

1. There is not big difference between host and end system. They are actually used interchangeably. End system is also referred to end system because it hosts application program. Hosts are divided to two categories, client and server, so web server is also an end system. Desktop, mobile PC and smartphones are also end system.
2. Processing delay, queueing delay, transmission delay and propagation delay. Processing delay usually is extremely small. Queueing delay is variable because it depends on the congestion level of router. Transmission delay is equal to packet length divides bandwidth and propagation delay is distance divides speed, so they are both constant.
3. No, because n layer relies on the service provided by lower layer. Because n - 1 layer only provides unreliable data transfer, n cannot achieve reliable data transfer.
4. Router is used to interconnect multiple networks. Router uses IP address to determine how to send the packet to its destination. Router is based on transport layer protocol. Link layer switch mostly examine the MAC address of incoming packet and the packet is switched to proper physical port. Switch performs at low level of network architecture.
5. Network architecture refers to five-layers internet architecture, which provides a set of services to application. It makes possible for users to send data over the internet. However, the application architecture dictates how the application is structured over various end systems.
6. Data integrity, timing, throughput, and security. For reliable data transfer, flow control, congestion control and connection oriented, TCP service is provided. UDP is provided for unreliable data transfer. There is also security service TCP-SSL.
7. The process that initiates the communication is labeled as client and the process that waits to be contacted to begin the session is server.
8. IP address and port number are used by process to identify a process on a different host.
9. UDP, because TCP provides flow control and congestion control service, which can slow the data transfer rate.
10. Bind method assigns the port number to server. Because for different port number, server provides different service, it is important for server to bound with a fixed port number. It may have other application running on different port number. However, the client does not provide any service, so it does not need a specific port number.

Problem-1:

Problem - 1

$$P_n(H=K) = \binom{N}{K} 0.15^K (1-0.15)^{N-K}$$

in our case $N=1000$

$$P_n(H=K) = \binom{1000}{K} 0.15^K (1-0.15)^{1000-K}$$

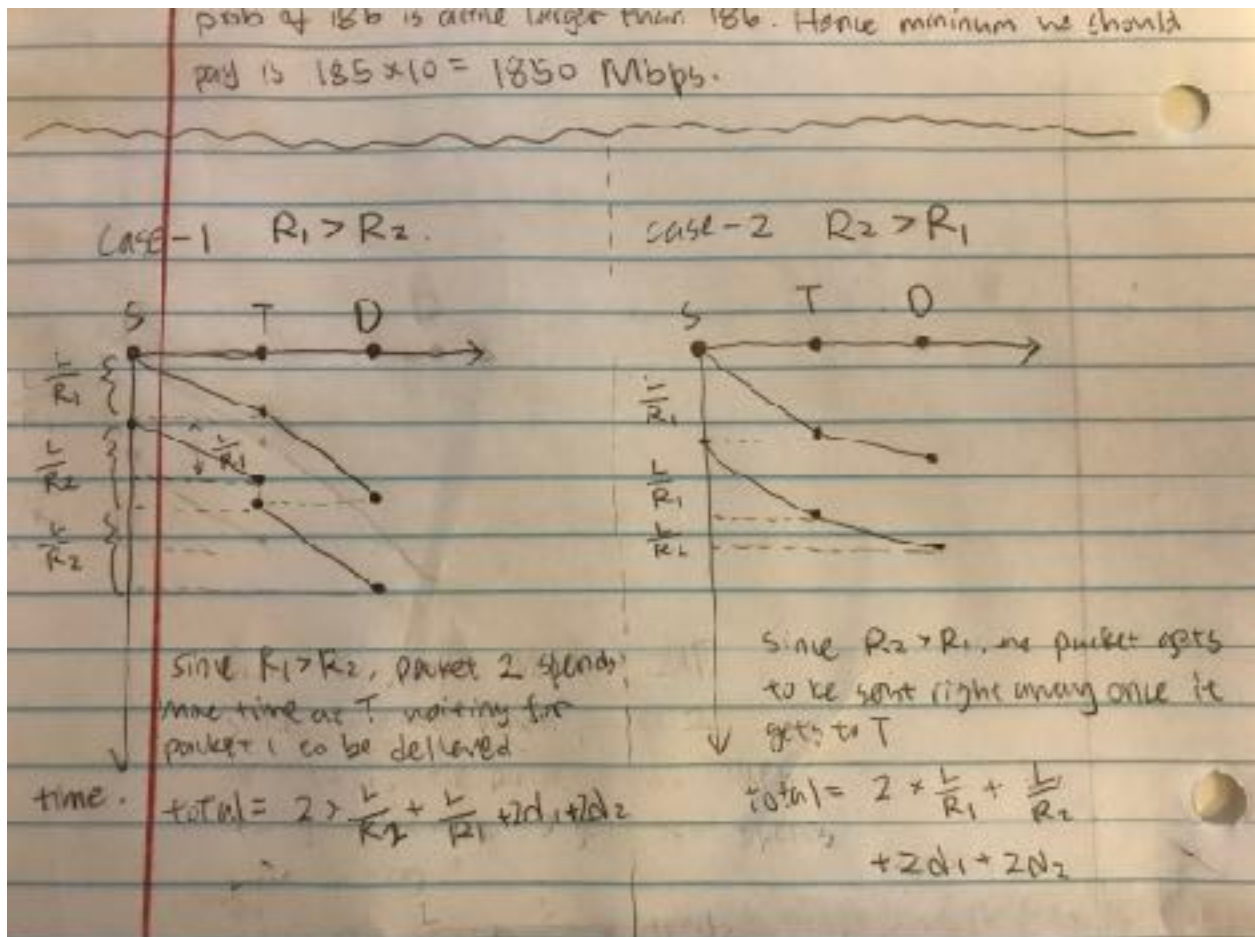
therefore the probability that larger than 12 employees online should be less than 0.1%.

