Beijing-Dublin International College

SEMESTER 2 FINAL EXAMINATION - 2017

School of Computer Science

COMP2001J
Computer Networks

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Time Allowed: 120 minutes

Instructions for Candidates

The exam is structured into 6 Questions – One to Six. All questions carry 25 marks.

Students **must** answer Question One

The **Three** best scoring questions from Question Two to Six will be used for the final grade.

Question One (25) + 3 x Question Two to Six (75) = 100.

BJUT Student ID: _____ **UCD Student ID: _____**

I have read and clearly understand the Examination Rules of both Beijing University of Technology and University College Dublin. I am aware of the Punishment for Violating the Rules of Beijing University of Technology and/or University College Dublin. I hereby promise to abide by the relevant rules and regulations by not giving or receiving any help during the exam. If caught violating the rules, I accept the punishment thereof.

Honesty Pledge：_____ (Signature)

Instructions for Invigilators

Non-programmable calculators are permitted.

Question One:

a) The computer networking stack is broken into multiple layers. In your own opinion what is the purpose of using the layered stack? In general, how are the different network functionalities implemented using the network stack?

[5 marks]

b) Worldwide networking with the Internet allows computers from all over the world communicate with each other. This is achieved using vast amounts of interconnected autonomous networks. Why is the world broken into these separate networks? Would it make sense to have one large network that all computers are connected to? Make reference to practical problems, but also specific problems that may be seen by the MAC layer if the world was one very large single LAN type network.

[5 marks]

c) Choosing the packet length for a link transmission is important for efficiency.
Explain in your own words the tradeoff that exists with the length of the data in the packet (*l*), and the length of the header (*l'*).
Below is a formula to work out the optimal length (l_{opt}) for a packet for a link with bit errors:

$$l_{opt} + l' = \sqrt{l' / p_b}$$

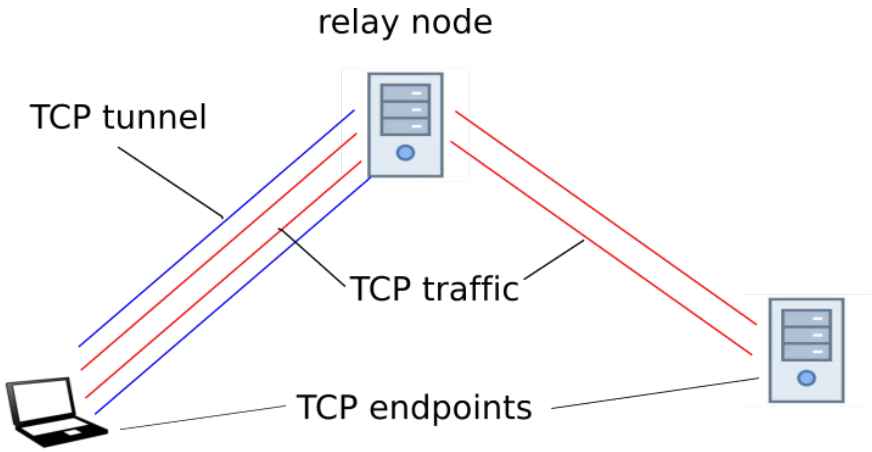
In a channel with probability of bit error p_b, *and* a non-changing header length *l'*, when would is it advisable to have large *l* or a short *l* ? Why?

[5 marks]

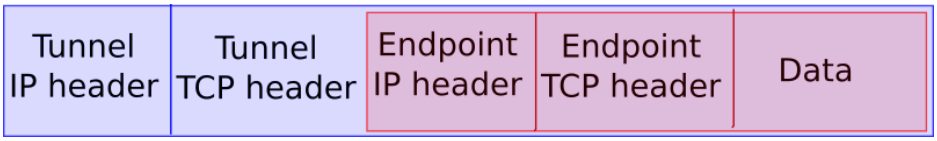
d) You are the network administrator for a large campus network. This network has many routers but also all routers have many links to other routers (It's a highly interconnected network with many possible routes). You have a choice to implement either a "link state" or a "Distance vector" routing protocol in the network. In your opinion, what are the main considerations to think about when making your choice, and what are the effects of choosing each protocol on the network?

