

## CS F303 - Computer Networks

### Assignment 1

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## Question 4.

### 1. List of applications generating background traffic

#### i) Sophos

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.16.229.69	172.16.0.30	TCP	54	33760 → 8090 [FIN, ACK] Seq=1 Ack=1 Win=3109 Len=0
▶ Frame 1: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface 0						
▶ Ethernet II, Src: IntelCor_14:06:6d (ac:ed:5c:14:06:6d), Dst: All-HSRP-routers_e1 (00:00:0c:07:ac:e1)						
▶ Internet Protocol Version 4, Src: 172.16.229.69, Dst: 172.16.0.30						
▼ Transmission Control Protocol, Src Port: 33760, Dst Port: 8090, Seq: 1, Ack: 1, Len: 0						
Source Port: 33760						
Destination Port: 8090						
[Stream index: 0]						
[TCP Segment Len: 0]						
Sequence number: 1 (relative sequence number)						
[Next sequence number: 1 (relative sequence number)]						
Acknowledgment number: 1 (relative ack number)						
0101 .... = Header Length: 20 bytes (5)						
▶ Flags: 0x011 (FIN, ACK)						
Window size value: 3109						
[Calculated window size: 3109]						
[Window size scaling factor: -1 (unknown)]						
Checksum: 0xa097 [unverified]						
[Checksum Status: Unverified]						
Urgent pointer: 0						
▶ [Timestamps]						

#### ii) Canonical-core

22	36.222057260	35.222.85.5	172.16.229.69	TCP	54	80 → 45168 [ACK] Seq=240 Ack=89 Win=29312 Len=0
23	111.764171739	172.16.229.69	91.189.89.199	NTP	90	NTP Version 4, client
24	116.935151136	IntelCor_14:06:6d	All-HSRP-routers_e1	ARP	42	Who has 172.16.225.1? Tell 172.16.229.69
25	117.004216415	All-HSRP-routers_e1	IntelCor_14:06:6d	ARP	60	172.16.225.1 is at 00:00:0c:07:ac:e1
26	144.014251551	172.16.229.69	91.189.89.199	NTP	90	NTP Version 4, client
27	149.191134316	IntelCor_14:06:6d	All-HSRP-routers_e1	ARP	42	Who has 172.16.225.1? Tell 172.16.229.69
28	149.215028343	All-HSRP-routers_e1	IntelCor_14:06:6d	ARP	60	172.16.225.1 is at 00:00:0c:07:ac:e1
29	208.264243824	172.16.229.69	91.189.89.199	NTP	90	NTP Version 4, client
▶ Ethernet II, Src: IntelCor_14:06:6d (ac:ed:5c:14:06:6d), Dst: All-HSRP-routers_e1 (00:00:0c:07:ac:e1)						
▶ Internet Protocol Version 4, Src: 172.16.229.69, Dst: 91.189.89.199						
▼ User Datagram Protocol, Src Port: 34158, Dst Port: 123						
Source Port: 34158						
Destination Port: 123						
Length: 56						
Checksum: 0x92d3 [unverified]						
[Checksum Status: Unverified]						
[Stream index: 0]						
▼ Network Time Protocol (NTP Version 4, client)						
▶ Flags: 0x23, Leap Indicator: no warning, Version number: NTP Version 4, Mode: client						
Peer Clock Stratum: unspecified or invalid (0)						
Peer Polling Interval: invalid (0)						
Peer Clock Precision: 1.000000 sec						
Root Delay: 0 seconds						
Root Dispersion: 0 seconds						
Reference ID: NULL						
Reference Timestamp: Jan 1, 1970 00:00:00.000000000 UTC						
Origin Timestamp: Jan 1, 1970 00:00:00.000000000 UTC						
Receive Timestamp: Jan 1, 1970 00:00:00.000000000 UTC						
Transmit Timestamp: Feb 7, 2020 13:37:09.195854326 UTC						

#### iii) ARP Protocol - Address Resolution Protocol requests.

ARP is the method by which any host or router on a LAN can dynamically learn the MAC address of another host or router on the same LAN.

