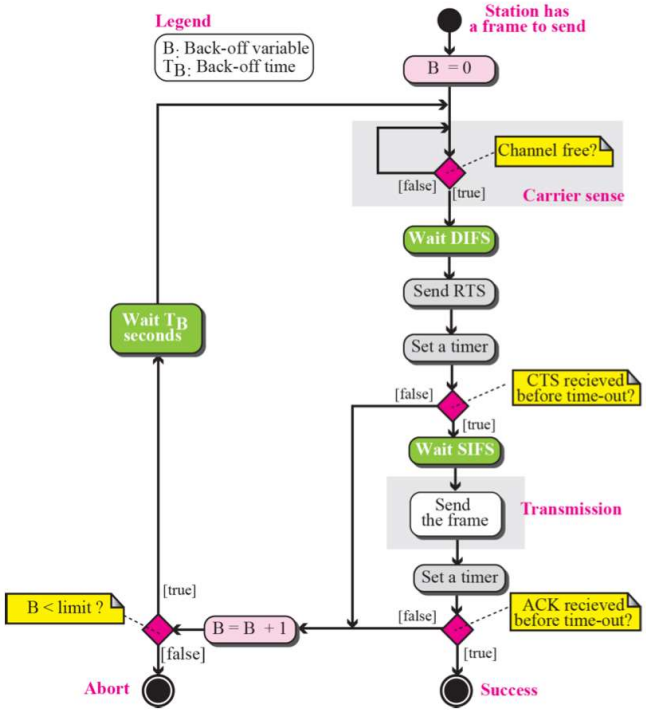
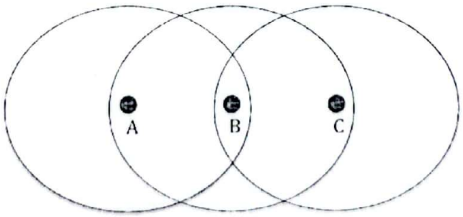
Q1. (6 marks)

1. Represent and briefly describe the algorithm of CSMA/CA for MAC sublayer

CSMA/CA flow diagram



The figure below shows three wireless nodes and their transmission ranges.



2. Use this figure to explain the concept of "hidden node" problem in wireless communication.

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1) Carrier sense mutipk Access / Collision Avoidnce is a Protocol for Carrier transmission in 802.11 networks.

Station ready to send start sensing the medium

If the medium is free for the duration of IFS, the station can start sending

If the medium is busy, the station has to wait for a free IFS then must wait for a random back-off time

If another station occupies the medium during the back off time of the station the back off timer stops.

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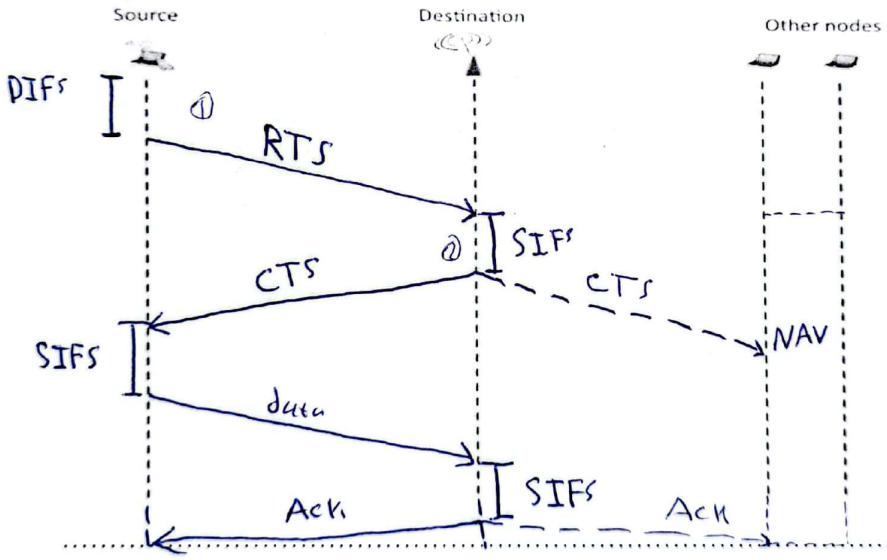
Hidden nodes are senders that cannot sense each other but collide at intended receiver

A, C are hidden nodes when sending to B

3. Use an exchange diagram (as represented below) to explain how CSMA/CA protocol can resolve this problem with the use of RTS/CTS and NAV. For your explanation, assume that the source wants to send a frame to the destination.

