EP2120 Internetworking/Internetteknik
IK2218 Internets Protokoll och Principer

Homework Assignment 3

Solutions due 17:00, September 30, 2015
Review due 17:00, October 2, 2015

Problems

1. Socket Interface (15 p)

The pseudo-code sample below (with most details omitted) describes an application that uses the socket interface (API) for communication.

```
s = socket(…);
bind(s, …);
listen(s, …);
while true {
    t = accept(s, …);
    recv(t, …);
    ProcessRequest(…);
    send(t, …);
    close(t);
}
```

a) Is the sample code for a client or a server? Does it use TCP or UDP? Explain your answer. (5 p)
b) The textbook gives two examples of communication using the socket interface: 1) connection-oriented, concurrent communication and 2) connectionless, iterative communication. Characterize the communication in the sample code using this terminology. (5 p)
c) In practice, this kind of communication is not frequently used. What is the main limitation? (5 p)

2. Multimedia Communication (25 p)

A video source is generating video frames of size 10,000 bytes at a constant rate of 25 frames per second. The frames are transmitted over a network with 1 Gb/s Ethernet links, and arrive at the receiver with a maximum jitter (delay variation) of 200 milliseconds.

a) What is the minimum size of the playback buffer in order to ensure smooth playback of the video stream at the receiver? (10 p)
b) The video frames are encapsulated in RTP and then transmitted over UDP. What is the reason for using RTP on top of UDP? What does it provide, that UDP does not? (5 p)
c) Consider the statement "A TCP connection has large variations in delay because of its error control, flow control and congestion control mechanisms. Therefore, it cannot be used for multimedia communication." Do you agree with the conclusion? Explain you answer. (5 p)
d) There are in fact compelling reasons for using TCP instead of UDP for multimedia communication. Give two such reasons. (5 p)

3. Web (35 p)

Suppose that you click on a link on a web page, which causes the following HTTP request to be sent. ("\r\n" means end of line – carriage return and line feed.)

```
GET /claypool HTTP/1.1\r\n
Host: www.opera.org:1935\r\n
Connection: keep-alive\r\n
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/
*;q=0.8\r\n
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_10_5)
AppleWebKit/600.8.9 (KHTML, like Gecko) Version/8.0.8
Safari/600.8.9\r\n
Cookie: driftwood=1.37034309.18321484.12653012.16530224.5\r\n
Accept-Encoding: gzip,deflate,sdch\r\n
Accept-Language: en-US,en;q=0.8\r\n
\r\n
```

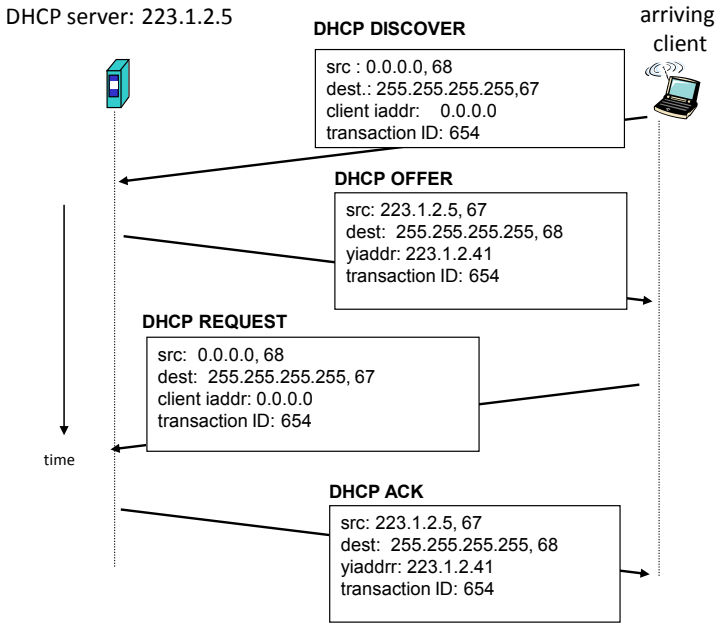
The server gives the following response:

```
HTTP/1.1 200 OK\r\n
Date: Wed, 23 Sep 2015 20:54:23 GMT\r\n
Server: Apache/2.2.3 (Red Hat)\r\n
Location: https://www.opera.org:1935/claypool/\r\n
Connection: keep-alive\r\n
Keep-alive: timeout=10, max=4\r\n
Cache-Control: no-cache\r\n
Etag: "feedabee"\r\n
Content-Length: 6928\r\n
Content-Type: text/html; charset=iso-8859-1\r\n
\r\n
more data…
```

a) Which object does the browser request? Answer by giving its URL. (3 p)
b) Which version of HTTP is the browser using? What kind of connection is requested, persistent or non-persistent? (Note that the textbook does not cover header fields related to persistence, so you may want to consult other resources, on the Internet for example.) (4 p)
c) What kind of connection does the server accept, persistent or non-persistent? (3 p)
d) Considering the kind of connection used, how long time does it take from that you click on the link until the entire page is loaded? The page consists of five embedded images, as separate objects. The round-trip delay to the server is 10 milliseconds. You have an ultrafast connection to the server, both your computer and the server are very powerful, so transfer time and processing time are neglectable. (Hint: study the header fields carefully.) (10 p)
e) Can you tell whether the client has visited the web site before? Explain! (5 p)
f) There is a proxy server sitting between the client and the server. If the client soon after receiving the response sends another request for the same object, what would the proxy server do? (Hint: to answer this question you also need to study header fields that are not discussed in the textbook.) (10 p)

4. DHCP (25 p)

Consider the following DHCP message exchange, where DHCP client arrives and requests an IP address from the DCHP server.



Answer the following questions:

a) Why can't the client use the IP address offered in the DHCP OFFER as source address when it sends the DHCP REQUEST back to the server? (10 p)
b) When (at what point in the message sequence above) can the client start using the IP address offered by the server? (5 p)
c) Why is the DHCP REQUEST sent to the limited broadcast address instead of directly to the DHCP server? (5 p)
d) Why is the DCHP client using a well-known port number instead of a random port number (which is the normal way a client would select its own port)? (5 p)