Submission Deadline: Tuesday, 7 December, 2021 by 11:59 pm (ELMS)

Chapter 1 – Computer Networks and the Internet

Q.1 Consider **two hosts**, **A** and **B**, connected by a single link of rate ***2*** **Mbps** and separated by ***100*** **kilometers**, and suppose the **propagation speed** along the link is **20000 meters/sec**. **Host A** is to send **a message** of **size** ***6000*** **bytes** to **Host B**. Each packet can contain **800 bytes** of data with **50 byes of header** for each packet.

i. Determine the **transmission delay (d_{trans})** and **propagation delay (d_{prop})** of each packet. **[2]**

ii. Find the **propagation speed** x in **m/s** so that d_{prop} equals d_{trans} for each packet. **[2]**

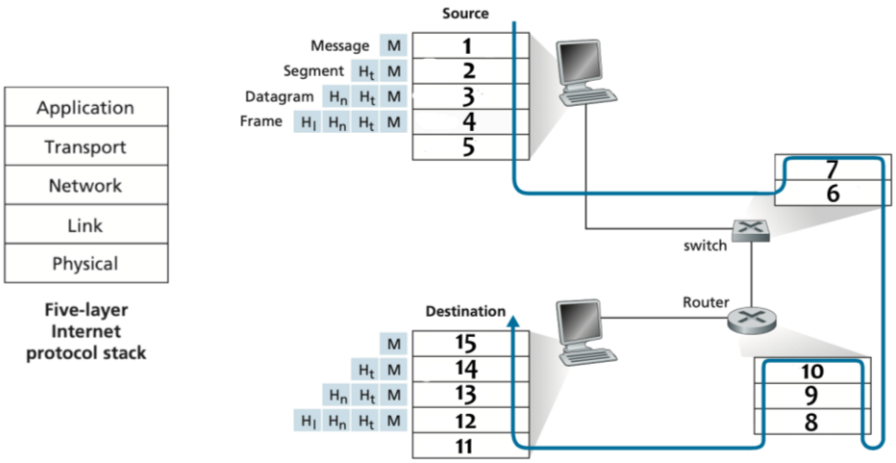
iii. Ignoring processing and queuing delays, find **end-to-end delay** to transfer the entire message. **[2]**

iv. What **percentage of transmitted bits** corresponds to the **message** and the **overhead**? **[2]**

v. If **data size** in each packet is increased to **1000 bytes** from 800 bytes with headers being the same, is it an **advantage** or **disadvantage**? Discuss in **2/3 sentences**. **[2]**

Q.2 A packet switch receives a **packet A** and determines the outbound link to which the packet should be forwarded. When the packet arrives, **400 bytes** of the **currently transmitting packet** is already transferred and **Eighty (80) other packets** are waiting to be transmitted. Packets are transmitted in order of arrival. Suppose all packets are **1,500 bytes** and the link rate is **5 Mbps**. What is the **queuing delay** for the **packet A**? **[3]**

Q.3 Consider the following diagram:



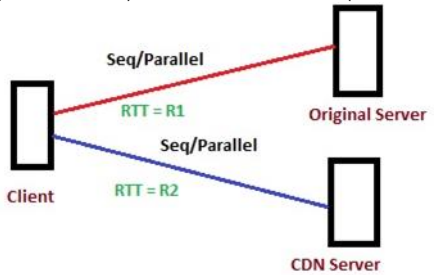
i. Name the **layer** corresponding to each of the boxes numbered **1 to 15** in the diagram. **[3]**

ii. List the **IP & MAC addresses** in **each of the links** from **source host** to the **destination host**. Use **symbolic IP & MACs** like **Src-IP, Src-MAC, Router-IP, Router-MAC** etc. for your answers. **[3]**

