Fall Term 2006
TelCom 2310
Computer Networks
Monday 3:00 pm - 5:50 pm
Sennott Square 6110
http://www.cs.pitt.edu/∼znati/tel2310.html

Homework 4
Due Date : 10/12/2006

Problem 1

Consider an HTTP client that wants to retrieve a Web document at a given URL. The IP address of the HTTP server is initially unknown. The Web document of the URL has one embedded GIF image that resides at the same server as the original document.

1. What transport and application layer protocols besides HTTP are needed in this scenario?
2. Based on the HTTP/1.1 specification (RFC 2616)[1], explain the mechanism used for signaling between the client and server to indicate that a persistent connection is begin closed. Can the client, the server, or both signal the close of a connection?
3. What encryption services are provided by HTTP?

Problem 2

Suppose within your Web browser you click on a link to obtain a Web page. The IP address of the associated URL is not cached in your local host, so a DNS look-up is necessary to obtain the IP address. Suppose that n DNS servers are visited before your host received the IP address from DNS; the successive visits induct an RTT of RTT_1, RTT_2, ... RTT_n, respectively. Further, suppose that the Web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Let RTT_0 denote the RTT between the local host and the server containing the object.

1. Assuming zero transmission time of the object, how much time elapses from when the client clicks on the link until the client receives the object?
2. Suppose the HTML file references three very small objects on the same server. Neglecting the transmission times, how much time elapses with:
   (a) Nonpersistent HTTP with no parallel TCP connections?
   (b) Nonpersistent HTTP with parallel TCP connections?
   (c) Persistent HTTP with pipelining?

[1] Click inside the box to view the RFC in PDF format in a separate window.

Problem 3

Suppose there are N active peers in a Gnutella network, and each pair of peers has an active TCP connection. Additionally, suppose that the TCP connections pass through a total of M routers.

1. How many nodes and edges are there in the corresponding overlay network?

   Now, assume that each participating node, in a Gnutella network, maintains TCP connections to at **least four distinct** peers at all times. Suppose Peer X, which has five TCP connections to other peers, wants to leave.

   (a) First consider the case of a graceful departure, that is , Peer X explicitly closed his application, thereby gracefully closing its five TCP connections. What actions would each of the five formerly connected peers take?

   (b) Now suppose that X abruptly disconnects for the Internet without notifying its five neighbors that it is closing the TCP connections. What would happen?

Problem 4

Suppose that an application layer entity wants to send an L-byte message to its per process, using and existing TCP connection. The TCP segment consists of a message plus 20 bytes of header. The segment is encapsulated into an IP packet that has an additional 20 bytes of header. The IP packet goes inside an Ethernet Frame that has 18 bytes of header and trailer.

1. What percentage of the transmitted bits in the physical layer corresponds to message information if L = 100 bytes?
2. What percentage of the transmitted bits in the physical layer corresponds to message information if L = 500 bytes?
3. What percentage of the transmitted bits in the physical layer corresponds to message information if L = 1000 bytes?

Problem 5

In this problem, we explore TCP performance with respect to two different applications.

1. In the first case, suppose that the TCP entity receives a 1.5 megabyte file from the application yet that the IP layer is willing to carry blocks of a maximum size of 1500 bytes. Compute the amount of overhead incurred from segmenting the file into packet-sized units.
2. In the second, the focus is on a real-time application. Suppose that a TCP entity receives a digital voice stream from the application layer. The voice stream arrives at a rate of 8000 bytes/second. Suppose that TCP arranges bytes into block sizes that result in a total TCP

and IP header overhead of 50 percent. How much delay is incurred by the first byte in each block.