Computer Networks WS20/21

Exercise 8

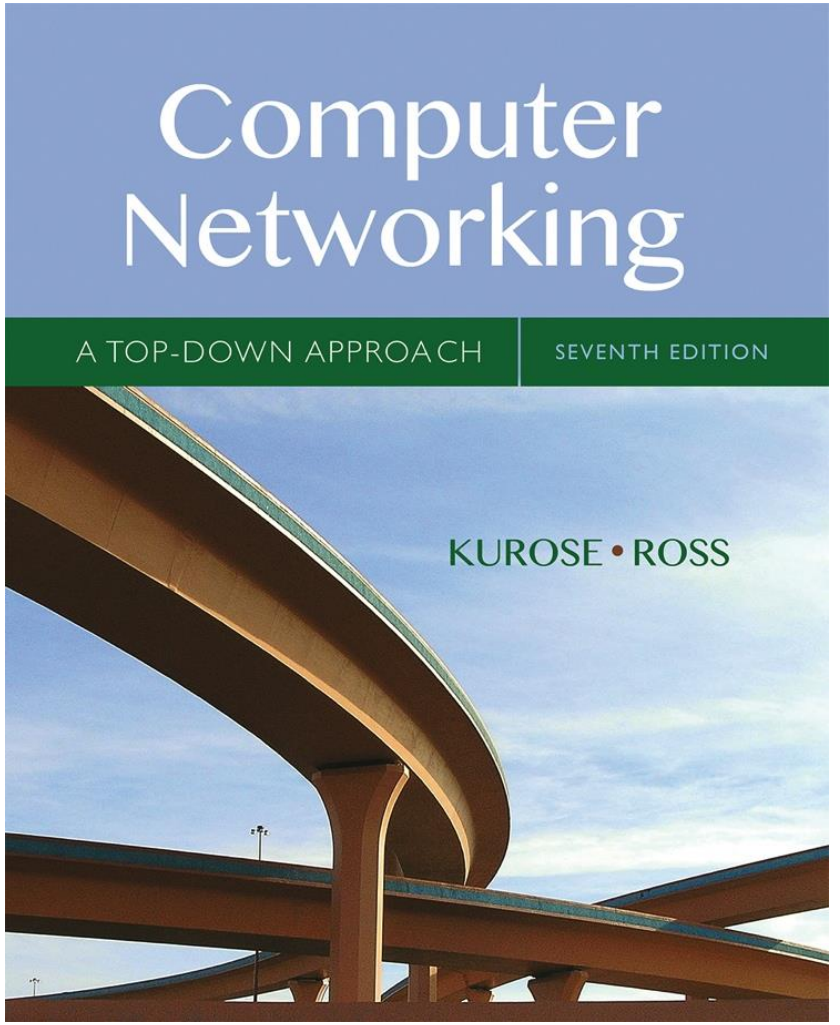
Recommendation

Try to borrow (or buy) this book:

Computer Networking: A Top Down Approach

7th edition. Jim Kurose, Keith Ross, Pearson, 2019.

It is very good to understand!



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?

Switch and router

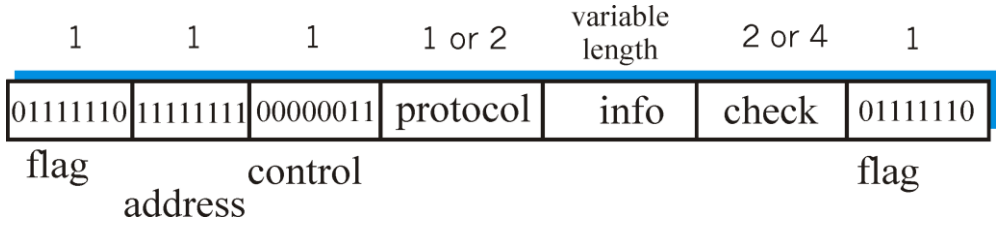
- both store-and-forward devices
  - routers: network layer devices (examine network layer headers)
  - switches are link layer devices
- routers maintain routing tables, implement routing algorithms - not plug and play, but more sophisticated
- switches maintain switch tables, implement filtering, learning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

Q3

- What is the byte stuffing in PPP protocol?

