Exercise 3

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Q1

- Please briefly describe the learning process that a switch uses to fill its tables.

Switch Learning Process

- Observation of traffic
  - When receiving a frame, location of sender is learned
    - Record that information as sender/location pair in **switch table**
- Forwarding Table: Mapping MAC addresses to ports
  - If it does not know where to forward to, it broadcasts the packet on all ports
    - If it gets an answer on one port, it updates the forwarding table (as when receiving a frame)

MAC address	Interface	TTL
12-34-56-78-9A-BC	1	60
AB-CD-EF-12-34-56	3	40

Q2

- What are the differences between a switch and a router?

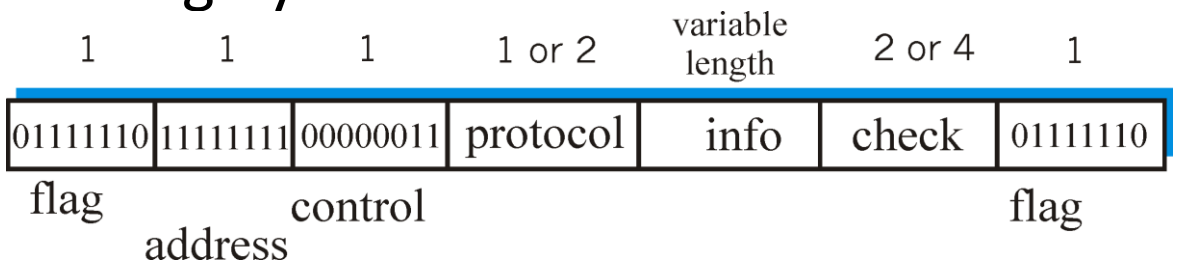
- both store-and-forward devices
  - routers: network layer devices (examine network layer headers)
  - switches are link layer devices
- routers maintain routing tables, implement routing algorithms - not plug and play, but more sophisticated
- switches maintain switch tables, implement filtering, learning algorithms - plug and play, fast

Q3

- What is the byte stuffing in PPP protocol?

- "data transparency" requirement: data field must be allowed to include flag pattern <01111110>
  - Q: is received <01111110> data or flag?
  - Solution: forbid higher layers to use pattern?
    - PPP should be transparent

- Sender: adds ("stuffs") extra < 01111110> byte after each < 01111110> *data* byte
- Receiver:
  - two 01111110 bytes in a row: discard first byte, continue data reception
  - single 01111110: flag byte



Q4

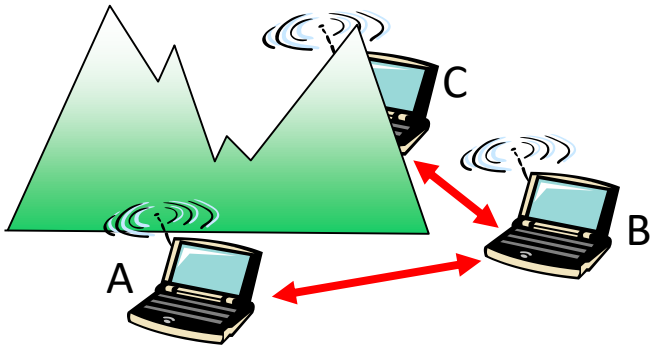
- Please explain the Hidden Terminal Problem

Hidden Terminal Problem

Hidden terminal problem

- B, A hear each other
- B, C hear each other
- A, C can not hear each other

> means A, C unaware of their interference at B



Q5

- Consider the IEEE 802.11 MAC Protocol: How does CSMA/CA tackle the problem of collisions (what steps are taken at the sender and receiver respectively)? What is the idea behind the RTS/CTS concept?

CSMA/CA Collision Avoidance

802.11 sender

1 if sense channel idle for **DIFS** then

transmit entire frame (no CD)

