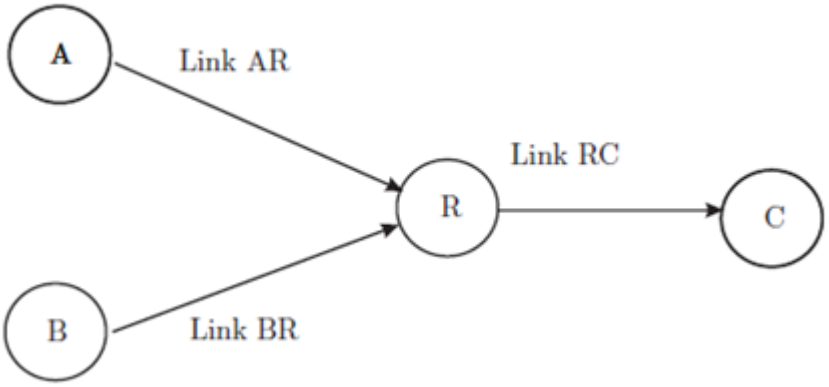
MIDDLE EAST TECHNICAL UNIVERSITY
Electrical and Electronics Engineering Department

EE444 Introduction to Computer Networks
Recitation Problems – Chapter 1-3

Question 1



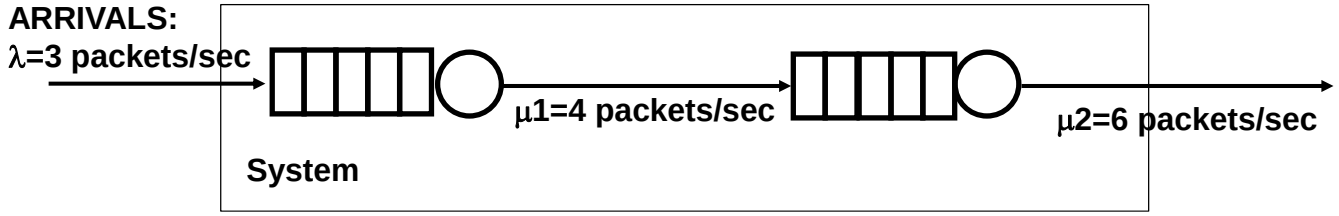
Two traffic flows, which are from nodes A and B, are both destined to node C via router R. Link RC has 10Mbps bandwidth and all of the traffic on this link is generated by these two flows. The observed traffic patterns for these flows exhibit exponentially distributed interarrival times, and packet sizes are also exponentially distributed with an average size of 500bits. The average packet interarrival time observed for the Flow 1 on Path AC is 0.1 msec, and for the Flow 2 on Path BC is 0.2 msec.

(a) What is the average utilization of Link RC?
(b) What is the average number of packets that are queued and being transmitted at R to be sent on Link RC?

Question 2 (2015 Exam)

Q.1 (30pts)

a) In the queuing system below, the arrivals to the system are Poisson arrivals and the packet sizes are exponentially distributed. What is the total expected number of packets in the system and the expected time a packet spends in the system. **Clearly show all your reasoning and work.**



