

# HW4

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We have discussed with zhengyuz5 and cmo8

## Question 1

*Answer 1:*

Path from \* to X

- A: D, C, Z, X
- B: A, D, C, Z, X
- C: Z, X
- D: C, Z, X
- V: W, Z, X
- W: Z, X
- Y: Z, X
- Z: X

*Answer 2:*

Path from Y to \*

- A: Z, C, D, A
- B: Z, C, D, A, B
- C: Z, C
- D: Z, C, D
- V: Z, C, D, A, V
- X: Z, X
- Z: Z

*Answer 3:*

Path from X to \*

- A: Z, C, D, A
- B: Z, C, D, A, B
- C: Z, C
- D: Z, C, D
- V: Z, C, D, A, V
- Y: Z, Y
- Z: Z

## Question 2

**default means any other conditions**

*Answer 1:*

Match	Action
IP src 10.1.0.2	forward(3)
IP src 10.3.0.5	
IP dest 10.2.0.3	
IP src 10.1.0.2	forward(4)
IP src 10.3.0.5	
IP dest 10.2.0.4	
default	DROP

Answer 2:

Match	Action
IP Proto = 6	forward(3)
IP dest 10.2.0.3	
IP Proto = 6	forward(4)
IP dest 10.2.0.4	
default	DROP

**\* means anything**

Answer 3:

Match	Action
IP dest 10.2.0.4	forward(4)
default	DROP

Answer 4:

Match	Action
IP Proto = 17	forward(3)
IP src 10.3.0.6	
IP dest 10.2.0.3	
default	DROP

## Question 3

Answer:

Type	MAC Src	MAC Dst	IP Src	IP Dst	TCP Src	TCP Dst	TCP Flags	Sender	Link
ARP	0:0:0:0:0:1	FF:FF:FF:FF:FF:FF	10.0.0.2	10.0.0.1	N/A	N/A	N/A	A	A-S
ARP	0:0:0:0:0:1	FF:FF:FF:FF:FF:FF	10.0.0.2	10.0.0.1	N/A	N/A	N/A	S	S-R

Type	MAC Src	MAC Dst	IP Src	IP Dst	TCP Src	TCP Dst	TCP Flags	Sender	Link
ARP	0:0:0:0:0:1	FF:FF:FF:FF:FF:FF	10.0.0.2	10.0.0.1	N/A	N/A	N/A	S	S-B
ARP	0:0:0:0:0:3	0:0:0:0:0:1	10.0.0.1	10.0.0.2	N/A	N/A	N/A	R	R-S
ARP	0:0:0:0:0:3	0:0:0:0:0:1	10.0.0.1	10.0.0.2	N/A	N/A	N/A	S	S-A
ARP	0:0:0:0:0:4	FF:FF:FF:FF:FF:FF	192.168.0.1	192.168.0.2	N/A	N/A	N/A	R	R-C
ARP	0:0:0:0:0:5	0:0:0:0:0:4	192.168.0.2	192.168.0.1	N/A	N/A	N/A	C	C-R
TCP	0:0:0:0:0:1	0:0:0:0:0:3	10.0.0.2	192.168.0.2	54321	1234	SYN	A	A-S
TCP	0:0:0:0:0:1	0:0:0:0:0:3	10.0.0.2	192.168.0.2	54321	1234	SYN	S	S-R
TCP	0:0:0:0:0:4	0:0:0:0:0:5	10.0.0.2	192.168.0.2	54321	1234	SYN	R	R-C
TCP	0:0:0:0:0:5	0:0:0:0:0:4	192.168.0.2	10.0.0.2	1234	54321	SYN ACK	C	C-R
TCP	0:0:0:0:0:3	0:0:0:0:0:1	192.168.0.2	10.0.0.2	1234	54321	SYN ACK	R	R-S
TCP	0:0:0:0:0:3	0:0:0:0:0:1	192.168.0.2	10.0.0.2	1234	54321	SYN ACK	S	S-A
TCP	0:0:0:0:0:1	0:0:0:0:0:3	10.0.0.2	192.168.0.2	54321	1234	ACK	A	A-S
TCP	0:0:0:0:0:1	0:0:0:0:0:3	10.0.0.2	192.168.0.2	54321	1234	ACK	S	S-R
TCP	0:0:0:0:0:4	0:0:0:0:0:5	10.0.0.2	192.168.0.2	54321	1234	ACK	R	R-C

## Question 4

*Question*

*Answer:*

1. (a) There are nine 1 bits so the priority bit should be one. Need to add 1 bit.
- (b) Need to add 9 bits. If we ignore the bit at the right corner, we need to add 8 bits.
- (c)

	col 1	col 2	col 3	col 4	P
row 1	1	1	1	1	0
row 2	0	0	1	1	0
row 3	1	0	0	0	1
row 4	1	0	0	1	0
P	1	1	0	1	1

(d)

Example (4 changes):

	col 1	col 2	col 3	col 4	P
row 1	1	1	1	1	0
row 2	0	0	1	1	0
row 3	1	1	0	0	0
row 4	1	0	0	1	0
P	1	0	0	1	0

Bit at row 3 col 2 flips. This will affect two parity bit so the parity bit for row 1 and parity bit for col 1 also flips. Bit at right corner also needs to flip.

