**Q.1 (2 marks)** Consider a packet of length 1,000 bytes that propagates over a link of distance 2,500 km with propagation speed of 2,5 · 108 m/s, and transmission rate 2 Mbps?

a. How long does the packet propagation take?

b. Does this propagation delay depend on the packet length?

c. Does this propagation delay depend on the transmission rate?

***Note: Explain your answer in details***

**Answer:**

a. Transmission delay = L/R

= 8 bits/byte \* 1,000 bytes / 2,000,000 bps

= 4\*10-3 s = 4 ms (mili second)

Propagation delay = d/s

= 2,500\*103/ 2,5×108

= 0,01s = 10 ms (mili second)

Therefore, the total time = 4ms + 10 ms = 14 ms

b. No, the delay depend on packet lenght is not true.

c. No, the delay depend on transmission rate is not true.

**Q2. (2 marks)** Suppose a header consists of four 16-bit words: (11111111 11111111, 11111111 00000000, 11110000 11110000, 11000000 11000000). Find the Internet checksum for this code

***Note: Explain your answer in details***

**Answer:**

**b0 = 11111111 11111111 = 216 - 1 = 65535**

**b1 = 11111111 00000000 = 65280**

**b2 = 11110000 11110000 = 61680**

**b3 = 11000000 11000000 = 49344**

**x = b0 + b1 + b2 + b3 modulo 65535 = 241839 modulo 65535 = 45234 b4 = −x modulo 65535 = 20301**

**So the Internet checksum = 01001111 01001101**

**Note: SV có thể làm cách khác nhưng kết quả đúng vẫn được tính điểm Link: https://youtu.be/AtVWnyDDaDI**

**Q3. (2 marks)**

Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates R1 = 500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps.

a. Assuming no other traffic in the network, what is the throughput for the file transfer?

b. Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?

***Note: Explain your answer in details***

**Answer:**

a)

Consider givend data:R1 = 500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps The throughput for the file transfer=min{R1,R2,R3}

=min{500 kbps, 2 Mbps, 1 Mbps}

**=500 kbps**

**So, the throughput for the file transfer=500 kbps**

**b)**

**Consider given data:**

The file size = 4 million bytes

Convert million bytes to bits

= 32,000,000 bits.

From (a), Throughput for the file transfer = 500 Kbps

= 500,000 bps

Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B:

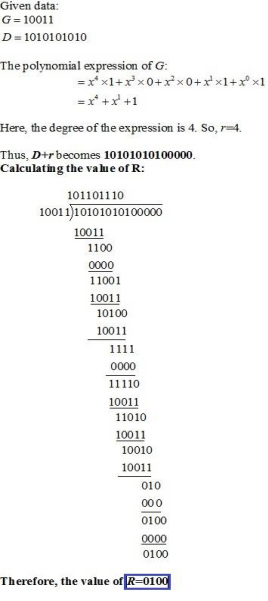
=file size/throughput for the file transfer

=32,000,000 bits/500,000 bps

= **64 seconds**

**Q.4 (2 marks)**

Consider the 7-bit generator, G=10011, and suppose that D has the value 1010101010. What is the value of R? Show your all steps to have result.

***Note: Explain your answer in details*** 



**Answer:**



**So, the 7-bit generator, G=10011, and D has the value 1010101010. then the value of R is 0100.**



**Q.5 (2 marks) A router has the following CIDR entries in its routing table:** *Address/mask Next hop*

135.46.56.0/22 Interface 0

135.46.60.0/22 Interface 1

192.53.40.0/23 Router 1

default Router 2

(a) What does the router do if a packet with an IP address 135.46.63.10 arrives?

Taking the first 22 bits of the above IP address as network address, we have 135.46.60.0.

It matches the network address of 135.46.60.0/22. So, the router will forward the packet to Interface 1.

(b) What does the router do if a packet with an IP address 135.46.57.14 arrives? Taking the first 22 bits of the above IP address as network address, we have 135.46.56.0.

It matches the network address of 135.46.56.0/22. The packet will be forwarded to Interface 0.

**Note:**

- **Students have to follow the steps and complete the tasks in details in order to have the results. If the students only write the result, that is, that result is not marked or recorded.**

- **Students do examination on paper and answer by English**

1. Let g1(x) = x + 1 and let g2(x) = x3 + x2 + 1. Consider the information bits (1,1,0,1,1,1).a. Find the codeword corresponding to these information bits if g1(x) is used as thegenerating polynomial.

