1. A group of N stations share a 56-kbps pure ALOHA channel. Each station outputs a 1000-bit frame on average once every 100 sec, even if the previous one has not yet been sent (e.g., the stations can buffer outgoing frames). What is the maximum value of N?

Solution:

With pure ALOHA, the usable bandwidth is 0.184 ×56 kbps = 10.3 kbps. Each station requires 10 bps, so N=10300/10=1030 stations

2. Consider the delay of pure ALOHA versus slotted ALOHA at low load. Which one is less? Explain your answer.

Solution:

With pure ALOHA, transmission can start instantly. At low load, no collisions are expected so the transmission is likely to be successful. With slotted ALOHA, it has to wait for the next slot. This introduces half a slot time of delay.

3. Sixteen stations, numbered 1 through 16, are contending for the use of a shared channel by 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?

Solution:

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

4. Six stations, A through F, communicate using the MACA protocol. Is it possible for two transmissions to take place simultaneously? Explain your answer.

Solution:

Yes. Imagine that they are in a straight line and that each station can reach only its nearest neighbors. Then A can send to B while E is sending to F.

5. Consider building a CSMA/CD network running at 1Gbps over a 1- km cable with no repeaters. The signal speed in the cable is 200,000 km/sec. What is the minimum frame size?

Solution:

t=1km/(200000km/s)=5*10^-6s

2*5*10^-6s * 10^9=10000bits

The minimum frame size is 10000 bits

6. Please show the differences between

(a) The Ethernet CSMA/CD protocol and the 802.11 CSMA/CA protocol

(b) The MACA protocol and the 802.11 CSMA/CA protocol

Solution:

(a) CSMA CD operates by detecting the occurrence of a collision. Once a collision is detected, CSMA CD immediately terminates the transmission so that the transmitter does not have to waste a lot of time in continuing. The last information can be retransmitted. In comparison, CSMA CA does not deal with the recovery after a collision. What it does is to check whether the medium is in use. If it is busy, then the transmitter waits until it is idle before it starts transmitting. This effectively minimizes the possibility of collisions and makes more efficient use of the medium.

Another difference between CSMA CD and CSMA CA is where they are typically used. CSMA CD is used mostly in wired installations because it is possible to detect whether a collision has occurred. With wireless installations, it is not possible for the transmitter to detect whether a collision has occurred or not. That is why wireless installations often use CSMA CA instead of CSMA CD.

(b) RTS/CTS in 802.11 does not help with the exposed terminals problem. So, given the scenario in Figure 4-11(b), MACA protocol will allow simultaneous communication, B to A and C to D, but 802.11 will allow only one of these communications to take place at a time.

7. An unscrupulous host, A, connected to an 802.3 (Ethernet) network biases their implementation of the binary exponential backoff algorithm so they always choose from {0,1} after a collision, in any situation. Another host, B, is trying to send a frame at the same time as A. Assuming A and B collide exactly three times before one of their transmissions succeeds, what are the odds that B sends its frame before A(as opposed to A sending before B)?

Solution:

After i collision, B will next be choosing from {0,1,…,2^i-1}, whereas A will still be choosing from {0,1}. Thus after 3 collisions, the following possibilities exist:

A	B	Winner
0	0	collision
0	1	A
0	⋮	⋮
0	7	A
1	0	B
1	1	collision
1	2	A
1	⋮	⋮
1	7	A

Out of the 16 scenarios, 2 are collisions. Out of the remaining 14, B wins one and A wins the rest. The odds of B sending before A are then 1:13, or 1/14.

8. Consider the following wireless network, where the circles are showing transmission ranges, and the presence of a host (letter) in a particular circle indicates it can hear that transmitter. If hosts A and C are both trying to send to host B will they encounter the hidden or exposed station problems? Does the MACA protocol help in this situation?

Solution:

Host C can hear both A and B, but A cannot hear C. Thus A transmitting to B will encounter C as a hidden station: A may listen, hear nothing and attempt to send to B while C is already sending to B.

MACA does help. In MACA, A and C would first send RTS packets to B to initiate their data transmissions. C can hear A' s transmission and would know to stay quiet if A sends first. If C sends first, while A cannot hear C , A can hear B' s CTS response to C and knows not to attempt sending until that has time to complete. This prevents A from interrupting a C->B transmission.

9. Consider the extended LAN connected using bridges B1 and B2in Fig. 4-41(b). Suppose the hash tables in the two bridges are empty. List all ports on which a packet will be forwarded for the following sequence of data transmissions:

(a) A sends a packet to C.
(b) E sends a packet to F.
(c) F sends a packet to E.
(d) G sends a packet to E.
(e) D sends a packet to A.
(f) B sends a packet to F

Solution:

(a) B1 will forward this packet on ports 2, 3, and 4. B2 will forward it on 1, 2 and 3.
(b) B2 will forward this packet on ports 1, 3, and 4. B1 will forward it on 1, 2 and 3.
(c) B2 will not forward this packet on any of its ports, and B1 will not see it.
(d) B2 will forward this packet on port 2. B1 will not see it.
(e) B2 will forward this packet on port 4 and B1 will forward it on port 1.
(f) B1 will forward this packet on ports 1, 3 and 4. B2 will forward it on port 2.