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[Computer Commnct & Networking](https://blackboard.liu.edu/webapps/blackboard/execute/launcher?type=Course&id=_236727_1&url=)

**Problem 1** Assume a 5 Mbps microwave link between a geostationary satellite orbiting at an altitude of 36000 km above the surface of the Earth, and assume the propagation speed is 2.4×108 meters/second. What is the length in bits of a packet whose ﬁrst bit arrives to the surface of the Earth at the same moment the last bit is pushed out of the satellite?

If queuing delay Dqueue = (I/1-I) L/R

Where;

Link Speed (transmission rate) = R = 5 Mbps

Packet Size (length of packet) = L =?

And

Transmission delay (Dt) = L/R

Then,

**L** = R \* Dt

Time t = 36000/ (2.4x108x (18/5))

= 36000/933.12

= 38.58hr (138888s)

**L** = 5 \* 138888

= **694440bits**

**Problem 2** Assume there are two routers between host A and host B:

Host A ------- R1 -------- R2 --------- Host B

The transmission rates are: • Host A to R1: 10,000 bits/second. • R1 to R2: 20,000 bits/second. • R2 to A: 15,000 bits/second. What is the total transmission delay for a 60,000 bit packet traveling from A to B, assuming store-and-forward routing?

**SOLUTION**

Let transmission delay (milliseconds) = Dtrans = L/R

Where; L = length of a packet = 60000 bit

R = transmission rate

Thus at times (T):

T1 between Host A ------- R1, Dtrans = L/R1 = 60000/10000 = **6ms**

T2 between R1 -------- R2, Dtrans = L/R2 = 60000/20000 = **3ms**

T3 between R2 --------- Host B, Dtrans = L/R3 = 60000/15000 = **4ms**

Meaning the total Dtrans = 6+3+4 =**13ms**

**Problem 3** Assume round-trip time between browser and web server is RTT = 20 milliseconds. Assume the browser requests an html page that contains references two four other objects in the same server. Also assume the transmission times for the requests and replies are negligible.

1. If the connection is not persistent, how long will it take from the browser to receive the base html page plus all the objects referenced?

**SOLUTION**

Suppose that **n** DNS servers are visited before the host receives the IP address of the base html page from the DNS: the successive visits incur an RTT of < **RTT1… RTTn**>.

Since the web page associated with the link contains **two objects** with references, Let **RTT20** denote the **RTT** between the local host and the server containing the objects.

The total amount of time to get the IP address is **RTT1+RTT2+…RTTn**. Once the IP address is known, **RTT20** elapses to setup the TCP connection and another **RTT20** elapses to request and receive the objects.

Therefore the total response time to receive the html page and the objects is:

**4 RTT20+ RTT1+RTT2+ RTT3+RTT4+…RTTn**.

1. Same question assuming the browser can establish two non-persistent connections to the server in parallel at a time.

**SOLUTION**

The total response time to establish the html page and the objects in non-persistent connections to server in parallel is: **RTT1+…RTTn+4RTT20+4.2RTT20=12RTT20+RTT1+…+RTTn**

3. Same question assuming the browser uses a single persistent connection to the server.

**SOLUTION**

The total response time to establish the html page and the objects in non-persistent connections to server in persistent connection is:

**RTT1+…RTTn+4RTT20+RTT20=5RTT20+RTT1+…+RTTn**

**Problem 4** A packet switch receives a packet and determines the outbound link to which the packet should be forwarded. When the packet arrives, one packet is halfway done being transmitted on this outbound link and ten other packets are waiting to be transmitted. Suppose packets are 2,000 bytes and the link rate is 2.4 Mbps. What is the queuing delay for that packet?

**SOLUTION**

Let

Queuing delay = dqueue

Link Speed= R = 2.4Mbps

Packet Size = L = 2000bytes

Offered Load in packets/second = a =10

Traffic intensity= I = aL/R

**Therefore:**

Dqueue = (I/1-I) L/R

**And** I = 10(2000 / (2.4\*1024\*1024)) = 0.0079

**And therefore;**

Dqueue = [0.0079/ (1-0.0079)] \*(2000 / (2.4\*1024\*1024))

= 0.0079/0.9921\*2516582.4

= **17,756.35ms**