CMP-4005 -- Homework 2

Answer the following questions.

1. Let A and B be two stations attempting to transmit on an Ethernet. Each has a steady queue of frames ready to send; A's frames will be numbered A1, A2, and so on, and B's similarly. Let T= 51.2μs be the exponential backoff base unit. Suppose A and B simultaneously attempt to send frame 1, collide, and happen to choose backoff times of 0 x T and 1 x T, respectively, meaning A wins the race and transmits A1 while B waits. At the end of this transmission, B will attempt to retransmit B1 while A will attempt to transmit A2. These first attempts will collide, but now A backs off for either 0 x T or 1 x T, while B backs off for time equal to one of 0 x T, . . ., 3 x T.

   a) Give the probability that A wins this second backoff race immediately after this first collision; that is A's first choice of backoff time k x 51.2 is less that B's.

   b) Suppose A wins this second backoff race. A transmits A3, and when it is finished, A and B collide again as A tries to transmit A4 and B tries once more to transmit B1. Give the probability that A wins this third backoff race immediately after the first collision.

   c) Give a reasonable lower bound for the probability that A wins all the remaining backoff races.

   d) What then happens to the frame B1?

   This scenario is known as the Ethernet capture effect.

2. Suppose Ethernet physical addresses are chosen at random (using true random bits).

   a) What is the probability that on a 1024-host network, two addresses will be the same?

   b) What is the probability that the above event will occur on some one or more of 2^20 networks?

   c) What is the probability that of the 2^30 hosts in all the network of (b), some pair has the same address?

   Hint: Check the Birthday Problem

3. Why might a mesh topology be superior to a base station topology for communications in a natural disaster?

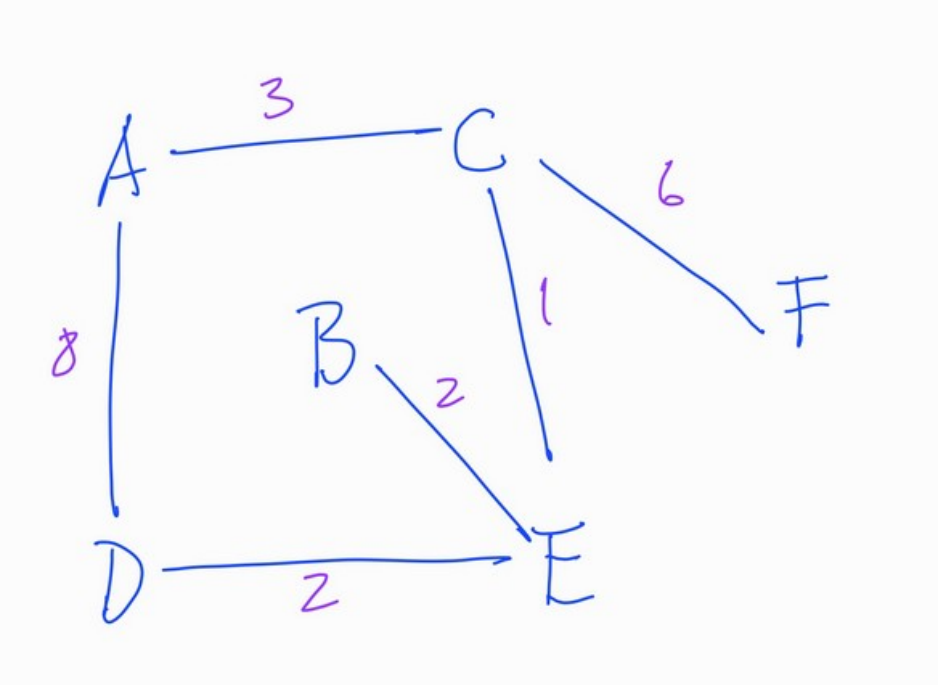
4. Suppose an IP packet is fragmented into 10 fragments, each with a 1% (independent) probability of loss. To a reasonable approximation, this means there is a 10% chance of losing the whole packet due to loss of a fragment. What is the probability of net loss of the whole packet if the packet is transmitted twice

   a) Assuming all fragments received must have been part of the same transmission?

