Homework 4 **Zhanghao Wu (516030910593)**
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Chapter6 P5

Solution: Shift the D to the left by three digit to be 11000111010000. According to the process in Figure 1, we have that R is 110.

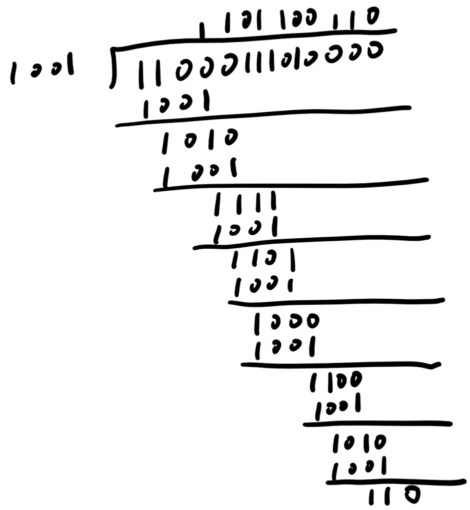

Figure 1: Process of P5

Chapter6 P10

Solution:

a. The average throughput of A is $p_A(1-p_B)$. The total efficiency of the protocol with these two nodes is $p_A(1-p_B)+p_B(1-p_A)$.

b. Node A's average throughput is not twice as large as that of node B, since when $p_A = 2p_B$, the average throughput of A and B are $p_A(1-p_B) = 2p_B(1-p_B)$ and $p_B(1-p_A) = p_B(1-2p_B)$, respectively, and generally the former one is not twice as large as the latter. In order to make that happen we let

$$p_A(1-p_B) = 2p_B(1-p_A) \implies \frac{1}{p_B} = \frac{2}{p_A} - 1$$

c. The average throughput of node A is $2p(1-p)^{N-1}$. The average throughput of any other node is $p(1-2p)(1-p)^{N-2}$.

Chapter6 P13

Solution: In the described situation, each round takes $N(\frac{Q}{R}+d_{poll})$ seconds and at most NQ bits can be transmit in a round. Therefore, the throughput would be $\frac{Q}{\frac{Q}{R}+d_{poll}}$

Chapter6 P21

Solution: Figure 2 below shows the network with numbered interfaces.

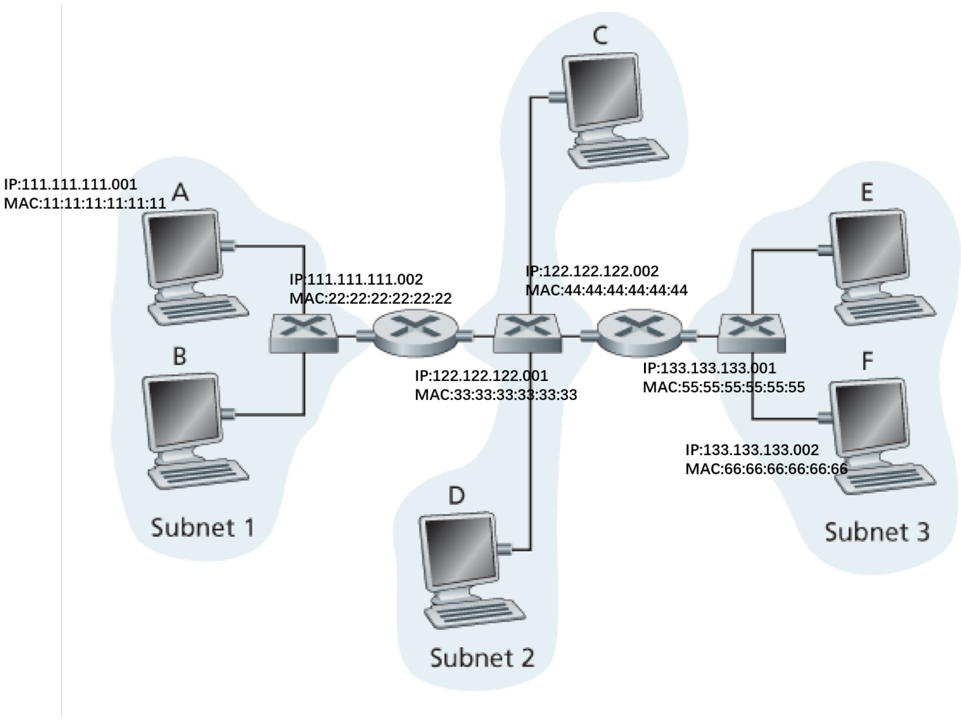

Figure 2: Network with numbered interface

(i) Source MAC: 11:11:11:11:11:11
Destination MAC: 22:22:22:22:22:22
Source IP: 111.111.111.001
Destination IP: 133.133.133.002 (If NAT in right router: 122.122.122.002)

(ii) Source MAC: 33:33:33:33:33:33
Destination MAC: 44:44:44:44:44:44
Source IP: 111.111.111.001 (If NAT in left router: 122.122.122.001)
Destination IP: 133.133.133.002 (If NAT in right router: 122.122.122.002)

(iii) Source MAC: 55:55:55:55:55:55
Destination MAC: 66:66:66:66:66:66
Source IP: 111.111.111.001 (If NAT in left router: 122.122.122.001)
Destination IP: 133.133.133.002

Chapter7 P2

Solution: The code of sender 2 is (1,-1,1,1,1,-1,1,1). When the first two bits sent by sender 2 are -1, the outputs are [-1,1,-1,-1,-1,1,-1,-1] and [-1,1,-1,-1,-1,1,-1,-1].

Chapter7 P7

Solution: The frame size of RTS, CTS and ACK are 20 bytes, 14 bytes and 14 bytes.[1] Therefore, the time required time to transmit the frame and receive the acknowledgment is

$$\begin{aligned}&\text{DIFS} + \frac{20\text{ bytes}}{12/8\text{ MB/s}} + \text{SIFS} + \frac{14\text{ bytes}}{12/8\text{ MB/s}} + \text{SIFS} + \frac{1000+34\text{ bytes}}{12/8\text{ MB/s}} + \text{SIFS} + \frac{14\text{ bytes}}{12/8\text{ MB/s}}\\ &= \text{DIFS} + 3\text{SIFS} + 721.3\ \mu\text{s}\end{aligned}$$

Chapter7 P11

a. No. Because the the distance-vector algorithm is decentralized and needs some time for the reachability information to be spread and to update the forwarding table of the respective routers. During the time the algorithm is updating the tables in routers, some routers may not be able to route packets destined to the mobile user.

b. Yes. When a mobile user just left a foreign network and joined a new foreign network, some routers may still contains the routing entries from the old foreign network but some others contains the routing entries from the new foreign network.

c. The timescale over which other routers in the network will eventually learn the path to the mobile users relies on the number of hops between the router and the border router of the foreign network that contains the mobile user.

Chapter7 P13

For indirect routing, the datagrams need firstly to be forward to the home agent, and from there to the foreign agent, which will increase the end-to-end delays between the source and destination. Also, the datagrams have to be processed at the home agent before the home agent sends them to the foreign agent, which will add processing time into the delay. However, the end-to-end delays for direct routing will be much smaller than indirect routing, since the datagrams do not need to be send to the home agent first. The delay depends on the route from source to the foreign agent.

[1] The size of the control frame is according to https://www.oreilly.com/library/view/80211-wireless-networks/0596100523/ch04.html