COMP3234B Computer and Communication Networks

Assignment 4 (8%)

Due by: 23:59 Wednesday May 8, 2024

Total mark is 100.

1. (13 marks) [Parity checks (Learning Outcome 3)]

Suppose the data in a packet, D=1001111010001001010101001110011111001, is to be protected by a two-dimensional parity scheme and an odd parity scheme is being used. What would the parity bits be such that the EDC field in the packet has minimum-length? Refer to pages 9 and 11 of 13_Link_I_COMP3234B_s2024.pdf. Give the answer in the form like the following:

```
10101|1
11110|0
01101|1
-------
00100|0
```

2. (18 marks) [Checksum (Learning Outcome 3)]

Compute the Internet checksum for a 18-byte data chunk containing the following in sequence: (i) 7 bytes of pattern 10101011; (ii) IP address 222.59.6.131; (iii) IP address 115.77.223.54; (iv) 8 bits representing the value of 43; (iv) 2 bytes representing value 0x86DD.

3. (15 marks) [CRC (Learning Outcome 3)]

Consider an 8-bit generator G = 10000111. Calculate the CRC code R given the following values of D:

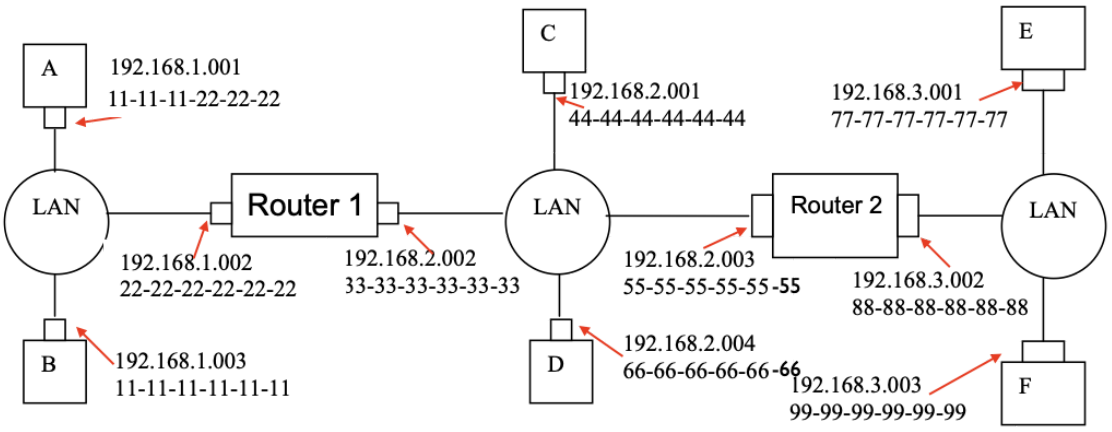
(1) 1100101010

(2) 10100101011111

(3) 1110100001001101

4. (12 marks) [Link-layer addressing (Learning Outcomes 1, 2)]

Consider 3 LANs interconnected by two routers, as shown in the following figure. Consider sending an IP datagram from Host A to Host F. Suppose the ARP table in Host A is empty while the ARP table in any other host/router is up to date. Enumerate the steps involved for sending the IP datagram from A to F. You should specify the interfaces traversed, the source and destination IP addresses contained in each datagram sent, the source and destination MAC addresses contained in each frame sent, and the basic steps of acquiring an IP-address-to-MAC-address mapping (if not known) using ARP. Suppose the IP datagram can always be carried entirely in a frame.



5. (20 marks) [Multiple Access (Learning Outcomes 2, 3)]

Consider two nodes A and B on a shared 25 Mbps CSMA/CD channel. A and B each have two 800-byte frames to send. Ignore propagation delay and assume that any existing transmission from one node can be immediately detected by the other. Suppose both nodes begin transmitting their first frame at time t = 0, and then collision occurs and both nodes back off. The CSMA/CD protocol at A and B follows the following conventions: A (or B) will immediately abort its transmission as soon as a collision is detected. After failure of an attempt to send a frame, A will attempt to retransmit after waiting 396K bit times, where K is chosen each time by exactly following the sequence of {1, 2, 3, 4, 5, . . .}, i.e., K = 1 is used when the first attempt to send frame x (x=1, 2) fails, K = 2 is used when the second attempt to send frame x (x=1, 2) fails, and so on. Similarly, B will attempt to retransmit a frame after waiting 512K bit times, where K is chosen each time by exactly following the sequence of {1, 2, 3, 4, 5, . . .}. A (or B) will attempt to send the second frame 900 bit time after the first frame is successfully sent.

(1) When will B start the successful transmission of its first frame?

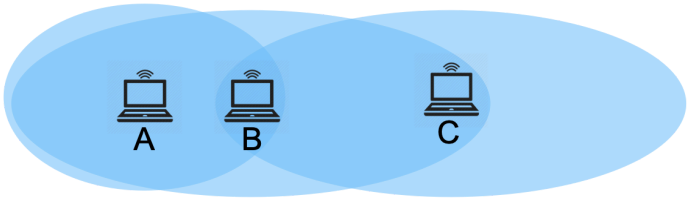
(2) When will A start the successful transmission of its second frame?

(3) Let T be the time when both A and B have completed the successful transmission of their respective two frames. Calculate the efficiency of the CSMA/CD channel during the time interval [0, T].

6. (22 marks) [Wireless Network (Learning Outcomes 2, 3)]

Consider nodes A, B and C on a shared 10Mbps wireless channel operating CSMA/CA, as shown in the figure below. Suppose node A has one 128-byte frame to send to node B, and node C has one 250-byte frame to send to node B. The propagation delay between A and B is 5 bit time; the propagation delay between C and B is 10 bit time. Suppose DIFS time is 50 microseconds and SIFS time is 10 microseconds. The system starts at time 0. Both node A and node C begin transmitting its respective frame to B after one DIFS time, and then collision occurs at B. The CSMA/CA protocol at A and C follows the conventions that: (i) after the (collided) frame transmission, A (or C) will wait for an amount of time equaling propagation delay+SIFS time+ACK transmission time+ propagation delay for ACK; (ii) if no ACK is received by then, A (or C) will attempt to retransmit after sensing the channel idle for DIFS time and then waiting for $512(2^k - 1)$ bit time, where K=1; A (or C) will repeat steps (i)(ii) with K being the number of its retransmissions, until ACK for its frame transmission is successfully received. At B, when it has successfully received a frame, it will send a 100-bit ACK after SIFS time. One frame's transmission is successful if B has received the frame and

sent its ACK out without collision (i.e., without receiving signal of the other frame transmission).



(1) What is the start time (in microseconds) of the successful retransmission from A, after which A successfully transmits its entire frame and receives ACK without collision? What is the start time (in microseconds) of the successful retransmission from C, after which C successfully transmits its entire frame and receives ACK without collision?

(2) Let $\mathbf{T}$ be the time when both A and C have completed the successful transmission of their respective frame and received their respective acknowledgement. Calculate the efficiency of the CSMA/CA channel during the time interval $\mathbf{[0, T]}$.

Submission:

You can write your answers in a word document or other document at your choice. Please convert your answer document to a ***a4-yourstudentid.pdf*** file and submit the PDF file on Moodle before 23:59 Wednesday May 8, 2024:

(1) Login Moodle.
(2) Find “Assignments” in the left column and click “Assignment 4”.
(3) Click “Add submission”, browse your .pdf file and save it. Done.
(4) You will receive an automatic confirmation email, if the submission was successful.
(5) You can “Edit submission” to your already submitted file, but ONLY before the deadline.