No.	Time	Source	Destination	Protocol	Length	Info
24	0.299503266	Dell fe:34:1a	Broadcast	ARP	60	Who has 172.16.38.102? Tell 172.16.38.114
69	0.619299287	Cisco 60:71:03	Broadcast	ARP	60	Who has 172.16.38.116? Tell 172.16.38.1
70	0.686838572	Dell 33:06:ae	Cisco-Li_51:d2:66	ARP	60	Who has 172.16.38.19? Tell 172.16.38.132
71	0.686843415	Dell 33:06:ae	D-LinkIn_f8:35:37	ARP	60	Who has 172.16.38.11? Tell 172.16.38.132
72	0.686843865	Dell 33:06:ae	Netgear_ed:8b:33	ARP	60	Who has 172.16.38.12? Tell 172.16.38.132
73	0.686857722	Dell 33:06:ae	Smartlin_44:06:1e	ARP	60	Who has 172.16.38.26? Tell 172.16.38.132
74	0.686864429	Dell 33:06:ae	Dell 33:fd:42	ARP	60	Who has 172.16.38.16? Tell 172.16.38.132
75	0.686908661	Dell 33:06:ae	AsustekC_78:df:fd	ARP	60	Who has 172.16.38.111? Tell 172.16.38.132
76	0.686909661	Dell 33:06:ae	D-LinkIn_6d:c9:17	ARP	60	Who has 172.16.38.32? Tell 172.16.38.132
77	0.686914042	Dell 33:06:ae	RealtekS_40:1f:73	ARP	60	Who has 172.16.38.49? Tell 172.16.38.132
78	0.686948779	Dell 33:06:ae	Dell 66:a7:5a	ARP	60	Who has 172.16.38.52? Tell 172.16.38.132
79	0.686949256	Dell 33:06:ae	da4b:27:1f:4f:7a	ARP	60	Who has 172.16.38.38? Tell 172.16.38.132
80	0.686958492	Dell 33:06:ae	Smartlin_4d:3b:fb	ARP	60	Who has 172.16.38.39? Tell 172.16.38.132
81	0.686965218	Dell 33:06:ae	Dell 2a:88:cb	ARP	60	Who has 172.16.38.55? Tell 172.16.38.132
82	0.687093817	Dell 33:06:ae	D-LinkIn_d4:c2:64	ARP	60	Who has 172.16.38.122? Tell 172.16.38.132
83	0.687094667	Dell 33:06:ae	Shenzhen_96:b6:39	ARP	60	Who has 172.16.38.58? Tell 172.16.38.132
84	0.687095909	Dell 33:06:ae	Tp-LinkT_dc:aa:12	ARP	60	Who has 172.16.38.161? Tell 172.16.38.132
85	0.687070346	Dell 33:06:ae	Dell_f4:d4:ba	ARP	60	Who has 172.16.38.65? Tell 172.16.38.132

#### iv) TCP Protocol - Handshakes

571	1.845864012	172.16.38.132	172.16.38.16	TCP	66	51849 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
573	1.846301544	172.16.38.132	172.16.38.111	TCP	66	51848 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
580	1.847201563	172.16.38.132	172.16.38.52	TCP	66	51853 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
581	1.847213137	172.16.38.132	172.16.38.49	TCP	66	51871 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
600	1.848193658	172.16.38.132	172.16.38.55	TCP	66	51876 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
621	1.850245908	172.16.38.132	172.16.38.161	TCP	66	51913 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
623	1.851183312	172.16.38.132	172.16.38.58	TCP	66	51897 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
642	1.852196221	172.16.38.132	172.16.38.172	TCP	66	51939 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
660	1.854290620	172.16.38.132	172.16.38.71	TCP	66	51961 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
672	1.856209211	172.16.38.132	172.16.38.144	TCP	66	51982 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
673	1.856220696	172.16.38.132	172.16.38.157	TCP	66	51985 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
687	1.857295737	172.16.38.132	172.16.38.153	TCP	66	51998 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
699	1.858174530	172.16.38.132	172.16.38.148	TCP	66	52005 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
700	1.858185845	172.16.38.132	172.16.38.146	TCP	66	52008 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
762	1.868270895	172.16.38.132	172.16.38.108	TCP	66	52099 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1

