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Discussion 1-5

how to calculate network utilization with TCP for both a single packet and pipelined operation. Include flow control of time.

source-https://multimedia.oregonstate.education/cs372/network/main.html

1. Stop-and-wait

TCP is called a stop-and-wait protocol, because the sender will send a number of packets and then wait for an acknowledgement from the receiver. The sender will wait because it doesn't want to overwhelm the receiver with too many packets (flow control), and because it wants to make sure that every packet reached its destination.

2. Total Time

When we talk about utilization and TCP, we define the **total time** as the **transmission time** plus the **RTT**, for only the first transmitted packet.

3. Network Utilization (TCP)

Utilization is defined as the ratio of the time spent transmitting to the total time (defined above). For a single packet this will therefore be:

example:

Assume a TCP sender is continuously sending 1,489-byte segment and with a link transmission rate 25 Mbps an end-to-end propagation delay of 20.5 ms, what is the utilization? Assume no errors, no processing or queueing delay, and ACKs transmit instantly. Also assume the sender will not transmit a non-full segment. Give answer in percentages, rounded to one decimal place, without units (e.g. for an answer of 10.43% you would enter "10.4" without the quotes).

Transmission Time = L/R

Total Time = Transmission time + RTT

utilization = Transmission time/Total Time

solution- transmission time = L=1489, R = 25mbps or 25000000, L = 1489 x 8 = 11912, L/R = 11912/25000000 = .00047648 x 1000ms = .47648

Total Time = .4768 + 41 = 41.4768

utilization = .4768/41.4768 = .011496

4. TCP Pipelining

In the example above we see that stop-and-wait yields very low network utilization. TCP uses something called "pipelining" to improve performance. In pipelining, a burst of packets are sent out, one right after another, and then the sender must wait for the acknowledgement. This increases the **Transmission Time** without changing the **Total Time**.

Assume a TCP sender is continuously sending 1,489-byte segment. If a TCP receiver advertises a window size of 6,299 bytes, and with a link transmission rate 25 Mbps an end-to-end propagation delay of 20.5 ms, what is the utilization? Assume no errors, no processing or queueing delay, and ACKs transmit instantly. Also assume the sender will not transmit a non-full segment. Give answer in percentages, rounded to one decimal place, without units (e.g. for an answer of 10.43% you would enter "10.4" without the quotes).

4.6

solution- L=1489, R = 25mbps or 25000000, L = 1489 x 8 = 11912, L/R = 11912/25000000 = .00047648 x 1000ms = .47648 = L/R. ,

end-to-end propagation delay of 20.5 ms x2 = 41 = RTT,

window size of 6,299 bytes, 6289/1489 = 4.23 approx 4, (assume the sender will not transmit a non-full segment)

formula is (4 ( l/r)) / ((l/r) + RTT) = (4 x .47648) / (.47648 + 41) = 1.90592/41.47648 = .04595 = 4.6%

We can see that pipelining 5 packets increased our transmission time by a factor of 4. Because the **Total Time** remained the same, our utilization also increased by a factor of 4.

Takeaway: Pipelining increases utilization   
without sacrificing reliable data transport