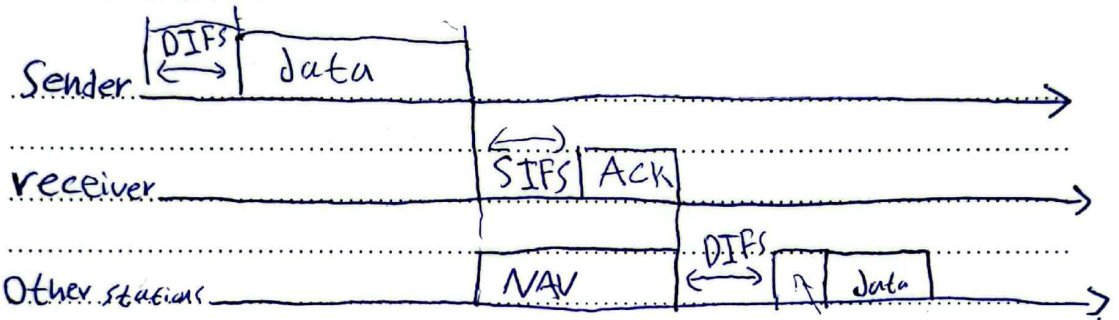


The CTS Frame in CSMA/CA handshake can prevent collision from a hidden station

4. The exchange of RTS/CTS in the CSMA/CA reduces the efficient throughput in the wireless network. Explain how?

The receiving node has to send CTS signal to all the neighbour nodes. So they have to wait before sending the data which causes neighbours to undergo exponential back off algorithm which is increasing wait time and can also result into decrement in throughput.

5. Explain with a diagram how CSMA/CA uses different inter-frame spaces to avoid collusion?



- Station has to wait DIFS before sensing data
- receiver sends Ack after waiting SIFS if the packet received correctly (CRC)
- Automatic retransmission of data packet in case of transmission error

6. Explain the main difference between FDMA and TDMA

In FDMA, the available bandwidth of the common channel is devided into bands that are separated by guard bands

In TDMA, the bandwidth is just one channel that is timeshared between different stations

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Q2. (4 marks)

1. Explain the difference between routing and forwarding processes of packets.

forwarding : move packets from router's input to the appropite router's output

routing : determine the path taken by packets from source host to the destination host

2. Explain how the packet at the input of the router are forwarded to the adequate output using the forwarding table

Each router contains a forwarding table. the forwarding table has a header value feild and an output link field. when a packet arrives at a router it checkes the header value of the router and the associated link to it. And send the packet to the associated output link with that header.

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(4 marks)

Q3.

Consider a machine that has the IP address 192.168.92.10

1. Suppose that we are using class-based addressing. To which class of address belongs this IP address?

Class C

2. If the network is not divided into subnets. What is the network mask in this case?

255.255.255.0

3. If the network administrator had decided to break the network into 8 different subnets, what would the network mask?

1111 1111.1111 1111.1111 1111.1110 0000 = 255.255.255.224

4. How many machines can be connected for every subnet?

$2^5 - 2 = 30$ machines

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Q4. (6 marks)

A.

Consider a wireless network using the CSMA/CA with RTS/CTS mechanism. We suppose that the propagation delay is α, SIFS is α, DIFS is 4α, and RTS and CTS are 6α respectively. α is a constant that is expressed in second.

1. Express using α, the earliest time for the receiver to send the CTS message?

$4\alpha + 6\alpha + \alpha + \alpha = 12\alpha$

2. If the data packet needs 100α to be transmitted, what is the shortest time for the receiver to send the ACK signal?

= DIFS + RTS + SIFS + CTS

$4\alpha + 6\alpha + \alpha + \alpha + 6\alpha + \alpha + \alpha + 100\alpha + \alpha + \alpha = 122\alpha$

FDMA or

3. A TDMA system uses 320 kbps data rate to support 8 users. What is the data rate provided for each user?

Data rate / users = each user

$\frac{320}{8} = 40$ Kbps

B.

Assume we send a file with a sliding window protocol from Riyadh to a host in Jeddah. We do not know exactly all the details of the sliding protocol, but we do know the following:

- The file is composed of n = 10 packets each one of a size L = 104 bits.

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Assume transmission time of Ack is negligible

- The bit rate available for transmission is R = 10^6 bps.
- Assume that the propagation time is equal to T_{pr} sec

1. Assume that the sender uses a window size W = 1 packet. The destination sends one ack for every packet received. What is the minimum time it takes to transmit the file and receive all necessary acknowledgements? (give the expression using T_{pr})

transmission time = $\frac{104}{10^6} = 104 \times 10^{-6}$ s

Prob time to packets = $10 T_{Pr}$

$10 \times (2T_{pr} + 104 \times 10^{-6}) = 20 T_{pr} + 104 \times 10^{-5}$ s

2. Suppose now that the window size W > n packets. What is the minimum time it takes to transmit the file and receive all necessary acknowledgements?

$10 \times 1.04 \times 10^{-6} + 11 T_{pr}$

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IP Address : 192.168.92.10

Class A : 0 - 127
Class B : 128 - 191
Class C : 192 - 223
class D : 224 - 239

(i) Given IP belong to class C

NID = 24 bit
HID = 8 bit

(ii) Network mask : 255.255.255.0
NID

(iii) Break into 8 subnet

# of Bit for subnetting from Host ID = $\lceil \log_2 8 \rceil = 3$

Subnet mask : 255.255.255.224

(iv) 11111111.11111111.11111111.111 00000
NID SID HID
NID

# of machine can be connected in each subnet $= 2^5 - 2 = 30$

↳ two reserved for subnet IP, Broadcast Address