CS 3873: Net-Centric Computing

Assignment 2: Network Applications

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[Mandatory] Declaration: “I warrant that this is my own work.”

Signed by Mahmoud Moustafa

[Optional] “I hereby give my permission for this work to be used (with my name and identifying information removed) for UNB Faculty of Computer Science program accreditation purposes.”

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1. (2 points) True or false?
    a. A user requests a Web page that consists of some text and three images. For this page, the client will send one HTTP request message and receive four HTTP response messages. Assume HTTP/1.1 is used.
    Answer: F
    b. With non-persistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.
    Answer: F
    c. The Date: header in the HTTP response message indicates when the object in the response was last modified.
    Answer: F
    d. HTTP response messages never have an empty entity body.
    Answer: F
2. (4 points) Consider the following string of ASCII characters that were captured by Wireshark when the browser sent an HTTP GET message (i.e., this is the actual content of an HTTP GET message). The characters are carriage return and line-feed characters (that is, the italic character string in the text below represents the single carriage-return character that was contained at that point in the HTTP header). Answer the following questions, indicating where in the HTTP GET message below you find the answer.

```
GET /cs453/index.html HTTP/1.1<cr><lf>Host: gai
a.cs.umass.edu<cr><lf>User-Agent: Mozilla/5.0 (
Windows;U; Windows NT 5.1; en-US; rv:1.7.2) Gec
ko/20040804 Netscape/7.2 (ax) <cr><lf>Accept:ex
t/xml, application/xml, application/xhtml+xml, text
/html;q=0.9, text/plain;q=0.8,image/png,*/*;q=0.5
<cr><lf>Accept-Language: en-us,en;q=0.5<cr><lf>Accept-
Encoding: zip,deflate<cr><lf>Accept-Charset: ISO
-8859-1,utf-8;q=0.7,*;q=0.7<cr><lf>Keep-Alive: 300<cr>
<lf>Connection:keep-alive<cr><lf><cr><lf>
```

-2: need to indicate where you find it in each question

    a. What is the complete URL (in the format http://.......) of the object requested by the browser?
    Answer: http://gaia.cs.umass.edu/cs453/index.html
    b. What version of HTTP is the browser running?
    Answer: HTTP/1.1
    c. Does the browser request a non-persistent or a persistent connection?
    Answer: persistent
    d. What is the file type of the requested object?
    Answer: html
3. (2 points) Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL has been cached in your local host, so a DNS lookup is not necessary to obtain the IP address. Suppose that the Web page associated with the link contains a small amount of HTML text, and it references to 8 very small objects on the same server. Neglect transmission times and let RTT_w denote the RTT

between the local host and the Web server containing the objects. How much time (in terms of RTT_w) elapses with

a. Non-persistent HTTP with no parallel TCP connections?

Answer: $(RTT_w + RTT_w + d_{trans}) * 9$

b. Persistent HTTP?

Answer: $RTT_w + (RTT_w + d_{trans}) * 9$

-1.5: need to calculate the final values in terms of RTTw

4. (1 point) In BitTorrent, consider a new peer Alice that joins BitTorrent without possessing any chunks. Without any chunks, she cannot become a top-four uploader for any of the other peers, since she has nothing to upload. How then will Alice get her first chunk?
Answer: using random neighbor selection. Every 30 seconds, a different peer is selected and sent chunks. The selected peer is said to be optimistically unchoked. Random peer selection allows new peers to get chunks, so that they can have something to trade.

5. (6 points) Consider distributing a file of F = 20 GB to N peers. The server has an upload rate of u_s = 1 Gbps, and each peer has a download rate of d_i = 20 Mbps and an upload rate of u_i. For N = 10, N = 100, or N = 1000, and u_i = 500 kbps, u_i = 5 Mbps, or u_i = 25 Mbps, prepare a table giving the distribution time for each of the combinations of N and u_i for both client-server distribution and P2P distribution. For simplicity, round your results for the distribution time into integers in terms of seconds. (Hint: Pay attention to the units in the question. You can refer to the following appendix.)

Distribution time for client / server:
$\max\{NF/u_s, F/d_i\}$

u_i (Mbps)	N = 10	N = 100	N = 1000
0.5	8000s = $8*10^3$s	16000s | $16*10^3$s	160000s | $16*10^4$s
5	8000s = $8*10^3$s	16000s | $16*10^3$s	160000s | $16*10^4$s
25	8000s = $8*10^3$s	16000s | $16*10^3$s	160000s | $16*10^4$s

Distribution time for peer-to-peer:
$\mathrm{Max}\{F/u_s, NF/(u_s+Nu_i), F/d_i\}$

u_i (Mbps)	N = 10	N = 100	N = 1000
0.5	10940s	15238s	106667s
5	8000s	10667s	26667s
25	8000s	8000s	8000s