## 2 ◦ Analysis of the webpage download

In terms of the number of HTTP connections, etc, and screenshots of wireshark showing DNS packets, HTTP requests, TCP headers, IP headers, etc

### i. Servers for which a DNS query was launched

The servers for which a DNS query was launched are:

- 172.16.0.30
- 172.217.167.45 (accounts.google.com)
- 172.217.166.10, 172.217.167.35, 216.58.203.3, 172.217.166.234 (googleapis.com)
- 216.58.203.131 (gstatic.com)
- 103.68.199.23 (erp.bits-pilani.ac.in)

No.	Time	Source	Destination	Protocol	Length	Info
13	3.076742196	172.16.38.65	172.16.0.30	DNS	75	Standard query 0xf1ea A www.gstatic.com
14	3.077655770	172.16.0.30	172.16.38.65	DNS	91	Standard query response 0xf1ea A www.gstatic.com A 216.58.203.131
27	3.099768064	172.16.38.65	172.16.0.30	DNS	89	Standard query 0x3e6c A clientservices.googleapis.com
28	3.100161282	172.16.0.30	172.16.38.65	DNS	105	Standard query response 0x3e6c A clientservices.googleapis.com A 216.58.203.3
80	3.313819569	172.16.38.65	172.16.0.30	DNS	79	Standard query 0xe874 A accounts.google.com
82	3.314240893	172.16.0.30	172.16.38.65	DNS	95	Standard query response 0xe874 A accounts.google.com A 172.217.167.45
160	3.571263195	172.16.38.65	172.16.0.30	DNS	78	Standard query 0xddb0 A www.googleapis.com
161	3.571669472	172.16.0.30	172.16.38.65	DNS	94	Standard query response 0xddb0 A www.googleapis.com A 172.217.166.10
163	3.573704503	172.16.38.65	172.16.0.30	DNS	81	Standard query 0x8d08 A erp.bits-pilani.ac.in
176	3.616018629	172.16.0.30	172.16.38.65	DNS	97	Standard query response 0x8d08 A erp.bits-pilani.ac.in A 103.68.199.23
223	4.128945338	172.16.38.65	172.16.0.30	DNS	94	Standard query 0x8fbb A oauthaccountmanager.googleapis.com
224	4.129325349	172.16.0.30	172.16.38.65	DNS	110	Standard query response 0x8fbb A oauthaccountmanager.googleapis.com A 172.217.166.234
274	9.576940642	172.16.38.65	172.16.0.30	DNS	76	Standard query 0x7d8a A mtalk.google.com
275	9.577334779	172.16.0.30	172.16.38.65	DNS	121	Standard query response 0x7d8a A mtalk.google.com CNAME mobile-gtalk.l.google.com A 172.217.167.35
279	9.578206754	172.16.38.65	172.16.0.30	DNS	79	Standard query 0x0135 A clients4.google.com
280	9.578601436	172.16.0.30	172.16.38.65	DNS	119	Standard query response 0x0135 A clients4.google.com CNAME clients.l.google.com A 172.217.167.35
286	9.614419369	172.16.38.65	172.16.0.30	DNS	81	Standard query 0x21f5 A update.googleapis.com
287	9.614801635	172.16.0.30	172.16.38.65	DNS	97	Standard query response 0x21f5 A update.googleapis.com A 172.217.167.35
354	10.033348671	172.16.38.65	172.16.0.30	DNS	93	Standard query 0x0ff8 A lkqvstjhysyt.bits-hyderabad.ac.in
355	10.033797496	172.16.38.65	172.16.0.30	DNS	94	Standard query 0xf4d2 A tbzafxfbvycgm.bits-hyderabad.ac.in
356	10.034182588	172.16.38.65	172.16.0.30	DNS	89	Standard query 0x6fc7 A dbuutibs.bits-hyderabad.ac.in
366	10.115119303	172.16.0.30	172.16.38.65	DNS	89	Standard query response 0x6fc7 No such name A dbuutibs.bits-hyderabad.ac.in
368	10.122866446	172.16.0.30	172.16.38.65	DNS	93	Standard query response 0x0ff8 No such name A lkqvstjhysyt.bits-hyderabad.ac.in
369	10.124745568	172.16.0.30	172.16.38.65	DNS	94	Standard query response 0xf4d2 No such name A tbzafxfbvycgm.bits-hyderabad.ac.in