PPP byte stuffing

- Pattern <01111110> used as flag to signal beginning and end of a frame
- “data transparency” requirement: data field also must be allowed to include the pattern <01111110>
  - Q: is received <01111110> data or flag?
  - Solution: Byte stuffing
- Sender: adds (“stuffs”) extra <01111101> byte before each < 01111110> and <01111101> *data* byte
- Receiver: when it receives
  - two 01111101 bytes in a row: discard first byte, continue data reception
  - 01111101 followed by 01111110: discard 01111101, 01111110 is part of the data field, continue data reception
  - single 01111110: flag byte



Q4

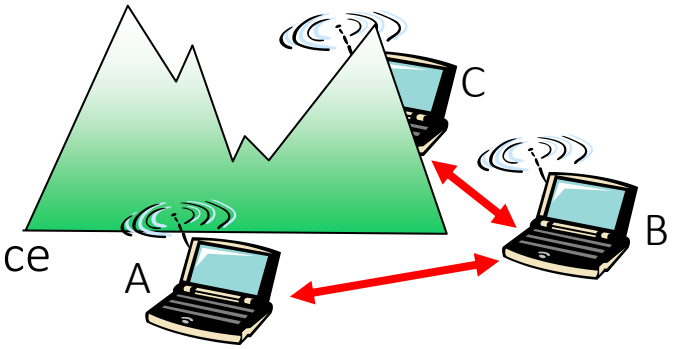
- Please explain the Hidden Terminal Problem

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



- This unawareness can result in both thinking that the channel is free and send data to B, which leads to collisions