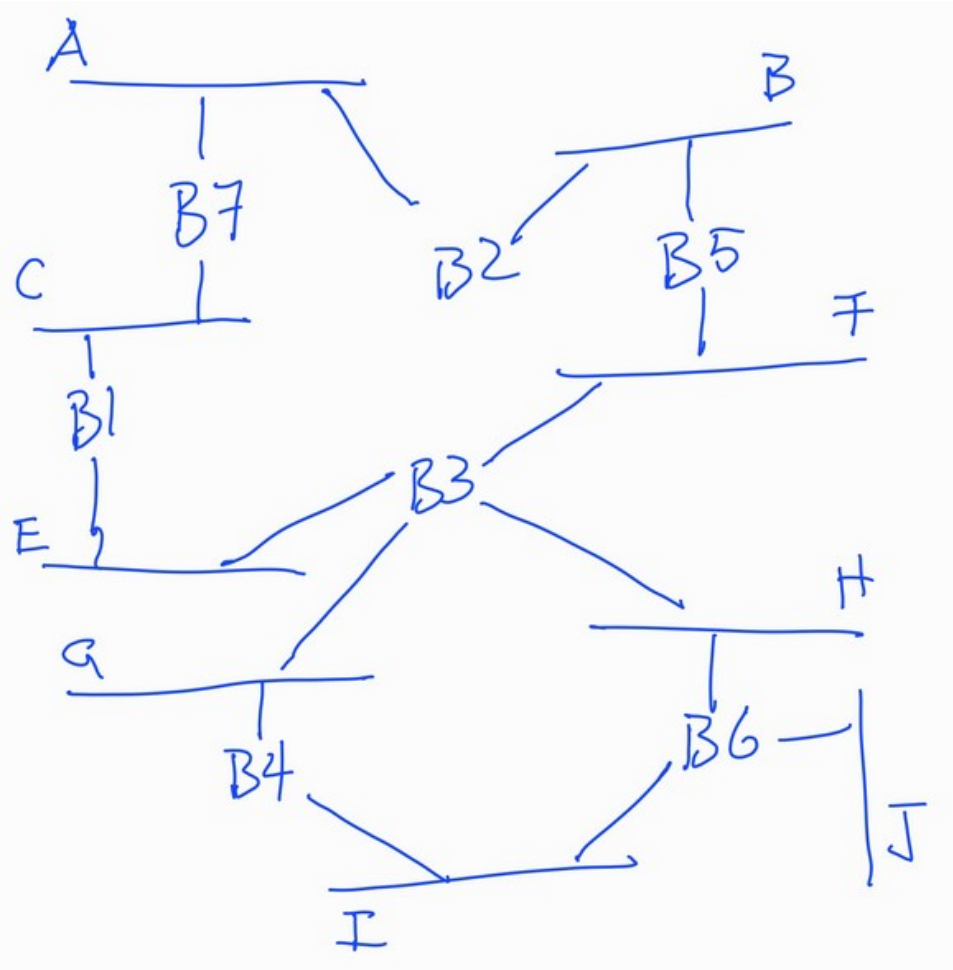
   b) Assuming any given fragment may have been part of either transmission?

   c) Explain how use of the ident field might be applicable here

5. For the network given in the figure below, give the datagram forwarding table for each node. The links are labeled with relative costs; your tables should forward each packet via the lowest-cost path to its destination



6. Given the extended LAN shown in the figure below, indicate which posts are not selected by the spanning tree algorithm



7. Use the Unix tool traceroute (Windows tracert) to determine how many hops it is from your host to other hosts in the internet (usfq.edu.ec, google.com, amazon.com, etc). How many routers do you traverse to get out of your local site? Read the documentation of this tool, and explain how it is implemented.

8. An ISP with a class B address is working with a new company to allocate it a portion of address space based on CIDR. The new company needs IP addresses for machines in three divisions of its corporate network: Engineering, Marketing, and Sales. These divisions plan to grow as follows: Engineering has 5 machines as of the start of year 1 and intends to add 1 machine every week; Marketing will never need more than 16 machines; and Sales needs 1 machine for every two clients. As of the start of year 1, the company has no clients, but the sales model indicates that by the start of year 2, the company will have six clients and each week thereafter gets one new client with probability 60%, loses one client with probability 20%, or maintains the same number with probability 20%.

    a) What address range would be required to support the company's growth plans for at least seven years if marketing uses all 16 of its addresses and the sales and engineering plans behave as expected?

    b) How long would this address assignment last? At the time when the company runs out of address space, how would the addresses be assigned to the three groups?

    c) If CIDR addressing were not available for the 7-year plan, what options would the new company have in terms of getting address space?

