

INST346 HW02

The Application Layer

September 15, 2017

1 Delay, Loss, and Throughput

1. Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable?
2. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates $R_1 = 500$ kbps, $R_2 = 2$ Mbps, and $R_3 = 1$ Mbps.
 - a) Assuming no other traffic in the network, what is the throughput for the file transfer?
 - b) Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?
 - c) Repeat (a) and (b), but now with R_2 reduced to 100 kbps.
3. Suppose you need to deliver a 40-terabyte data set from Boston to Los Angeles. You use FedEx overnight, and the delivery person drops off the drive containing this data exactly 24 hours after you package and send the drive.
 - a) What is the average throughput of this data transfer?
 - b) What is the median instantaneous throughput of this data transfer (For simplicity, we will specify "instantaneous" as the transfer speed at a particular second)?

2 Network Security

1. Describe how a botnet can be created, and how it can be used for a DDoS attack.
2. Suppose Alice and Bob are sending packets to each other over a computer network. Suppose Sybil positions herself in the network so that she can capture all the packets sent by Alice and send whatever she wants to Bob; she can also capture all the packets sent by Bob and send whatever she wants to Alice.
 - a) List some of the malicious things Sybil can do from this position.
 - b) List some techniques (if any) that could be employed to counter the threats you listed above.
3. Recall that TCP can be enhanced with SSL to provide process-to-process security services, including encryption. Does SSL operate at the transport layer or the application layer? Justify your answer.

3 Client-Server and P2P Models

1. List two different applications that are naturally suitable for P2P architectures and explain why P2P would be better than client-server.
2. List two different applications that are naturally suitable for client-server architectures and explain why.
3. State whether you agree or disagree with the following statements, and justify your answer.
 - a) Sharing a file via BitTorrent gives the publisher confidence that the file will be available regardless of disaster or censorship.
 - b) Files shared via BitTorrent are more secure against unauthorized access than files shared via HTTP.

4 Transport Services and Network Communication

1. Suppose you wanted to do a transaction from a remote client to a server as fast as possible. Would you use UDP or TCP? Why?
2. Suppose you wanted to do a transaction from a remote client to a server and it was critical to ensure your transaction was processed and processed correctly. Would you use UDP or TCP? Why?
3. Describe an application that requires no data loss and that is also highly time-sensitive?

5 HTTP, DNS, and the Web

1. Explain why you think HTTP uses TCP instead of UDP.
2. Describe how Web caching can reduce the delay in receiving a requested object. Will Web caching reduce the delay for all objects requested by a user or for only some of the objects? Why?
3. Obtain the HTTP/1.1 specification (RFC2616). Answer the following questions:
 - a) Explain the mechanism used for signaling between the client and server to indicate that a persistent connection is being closed. Can the client, the server, or both signal the close of a connection?
 - b) Can a client open three or more simultaneous connections with a given server?
4. Answer the following questions regarding DNS:
 - a) What is a *whois* database?
 - b) Use the ARIN whois database to determine the IP address ranges used by the University of Maryland.
 - c) How can an attack leverage open DNS resolvers to conduct DDoS attacks?
5. Suppose you can access the caches in the local DNS servers of your department. Can you propose a way to roughly determine the Web servers (outside your department) that are most popular among the users in your department? Explain.

6. Assume you are developing a video streaming service to compete with Netflix. You want to make your service cheaper by reducing your infrastructure costs (e.g., dollars spent on bandwidth, file transfers, and building out data centers). Describe a content distribution strategy that may help you achieve these goals.

6 Socket Programming

1. A UDP server needs only one socket for accepting data, whereas TCP servers need two sockets. Why?
2. If a TCP server were to support n simultaneous connections, each from a different client, how many sockets would the TCP server need?