## ii. Number of HTTP requests generated

HTTP requests generated and their counts:

Time	Source	Destination	Protocol	Length	Info
81	3.314235096	172.16.38.65	HTTP	532	GET /psp/hcsprod/EMPLOYEE/HRMS/h/?ta
91	3.350615603	10.2.102.21	HTTP	74	HTTP/1.1 302 Moved Temporarily (tex
95	3.352483024	172.16.38.65	HTTP	700	GET /psp/hcsprod/EMPLOYEE/HRMS/h/?ta
101	3.392950021	10.2.102.21	HTTP	507	HTTP/1.1 302 Moved Temporarily (tex
114	3.465069445	172.16.38.65	HTTP	738	GET /psp/hcsprod/EMPLOYEE/HRMS/h/?ta
157	3.538810880	10.2.102.21	HTTP	1010	HTTP/1.1 200 OK (text/html)
164	3.574068797	172.16.38.65	HTTP	669	GET /favicon.ico HTTP/1.1
174	3.611888341	10.2.102.21	HTTP	1355	HTTP/1.1 404 Not Found (text/html)

Wireshark · Requests · enp2s0			
Topic / Item	Count	Average	Min
HTTP Requests by HTTP Host	4		
10.2.102.21:9000	4		
/psp/hcsprod/EMPLOYEE/HRMS/h/?tab=DEFAULT&cmd=login&errorCode=106&languageCd=UKE	1		
/psp/hcsprod/EMPLOYEE/HRMS/h/?tab=DEFAULT&	1		
/psp/hcsprod/EMPLOYEE/HRMS/h/?tab=DEFAULT	1		
/favicon.ico	1		

Number and type (response/request) of HTTP Packets:

Wireshark · Packet Counter · enp2s0								
Topic / Item	Count	Average	Min val	Max val	Rate (ms)	Percent	Burst rate	Burst start
Total HTTP Packets	8				0.0269	100%	0.0400	3.314
Other HTTP Packets	0				0.0000	0.00%	-	-
HTTP Response Packets	4				0.0134	50.00%	0.0200	3.351
???: broken	0				0.0000	0.00%	-	-
5xx: Server Error	0				0.0000	0.00%	-	-
4xx: Client Error	1				0.0034	25.00%	0.0100	3.612
404 Not Found	1				0.0034	100.00%	0.0100	3.612
3xx: Redirection	2				0.0067	50.00%	0.0200	3.351
302 Found	2				0.0067	100.00%	0.0200	3.351
2xx: Success	1				0.0034	25.00%	0.0100	3.539
200 OK	1				0.0034	100.00%	0.0100	3.539
1xx: Informational	0				0.0000	0.00%	-	-
HTTP Request Packets	4				0.0134	50.00%	0.0200	3.314
GET	4				0.0134	100.00%	0.0200	3.314

## iii. Number of TCP connections opened

Two TCP connections were established:

Address A	Port A	Address B	Port B	Packets	Bytes	Packets A → B	Bytes A → B	Packets B → A	Bytes B → A
172.16.38.65	60798	10.2.102.21	9000	31	18 k	16	1,736	15	16 k
172.16.38.65	60790	10.2.102.21	9000	13	2,318	7	1,047	6	1,271

