Networking Chapter 1 Q&A Notes

Question 1

We have a 1 Gb/s link. Each user requires 100 Mb/s when active and is active 10% of the time.

1. Under **circuit switching**, how many users can the link support?
2. Under **packet switching**, with 35 users, what is the probability that more than 10 users are active at the same time?

Answer

(a) Circuit Switching:

$$\text{Max Users} = \frac{1000 \text{ Mb/s}}{100 \text{ Mb/s}} = 10$$

Hence, only **10** users can be supported.
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(b) Packet Switching: In packet switching, bandwidth is shared dynamically. Each user is active with probability $p = 0.1$ (10%) and inactive with probability 0.9.
Let X = number of active users. Then:

$$X \sim \text{Binomial}(n = 35,\ p = 0.1).$$

We want the probability that more than 10 users are active at the same time:

$$P(X > 10) = 1 - P(X \leq 10).$$

Expanding:

$$P(X > 10) = 1 - \sum_{k=0}^{10} \binom{35}{k} (0.1)^k (0.9)^{35-k}.$$

Answer (numerical): Evaluating the sum (using exact binomial computation in software or a scientific calculator) gives

$$P(X > 10) \approx 0.0004243 \approx 4.24 \times 10^{-4}.$$

Interpretation: This means that with 35 users who are each active 10% of the time, the chance that more than 10 users are simultaneously active is about 0.042%, i.e. extremely small. —

Question 2

A packet of length $L = 10\,\text{Kbits}$ is transmitted over a link with transmission rate $R = 100\,\text{Mbps}$.

1. Calculate the one-hop transmission delay.
2. Express your answer in milliseconds.

Answer

Step 1: Formula

$$d_{\text{trans}} = \frac{L}{R}$$

Step 2: Substitution

$$d_{\text{trans}} = \frac{10 \times 10^3\,\text{bits}}{100 \times 10^6\,\text{bits/sec}}$$

Step 3: Simplify

$$d_{\text{trans}} = \frac{10^4}{10^8} = 10^{-4}\,\text{sec}$$

Step 4: Convert to ms

$$d_{\text{trans}} = 0.1\,\text{ms}$$

Final Answer: The one-hop transmission delay is **0.1 ms**.

Question 3

Consider a caravan of 10 cars (analogous to a 10-bit packet) passing through a toll booth (analogous to a link). The toll booth takes 12 seconds to service each car (analogous to bit transmission time), and the highway allows cars to propagate at a speed of 100 km/hr.

1. Calculate the total time to "push" the entire caravan through the first toll booth.
2. Calculate the propagation time for the last car to reach the second toll booth, 100 km away.
3. Determine the total time until the caravan is lined up before the second toll booth.

Answer

Step 1: Time to service entire caravan at first toll booth

$$t_{\text{service}} = \text{number of cars} \times \text{service time per car}$$

$$t_{\text{service}} = 10 \times 12\,\text{sec} = 120\,\text{sec}$$

Step 2: Propagation time from first to second toll booth

$$t_{\text{prop}} = \frac{\text{distance}}{\text{speed}}$$

$$t_{\text{prop}} = \frac{100\,\text{km}}{100\,\text{km/hr}} = 1\,\text{hr} = 60\,\text{min}$$

Step 3: Total time until caravan reaches second toll booth

$$t_{\text{total}} = t_{\text{service}} + t_{\text{prop}}$$

$$t_{\text{total}} = 120\,\text{sec} + 60\,\text{min} = 2\,\text{min} + 60\,\text{min} = 62\,\text{min}$$

Final Answer: The caravan will be lined up before the second toll booth after **62 minutes**.

Question 4

Suppose the cars now "propagate" at 1000 km/hr and the toll booth takes 1 minute to service each car.

1. Will any car arrive at the second toll booth before all cars are serviced at the first booth?
2. If so, calculate when the first car reaches the second booth and how many cars are still at the first booth at that time.

Answer

Step 1: Service time at first toll booth

$$t_{\text{service}} = 10 \times 1\,\text{min} = 10\,\text{min}$$

Step 2: Propagation time to second toll booth

$$t_{\text{prop}} = \frac{100\,\text{km}}{1000\,\text{km/hr}} = 0.1\,\text{hr} = 6\,\text{min}$$

Step 3: First car arrival at second booth - Leaves first booth after 1 min - Travels 6 min

$$t_{\text{arrival}} = 1 + 6 = 7\,\text{min}$$

Step 4: Cars still at first booth when first car arrives at second booth

$$\text{cars serviced by 7 min} = \frac{7\,\text{min}}{1\,\text{min/car}} = 7\text{ cars}$$

$$\text{cars remaining at first booth} = 10 - 7 = 3\text{ cars}$$

Conclusion: Yes, the first car arrives at the second toll booth after 7 minutes while 3 cars are still being serviced at the first booth.

Question 5

Write your next question here.

Answer

Write the solution here.