time by which all the frames can be delivered to their destinations.
- Assume: 200 bytes may be transmitted in one SlotTime; SlotTime = 20μs; SIFSTime = 10μs; RTS Size =CTS Size = ACK Size = 100bytes; FragmentationThreshold = 2400bytes; RTSThreshold = 1200bytes;

Frame format



MAC address format

scenario	to DS	from DS	address 1	address 2	address 3	address 4
ad-hoc network	0	0	DA	SA	BSSID	-
infrastructure network, from AP	0	1	DA	BSSID	SA	-
infrastructure network, to AP	1	0	BSSID	SA	DA	-
infrastructure network, within DS	1	1	RA	TA	DA	SA

DS: Distribution System
AP: Access Point
DA: Destination Address
SA: Source Address
BSSID: Basic Service Set Identifier
RA: Receiver Address
TA: Transmitter Address

Question: MAC addressing

- Consider the scenario in slide 3.
  - Suppose STA1 wants to transmit a frame to STA2.

  - What is the sequence of frame transmissions?
  - What are the addresses in the various frames?

At the end of this topic

You should be able to do:

- Distinguish between DCF and PCF modes of 802.11.
- Distinguish between physical and virtual carrier sensing.
- Perform binary exponential back-off calculations.
- Perform calculations involving SIFS and DIFS.
- Perform throughput calculations for various modes of 802.11.
- For a given scenario, determine the sequence of frame transmission and the addresses in each frame.
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