The following are the TCP packets transmitted:

25	3.093095520	172.16.38.65	10.2.102.21	TCP	74	51782 → 9000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=3859718058 TSecr=0
26	3.093146514	172.16.38.65	10.2.102.21	TCP	74	51784 → 9000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=3859718058 TSecr=0
34	3.122784986	10.2.102.21	172.16.38.65	TCP	74	9000 → 51782 [SYN, ACK] Seq=0 Ack=1 Win=14360 Len=0 MSS=1436 WS=1 SACK_PERM=1
35	3.122819672	172.16.38.65	10.2.102.21	TCP	66	51782 → 9000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3859717830 TSecr=1
36	3.125414229	10.2.102.21	172.16.38.65	TCP	74	9000 → 51784 [SYN, ACK] Seq=0 Ack=1 Win=14360 Len=0 MSS=1436 WS=1 SACK_PERM=1
37	3.125447138	172.16.38.65	10.2.102.21	TCP	66	51784 → 9000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3859717833 TSecr=1
88	3.342595658	10.2.102.21	172.16.38.65	TCP	66	9000 → 51782 [ACK] Seq=1 Ack=467 Win=14826 Len=0 TSval=182789384 TSecr=
89	3.350577620	10.2.102.21	172.16.38.65	TCP	886	9000 → 51782 [PSH, ACK] Seq=1 Ack=467 Win=14826 Len=820 TSval=182789390 TSecr=
90	3.350603786	172.16.38.65	10.2.102.21	TCP	66	51782 → 9000 [ACK] Seq=467 Ack=821 Win=64128 Len=0 TSval=3859718058 TSecr=
92	3.350618697	172.16.38.65	10.2.102.21	TCP	66	51782 → 9000 [ACK] Seq=467 Ack=829 Win=64128 Len=0 TSval=3859718058 TSecr=
93	3.350620817	10.2.102.21	172.16.38.65	TCP	66	9000 → 51782 [FIN, ACK] Seq=829 Ack=467 Win=14826 Len=0 TSval=182789390 TSecr=
94	3.350676426	172.16.38.65	10.2.102.21	TCP	66	51782 → 9000 [FIN, ACK] Seq=467 Ack=830 Win=64128 Len=0 TSval=3859718058 TSecr=
96	3.373909776	10.2.102.21	172.16.38.65	TCP	66	9000 → 51782 [ACK] Seq=830 Ack=468 Win=14826 Len=0 TSval=182789414 TSecr=
97	3.385398802	10.2.102.21	172.16.38.65	TCP	66	9000 → 51784 [ACK] Seq=1 Ack=635 Win=14994 Len=0 TSval=182789427 TSecr=
98	3.392486551	10.2.102.21	172.16.38.65	TCP	500	9000 → 51784 [PSH, ACK] Seq=1 Ack=635 Win=14994 Len=434 TSval=182789431 TSecr=
99	3.392505134	172.16.38.65	10.2.102.21	TCP	66	51784 → 9000 [ACK] Seq=635 Ack=435 Win=64128 Len=0 TSval=3859718100 TSecr=
100	3.392775343	172.16.38.65	10.2.102.21	TCP	66	51784 → 9000 [FIN, ACK] Seq=635 Ack=435 Win=64128 Len=0 TSval=3859718100 TSecr=
102	3.392976884	172.16.38.65	10.2.102.21	TCP	54	51784 → 9000 [RST] Seq=635 Win=0 Len=0
103	3.394069709	172.16.38.65	10.2.102.21	TCP	74	51790 → 9000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=182789431 TSecr=
104	3.396808558	10.2.102.21	172.16.38.65	TCP	66	9000 → 51784 [FIN, ACK] Seq=876 Ack=635 Win=14994 Len=0 TSval=182789431 TSecr=
105	3.396832914	172.16.38.65	10.2.102.21	TCP	54	51784 → 9000 [RST] Seq=635 Win=0 Len=0
106	3.416350784	10.2.102.21	172.16.38.65	TCP	60	9000 → 51784 [RST, ACK] Seq=435 Ack=636 Win=0 Len=0
110	3.463182079	10.2.102.21	172.16.38.65	TCP	74	9000 → 51790 [SYN, ACK] Seq=0 Ack=1 Win=14360 Len=0 MSS=1436 WS=1 SACK_PERM=1
111	3.463221960	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3859718171 TSecr=1
132	3.513015682	10.2.102.21	172.16.38.65	TCP	66	9000 → 51790 [ACK] Seq=1 Ack=673 Win=15032 Len=0 TSval=182789543 TSecr=
133	3.514237950	10.2.102.21	172.16.38.65	TCP	386	9000 → 51790 [PSH, ACK] Seq=1 Ack=673 Win=15032 Len=320 TSval=182789543 TSecr=
134	3.514253005	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000 [ACK] Seq=673 Ack=321 Win=64128 Len=0 TSval=3859718222 TSecr=
135	3.516606225	10.2.102.21	172.16.38.65	TCP	1490	9000 → 51790 [PSH, ACK] Seq=321 Ack=673 Win=15032 Len=1424 TSval=182789543 TSecr=
136	3.516629988	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000 [ACK] Seq=673 Ack=1745 Win=64128 Len=0 TSval=3859718224 TSecr=
137	3.517757641	10.2.102.21	172.16.38.65	TCP	1490	9000 → 51790 [PSH, ACK] Seq=1745 Ack=673 Win=15032 Len=1424 TSval=182789543 TSecr=
138	3.517766795	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000 [ACK] Seq=673 Ack=3169 Win=64128 Len=0 TSval=3859718225 TSecr=
139	3.518909795	10.2.102.21	172.16.38.65	TCP	1490	9000 → 51790 [PSH, ACK] Seq=3169 Ack=673 Win=15032 Len=1424 TSval=182789543 TSecr=

