Assignment #003

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1. In this problem, we compare non-persistent HTTP with persistent HTTP. Suppose the page that your browser wants to download is 300K bits long, and contains 5 embedded images, each of which is 200K bits in length. The page and the five images are all stored on the same server, which has a 300ms RTT from your browser. We will abstract the network path between your browser and the web server as a 100Mbps "link". You can assume that the time it takes to transmit a GET message into the "link" is zero, but you should account for the time it takes to transmit the base page and the embedded objects into the "link". In your answer below, make sure to take into account the time needed to setup up TCP connections (1 RTT). Note: Please give the calculation process in detail.

(1) Assume non-persistent HTTP (and assuming no parallel connections are open between the browser and server). How long is the **response time**, i.e., from the time when the user requests the URL to the time when the page and its embedded objects are displayed?

Answer：

$$T_{transmit} = \frac{P(packet\ length\ in\ bits)}{R(transmission\ rate, bps)} = \frac{300kb + 200kb * 5}{10^8 b/sec} = 13ms$$

Text and 5 embedded images need to set up TCP connections 6 times and the client also need to send request and receive response 6 times,so there are 12 RTT in total:

$$(6 + 6) \times \mathrm{RTT} = 3600\mathrm{ms}$$

Response time: $13 + 3600 = 3613\mathrm{ms}$

(2) Now assume persistent HTTP. What is the **response time**, assuming no parallel connections?

Answer:

$$T_{transmit} = \frac{P(packet\ length\ in\ bits)}{R(transmission\ rate, bps)} = \frac{300kb + 200kb * 5}{10^8 b/sec} = 13ms$$

Text and 5 embedded images need to set up TCP connections only one time and the client need to send request and receive response 6 times:

$$(1 + 6) \times \mathrm{RTT} = 2100\mathrm{ms}$$

Response time: $13 + 2100 = 2113\mathrm{ms}$

(3) Now assume persistent HTTP, but assume that the browser can open as many parallel TCP connections to the server as it wants. What is the **response time**?

Answer:

Firstly the client sets up a TCP connection(1 RTT) and sends request and receives response (1 RTT).

$$2 \times \mathrm{RTT} = 600\mathrm{ms}$$

$$T_{transmit} = \frac{P(packet\ length\ in\ bits)}{R(transmission\ rate, bps)} = \frac{300kb}{10^8 b/sec} = 3ms$$

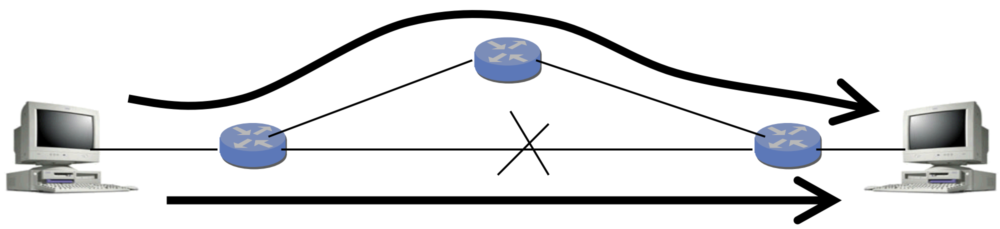
Secondly the client can open 5 TCP connections(1 RTT) at the same time,then sends request and receives response (1 RTT):

$$2 \times \mathrm{RTT} = 600\mathrm{ms}$$

$$T_{transmit} = \frac{P(packet\ length\ in\ bits)}{R(transmission\ rate, bps)} = \frac{200kb}{10^8 b/sec} = 2ms$$

Response time:$600 + 3 + 600 + 2 = 1205\text{ms}$

2. Suppose two hosts have a long-lived TCP session over a path with a 100ms round-trip time (RTT). Then, a link fails, causing the traffic to flow over a longer path with a 500ms RTT.



(1) Suppose the router on the left recognizes the failure immediately and starts forwarding data packets over the new path, without losing any packets. (Assume also that the router on the right recognizes the failure immediately and starts directing ACKs over the new path, without losing any ACK packets.) Why might the TCP sender retransmit some of the data packets anyway?

Answer:

$\text{EstimatedRTT} \approx 100\text{ms}, \text{RTO} = \beta \times \text{EstimatedRTT} \approx 200\text{ms}(\text{取}\beta = 2)$，

500ms has far exceeded the retransmission timeout 200ms,so the TCP sender retransmit some of the data packets anyway.

(2) Suppose instead that the routers do not switch to the new paths all that quickly, and the data packets (and ACK packets) in flight are all lost. What new congestion window size does the TCP sender use? Why?

Answer:

New congestion window size：$cwnd = 1$

Because when loss event occurs(Tahoe) or loss detected by timeout(Reno)the cwnd will be set to 1(1 MSS) by TCP Congestion Control.