

23-1 computer network

Hw1 due 10.09 23:59

22100579 Jinju Lee

1.

1-a. 50 users

1-b. 0.2

1-c.

$$P(n) = {}^{100}C_n (0.2)^n \times 0.8^{100-n}$$

1-d.

$$(\text{if there are } n \text{ user}) P(X > 31) = \sum_{k=31}^n {}^nC_k (p)^k (1-p)^{n-k}$$

2.

$$\left( \frac{721}{312} = \frac{96 \text{ byte}}{5 \text{ mbyte/s}} = \frac{96 \cdot 8 \text{ bit}}{5 \cdot 10^6 \text{ bit}} = 0.0001536 \text{ s} = 0.1536 \text{ msec} \right) + 5 \text{ msec} + 6 \text{ msec} = 11.1536 \text{ msec}$$

11.1536 (msec)

3.

3-a. 200msec, 6000msec

3-b. 2msec, 4msec

3-c. 204msec / if we don't use message segmentation, the transmission delay is  $N \cdot P \cdot (L/R)$ . but when we use message segmentation, the transmission delay is  $(N+P-1) \cdot (L/R)$  and as  $P$  increases, it becomes more time-efficient to use message segmentation. (N: number of links, P: number of packets, L: length of packet, R: bps of link)

3-d. using message segmentation is very useful when the switches use store-and-forward packets switching. Each router should store all unit to send to next router, and the unit need to be stored became smaller when using message segmentation, it can prevent packet loss. And message

segmentation makes the users who want to be using the same link can using it fair. It prevents that user need to be waiting too much time for a single transfer.

4.

Non-persistence requires RTT time for each packet transmissions. So, we need handshaking 11 times. But even if we use parallel downloads, the total time is same as non-parallel downloads because each link transmit rate became  $300/N$  bps when there are  $N$  parallel connections. So, I think this way is not efficient because cannot take the advantage of parallel connections.

If we consider persistent HTTP, the procedure of 10 handshaking is not needed. Still, we cannot take the advantage of parallel connection, but the absolute time taken might be better than non-persistent way because its matter of amount of data needs to be delivered.

5.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.97.239	203.252.97.81	TCP	66	51411 → 9442 [SYN] Seq=0 Win=642
2	1.194609	192.168.97.239	20.24.125.47	TCP	54	51339 → 443 [RST, ACK] Seq=1 Ack=
3	2.004839	192.168.97.239	203.252.97.81	TCP	66	[TCP Retransmission] 51411 → 944
4	4.704767	192.168.97.239	192.168.97.89	DNS	75	Standard query 0x54ac A www.exam
5	4.704981	192.168.97.239	192.168.97.89	DNS	75	Standard query 0xbf46 AAAA www.e
6	4.842118	192.168.97.89	192.168.97.239	DNS	91	Standard query response 0x54ac A
7	4.971153	192.168.97.89	192.168.97.239	DNS	103	Standard query response 0xbf46 A
8	4.983920	2001:2d8:7002:8424:...	2606:2800:220:1:248...	TCP	86	51412 → 80 [SYN] Seq=0 Win=64860
9	5.123640	2606:2800:220:1:248...	2001:2d8:7002:8424:...	TCP	86	80 → 51412 [SYN, ACK] Seq=0 Ack=
10	5.123705	2001:2d8:7002:8424:...	2606:2800:220:1:248...	TCP	74	51412 → 80 [ACK] Seq=1 Ack=1 Win=
11	5.124365	2001:2d8:7002:8424:...	2606:2800:220:1:248...	HTTP	234	GET / HTTP/1.1
12	5.265390	2606:2800:220:1:248...	2001:2d8:7002:8424:...	TCP	74	80 → 51412 [ACK] Seq=1 Ack=161 W
13	5.276907	2606:2800:220:1:248...	2001:2d8:7002:8424:...	TCP	1294	80 → 51412 [ACK] Seq=1 Ack=161 W
14	5.276907	2606:2800:220:1:248...	2001:2d8:7002:8424:...	HTTP	445	HTTP/1.1 200 OK (text/html)
15	5.276960	2001:2d8:7002:8424:...	2606:2800:220:1:248...	TCP	74	51412 → 80 [ACK] Seq=161 Ack=159
16	5.808517	IntelCor_66:26:96	9e:a8:a5:3e:ea:89	ARP	42	Who has 192.168.97.89? Tell 192.
17	5.812541	9e:a8:a5:3e:ea:89	IntelCor_66:26:96	ARP	42	192.168.97.89 is at 9e:a8:a5:3e:
18	6.012045	192.168.97.239	203.252.97.81	TCP	66	[TCP Retransmission] 51411 → 944

