**Question:**What is the total delay (latency) for a frame of size 5 million bits that is being sent on a link with 10 routers each having a queuing time of 2 μs and a processing time of 1 μs. The length of the link is 2000 Km. The speed of light inside the link is https://tex.z-dn.net/?f=2%20%5Ctimes%2010%5E%7B8%7D%20m%2Fs. The link has a bandwidth of 5 Mbps.

**Answer:**1.01000030 s

**Step-by-step explanation:**

Given,

Frame of size = 5 million bits = 5 × https://tex.z-dn.net/?f=10%5E%7B6%7D bits = 5000000 bits

Queuing time = 10\*2 μs =  2 × https://tex.z-dn.net/?f=10%5E%7B-6%7D sec = 0.00002 sec

Processing time =10\* 1 μs = 1 × https://tex.z-dn.net/?f=10%5E%7B-6%7D sec = 0.00001 sec

Length of link, distance d = 2000 Km = 2000 × https://tex.z-dn.net/?f=10%5E%7B3%7D m

The speed of light (Propagation speed) = https://tex.z-dn.net/?f=2%20%5Ctimes%2010%5E%7B8%7D%20m%2Fs

Bandwidth , B = 5 Mbps = 5 × https://tex.z-dn.net/?f=10%5E%7B6%7D bps

For delay (latency), use the following formula

Delay (latency) = Propagation time + Transmission time + Queuing time + Processing time ...........(i)

Propagation time = https://tex.z-dn.net/?f=%5Cfrac%7B%5Ctext%7BDistance%7D%7D%7B%5Ctext%7BPropagation%20speed%7D%7D

                             = https://tex.z-dn.net/?f=%5Cfrac%7B2000%20%5Ctimes%2010%5E%7B3%7D%7D%7B2%20%5Ctimes%2010%5E%7B8%7D%7D

                             = 0.01 sec

Transmission time = https://tex.z-dn.net/?f=%5Cfrac%7B%5Ctext%7BFrame%20of%20size%7D%7D%7B%5Ctext%7BBandwidth%7D%7D

                              = 5million bits/5mbps

                              = 1 sec

Latency = processing time + queuing time + transmission time + propagation time.

Processing time = 10 × 1 µs = 10 µs = 0.000010 s.

Queuing time = 10 × 2 µs = 20 µs = 0.000020 s.

Transmission time = 5,000,000 / (5 Mbps) = 1 s.

Propagation time = (2000 Km) / (2 108) = 0.01 s.

Latency = 0.000010 + 0.000020 + 1 + 0.01 = 1.010030 s.

The transmission time is dominant here because the packet size is huge