100101

Lấy dãy số ban đầu 110111

Bậc cao nhất của g1(x)=1

=> Thêm 1 số 0 vào cuối

ghép lại vô dãy ban đầu 1101110

=> Codeword = Số bđ + r

(Không copy phần này, phần này chỉ đề hiểu)

11 | 1101110



11



00

00

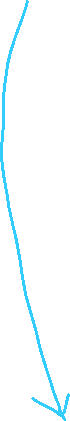


01

00



11



11



01

00



10

11



1



r(x) = 1



q(x) = 100101Codeword = 1101111b. Find the codeword corresponding to these information bits if g2(x) is used as thegenerating polynomial.



100010

1101 | 110111000

1101

0001

0000

0011

0000

0110

0000

1100

1101

0010

0000

010

r(x) = 010

q(x) = 100010Codeword = 110111010

2. Consider the 7-bit generator, G=10111, and suppose that D has the value 1010100001.What is the value of R? Show your all steps to have result.Given data:  
G = 10111  
D = 1010100001  
The polynomial expression of G:  
= x^4 \* 1 + x^3 \* 0 + x^2 \* 1 + x^1 \* 1 + x^0 \*1  
= x^4 + x^2 + x + 1  
Here, the degree of the expression is 4, so r = 4.  
Thus, D+r becomes 10101000010000  
Calculating the value of R:



D+r tương tự câu trên thêm 4 số 0 vào cuối

**Text

Description automatically generated**

3. Consider the following network Figure 1. With the indicated link costs, use Dijkstra’sshortest-path algorithm to compute the shortest path from u to all network nodes. Showhow the algorithm works by computing a table.

(Bài toán tìm đường đi ngắn nhất từ u -> các đỉnh khác)

**Table

Description automatically generated**

Here,  
***S’*** = subset of nodes.  
***c(v)*** = Current path of node v  
***l(v)*** = least cost path of node v  
So, the following are shortest paths from u along with their costs:  
**v:** uv = 2;  
**w:** uxw = 4;  
**x:** ux = 1;

**y:** uxy = 2;  
**z:** uxyz = 5;  
**4. A router has the following CIDR entries in its routing table:  
Address/mask Next hop  
135.46.56.0/22 Interface 0  
135.46.60.0/22 Interface 1  
192.53.40.0/23 Router 1  
default Router 2  
(a) What does the router do if a packet with an IP address 135.46.63.10 arrives?**Ans:(a)135.46.63.10  
Taking the first 22 bits of 135.46.63.10 as network address, we have 135.46.60.0.  
The bit pattern of 135.46.63.10 is 10000111.00101110.00111111.00001010  
When we perform the bit and operation with 22 leading bit 1s and 10 bit 0s, it is  
equivalent of making the last 10 bit zero. We get the following network address bit  
pattern: 10000111.00101110.00111100.00000000. The first two bytes are not changed.  
The 3rd type changes from 63 to 60 while the 4th byte become zero.  
Match with network address in the routing table. The 2rd row matches. The router will  
forward the packet to Interface 1.  
**(b)What does the router do if a packet with an IP address 135.46.57.14 arrives?**Taking the first 22 bits of the above IP address as network address, we have  
135.45.56.0. It matches the network address of the first row. The packet will be  
forwarded to Interface 0.  
**5. Suppose two hosts, A and B, are separated by 30,000 kilometers and are connected by a  
direct link of R = 3 Mbps. Suppose the propagation speed over the link is 2.5 x 10^8  
meters/sec.  
a. Calculate the bandwidth-delay product, R \_ dprop.  
b. Consider sending a file of 900,000 bits from Host A to Host B. Suppose the file is sent  
continuously as one large message. What is the maximum number of bits that will be in the  
link at any given time?**



63 ~~ 00111111

60 ~~ 00111100



57 ~~ 00111001

56 ~~ 00111000



The distance (Distance) between two hosts A and B = 30,000 km  
a)  
The distance (Distance) between two hosts A and B = 30,000 km  
*= 3 x10^7 meters (since 1km = 10^3m).*Trasmission rate(R) of the direct link between A and B = 3Mbps  
*= 3 x 10^6bps(1Mbps = 10^6bps).*