Whole packets

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.97.239	203.252.97.81	TCP	66	51411 → 9442 [SYN] Seq=0 Win=0
2	1.194609	192.168.97.239	20.24.125.47	TCP	54	51339 → 443 [RST, ACK] Seq=51339 Win=0 Len=0
3	2.004839	192.168.97.239	203.252.97.81	TCP	66	[TCP Retransmission] 51411 → 9442 [SYN] Seq=0 Win=0
4	4.704767	192.168.97.239	192.168.97.89	DNS	75	Standard query 0x54ac A www.example.com
5	4.704767	192.168.97.89	192.168.97.239	DNS	91	Standard query response 0x54ac AAAA www.example.com
6	4.842118	192.168.97.89	192.168.97.239	DNS	103	Standard query response 0x54ac A www.example.com
7	4.971153	192.168.97.89	192.168.97.239	DNS	103	Standard query response 0x54ac A www.example.com
8	4.983920	2001:2d8:7002:8424::...	2606:2800:220:1:248::...	TCP	86	51412 → 80 [SYN] Seq=0 Win=0
9	5.123640	2606:2800:220:1:248::...	2001:2d8:7002:8424::...	TCP	86	80 → 51412 [SYN, ACK] Seq=0 Win=0
10	5.123705	2001:2d8:7002:8424::...	2606:2800:220:1:248::...	TCP	74	51412 → 80 [ACK] Seq=1 Ack=80
11	5.124365	2001:2d8:7002:8424::...	2606:2800:220:1:248::...	HTTP	234	GET / HTTP/1.1
12	5.265390	2606:2800:220:1:248::...	2001:2d8:7002:8424::...	TCP	74	80 → 51412 [ACK] Seq=1 Ack=80
13	5.276907	2606:2800:220:1:248::...	2001:2d8:7002:8424::...	TCP	1294	80 → 51412 [ACK] Seq=1 Ack=80

  

> Frame 4: 75 bytes on wire (600 bits), 75 bytes captured (600 bits) on interface \Device\NPF{...}

> Ethernet II, Src: IntelCor\_66:26:96 (60:f6:77:66:26:96), Dst: 9e:a8:a5:3e:ea:89 (9e:a8:a5:3e:ea:89)

> Internet Protocol Version 4, Src: 192.168.97.239, Dst: 192.168.97.89

> User Datagram Protocol, Src Port: 53868, Dst Port: 53

> Domain Name System (query)

Transaction ID: 0xb46

Flags: 0x0100 Standard query query

0... .. = Response: Message is a query

.000 0... .. = Opcode: Standard query (0)

... .. = Truncated: Message is not truncated

... .. = Recursion desired: Do query recursively

... .. = Z: reserved (0)

... .. = Non-authenticated data: Unacceptable

Questions: 1

Answer RRs: 0

Authority RRs: 0

Additional RRs: 0

Queries

www.example.com: type A, class IN

Name: www.example.com

[Name Length: 15]

[Label Count: 3]

Type: A (Host Address) (1)

5-a. first destination might be the IP of my default DNS.