$N = 10 \quad F = 20\,GB \quad u_s = 1\,Gbps \quad d_i = 20\,Mbps$

$u_i = 0.5\,Mbps$

$\max\{NF/u_s,\ F/d_i\}$

$F = 20 \times 10^9 \times 8 = 160{,}000{,}000{,}000$ bits $= 16 \times 10^{10}$ bits

$u_s = 1 \times 10^9 = 1{,}000{,}000{,}000$ bits/s

$d_i = 20 \times 10^6 = 20{,}000{,}000$ bits/s

$0.5 \times 10^6 = 500{,}000$ bits/s

$10 \times 160000000000 / 1000000000 = 1600$

$(16 \times 10^{10}) / 20 \times 10^6 = 8000 = 8 \times 10^3$

$N = 100$

$100 \times (16 \times 10^{10}) = 16 \times 10^{12}$

$(16 \times 10^{12}) / 1 \times 10^9 = 16\,000 = 16 \times 10^3$

$(16 \times 10^{10}) / 20 \times 10^6 = 8\,000 = 8 \times 10^3$

$N = 1000$

$(1000 \times (16 \times 10^{10})) / 1 \times 10^9 = 160\,000 = 16 \times 10^4$

$(16 \times 10^{10}) / 20 \times 10^6 = 8000 = 8 \times 10^3$

$u_i = 5$ Mbps $= 5\times10^6$ bits/s

$N=10$

$\max\{NF/u_s, F/d_i\}$

$(10\times(16\times10^{10}))/1\times10^9 = 1600 = 16\times10^2$

$(16\times10^{10})/20\times10^6 = 8000$

$N=100$

$(100\times(16\times10^{10}))/1\times10^9 = 16\,000 = 16\times10^3$

$(16\times10^{10})/20\times10^6 = 8000$

$N=1000$

$(1000\times(16\times10^{10}))/1\times10^9 = 160\,000 = 16\times10^4$

$(16\times10^{10})/20\times10^6 = 8000$

$u_i = 25$ Mbps $= 25\times10^6$ bits/s

$N=10$

$(10\times(16\times10^{10}))/1\times10^9 = 1600 = 16\times10^2$

$(16\times10^{10})/20\times10^6 = 8\,000 = 8\times10^3$

$N=100$

$(100\times(16\times10^{10}))/1\times10^9 = 16\,000 = 16\times10^3$

$(16\times10^{10})/20\times10^6 = 8\,000 = 8\times10^3$

$N=1000$

$(1000\times(16\times10^{10}))/1\times10^9 = 160\,000 = 16\times10^4$

$(16\times10^{10})/20\times10^6 = 8000 = 8\times10^3$

$\max\{F/u_s, NF/(u_s + Nu_i), F/d_i\}$

$F = 16\times10^{10}$, $N = 10$, $u_s = 1\times10^9$, $u_i = 0.5\times10^6$, $d_i = 20\times10^6$

$(16\times10^{10})/1\times10^9 = 160 = 16\times10^1$

$(10\times(16\times10^{10}))/(1\times10^9 + 10\times0.5\times10^6) = 10940.4$

$16\times10^{10}/20\times10^6 = 8000$

$N = 100$, $u_i = 0.5\times10^6$

$(16\times10^{10})/1\times10^9 = 160$

$(100\times(16\times10^{10}))/(1\times10^9 + 100\times0.5\times10^6) = 15238.1$

$16\times10^{10}/20\times10^6 = 8000$

$N = 1000$, $u_i = 0.5\times10^6$

$(16\times10^{10})/1\times10^9 = 160$

$(1000\times(16\times10^{10}))/(1\times10^9 + 1000\times0.5\times10^6) = 106667$

$(16\times10^{10})/20\times10^6 = 8000$

$N = 10$, $u_i = 5\times10^6$

$(16\times10^{10})/1\times10^9 = 160$

$(10\times(16\times10^{10}))/(1\times10^9 + 10\times5\times10^6) = 1524$

$(16\times10^{10})/20\times10^6 = 8000$

$N = 100$, $u_i = 5\times10^6$

$(100\times(16\times10^{10}))/(1\times10^9 + 100\times5\times10^6) = 10667$

$160 < \underline{10667} > 8000$

$N = 1000$, $u_i = 5\times10^6$

$(1000\times(16\times10^{10}))/(1\times10^9 + 1000\times5\times10^6) = 26667$

$160 < 26667 > 8000$

$N = 10,\ u_i = 25 \times 10^6$ $\quad NF/(u_s + Nu_i)$

$(10 \times (16 \times 10^{10}))/(1 \times 10^9 + 10 \times 25 \times 10^6) = 1280$

$160 < 1280 < 8000$

$N = 100,\ u_i = 25 \times 10^6$

$(100 \times (16 \times 10^{10}))/(1 \times 10^9 + 100 \times 25 \times 10^6) = 4571$

$160 < 4571 < 8000$

$N = 1000,\ u_i = 25 \times 10^6$

$(1000 \times (16 \times 10^{10}))/(1 \times 10^9 + 1000 \times 25 \times 10^6) = 6154$

$160 < 6154 < 8000$