Problem 1

How long does a station, s, have to wait in the worst case before it can start transmitting its frame over a LAN that uses the basic bit-map protocol? How about the worst case for binary-countdown protocol?

The worst case is where all stations want to send, s is the lowest-numbered station out of the N stations (who sends last in the cycle), and s becomes ready to send just after the bitmap has passed. Station s must wait $(N-1)\times d$ bit times for the transmission of the other stations before a new contention cycle begins, N bit times for a contention bitmap, and $(N-1)\times d$ bits for transmission of other frames before its frame starts. The total is $N+2(N-1)d$ bit times. This is worse than the delay in steady-state when all stations want to send; each station must then wait $N+(N-1)d$ bit times after its frame for all other stations and a contention bitmap until it begins to send again.

The worst case for binary countdown is similar as above where the contention period is no longer N, but $log(N)$. Thus the worst case is $log(N)+2(N-1)d$ bits.

Problem 2

Sixteen stations, numbered 1 through 16, are contending for the use of a shared channel using the adaptive tree walk protocol. If all the stations whose addresses are prime numbers suddenly become ready at once, how many bit slots are needed to resolve the contention.

Stations 2, 3, 5, 7, 11, and 13 want to send. Eleven slots are needed, with the contents of each slot being as follows:

Slot 1: 2, 3, 5, 7, 11, 13
Slot 2: 2, 3, 5, 7
Slot 3: 2, 3
Slot 4: 2
Slot 5: 3
Slot 6: 5, 7
Slot 7: 5
Slot 8: 7
Slot 9: 11, 13
Slot 10: 11
Slot 11: 13

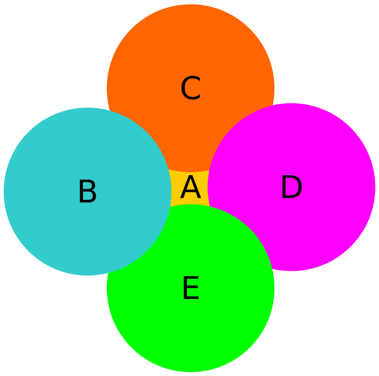
Problem 3

Consider five wireless stations, A, B, C, D, and E. Station A can communicate with all other stations. B can communicate with A, C and E. C can communicate with A, B, and D. D can communicate with A, C and E. E can communicate with A, D, and B. Assume that MACA is used to allow multiple access control.

- When A is sending to B, what other communications are possible?
- When B is sending to A, what other communications are possible?
- When B is sending to C, what other communications are possible?

Problem 3 continued on next page. . .

The relationsihp amongst the stations are the following:



- When A is sending to B, the other 3 stations can all hear A's RTS. Thus CDE will wait until A got B's CTS. When B sends its CTS, C and E can hear the CTS thus they will wait until A finishes sending. Thus when A is sending to B, D can send a frame to A or C or E. This communication from D to A might be damaged or lost, however, since a wireless station can't really send and receive at the same time.
- When B is sending to A, stations C and E can hear B's RTS. They will wait until B gets A's CTS. CDE can all hear A's CTS. Thus they won't transmit during B's frame transmission. So no station can send while B is sending its frame to A.
- When B is sending to C, stations A and E can hear B's RTS. They will wait until B gets the CTS back from C. When C sends its CTS to B, stations A and D can hear the CTS thus won't send during the transmission. However, station E is allowed to send once B receives the CTS from C. It can send to A or B or D. The transmission from E to B might be damaged or lost because B can't send and receive at the same time.

Problem 4

What is the encoding on a classic Ethernet for the bit stream 0001110101 using

- FSK
- ASK

Ethernet uses Manchester encoding in its physical layer which uses Hight to Low to present 1 and Low to High for 0. Thus The encoding for 0001 1101 01 will be LHLHLHHL HLHLLHHL LHHL. As for the modulation using frequency modulation or amplitude modulation, the result is

- FSK
  I will use F and S to represent faster and slower frequencies. The encoding is SFSFSFFS FSFSSFFS SFFS.
- ASK I will use W to present wave and F to present flat line. The encoding is FWFWFWWF WFWF-FWWF FWWF.

Problem 5

A 1-km-long, 10-Mbps CSMA/CD LAN has a propagation speed of 200m/μsec using bitmap approach. Repeaters are not allowed in this system. Data frames are 256 bits long including 32 bits of header, checksum, and other overhead. The first bit slot after a successful transmission is reserved for the receiver to capture the channel in order to send a 32-bit ack frame. What is the effective data rate, excluding overhead, assuming that there are no collisions?

The round-trip propagation time of the cable is 10 sec. A complete transmission has six phases:

1. Transmitter seizes cable (10 sec)
2. Transmit data (25. 6 sec)
3. Delay for last bit to get to the end (5. 0 sec)
4. Receiver seizes cable (10 sec)
5. Acknowledgement sent (3. 2 sec)
6. yeDelay for last bit to get to the end (5. 0 sec)

The sum of these is 58. 8 sec. In this period, 224 data bits are sent, for a rate of about 3.8 Mbps.