Propagation Speed(S) of the link between A and B  
Calculate the propagation delay:  
*Dprog = Distance/Speed = (3x10^7)/(2.5x10^8) = 0.12sec*Calculate the band-width delay product:  
*R x dprog = 3 x 10^6 x 0.12 = 36 x 10^4 bits.*Therefore, band-with delay product is 360000bits.  
b)  
Size of the file =900000 bits = 9 x10^5 bits.  
Trasmission rate(R) of the direct link between A and B = 3Mbps  
*= 3 x 10^6bps(1Mbps = 10^6bps).*The band-width delay product:  
*R x dprog = 3x10^6 x 0.12 = 36x10^4 bits.*Therefore, the maximum number of bits at a given time will be 360000bits.  
**6. Let g(x)=x3+x+1. Consider the information sequence 1011. Find the codeword corresponding to the  
preceding information sequence. Using polynomial arithmetic we obtain**

The same



**Text, letter

Description automatically generated**



x = L/2

**7. A packet switch receives a packet and determines the outbound link to which the packet should be  
forwarded. When the packet arrives, one other packet is halfway done being transmitted on this  
outbound link and four other packets are waiting to be transmitted. Packets are transmitted in order  
of arrival.  
Suppose all packets are 2,500 bytes and the link rate is 3 Mbps. What is the queuing delay for the  
packet? More generally, what is the queuing delay when all packets have length L, the transmission  
rate is R, x bits of the currently-beingtransmitted packet have been transmitted, and n packets are  
already in the queue?**Consider the given data:  
Packet length = L  
Transmission rate = R  
Currently transmitted packet = x bits  
Waiting queue = n packets  
Formula for Queuing delay:  
Queuing delay = [nL + ( L – x )]/R  
Given data:  
L = 2500 bytes  
R = 3 Mbps = 3 x 10^6 bps.  
x = L/2 = 2500/2 = 1250 bytes.  
n = 4.  
Calculation:

đổi sang bits per second



t: thời gian



R: vận tốc

L: quãng đường



[nL + (L –x)] = (4x2500) + (2500 – 1250)  
= 10000 + 1250  
= 11250 bytes = 90000 bits

1 byte = 8 bits

The queuing delay for packet is calculated as follows:  
Queuing delay = 90000/(3\*10^6)  
= 0,03sec.  
Thus, the queuing delay = 0.03seconds.

**8. Suppose a header consists of four 16-bit words: (11111111 11111111, 11111111 00000000,  
11110000 11110000, 11000000 11000001). Find the Internet checksum for this code**Solution:  
b0 = 11111111 11111111 = 2^16 – 1 = 65535  
b1 = 11111111 00000000 = 65280  
b2 = 11110000 11110000 = 61680  
b3 = 11000000 11000001 = 49345  
x = (b0 + b1 + b2 + b3) mod 65535  
= 241480 mod 65535  
= 45235.  
b4 = -x mod 65535 = 20300  
So the Internet checksum = 0100 1111 0100 1100.  
**9. Consider a packet of length 2,000 bytes that propagates over a link of distance 3,500 km with  
propagation speed of 2,5 · 10^8 m/s, and transmission rate 2 Mbps?  
a. How long does the packet propagation take?**Ans: (3500\*10^3)/(2.5\*10^8) = 0.014s = 14ms.  
**b. Does this propagation delay depend on the packet length?**=> No

= d/s (Note: Nhớ đổi đơn vị)



-45235 / 65535 = -1 dư 20300

b cuối cùng = -x module cho tổng

checksum = đổi sang nhị phân của b cuối cùng



x = tổng đem module cho b0



**c. Does this propagation delay depend on the transmission rate?**=> No.  
**10. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links,  
of rates R1 = 250 kbps, R2 = 3 Mbps, and R3 = 2 Mbps.  
a. Assuming no other traffic in the network, what is the throughput for the file transfer?  
b. Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it  
take to transfer the file to Host B?**a) Consider given data:  
R1 = 250kbps, R2 = 3Mbps, R3 = 2Mbps  
The throughput for the file transfer = min{R1,R2,R3}  
= min{250 kbps, 3 Mbps, 2Mbps}  
= 250 kbps  
So, the throughput for the file transfer = 250 kbps.  
b. Consider given data:  
The file size = 4million bytes  
Convert million bytes to bits  
= 32000000 bits.  
From (a), Throughput for the file transfer = 250 kbps = 250000 bps  
Diving the file size by the throughput, roughly how long will it take to transfer the file to Host B:  
= file size/throughput for the file transfer  
=32000000 bits/250000bps  
= 128 seconds.

