Homework 7

Due Date: November 1st 2020 (Friday)

Nathan Cauwet

DU ID: 873271826

Problem 1 – Two Dimensional Parity Scheme

Suppose the information content of a packet is the bit pattern 1110101010101111 and an even parity scheme is being used. What would the value of the checksum field be for the case of a two-dimensional parity scheme? Your answer should be such that a minimum-length checksum field is used.

1	1	1	0	1
1	0	1	0	0
1	0	1	0	0
1	1	1	1	0
0	0	0	1	

Checksum for 1110101010101111 is: 1110110100101001111100001

The parity bits from the row analysis are in red and green is for the column bits (just for readability)

Problem 2 – CRC

Consider the 4-bit generator G = 1001, and suppose that D has the value 111010. What is the value of R?

Using formula R = remainder[(D*2^r)/G]:

1001 XOR 111010000:

1001

0111**1**

1001

0110**0**

1001

0110**0**

1001

01010

1001

001100

1001

0101

R = 0101 (in binary. In decimal it is = 5)

Problem 3 – Carrier Sense and Collision Detection

Suppose nodes A and B are on the same 10 Mbps Ethernet segment, and the propagation delay between the two nodes is 225 bit times. Suppose at time t = 0, B starts to transmit a frame. Suppose A also transmits at some t = x but before completing its transmission it receives bits from B (hence, a collision occurs at A). Assuming node A follows the CSMA/CD protocol, what is the maximum value of x?

(255) bit times / (10Mbps) = 25.5 µs = propagation delay (t_prop)

$$efficiency = \frac{1}{1 + \frac{5 * t\_prop}{t\_trans}}$$

For calculation purposes, assume efficiency is = 0.9 (90% efficiency)

$$t_{trans} + 5 * t_{prop} = \frac{t_{trans}}{0.9} = 1.111 * t_{trans}$$

$$5 * 25.5 * 10^{\wedge}(-6) = 0.111 * t_{trans}$$

Solving this gets us t_{trans} = 1.1475 ms

The maximum value of x = t_{trans} + t_{prop} = **1.173 miliseconds**

Problem 4 – Ethernet Efficiency

Consider a 100 Mbps 100BaseT Ethernet. Suppose the maximum propagation delay between any two nodes on the Ethernet is .512 microseconds. What is the efficiency of this LAN? Assume a frame length of 64 bytes and that there are no repeaters.

$$efficiency = \frac{1}{1 + \frac{5 * t\_prop}{t\_trans}}$$

Max t_prop = 0.512 µs

t_trans = (64 bytes)/(100Mbps) = (64*8 bits)/(100Mbps) = 5.12 µs

$$efficiency = \frac{1}{1 + \frac{5 * 0.512}{5.12}} = \frac{2}{3} = 0.6667$$

Efficiency here is 66.67%

Problem 5 – Link-Layer Services and Ethernet

Section 5.1.1 lists a number of different services that a link layer can potentially provide to the network layer. These services include: a) framing, b) medium access, c) reliable delivery, d) flow control, e) error detection, f) error correction, g) full-duplex and half-duplex. For each of these services, discuss how or how not Ethernet provides the service.

a) framing

lower chance of data loss if using ethernet because of the structure of the frame, however because of the added identifiers in the header the packet is larger

b) medium access

ethernet is necessary for this service whether the LAN is wired or wireless.

c) reliable delivery

since ethernet is a physical connection (connects with a cable) it is less prone to data loss / corruption of packets.

d) flow control

ethernet has a lower latency than other types of connections so it can more accurately control the flow because there isn’t a time offset for when it measures transfer speeds / bandwidth use

e) error detection

No benefit to error detection. Error detection is performed essentially the same way as other transfer methods

f) error correction

I assume it would correct more efficiently but that depends on the hardware of the network. No clear benefit for this service.

g) full-duplex and half-duplex

these services requires ethernet and they are used to avoid collisions. In half duplex only one station can transmit at a time; in full duplex data can be sent and received simultaneously.

Problem 6 – Ethernet Broadcast Packets

List two protocols that require Ethernet to use broadcast frames. Explain.

Two of the protocols that require ethernet to use broadcast frames are ARP and DHCP.

First, the clearest similarity in this context is that ARP and DHCP both rely on network discovery

ARP:

ARP (address resolution protocol) uses broadcast frames to find the MAC addresses and IP addresses of nodes on the network in order to map them (I'd say the best example is 'ip tables')

DHCP: (Dynamic Host Configuration Protocol)

DHCP is used to identify new devices and map them onto the network (get their MAC address and assign an IP address to the client). This happens dynamically (plug-and-play) so the host must use broadcast frames to identify (or "discover") clients that have not been assigned an IP address so that it can send an 'offer' to assign one to the client.

Problem 7 – Multiple Access Protocols

In this chapter, we studied a number of multiple access protocols, including TDMA, CSMA, slotted Aloha, and token passing.

a) *Suppose you were charged with putting together a large LAN to support IP telephony (only) and that multiple users may want to carry on a phone call at the same time. Recall that IP telephony digitizes and packetizes voice at a constant bit rate when a user is making an IP phone call. How well suited are these four protocols for this scenario? Provide a brief (one sentence) explanation of each answer.*

TDMA: works at a constant bitrate with 1 slot per frame so it would work well in this case

CSMA: would not work well because of its tendency to have collisions and it does not work at a constant (or even steady) rate

slotted Aloha: would not work well because of the same reasons as CSMA, mainly the access speed

token passing: would work well but not as well as TDMA. It avoids collisions and comes close to a constant bitrate, however, clients must wait their turn so depending on the number of users it could be impractical.

b) *Now suppose you were charged with putting together a LAN to support the occasional exchange of data between nodes (in this part of this question, there is no voice traffic). That is, any individual node does not have data to send very often. How well suited are these four protocols for this scenario? Provide a brief (one sentence) explanation of each answer*.

TDMA: a constant bitrate is not a valuable factor to this system, therefore TDMA would not be a smart choice in this case.

CSMA: would work well because it's main drawback is that it is prone to collisions, but in this system any individual node does not have to send data often which significantly lowers the risk of collisions.

slotted Aloha: would work well for the same reasons as CSMA. Since no client has to send data often, there would be a slot available right away when it is needed.

token passing: this would not make sense for this system. Data is not being sent often so the token would consistently be passed to clients that have nothing to send.

c) *Now suppose the LAN must support both voice and data and you must choose one of these multiple access strategies in order to support both applications on the same network, with the understanding that voice calls are more important than data. Which would you choose and why? How would voice and data be sent in this scenario? That is, which access protocol would you use, or adapt/modify, and why?*

Personally I would use slotted Aloha. I'd avoid TDMA because a constant bitrate would likely cause transfer issues since voice and data are not transferred at the same rate. CSMA is not logical because of its tendency for collision issues. Token passing would work, but there would most likely be too many clients for it to be practical. With slotted Aloha the voice and data can be organized to use different channels, enabling us to prioritize voice calls and make the bitrate for the calls as consistent as possible; the data would be the lower priority and have a non-consistent bitrate, but with a higher bandwidth (and depending on the kind of data it could potentially be set up to have a higher transfer rate, as long as that would not affect the bitrate/consistency of the voice calls).