Deber 2

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1 a) $A: k_A(2) \rightarrow Es\ 0,1 = \frac{1}{2}$

$B: k_B(2) \rightarrow (0,1,2,3) = \frac{1}{4}$

$k_A(2) < k_B(2)$

$$P(A) = P(k_A(2) < k_B(2))$$

$$= P(k_A(2)=0) \times P(k_B(2)>0) + P(k_A(2)=1) \times P(k_B(2)>1)$$

$$= \frac{1}{2} \times \frac{3}{4} + \frac{1}{2} \times \frac{2}{4}$$

$$= \frac{5}{8}$$

b) $A: k_A(3) \rightarrow 0,1 = \frac{1}{2}$

$B: k_B(3) \rightarrow (1, \cdots, 7) = \frac{1}{8}$

$$P(A) = P(k_A(3) < k_B(3))$$

$$= P(k_A(3)=0) \times P(k_B(3)>0) + P(k_A(3)=1) \times P(k_B(3)>1)$$

$$= \frac{1}{2} \times \frac{7}{8} + \frac{1}{2} \times \frac{6}{8}$$

$$= \frac{13}{16}$$

c) B → 16 veces
k → Entre 0 y $2^n - 1$

$P(A \text{ win on racer}) = \prod_{i=4}^{16} P(A \text{ win } i \mid A \text{ win } i-1)$

$= P(k_A(i)+1 < k_B(i)) \cdot 1$
$+ P(k_A(i)+1 \geq k_B(i)) \cdot P(k_A(i+1) < k_{B(i+1)})$

$\geq P(k_A(i)+1 < k_B(i)) \cdot P(k_A(i+1) < k_B(i+1))$
$+ P(k_A(i)+1) \geq k_B(i) \cdot P(k_A(i+1) < k_B(i+1))$

$= \left(P(k_A(i)+1) < k_B(i)) + P(k_A(i)+1 \geq k_B(i)\right) \times P_{(k_A(i+1) < k_B(i+1))}$
$= P(k_A(i+1) < k_B(i+1)$

- $P(k_A(i) < k_B(i)) = P(k_A(i) = 0) \times P(k_B(i) > 0) + P(k_A(i) = 1) \times P(k_B(i) > 1)$

$= \frac{1}{2} \times \frac{2^i - 1}{2^i} + \frac{1}{2} \times \frac{2^i - 2}{2^i}$

$= \frac{2^{i+1} - 3}{2^{i+1}}$

- Para $10 \leq i \leq 16$
- $P(k_A(i) < k_B(i)) = \frac{1}{2} \times \frac{2^{10} - 1}{2^{10}} + \frac{1}{2} \times \frac{2^{10} - 2}{2^{10}}$

$= \frac{2045}{2048}$

Reemplazando a la formula de arriba

$= \prod_{i=4}^{16} P(A \text{ win } i \mid A \text{ win } i-1) > \prod_{i=4}^{16} P(k_A(i) < k_B(i))$

$= \prod_{i=4}^{9} P(k_4(i) < k_B(i)) \cdot \prod_{i=10}^{16} P(k_A(i) < k_B(i))$

$= \prod_{i=4}^{9} \frac{2^{i+1} - 3}{2^{i+1}} \cdot \prod_{i=10}^{16} \frac{2045}{2048}$

≈ 0.82

d) B_1 se va a caer y va a intentar con B_2

2) a) $\sum_{i=1}^{1023} (1 - i/2^{48}) = (1 - 1/2^{48})(1 - 2/2^{48}) \ldots (1 - 1023/2^{48})$

$= 1 - (1 + 2 + 3 \ldots + 1023)/2^{48}$

$= 1 - (52377)/2^{48}$

$= 1 - (1.8608 \cdot 10^{-9})$

b) Probabilidad:

$20^{20} \approx 1$ millon $\rightarrow 1.77 \cdot 10^{-3}$

c) $\frac{(2^{30})^2}{2 \cdot 2^{48}} = 2^{11}$

3

Una topología de malla puede ser mejor para desastres naturales porque:

- Cada nodo de la topología de malla se apoya con otro nodo
- En una estación base si se daña un nodo, la red deja de funcionar, y en topología de malla no pasa esto.