Dst: 192.168.97.89

5-b. UDP protocol

<p>&gt; Frame 4: 75 bytes on wire (600 bits), 75 bytes captured (600 bits) on interface \Device\NPF{...}</p> <p>&gt; Ethernet II, Src: IntelCor_66:26:96 (60:f6:77:66:26:96), Dst: 9e:a8:a5:3e:ea:89 (9e:a8:a5:3e:ea:89)</p> <p>&gt; Internet Protocol Version 4, Src: 192.168.97.239, Dst: 192.168.97.89</p> <p>&gt; User Datagram Protocol, Src Port: 53868, Dst Port: 53</p> <p>&gt; Domain Name System (query)</p> <p>Transaction ID: 0xb46</p> <p>Flags: 0x0100 Standard query query</p> <p>0... .. = Response: Message is a query</p> <p>.000 0... .. = Opcode: Standard query (0)</p> <p>... .. = Truncated: Message is not truncated</p> <p>... .. = Recursion desired: Do query recursively</p> <p>... .. = Z: reserved (0)</p> <p>... .. = Non-authenticated data: Unacceptable</p> <p>Questions: 1</p> <p>Answer RRs: 0</p> <p>Authority RRs: 0</p> <p>Additional RRs: 0</p> <p>Queries</p> <p>www.example.com: type A, class IN</p> <p>Name: www.example.com</p> <p>[Name Length: 15]</p> <p>[Label Count: 3]</p> <p>Type: A (Host Address) (1)</p>	<p>&gt; Internet Protocol Version 4, Src: 192.168.97.239, Dst: 192.168.97.89</p> <p>&gt; User Datagram Protocol, Src Port: 53868, Dst Port: 53</p> <p>&gt; Domain Name System (query)</p> <p>Transaction ID: 0xb46</p> <p>Flags: 0x0100 Standard query query</p> <p>0... .. = Response: Message is a query</p> <p>.000 0... .. = Opcode: Standard query (0)</p> <p>... .. = Truncated: Message is not truncated</p> <p>... .. = Recursion desired: Do query recursively</p> <p>... .. = Z: reserved (0)</p> <p>... .. = Non-authenticated data: Unacceptable</p> <p>Questions: 1</p> <p>Answer RRs: 0</p> <p>Authority RRs: 0</p> <p>Additional RRs: 0</p> <p>Queries</p> <p>www.example.com: type AAAA, class IN</p> <p>Name: www.example.com</p> <p>[Name Length: 15]</p> <p>[Label Count: 3]</p> <p>Type: AAAA (IPv6 Address) (28)</p> <p>Class: IN (0x0001)</p> <p>[Response In: 7]</p>
---	---

5-c.

response filed is 0 and it means this is query packet. Opcode is type of query, and the value is 0000 in common case. Truncation is 0 and it means that all the contents is delivered. Recursion is 1 and it means this packet is using recursion. Reserved bit is reserved, so it is cleared to 0. Question means the number of questions. In these cases, only one question is delivered. Other fields are number of each session.

Queries are consisting of some fields. Name filed contains name of domain that required, and name of host. Type means type of query. In the cases, A mean the address of host and AAAA means address of Ipv6. Class filed is type of network class. The case is IN, means Internet.

<pre> .....0 .... = Non-authenticated data: Unacceptable ..... 0000 = Reply code: No error (0) Questions: 1 Answer RRs: 1 Authority RRs: 0 Additional RRs: 0   Queries     www.example.com: type A, class IN       Name: www.example.com       [Name Length: 15]       [Label Count: 3]       Type: A (Host Address) (1)       Class: IN (0x0001)   Answers     www.example.com: type A, class IN, addr 93.184.216.34       Name: www.example.com       Type: A (Host Address) (1)       Class: IN (0x0001)       Time to live: 49492 (13 hours, 44 minutes, 52 seconds)       Data length: 4       Address: 93.184.216.34       [Request In: 4]       [Time: 0.137351000 seconds] </pre>	<pre> .....0 .... = Non-authenticated data: Unacceptable ..... 0000 = Reply code: No error (0) Questions: 1 Answer RRs: 1 Authority RRs: 0 Additional RRs: 0   Queries     www.example.com: type AAAA, class IN       Name: www.example.com       [Name Length: 15]       [Label Count: 3]       Type: AAAA (IPv6 Address) (28)       Class: IN (0x0001)   Answers     www.example.com: type AAAA, class IN, addr 2606:2800:220:1:248:1893:25c8:1946       Name: www.example.com       Type: AAAA (IPv6 Address) (28)       Class: IN (0x0001)       Time to live: 1800 (30 minutes)       Data length: 16       AAAA Address: 2606:2800:220:1:248:1893:25c8:1946       [Request In: 5]       [Time: 0.266172000 seconds] </pre>
---	--

5-d.

Answers section is about the response of queries and consist of some fields. Name filed indicates name of domain, type and class filed are same as above answer. Time to live means the time DNS server saved the data as cache. Data length is length of data, and Address is actual data they tried to deliver.

5-e.

In the final response packet, AAAA Address might be the IP address.