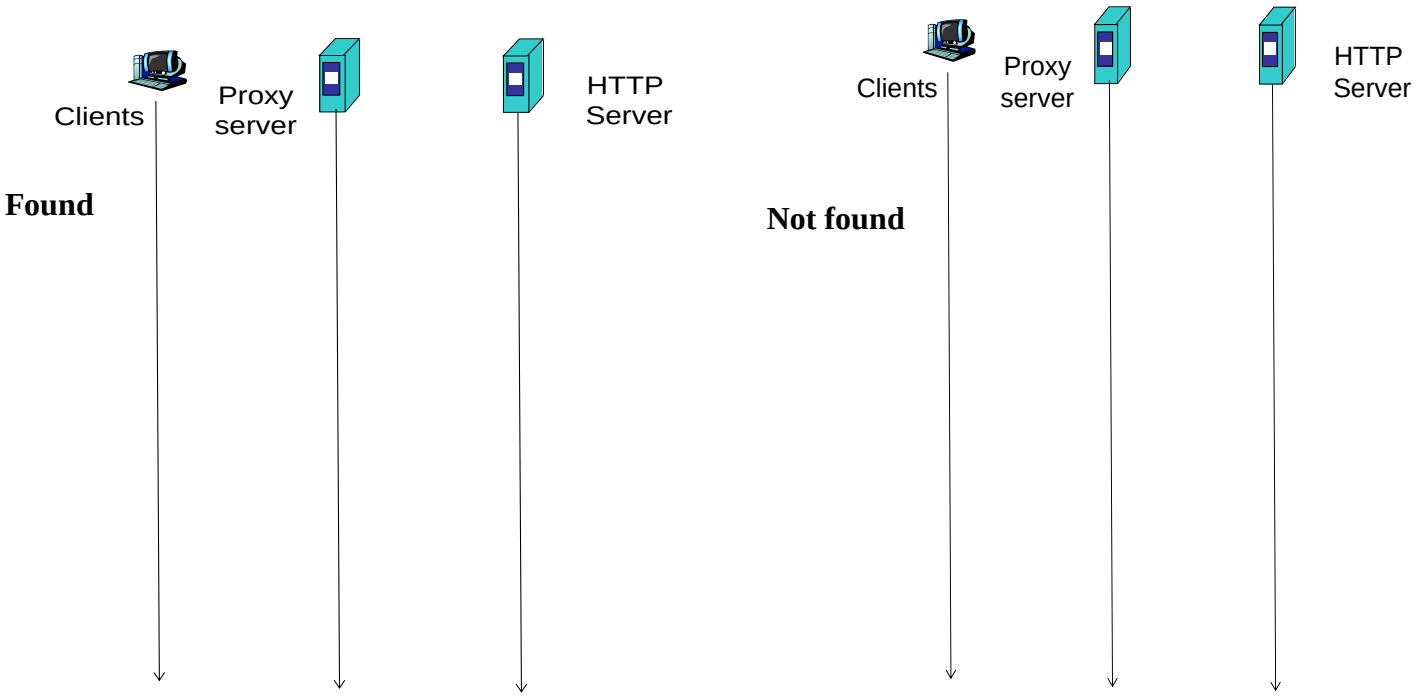
b)A bit torrent user A has a file of 4 GBytes and makes it available for sharing. 3 other users (C1, C2, C3) start to download concurrently at t=0sec. The bandwidth parameters of the hosts are as follows:

A: upload rate=10 Mbps, download rate =10Mbps
C1: upload rate=100 Mbps, download rate =100Mbps
C2: upload rate=10 Mbps, download rate =10Mbps
C3: upload rate=100 Mbps, download rate =10Mbps

What is the minimum bound on the time spent for all C1, C2, C3 complete the download?

c) A web server hosts web pages that consist of a base html file and a single jpeg. The web service company employs a proxy server to give better service to the clients a campus network. Persistent HTTP is used. The RTT between campus clients and the proxy server is RTT_{CP}=100msec. The RTT between campus clients and the web server is RTT_{CS}=500msec. The RTT between the proxy server and the web server is RTT_{PS}=500msec.

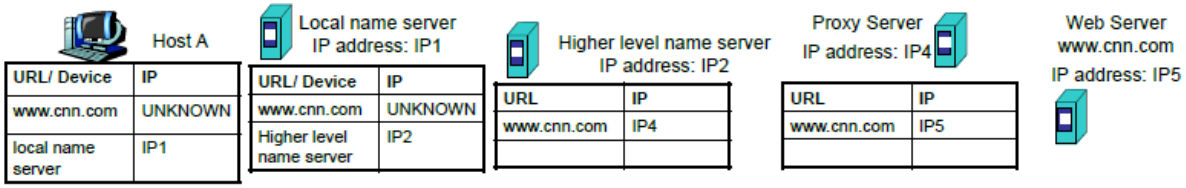
i)Draw the transmissions and compute the response time when the web page requested by a client is found on the proxy server and when it is not found on the proxy server.



ii)What is the minimum probability P_{find} that the proxy server has the requested file such that using the Proxy Service has better average response time than directly downloading from the web server.

Question 3 (2013 Exam)

Q.2. The IP addresses and the table of URL-IP mappings and DNS server-IP mappings of each involved networking device is provided in the figure. The name server configuration is such that the Proxy Server improves the web service of www.cnn.com. Initially, the proxy server does not store any files. DNS application runs over UDP.



