Computer Networks

Homework 2

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# Problem 1:

A company has X PB of data it wants to move from Ljubljana to Koper. It decides to use the Amazon   
Snowmobile, pictured below, as the communication channel. The Snowmobile needs to travel a road of 107 km with a speed of 80 km/h and can carry all the data in one go.

1. Find the data rate and latency of the (one-time) data transmission via Snowmobile.
2. How much time in months would sending the data via a 40 Gb/s fiber optic cable take? What   
   is the latency of sending a single bit over the cable, assuming the signal travels at 2/3 the speed of light in vacuum? Assume the road and the cable have the same length.

data = 53 PB = 53 \* 1015 B

distance = 107 km = 107 \* 103 m

speed = 80 km/h = 80 \* 103 m / 3600 s = 22.22 m/s

1. latency = distance / speed = 107 \* 103 m / 22.22 m/s = 4 815 s

data rate = data / latency = 53 \* 1015 B / 4 815 s = 11.007 TB/s

**Answer**: The data rate of one-time transmission via Snowmobile is approximately 11 TB/s and the latency is 1h 20min and 15s.

data rate fiber = 40 Gb/s

speed fiber = 2/3 \* c = 2/3 \* 3 \* 108 m/s = 2 \* 108 m/s

distance fiber = 107 km = 107 \* 103 m

1. time fiber = data / data rate fiber = 53 \* 1015 \* 8 b / 40 \* 109 b/s = 10.6 \* 106 s = 4.03 months

latency fiber = distance fiber / speed fiber = 107 \* 103 m / 2 \* 108 m/s = 535 µs

**Answer**: Sending the same amount of data via a 40 Gb/s fiber optic cable would take about 4 months. The latency of sending a single bit over cable would take 535 microseconds.

# Problem 2:

Find the latency, from first bit sent to last bit received, of sending a 2000 bit packet over a 10 Mbps link with two switching elements between the sender and the receiver. Both switching elements implement cut-through switching and forward a packet after readings its first 100 bits. Assume each section of the link introduces a propagation delay of 20 μs.

Diagram

Description automatically generated with low confidence

data = 2000 b

data head = 100 b

data rate = 10 \* 106 b/s = 10 b/μs

propagation delay = 20 μs = 2 \* 10-6 s

time 1 (A to Switch 1) = propagation delay + data head / data rate = 20 μs + 100 b / 10 b/μs = 30 μs

time 2 (Switch 1 to Switch 2) = time 1 = 30 μs

time 3 (Switch 2 to B) = propagation delay + data / data rate = 20 μs + 2000 b / 10 b/μs = 220 μs

latency = time 1 + time 2 + time 3 = 30 μs + 30 μs + 220 μs = 280 μs

**Answer**: The latency of first bit sent to last bit received is 280 microseconds.