2 if sense channel busy then

start random backoff time

timer counts down while channel idle

transmit when timer expires

if no ACK, increase random backoff interval, repeat 2

802.11 receiver

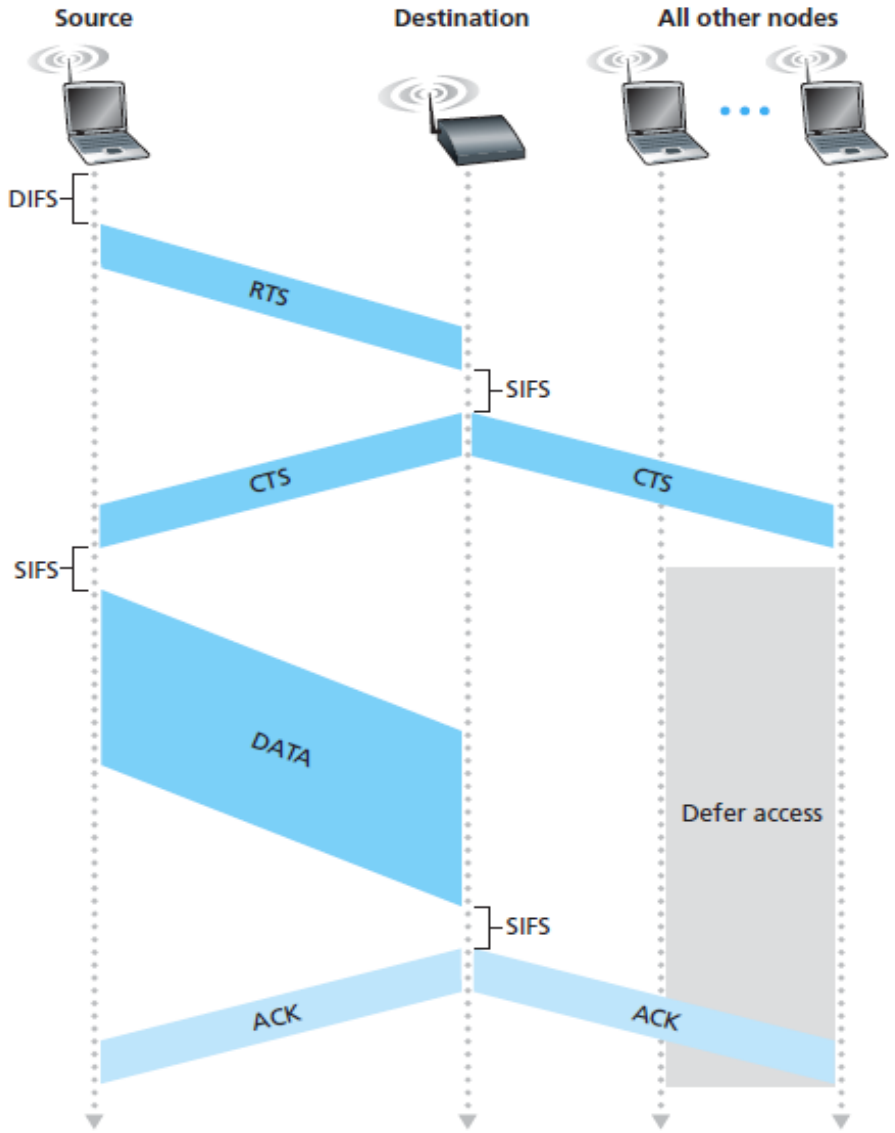
- if frame received OK

return ACK after **SIFS** (ACK needed due to hidden terminal problem)

CSMA/CA RTS/CTS

- Goal: Avoid collsions of large data frames
- Idea:
  - Use reservation of channel instead of random access
  - Allow collisions of reservation packets (small!)
  - Only reservation packets collide, no data frames!
- Solution: Sender transmits Request-To-Send (RTS) to BS, BS broadcasts Clear-To-Send (CTS) as answer (notifies other nodes in range that channel is busy)

Collision Avoidance: RTS-CTS exchange

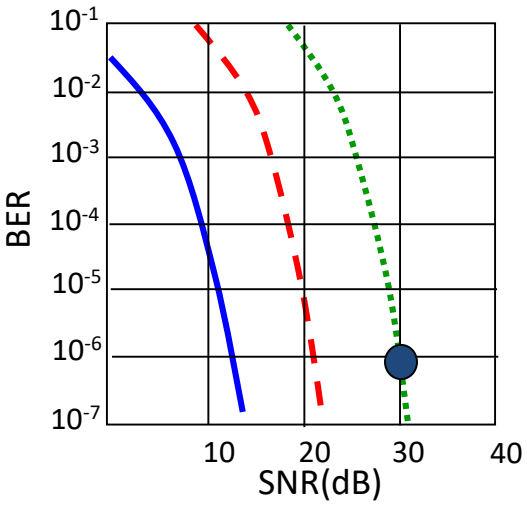


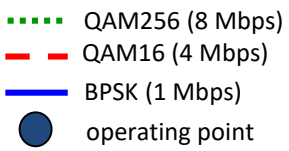
Q6

- One of the advanced capabilities of IEEE802.11 Standard is Rate Adaptation, Please describe this briefly.

Rate Adaptation

- base station, mobile dynamically change transmission rate (physical layer modulation technique) as mobile moves, SNR varies





1. SNR decreases, BER increase as node moves away from base station

2. When BER becomes too high, switch to lower transmission rate but with lower BER