At least we need to change 4 bits.

If we ignore the bit at the left most corner, change for 3 bit may not be detected. And if we don't ignore it, we need at least 4 changes.

(e) Advantage: Most of the time, two-dimensional parity can find the location of the error bit if only 1 bit changes. It's also more stable than one parity bit because we need to change at least 4 bits to make the error unable to be detected.

Disadvantage: It takes more space to store parity bit.

2. (a) 11110011 10001001 00000000 / 1 00100110

step	quotien	remainder
(0)	1	110000010001001000000000
(1)	1	10100100001001000000000
(2)	1	0110111001001000000000
(3)	0	110111001001000000000
(4)	1	1001111100100000000
(5)	1	000110000100000000
(6)	0	00110000100000000
(7)	0	0110000100000000
(8)	0	110000100000000
(9)	1	10100010000000
(10)	1	0110001000000
(11)	0	110001000000
(12)	1	10101110000
(13)	1	0111101000
(14)	0	111101000

step	quotien	remainder
(15)	1	11001110

CRC bit is 11001110.

(b) result is 11110011 10001001 11001110.

(c) Divide the result by 100100110 (generator) using modulo 2 division. The remainder should be zero. If it's not zero, the error will be detected.

(d) 01110011 10001001 11001110 / 1 00100110

step	quotient	remainder
(0)	1	01110100000100111001110
(1)	1	0111101100100111001110
(2)	1	011001010100111001110
(3)	1	01011001100111001110
(4)	1	0010000000111001110
(5)	0	010000000111001110
(6)	1	00010011111001110
(7)	0	0010011111001110
(8)	0	010011111001110
(9)	1	00001100001110
(10)	0	0001100001110
(11)	0	001100001110
(12)	0	01100001110
(13)	1	0101000010
(14)	1	001100100

Remainder is not zero and error will be detected.

3. 7EFF + AAC8 = 1 29C7 --> roll back bit 1

1 + 29C7 + EC05 = 1 15CD --> roll back bit: 1

15CD + 1 = 15CE

not(15CE) = EA31

check sum is EA31

## Question 5

Question

Answer:

1. There are  $2^{i-1}$  slots to choose and when A and B choose the same slot, a collision happens. The probability is  $2^{i-1} * (1/2^{i-1}) * (1/2^{i-1}) = 1/2^{i-1}$
2.  $p_1 = 1 - 1/2^{1-1} = 0$   
 $p_2 = (1/2^{1-1}) * (1 - 1/2^{2-1}) = 1/2$   
 $p_3 = (1/2^{1-1}) * (1/2^{2-1}) * (1 - 1/2^{3-1}) = 3/8$   
 $p_4 = (1/2^{1-1}) * (1/2^{2-1}) * (1/2^{3-1}) * (1 - 1/2^{4-1}) = 7/64$
3. In the 1st round, A and B choose slot 0. Then A successes and B fails. A sends with slot 0 and B sends with slot 1 and collision happens again. Then A will wait from slot 0 to slot 1 and B wait from slot 0 to slot 3.  
 $P = 1/2 * (2/4 + 3/4) = 5/8$

## Question 6

Question

Answer:

1. F-B, E-B, A-C, B-D
2. No. If F and E send RTS to A at the same time, collision will happen.
3. ACK is necessary. It can tell other terminals that A has released the occupied channel and A's channel is now available. Also, packet can lost and ACK is needed to tell the sender that the node have recieved the packet. If the sender haven't recieved packet for some time, it will resend packet.
4. (a)  $P_{Rx} = \frac{G_{Tx}G_{Rx}\lambda^2}{(4\pi d)^2} * P_{Tx}$  So,  $P_{Rx} \propto \frac{1}{d^2}$   
Assume the power at D is P. For  $d = 3$ ,  $SINR = P/(P/9) = 9$   
(b) The noise at D is  $P/18$ .  $SINR = P/(P/18 + P/9) = 6$
5. (a) BPSK should be used. When SNR = 12dB, only BPSK has BER less than  $10^{-6}$   
(b) 1 bit per second. It's 10 Mbps.  
(c)  $P = 1 - (1 - 10^{-8})^{1500*8} = 1.2e - 4$