The distance from earth to a distant planet is approximately 9 × 10^10 m. What is the channel utilization if a stop-and-wait protocol is used for frame transmission on a 64 Mbps point-to-point link? Assume that the frame size is 32 KB and the speed of light is 3 × 10^8 m/s.

Solution:

Distance = 9 x 10^10 m
Datarate = 64 Mbps
Size = 32 KByte = 256 Kbits
Propagation Speed = 3 x 10^8 m/s

Transmission Delay = Packet Size / Datarate = 256 Kb/ 64 Mbps = 4 ms = 0.004 s
Propagation Delay = Distance / Propagation Speed = 9×10^10 / 3×10^8 = 300 s

Assuming no processing delay on receiver and ack size is negligible, only one packet is sent in RTT ie 600 s
Utilization = 0.004 / (0.004 + 600) = 6 x 10^-6

In the previous problem, suppose a sliding window protocol is used instead. For what sender window size will the link utilization be 100%? You may ignore the protocol processing times at the sender and the receiver.

Solution:

In order to have efficiency of 100%, the window size should be equal to number of packets that can be sent in one RTT
So RTT here is 600 s, trasmission time of 1 packet is 4 ms, so we can send 1.5×10^5 packets in 1 RTT
So window size should be 150000

. Consider the use of 10 K-bit size frames on a 10 Mbps satellite channel with 270 ms delay. What is the link utilization for stop-and-wait ARQ technique assuming P = 10^{-3}?

Ans: Link utilization = (1-P) / (1+2a)

Where a = (Propagation Time) / (Transmission Time)

Propagation time = 270 msec

Transmission time = (frame length) / (data rate) = (10 K-bit) / (10 Mbps) = 1 msec

Hence, a = 270/1 = 270

Link utilization = 0.999/(1+2*270) ≈0.0018 =0.18%

What is the channel utilization for the go-back-N protocol with window size of 7 for the previous problem?

Ans: Channel utilization for go-back-N = N(1 – P) / (1 + 2a)(1-P+NP)

P = probability of single frame error ≈ P = 10^{-3}

Channel utilization ≈ 0.01285 = 1.285%

Assume a 100Mbps link of 10,000 meters in length with 5 nanoseconds per meter propagation delay. Assume constant length 400 byte data frames, 64 byte ACK frames, 10 microsecond of processing delay for each data frame, and 5 microseconds of processing time for each ACK. The sender always has data to send. Solve for link utilization (U) between a sender and a receiver assuming a stop and wait sliding window protocol.

Ans.

t_pr = 10,000 * 5e9 = 50 s

t_fr = 8 * 400 / 100e6 = 32 s

Ack Delay : t_ack = 8 * 64 / 100e6 = 5.12 s

note that the processing delays are not negligible compared to these values so we must include them in our calculation of U...

U = t_fr / (t_pr + t_fr + t_proc + t_ack + t_proc) = 21%

If t_ack and t_proc are neglected result would have been U = 24%

which is more than 10% "off" from the real result confirming that to

ignore these values would not have been correct to do