$$P_n(K) + P_n(K+1) + \dots + P_n(1000) \leq 0.1\%$$

by using program we get $K = 165$

in this case prob of 15 is active online is less than 0.1% but prob of 164 is active larger than 0.1. Hence minimum we should pay is $105 \times 10 = 1650$ Mbps.

Problem-2:



Problem-3:

Problem 3.

$\begin{matrix} \text{\# packets} & \text{rate} \\ \downarrow & \downarrow \\ N & = \lambda W \end{matrix}$
 ← average time.

① $\lambda = \frac{N}{W} = \frac{0.5L}{\frac{L}{R}} = \frac{5}{1} R.$

② $L = 1500 \text{ B} = 1500 \times 8 = 12000 \text{ b}$
 $R = 100 \text{ Mbps} = 100 \times 1000 \times 1000 = 10^8 \text{ bps.}$
 $\lambda = 8000.$
 $W = 0.0012 + \frac{12000}{10^8} = 0.0012 + 0.00012 = 0.00132 \text{ s}$
 $N = 0.00132 \times 8000 = 10.56.$

③ $N = \lambda W = 2 \cdot \frac{R}{L} \times \left(\frac{L}{R} + \text{delay} \right) = 2 + 2 \frac{R}{L} \times \text{delay}$
 In this case, total waiting time is $2 + 2 \frac{R}{L} \times \text{delay}$. We can apply little law otherwise the transmission rate is always 2

Problem-4:

Problem-4

①. $100 \text{ Mbps} = 100 \times 1000 \times 1000 \text{ bps} = 10^8 \text{ bps}$
 $\frac{240000}{186000} \times 2 = 2.58 \text{ s}$

② $2.58 \times 10^8 = 2.58 \times 10^6$ I think it means given a certain amount of time, how much data are transmitted.

③ $25 \text{ MB} = 25 \times 1024 \times 1024 \text{ B} = 26214400 \text{ B} = 209715200 \text{ b}$
 $\frac{209715200}{10^8} \times 2 = 4.19$
 $= 4.19 + 2.58 = 6.77 \text{ s}$