URL/ Device	IP
www.cnn.com	UNKNOWN
local name server	IP1

URL/ Device	IP
www.cnn.com	UNKNOWN
Higher level name server	IP2

URL	IP
www.cnn.com	IP4

URL	IP
www.cnn.com	IP5

a) Host A wants to browse a web page located on www.cnn.com. Complete the sequence of steps carried out at the application and transport layer until the base HTML file of the web page is displayed on Host A. Use as many rows as you need.

Step	From	To	Explanation
1	Host A		

b) The RTT values between device pairs are provided in the Table below.

Device Pair	RTT (msec)
Host A-Local name server	10msec
Host A-Higher level name server	30msec
Host A-Proxy server	50msec
Host A-Web server	300msec
Local Name Server-Higher level name server	25msec
Higher level name server-Proxy Server	40msec
Proxy Server-Web Server	100msec

What is the total time elapsed to display the web page on Host A? (Choose the required values from the table.) **Hint:** Identify the round trips in your answer in part (a).

c) Assume after a short time Host A wants to display the same web page. Assume no local caching exists on Host A for any purpose. Local name server ***caches*** the DNS replies. What is the total time elapsed to display the web page on Host A again?

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EE444 Introduction to Computer Networks
Recitation Problems – Chapter 4-6

Question 1

2 stations are communicating with sliding window protocol with Selective Repeat. Each packet takes 1ms to transmit on the sender side. The RTT is 10ms. The acknowledgement size and all headers are negligible. The sequence numbers are represented with 3 bits.

(a) What is the maximum efficiency that can be achieved?
(b) Repeat part (a) if it is known that probability that a packet or its corresponding acknowledgement or both are lost is 0.2.

Question 2

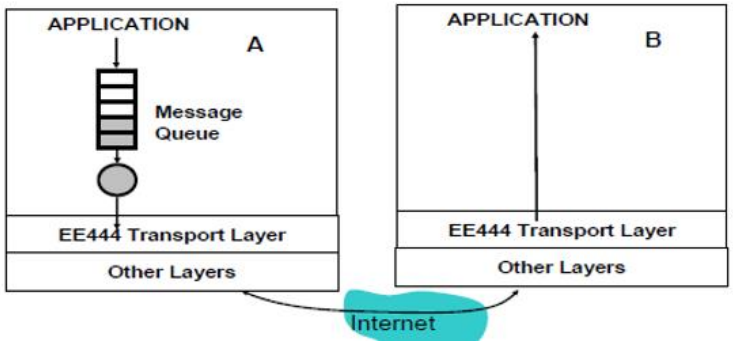
(a) A channel has a data rate of 4 kbps and a propagation delay of 20 ms. For what range of packet sizes does stop-and-wait give an efficiency of at least 50%?
(b) Two nodes n1 and n2 communicate using Go-Back-N as the ARQ mechanism with a window size of 4 packets. Assume that n1 is transmitting and n2 is receiving. Show the window positions for the following sequence of events.
1. Before n1 sends any packets.
2. After n1 sends packets 0, 1, 2 and n2 acknowledges 0, 1 and the ACKs are received by n1.
3. After n1 sends packets 3, 4 and 5 and n2 acknowledges 4 and the ACKs are received by n1.

Question 3 (2011 Exam)

Q.1. Two computers A and B implement the EE444 Transport Layer Protocol which is a Stop and Wait protocol. Data segments have fixed size of 1250 bits *including* 250 bits of header. The capacity of the physical link that connects computer A to the Internet is 50Kbps. Probability of losing a segment or an error in the transmission on the way from A to B is measured to be 0.2. The time out duration is selected to be 75msec (after sending the last bit of data segment). The Round Trip Time (RTT) between A and B is measured to be 50 msec. Acknowledgement (ACK) segment size (including headers) is negligible and ACKs are transmitted without any loss or error. ACK transmission starts immediately after the last bit of the corresponding data segment is correctly received.

a) What is the efficiency of EE444 Transport Layer Protocol?

Now consider the *application* that is running on computer A which generates messages and sends them to computer B. The messages have exponentially distributed sizes with an average of 8000 bits. Message generation in the application happens according to a Poisson process with rate 0.5 message/sec. The generated message is stored in a **Message Queue** in computer A and then handed out (given) to the Transport Layer to be sent to computer B as shown in the figure below.