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

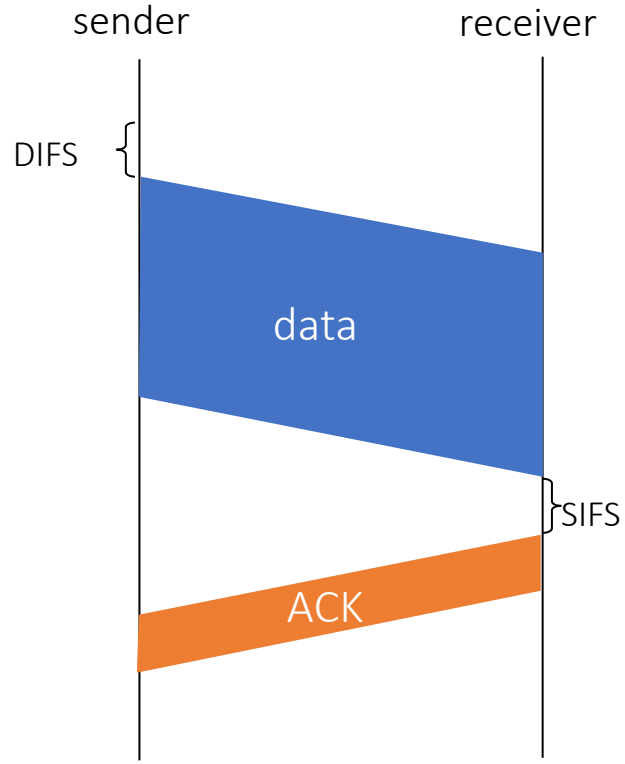
transmit when timer expires

if no ACK, increase random backoff interval, repeat 2

802.11 receiver

- if frame received OK

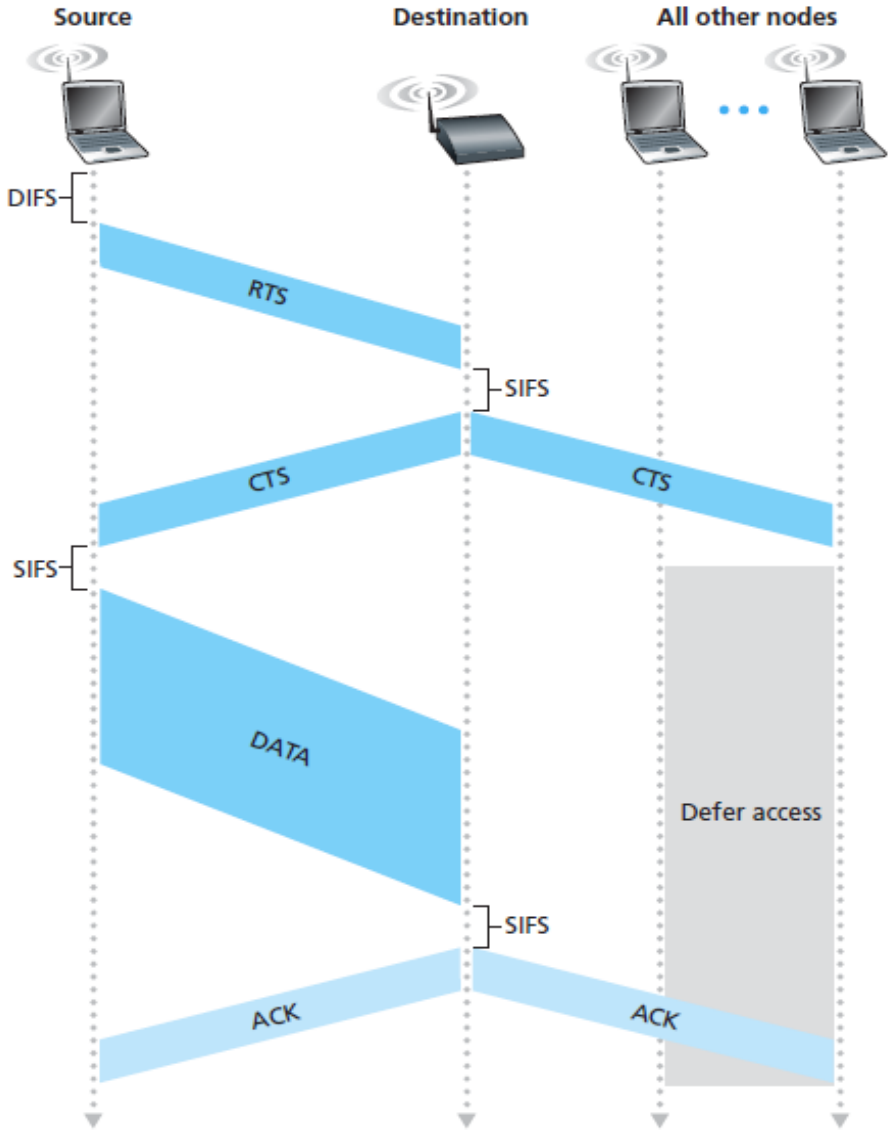
return ACK after **SIFS** (ACK needed due to hidden terminal problem)



CSMA/CA RTS/CTS

- Goal: Avoid collisions 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 base station, base station broadcasts Clear-To-Send (CTS) as answer (notifies other nodes in range that channel is busy)

Collision Avoidance: RTS-CTS exchange



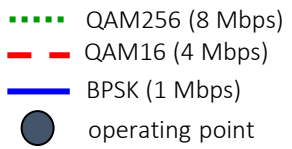
Q6

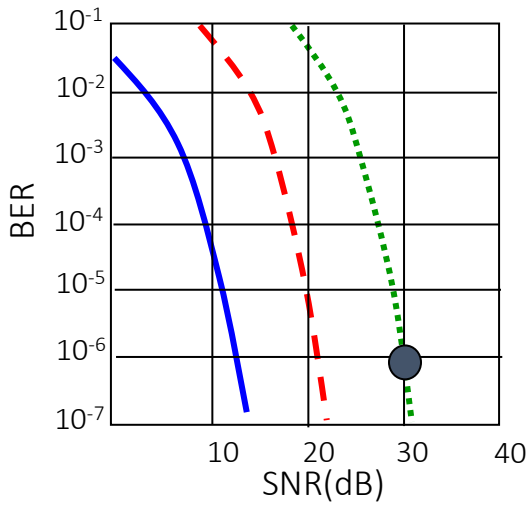
- One of the advanced capabilities of IEEE802.11 Standard is Rate Adaptation, Please describe this briefly.

Rate Adaptation

Rate Adaptation

- base station & mobile node
- dynamically change transmission rate (physical layer modulation technique) as mobile node moves away from or towards base station, 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

Any Questions?

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