Chapter 2 – Application Layer

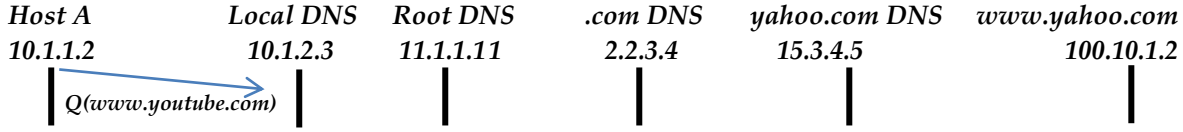
Q.1 Suppose your browser (client) downloads a webpage. The **base html (master index file)** object is **500 bytes** in length and additionally contains **5 embedded images**, each **50 Kbytes** in length. All links have capacity of **1 Mbps**. Assume as shown in the following diagram:

- ✓ The **base html** is stored in the **original server** and the **5 images** are all stored on the **CDN server**.
- ✓ **R1** (RTT between Client and original server) = **100 ms** and **R2** (RTT between Client and CDN server) = **50 ms.**



Calculate the **response time** to download the entire web page for (i) **Sequential** non-persistent HTTP, (ii) **Parallel** non-persistent HTTP, (iii) **Sequential** persistent HTTP, and (iv) **Parallel** persistent HTTP. **[5]**

Q.2 The diagram below shows a **DNS query** from a **Host *A*** to its **local DNS server**. The IP addresses of all hosts are shown in the diagram. The label ***"Q(www.yahoo.com)"*** specifies the query string.

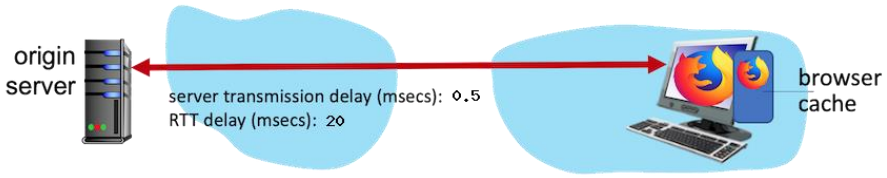


i. **Complete the above diagram** to show all steps how **Host A** gets the IP address for **www.yahoo.com**. **[2]**

ii. Assuming that **Local DNS server cache** is **empty** initially, **list** the **DNS server names** and corresponding **IP addresses** that will be stored in the **Local DNS server**. **[2]**

iii. List the **DNS record** (name, value, type, ttl) that **youtube.com** authoritative DNS will store for **www.youtube.com**. **[1]**

Q.3 Consider an **HTTP server and client** as shown in the figure below. Suppose that the **RTT delay** between the client and server is **20 msecs**; the time a server needs to transmit an object into its outgoing link is **0.5 msecs**; and any other HTTP message not containing an object has a **negligible (zero) transmission time**. Suppose the client again makes **90 requests**, one after the other, waiting for a reply to a request before sending the next request.



Assume the client is using **HTTP 1.1** and the **IF-MODIFIED-SINCE** header line. Assume **30%** of the objects requested have NOT changed since the client downloaded them (before these 90 downloads are performed).

1. **How much time elapses (in milliseconds)** between the client transmitting the first request, and the completion of the last request? **[2]**
2. Re-calculate the same for **50% caching capability** and **compare**. **[2]**

Wireshark Traffic Analysis

Open the trace file "**trace-http.pcap**" (uploaded in the ELMS) and answer the following questions and support your answer with **appropriate screenshots**:

1. List **any 3 different protocols** that appear in the protocol column in the **unfiltered** packet-listing window. **[1]**
2. Select the **first GET request & response messages** in the trace using packet filter option and answer the following questions: **[6]**
    a. Is the **client (browser)** running HTTP version 1.0 or 1.1? What version of HTTP is the **server** running?
    b. What is the **IP address** of the client and the server?
    c. What is the **status code & phrase** returned from the server to the browser?
    d. When was the sent HTML file **last modified** at the server?
    e. **How many bytes** of content are being returned to your browser?
    f. What is the **server's response (status code and phrase)** in response to the initial HTTP GET message from your browser?