- En un desastre natural la de malla resiste más al no fallar si un nodo se destruye
- la topología de malla tiene mas alcance lo que hace que sea mejor para evitar terrenos o lugares no tan adecuados y seguros ante desastres.

4) a) Probabilidad:

$$(0,1) \cdot (0,1) = 0,01$$

b)

Se perderían 2 instancias, lo que da:

$$(0.01) \cdot (0.01) = 10^{-4}$$

lo que quedo que si hay 10 fragmentos:

$$10 \cdot 10^{-4} = 0.001 \text{ //}$$

c) El (Ident field) puede ser usado cuando el paquete tiene que ser retransmitido.

Un ejemplo es que cuando el tiempo de la retransmisión fue menor al tiempo de espera del reensamblaje.

5 Diagrama de Reenvio por cada nodo

nodo A:

Destino	NextHop
B	C
C	C
D	C
E	C
F	C

Nodo B

Destino	NextHop
A	E
C	E
D	E
E	E
F	E

Nodo C

Destino	NextHop
A	A
B	E
D	E
E	E
F	F

Nodo D

Destino	NextHop
A	E
B	E
C	E
E	E
F	E

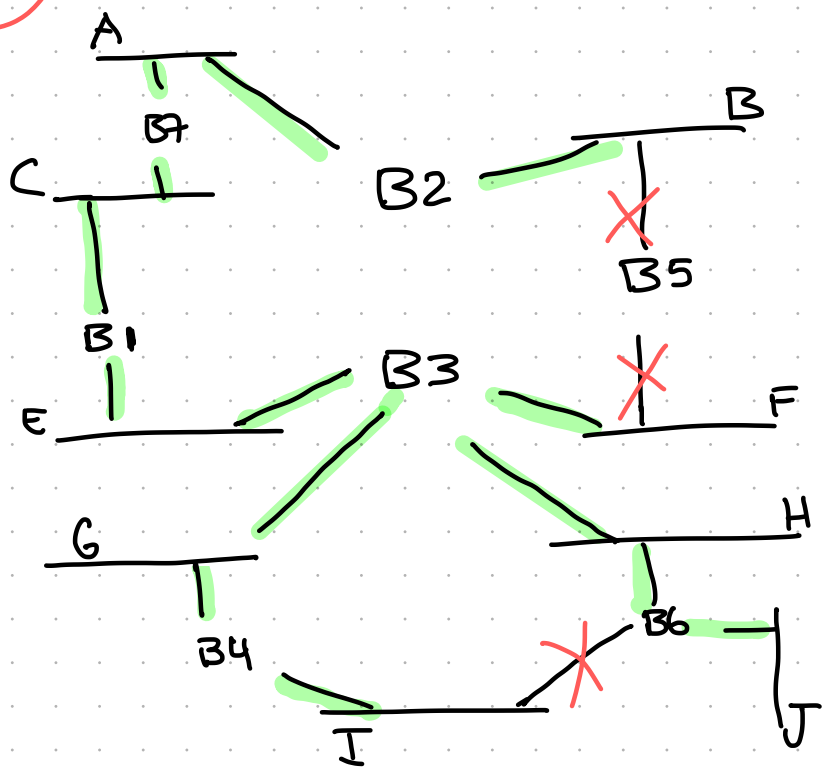
nodo E

Destino	NextHop
A	C
B	B
C	C
D	D
F	C

Nodo F

Destino	NextHop
