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Theory Assignment 2

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Question 1

(a)

To compute the checksum, we first add each 16-bit word into

$$1001100110011111 + 1010101010101010 = 1\_0100010001001001$$

Then we add the carry to the result

$$1 + 0100010001001001 = 0100010001001010$$

Finally, we take the one's complement of the result

$$1011101110110101$$

(b)

To check whether the data is corrupted, the receiver needs to compute the checksum of the received data. Similarly, we first add each 16-bit word and add the carry to the result. Then we take the one's complement of the result. If the checksum is 16 1's, the data is not corrupted. Otherwise, the data is corrupted.

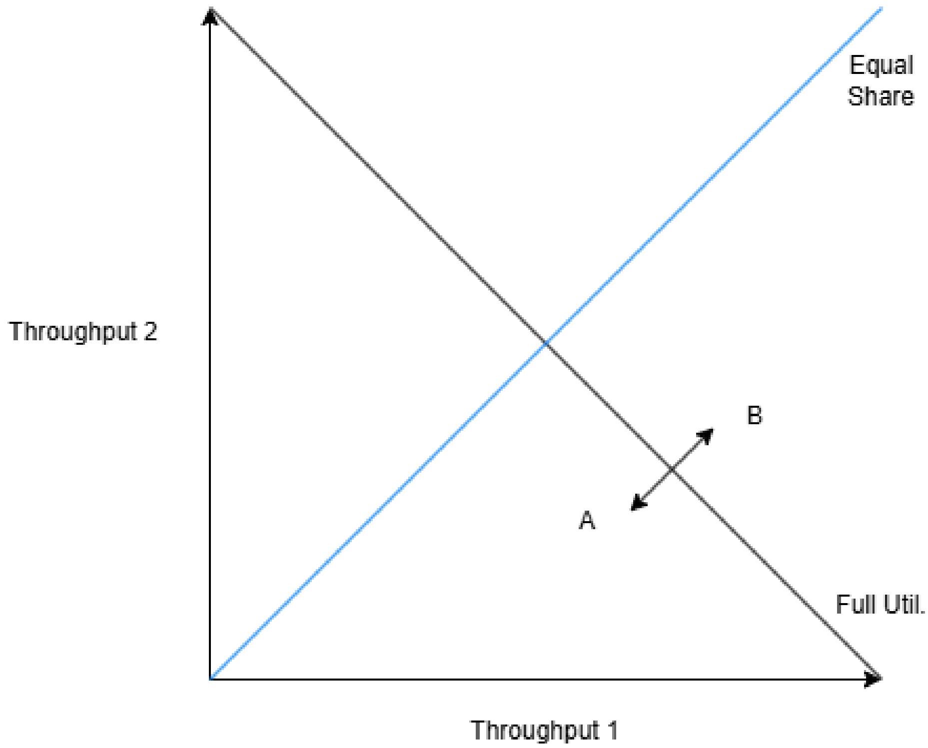
(c)

Even if the checksum detects no errors, the data may still be corrupted. The data may experience multiple bit errors that cancel each other out.
For example, if the data is 0000 0000 0000 0000, then its checksum is 1111 1111 1111 1111. Suppose during transmission, the data and checksum's last bit are both flipped. Then, the data becomes 0000 0000 0000 0001, and its checksum is 1111 1111 1111 1110. However, summation of the data and the checksum is still 1111 1111 1111 1111, which indicates no error.

Question 2

Firstly, go-back-N's receiving window is always one frame, while selective repeat's receiving window can be multiple frames.
Secondly, go-back-N retransmits all frames from the lost frame to the last frame received correctly. In contrast, selective repeat only retransmits the lost frame.
Thirdly, go-back-N has a cumulative acknowledgment, which means the receiver only sends one acknowledgment for the last frame received correctly. In contrast, selective repeat has individual acknowledgment, which means the receiver sends an acknowledgment for each frame received correctly.

Question 3



No, AIAD will not converge to equal share of bandwidth.
As demonstrated in the figure, the two connection will fluctuate between A and B. At point A, the two connections will increase their window size, which reaches point B. At point B, congestion occurs, and the two connections will decrease their window size, which reaches point A. The two connections will keep fluctuating between A and B, and the bandwidth will not be equally shared.

Question 4

(a)

102

(b)

110

(c)

110

(d)

130

(e)

102

(f)

130

Question 5

In congestion avoidance state, the sender increases the window size by 1 MSS every RTT. Thus, the time to increase window size from 8KB to 32KB is

$$\frac{32\text{KB} - 8\text{KB}}{2\text{KB / RTT}} \times 4\text{ms / RTT} = 48\text{ms}$$

Question 6

Prefix	Range of destination host addresses	Number of addresses
1110****	11100100 - 11101111	12
111000**	11100000 - 11100011	4
111111**	11111100 - 11111111	4
Otherwise	00000000 - 11011111 and 11110000 - 11111011	236

Question 7

Since we allocate IP address group with size of power of 2, each of the 4 groups will have 64 addresses.
Thus, the prefixes are

- Organization 1: 128.119.40.0/26
- Organization 2: 128.119.40.64/26
- Organization 3: 128.119.40.128/26
- Organization 4: 128.119.40.192/26

Question 8

a)

Without poisoned reverse, the distance vector table of node Z is

From	Cost To			
	X	Y	Z	W
X	0	3	1	13
Y	3	0	2	10
Z	1	2	0	12

b)

With poisoned reverse, the distance vector table of node Z is

From	Cost To			
	X	Y	Z	W
X	0	∞	1	∞
Y	∞	0	2	10
Z	1	2	0	12

c)

Prefix	Interface
176.14.255.0/25	(Z, Y)
176.14.255.128/25	(Z, Y)

d)

Yes, the two entries can be combined into one entry with prefix

Prefix	Interface
176.14.255.0/24	(Z, Y)

e)

(i)

When cost of link (Y, Z) increases to 100, node Y and Z will update their distance vector table immediately.

(ii)

In the first iteration, node Z discovers that the cost to Y is 100, and updates its distance vector table. The distance vector table of node Z is

From	Cost To			
	X	Y	Z	W
X	0	3	1	13
Y	3	0	2	10
Z	1	4	0	12

(iii)

The updates of the distance vector table of node X and Z can be viewed as

$$D_Z(Y) = \min\{c(Z,X) + D_X(Y), c(Z,Y)\} = \min\{1 + D_X(Y), 100\}$$
$$D_X(Y) = \min\{c(X,Z) + D_Z(Y), c(X,Y)\} = \min\{1 + D_Z(Y), 30\}$$

Thus, the two values' update depends on each other, and the two nodes will keep updating the values until they reach the true cost by adding 1 each iteration.

$$\begin{aligned}
D_Z(Y) &= \min\{1+3, 100\} = 4 \\
D_X(Y) &= \min\{1+4, 30\} = 5 \\
D_Z(Y) &= \min\{1+5, 100\} = 6 \\
D_X(Y) &= \min\{1+6, 30\} = 7 \\
&\vdots \\
D_Z(Y) &= \min\{1+30, 100\} = 31
\end{aligned}$$

Thus, Z needs 27 iterations to discover the true cost (from 4 to 31). This example explains "bad news travels slowly".