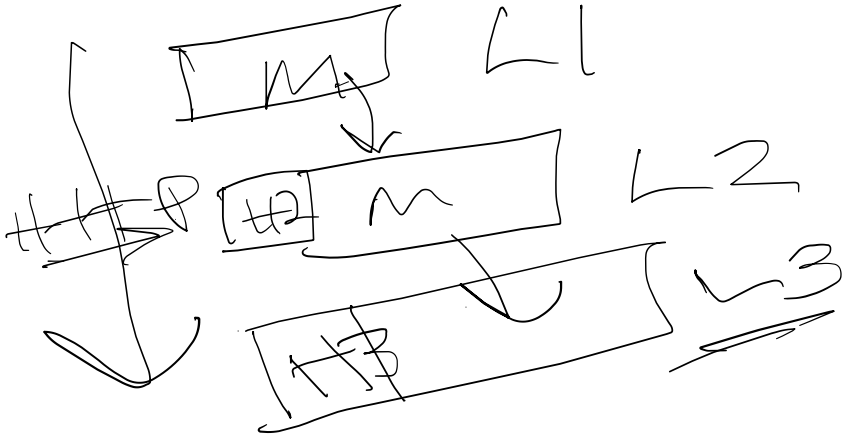
3 Several
Define how are ex.
1) Actions
2) Without protocols.

2. Explain how data encapsulation allows data to be transported across the network. Discuss the advantages and disadvantages of data encapsulation. **[5 marks]**



} independently attach headers (lower) } How

→ TCP/UDP protocols for each layer can be independently developed

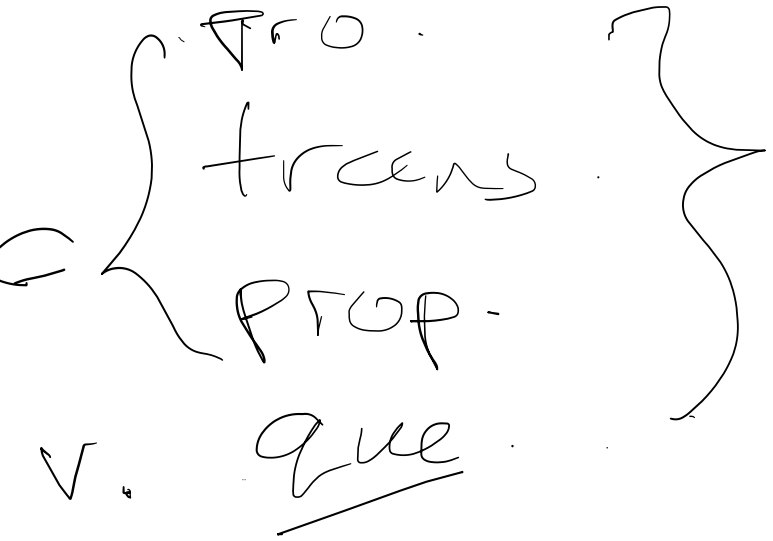
HTTP 2.0 pg 54

TCP

TCP/IP 4.0 → 6.0

[duplicated error check

3. Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable? **[2 marks]**



4. Suppose you urgently want to deliver 300 terabytes of data from Icacos to Arima. You have available a 1 Mbps dedicated link for data transfer. Would you prefer to transmit the data via this link or instead use TTPost overnight delivery? Explain. **[3 marks]**

1 byte = 8 bits

Amount bits = 300 TB = 2400 Tb

Bandwidth (R) = 1 Mbps = 1×10^6

Transtime = $\frac{L}{R} = \frac{2400 \times 10^{12}}{1 \times 10^6}$ (s)

$= 27777.8$ days

How?

6. Suppose you wanted to do a transaction from a remote client to a server as fast as possible. Explain why you would you use UDP or TCP. **[4 marks]**

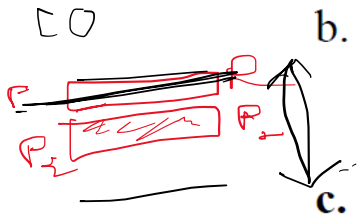
Roundtrips

TCP → 2 round trips:
→ Est. connection
→ send data

= 7

UDP → 1 Roundtrip:
client send Req
Server send data

5. Suppose users share a 2 Mbps link. Also suppose each user transmits continuously at 0.5Mbps when transmitting, but each user transmits only 10% of the time.
   a. When circuit switching is used, how many users can be supported? **[1 mark]**
   b. For the remainder of this problem, suppose packet switching is used. How many users need to be transmitting at the same time for a queuing delay to occur? Explain your answer. **[2 marks]**
   c. Find the probability that a given user is transmitting. **[1 mark]**
   d. Suppose now there are 10 users. Find the probability that any given time 6 users are transmitting simultaneously. **[4 marks]**



a) No. of users $= \frac{2}{0.5} = 4$

b) ≥ 5

c) 0.1

d) $\binom{10}{6}(0.1)^{6}(0.9)^{4}$ ✓ ↑ COMBO.

$= 1.3778 \times 10^{-4}$

10
6 < using ✓
4 will ✓
not be using

{ ABCDEF } Diff.
{ BACDEF } Per.
+ same comb.

7. Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answer:

a. Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why? **[4 marks]**

b. Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why? **[3 marks]**