[5 marks]

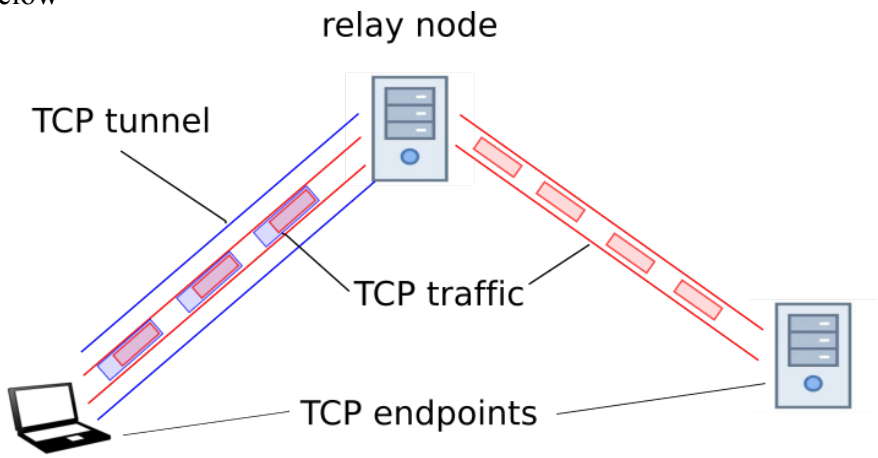
e) "Tunnelling" can be used to send packets between two points using a forwarding "relay" point. A TCP tunnel looks like the figure below. The TCP data first goes to the relay node by a tunnel, and then the relay node forwards the traffic to the endpoint.



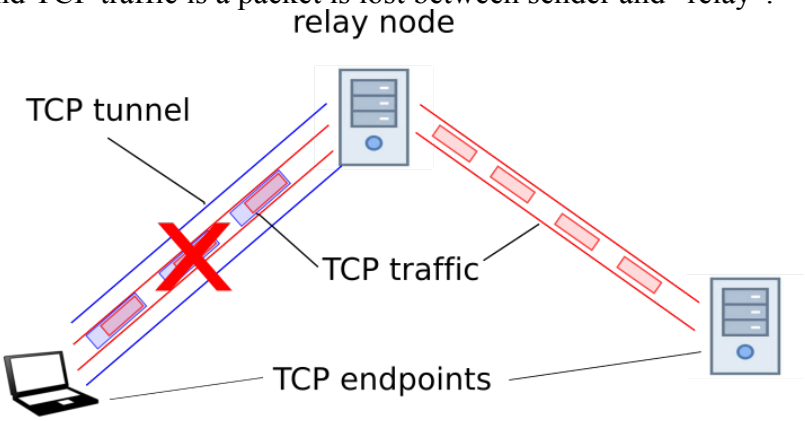
This is implemented using special IP packets which carry the traffic to the receiver within an IP packet sent to the "relay" point.



If we have an existing connection between sender and receiver using a tunnel as shown below"



Discuss what effects might occur on the throughput of the TCP tunnel traffic and the end to end TCP traffic is a packet is lost between sender and "relay".



[5 marks]
[25 marks]

Question Two:

a) Name 3 different physical media types? Briefly outline the positives and negatives of using each type.

[5 marks]

b) In communications, noise level on the channel reduces the theoretical maximum rate of information transfer. In your opinion and with the use of a diagram, explain how noise level effects the maximum transfer rate.

[7 marks]

c) Suppose a communications channel uses a spectrum between 14MHz and 18MHz for communications and has an intended capacity of 20Mbps:

i) Use Shannon's theorem to find the required SNR to obtain this capacity.

ii) Use the Nyquist theorem to find the number of signaling levels required to achieve this capacity.

[6 marks]

d) Describe the concept of clock skew when sending data between two devices. When does clock skew become a problem? Explain how using Non Return to Zero Invert (NRZI) baseband encoding with 4/5 Mapping will reduce the effect of clock skew on reading the data.