A	C
B	C
C	C
D	C
E	C

6



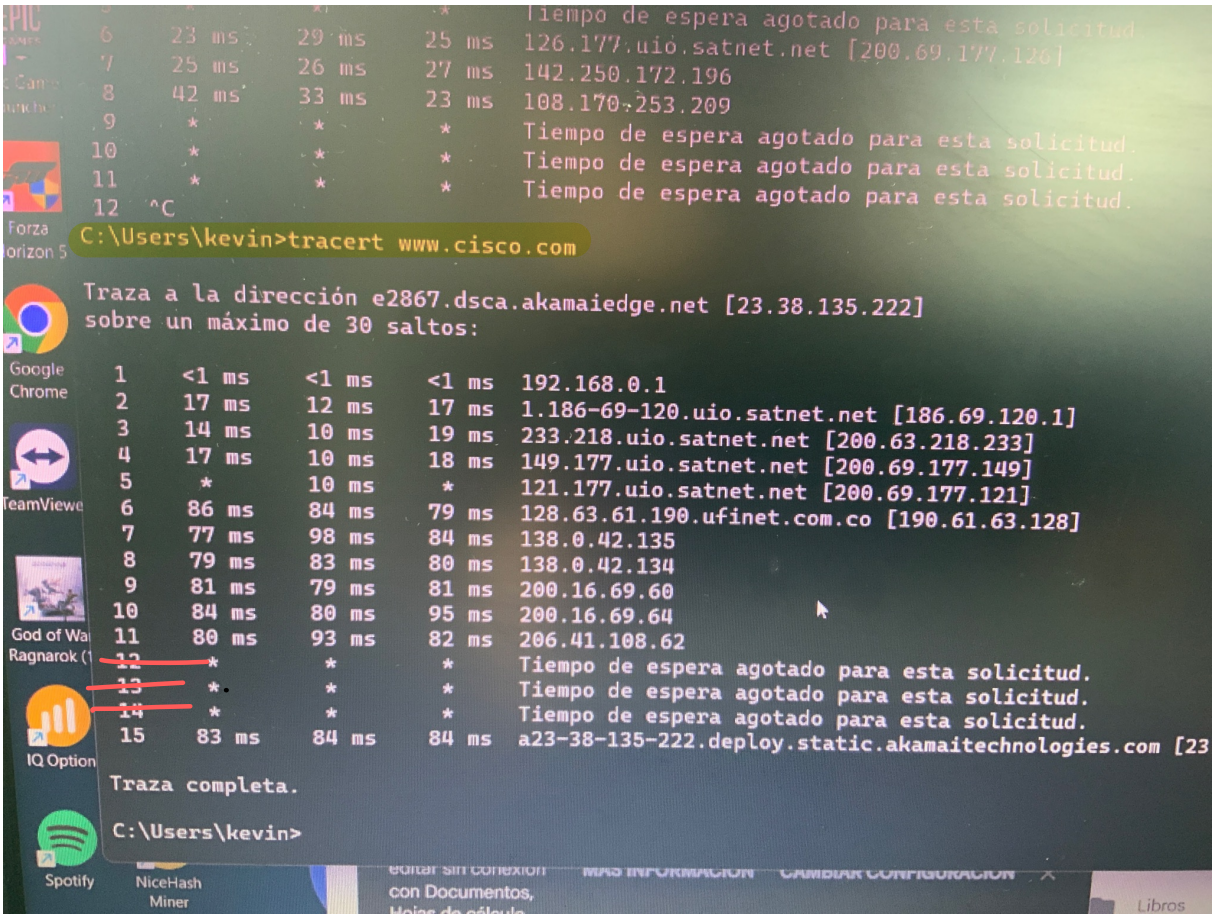
Los puertos que no se utilizan

B - B5

F - B5

I - B6

7



Saltos: 12

Routers: 11

8) a) número computadoras : 1 mar cada semana = 52 en el año

Ventas incremento en Clientes

$= (-1)\cdot 0.20 + (1)\cdot 0.60 + (0)\cdot 0.2$

$= 0.40$

↳ $0.4 \cdot \frac{1}{2} = 0.2$ cada semana aumento en Clientes

↳ $0.2 \cdot 54 = 10.4$ cada año

Para 7 años

$(5 + 52\cdot 7) + (3 + 10.4\cdot 6) + 16 = 450.4 \approx 451$ direcciones

Ing. Ventas Marketing

↳ Necesitamos una tamaño de subnet de $2^9 = 512$

Entonces

necesita un rango de 23 direcciones

para poder sobrellevar 512

b) Para n años

$= (5 + 52\cdot n) + (3 + 10.4\cdot(n-1)) + 16$

$= 13.6 + 62.4(n) = 512$

$n = 7.99$

Marketing = 16

Ing:

$5 + 52(n) = 5 + 52(7.99)$

$= 420.48$

≈ 420

Ventas: $(3 + 10.4\cdot(n-1)$

$= 3 + 10.4(7.99 - 1)$

$= 75.67$

≈ 76

c) B acepta 65 534

C acepta 254

∴ Necesitamos una B o dos de C