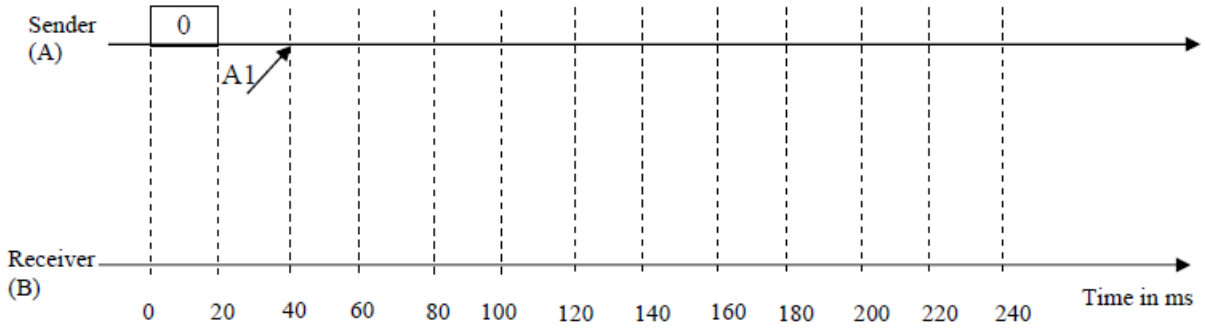
b) What is the average data rate available to the application layer on computer A?

c) What is the expected size of the Application layer Message Queue (including the message getting service) at computer A?

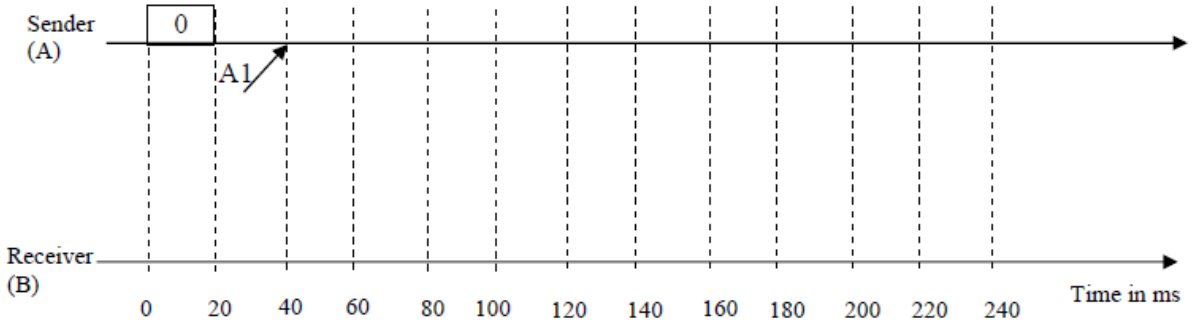
Question 4 (2011 Exam)

Q.3. Computer A sends 200bit data packets to computer B. The capacity of the physical link that connects computer A to the internet is 10Kbps. Acknowledgement (ACK) packet size is negligible and ACKs are transmitted without any loss or error. ACK transmission starts immediately after the last bit of the corresponding data packet is correctly received. The Round Trip Time (RTT) between A and B is measured to be 20 msec. Assume A wants to send 6 data packets to B numbered from 0 to 5 (which also serve as the sequence number). The sequence number is represented by 3 bits. The receiver sends a repeated ACK for the last received in sequence packet if it gets an out of sequence packet. The sender retransmits when it gets the first repeated ACK.

a) Complete the timing diagram below as shown until the ACK verifying the correct reception of Packet 5 comes back to the sender. Indicate the packet sequence numbers and ACK numbers. The transmission of Packet 0 starts at time t=0. The first transmission of Packet 1 is lost. There are no other losses. The reliable transmission method is **Go BACK N with a window size of 4**.



b) Repeat part a). The reliable transmission method is now **SELECTIVE REPEAT with sender window size=receiver window size = 4.** The receiver sends cumulative ACKs for all correctly received packets whenever possible.



Question 5 (2012 Exam)

Your company has IP address block: 124.122.10111000.0/21
There are three departments: Department A: Has 900 host machines
Department B: Has 400 host machines
Department C: Has 450 host machines
Divide the address space into three blocks for these departments. Indicate their subnet addresses in x.y.z.w/m format. You do not need to convert the given binary section in the IP address block to decimal.