[7 marks]
[25 marks]

Question Three:

a) Using the Layer 2 hamming code bit error encoding technique, calculate the check bits used and the final message (including check bits) sent if the data to be sent is:
`1011100110`

[5 marks]

b) Using layer 2 Cyclic Redundancy Check (CRC), determine if the received messages have been received without bit errors:
Generator polynomial g(x) = `11011`
`i)` `1111010101`
`ii)` `1100010011`
`iii)` `11001011110011`

[6 marks]

c) In Carrier Sense Multiple Access/Collision Detection (CSMA/CD) a node must sense if the channel is busy before sending a message. In CSMA/CD describe with the aid of a diagram what a node will do if the channel is busy if it is:
i) 1-Persistent CSMA/CD
ii) Nonpersistent CSMA/CD
iii) p-Persistent CSMA/CD

[7 marks]

d) With the aid of a diagram explain in what circumstances CSMA might see the "hidden node problem"? Describe the CSAM-CA scheme and explain how this solves the hidden node problem.

[7 marks]

[25 marks]

Question Four:

a) Explain using a diagram how the size of the channel effects the window size in layer 2 flow control. How is the size of the channel measured?

[5 marks]

b) Explain what is meant by "contention" in layer 2 Multiple Access Control (MAC). How is channel contention handled using the "Token Ring" technique?

[6 marks]

c) Describe using a diagram the mechanics of a recursive Domain Name Server (DNS).

[7 marks]

d) What is the purpose of the Address Resolution Protocol (ARP)? Explain the mechanics of ARP.

[7 marks]

[25 marks]

Question Five:

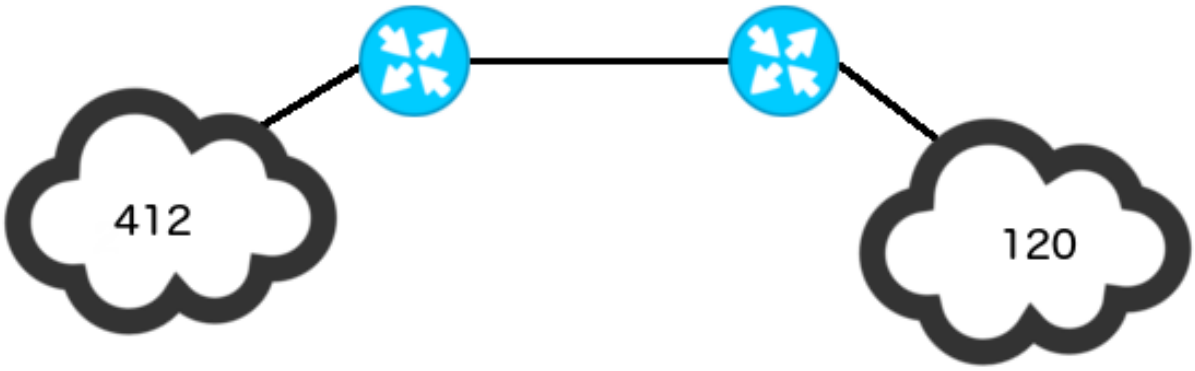
a) Explain what is meant by the term "longest prefix matching" when forwarding packets on a router.

[5 marks]

b) Classless Inter-Domain Routing (CIDR) was introduced to Internet Protocol (IP) to address what issues of the class based system? How is CIDR implemented?

[6 marks]

c) You are given an IP range of 10.36.224.0/19. Design the IP ranges required to facilitate the network shown in the figure below. Design the subnet ranges for maximum efficiency of use of IP addresses.



[7 marks]

d) Use Djikstra's algorithm to work out the path for router "?" for the Link State Database below. Draw a separate diagram showing the PATH and the TENT after each change is made.

a	
b	6
c	2
g	5

b	
a	6
d	4

c	
a	2
d	3
e	5

d	
b	4
c	3
e	1
f	3

e	
c	5
d	1
f	2
g	2

f	
d	3
e	2

g	
a	5
e	2

[7 marks]
[25 marks]

Question Six:

a) List the main responsibilities of the Transmission Control Protocol (TCP) and explain briefly how these are achieved.

[5 marks]

b) TCP uses a 3-way handshake to create a connection between two endpoints. In he past TCP used a 2-way handshake, but this was a weak point for attacks on servers. How was the 2-way handshake exploited by hackers in order to disable servers, and how does the 3-way handshake solve this problem?

[6 marks]

c) Discuss the Silly Window phenomenon in TCP with regard to TCP windowing. How does TCP prevent the silly window from happening?

[7 marks]

d) TCP uses windowing to manage the packets sent and received over a connection. This is similar to layer 2 windowing, however, TCP changes the window size dynamically. Why

is it necessary for TCP to dynamically control the window size, and what mechanism is used to do this?

[7marks]

[25 marks]