**AAAA Address: 2606:2800:220:1:248:1893:25c8:1946**

<pre> 11 5.124365 2001:2d8:7002:8424:... 2606:2800:220:1:248... HTTP 234 GET / HTTP/1.1 12 5.265390 2606:2800:220:1:248... 2001:2d8:7002:8424:... TCP 74 80 → 51412 [ACK] Seq=1 Ack= </pre>	<pre> &gt; Frame 11: 234 bytes on wire (1872 bits), 234 bytes captured (1872 bits) on inter &gt; Ethernet II, Src: IntelCor_66:26:96 (60:f6:77:66:26:96), Dst: 9e:a8:a5:3e:ea:89   Internet Protocol Version 6, Src: 2001:2d8:7002:8424:7870:bd05:7408:af14, Dst: 2606:2800:220:1:248:1893:25c8:1946     0110 .... = Version: 6     .... 0000 0000 .... = Traffic Class: 0x00 (DSCP: CS0, ECN: 0)     .... 0010 1000 0100 1110 0100 = Flow Label: 0x284e4     Payload Length: 180     Next Header: TCP (6)     Hop Limit: 6     Source Address: 2001:2d8:7002:8424:7870:bd05:7408:af14     Destination Address: 2606:2800:220:1:248:1893:25c8:1946   Transmission Control Protocol, Src Port: 51412, Dst Port: 80, Seq: 1, Ack: 1, Len: 180     Source Port: 51412     Destination Port: 80     [Stream index: 2]     [Conversation completeness: Incomplete, DATA (15)]     [TCP Segment Len: 160]     Sequence Number: 1 (relative sequence number)     Sequence Number (raw): 1024046280     [Next Sequence Number: 161 (relative sequence number)]     Acknowledgment Number: 1 (relative ack number) </pre>
---	--

5-f. TCP protocol

11	5.124365	2001:2d8:7002:8424::...	2606:2800:220:1:248::...	HTTP	234 GET / HTTP/1.1	
12	5.265390	2606:2800:220:1:248::...	2001:2d8:7002:8424::...	TCP	74 80 → 51412 [ACK] Seq=1 Ack=	
13	5.276907	2606:2800:220:1:248::...	2001:2d8:7002:8424::...	TCP	1294 80 → 51412 [ACK] Seq=1 Ack=	
14	5.276907	2606:2800:220:1:248::...	2001:2d8:7002:8424::...	HTTP	445 HTTP/1.1 200 OK (text/html	
15	5.276960	2001:2d8:7002:8424::...	2606:2800:220:1:248::...	TCP	74 51412 → 80 [ACK] Seq=161 Ac	

  

> Frame 11: 234 bytes on wire (1872 bits), 234 bytes captured (1872 bits) on interface	0000	9e a8 a5 3e ea
> Ethernet II, Src: IntelCor_66:26:96 (60:f6:77:66:26:96), Dst: 9e:a8:a5:3e:ea:89 (9e:a8:a5:3e:ea:89)	0010	84 e4 00 b4 06
> Internet Protocol Version 6, Src: 2001:2d8:7002:8424::7870:bd05:7408:af14, Dst: 2606:2800:220:1:248::80	0020	bd 05 74 08 af
> Transmission Control Protocol, Src Port: 51412, Dst Port: 80, Seq: 1, Ack: 1, Len: 234	0030	18 93 25 c8 1f
> Hypertext Transfer Protocol	0040	42 57 50 18 06
> GET / HTTP/1.1\r\n	0050	48 54 54 50 21
User-Agent: Mozilla/5.0 (Windows NT; Windows NT 10.0; ko-KR) WindowsPowerShell/5.0	0060	67 65 6e 74 3a
Host: www.example.com\r\n	0070	30 20 28 57 69
Connection: Keep-Alive\r\n	0080	69 6e 64 6f 77
\r\n	0090	6b 6f 72 4b 52
[Full request URI: http://www.example.com/]	00a0	77 65 72 53 68
[HTTP request 1/1]	00b0	32 31 2e 31 31
[Response in frame: 14]	00c0	77 77 2e 65 7f
	00d0	43 6f 6e 6e 65
	00e0	2d 41 6c 69 76

5-g. User-Agent means OS information of client's application. In this case, User-agent is like that.

