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C-Net
CS-C

Assignment 02

Q2:

Link bandwidth = 500 Mbps
packet size = 10,000 bits
propagation delay = 20 ms
pipeline size = 6 packets
utilization of the link = ?

Sol:

1- Transmission time for one packet:

$$\text{Transmission time} = \frac{\text{Packet size}}{\text{Bandwidth}} = \frac{10,000}{500 \times 10^6}$$

$$= 0.00002 \text{ seconds}$$

$$= 0.02 \text{ ms}$$

2- Round Trip time (RTT):
- forward and backward propagation delay.

$$RTT = 2 \times \text{propagation delay}$$

$$= 2 \times 20\text{ms} = 40\text{ms}$$

As pipelining allows sending multiple packets before waiting for an acknowledgement.

So, with 6-packet pipelining, we can send 6 packets before waiting for ACK.

3- Utilization Calculation:

$$U = \frac{(\text{Number of packets} \times \text{transmission time})}{RTT + \text{transmission time}}$$

$$= \frac{6 \times 0.02}{0.02 + 40} = \frac{0.12}{40.02} = 0.003$$

$$= 0.3\%$$

utilization link is 0.3 %.

Q3:

bandwidth = 50 Mbps

Go-Back N window size = 10

RTT = 600 ms

Packet size = 10,000 bits

Timeout = 1.5 × RTT = 1.5 × 600

= 900 ms

1- Link utilization:

$$\text{transmission time} = \frac{10,000}{50 \times 10^6 \text{ bps}} = 0.2 \text{ ms}$$

$$\text{Link utilization} = \frac{\text{No. of packets} \times \text{transmission time}}{RTT + \text{transmission time}}$$

$$= \frac{10 \times 0.2}{600 + 0.2} = \frac{2}{600.2}$$

$$= 0.0033$$

$$= 0.33\%$$

2- Handling packet no. 7 in Go-Back-N ACK:

=> If packet 7 is lost, receiver discards that packet and all subsequent packets even if arrived correctly.

=> Receiver sends an ACK for the last correctly

received packet, which is packet 6 for this case.

⇒ The sender waits for the timeout since no new acknowledgments have arrived.

⇒ When timeout occurs, the sender retransmits packet 7 and all subsequent packets.

Additional time for successful delivery?

⇒ Sender detects loss after timeout period (900ms)

⇒ It then retransmits packet 7 and the rest of the window.

⇒ The retransmitted packets take one RTT (600ms) to reach the receiver.

⇒ Receiver then processes the packets and send ACKs.

Total additional delay = Timeout + RTT = 900 + 600

= 1500 ms / 1.5 sec

3- Improve Efficiency:

The current utilization is very low (0.33%) due to:

⇒ high RTT (600ms) compared to transmission time (0.2ms)

⇒ Small window size (10 packets)

Improvements:

⇒ Increase windowsize

⇒ Reduce RTT

⇒ Adjust timeout value

⇒ Use selective repeat ARQ instead of Go-Back-N.

Q4:- Interval calculation:

timeout interval = Estimated RTT + 4 × Deviation

Expected RTT = avg of given RTT values

$$= \frac{48 + 52 + 51 + 49 + 50}{5} = 50\text{ms}$$

$$\text{Deviation} = \frac{|48-50| + |52-50| + |51-50| + |49-50| + |50-50|}{5}$$

$$= 1.2\text{ ms}$$

Thus,

timeout interval $= 50 + 4 \times 1.2 = 54.8\text{ms}$

2- Link utilization:

$$\Rightarrow \text{transmission delay} = \frac{8000}{20 \times 10^6} = 0.4\text{ms}$$

$$\text{utilization} = \frac{\text{No. of packets} \times \text{transmission delay}}{\text{RTT} + \text{transmission delay}}$$

$$= \frac{8 \times 0.4}{50 + 0.4} = 0.064$$

$$= 6.4\%$$

3- If packet 6 is lost, it won't be acknowledged, causing a transmission after timeout interval.

RTT = 50ms

Timeout = 54.8ms

Additional delay = Time out + RTT

$$= 50 + 54.8$$

$$= 104.8\text{ms}$$