User-Agent: Mozilla/5.0 (Windows NT; Windows NT 10.0; ko-KR) WindowsPowerShell/

14	5.276907	2606:2800:220:1:248::...	2001:2d8:7002:8424::...	HTTP	445 HTTP/1.1 200 OK (text/html	
15	5.276960	2001:2d8:7002:8424::...	2606:2800:220:1:248::...	TCP	74 51412 → 80 [ACK] Seq=161 Ac	

  

> Frame 14: 445 bytes on wire (3560 bits), 445 bytes captured (3560 bits) on interface	0000	60 f6 77 66 26 96
> Ethernet II, Src: 9e:a8:a5:3e:ea:89 (9e:a8:a5:3e:ea:89), Dst: IntelCor_66:26:96	0010	51 f2 01 87 06
> Internet Protocol Version 6, Src: 2606:2800:220:1:248:1893:25c8:1946, Dst: 2001:2d8:7002:8424::80	0020	18 93 25 c8 19 46
> Transmission Control Protocol, Src Port: 80, Dst Port: 51412, Seq: 1221, Ack: 161, Len: 445	0030	bd 05 74 08 af 14
> [2 Reassembled TCP Segments (1591 bytes): #13(1220), #14(371)]	0040	b5 68 50 18 00 1f
> Hypertext Transfer Protocol	0050	68 3a 20 61 75 1f
> HTTP/1.1 200 OK\r\n	0060	20 7d 0a 20 20 20
Age: 300250\r\n	0070	74 79 6c 65 3e 1f
Cache-Control: max-age=604800\r\n	0080	3e 0a 0a 3c 62 00
Content-Type: text/html; charset=UTF-8\r\n	0090	20 20 20 20 3c 00
Date: Sat, 07 Oct 2023 12:55:34 GMT\r\n	00a0	44 6f 6d 61 69 00
Etag: "3147526947+ident"\r\n	00b0	3c 70 3e 54 68 00
Expires: Sat, 14 Oct 2023 12:55:34 GMT\r\n	00c0	73 20 66 6f 72 1f
Last-Modified: Thu, 17 Oct 2019 07:18:26 GMT\r\n	00d0	75 73 74 72 61 1f
Server: ECS (3c7:5037)\r\n	00e0	65 73 20 69 6e 1f
Vary: Accept-Encoding\r\n	00f0	20 59 6f 75 20 20
X-Cache: HIT\r\n	0100	73 0a 20 20 20 20
> Content-Length: 1256\r\n	0110	6c 69 74 65 72 1f
\r\n	0120	75 74 20 70 72 1f
[HTTP response 1/1]	0130	61 74 69 6f 6e 1f
[Time since request: 0.152542000 seconds]	0140	66 6f 72 20 70 1f
	0150	2f 70 3e 0a 20 20

5-h HTTP/1.1 version

5-i. status code returned from the server is 200 OK

5-j last modified time is like that.

Last-Modified: Thu, 17 Oct 2019 07:18:26 GMT\r\n

14	5.276907	2606:2800:220:1:248...	2001:2d8:7002:8424:...	HTTP	445	HTTP/1.1	200	OK	(text/html)
15	5.276960	2001:2d8:7002:8424:	2606:2800:220:1:248	TCP	74	51412 → 80	[ACK]	Seq=161	Ar

> HTTP/1.1 200 OK\r\nAge: 300250\r\nCache-Control: max-age=604800\r\nContent-Type: text/html; charset=UTF-8\r\nDate: Sat, 07 Oct 2023 12:55:34 GMT\r\nEtag: "3147526947+ident"\r\nExpires: Sat, 14 Oct 2023 12:55:34 GMT\r\nLast-Modified: Thu, 17 Oct 2019 07:18:26 GMT\r\nServer: ECS (sec/96EE)\r\nVary: Accept-Encoding\r\nX-Cache: HIT\r\nContent-Length: 1256\r\n\r\n[HTTP response 1/1]\n[Time since request: 0.152542000 seconds]\n[Request in frame: 11]\n[Request URI: http://www.example.com/]

01303a 20 48 49 54014065 6e 67 74 68015021 64 6f 63 74016068 74 6d 6c 3e017020 3c 74 69 74018044 6f 6d 61 69019020 20 20 20 3c01a074 3d 22 75 7401b020 3c 6d 65 7401c076 3d 22 43 6f01d020 63 6f 6e 7401e074 6d 6c 3b 2001f02d 38 22 20 2f020020 6e 61 6d 65021020 63 6f 6e 74022064 65 76 69 63023069 74 69 61 6c02403e 0a 20 20 20

5-k. bytes of contents are 1256 in this case.