140	3.518923865	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=673 Ack=4593 Win=64128 Len=0 TSval=3859718226
141	3.520025980	10.2.102.21	172.16.38.65	TCP	1490	9000 → 51790	[ACK]	Seq=4593 Ack=673 Win=15032 Len=1424 TSval=18278954
142	3.520042294	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=673 Ack=6017 Win=64128 Len=0 TSval=3859718227
143	3.521159360	10.2.102.21	172.16.38.65	TCP	1490	9000 → 51790	[PSH, ACK]	Seq=6017 Ack=673 Win=15032 Len=1424 TSval=182
144	3.521167908	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=673 Ack=7441 Win=64128 Len=0 TSval=3859718229
145	3.522195453	10.2.102.21	172.16.38.65	TCP	1490	9000 → 51790	[PSH, ACK]	Seq=7441 Ack=673 Win=15032 Len=1424 TSval=182
146	3.522202624	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=673 Ack=8865 Win=64128 Len=0 TSval=3859718230
147	3.523309262	10.2.102.21	172.16.38.65	TCP	1490	9000 → 51790	[PSH, ACK]	Seq=8865 Ack=673 Win=15032 Len=1424 TSval=182
148	3.523320182	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=673 Ack=10289 Win=64128 Len=0 TSval=3859718231
149	3.524399880	10.2.102.21	172.16.38.65	TCP	1490	9000 → 51790	[ACK]	Seq=10289 Ack=673 Win=15032 Len=1424 TSval=1827895
150	3.524411540	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=673 Ack=11713 Win=64128 Len=0 TSval=3859718232
151	3.525543697	10.2.102.21	172.16.38.65	TCP	1490	9000 → 51790	[PSH, ACK]	Seq=11713 Ack=673 Win=15032 Len=1424 TSval=18
152	3.525553936	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=673 Ack=13137 Win=64128 Len=0 TSval=3859718233
153	3.526408687	10.2.102.21	172.16.38.65	TCP	1170	9000 → 51790	[PSH, ACK]	Seq=13137 Ack=673 Win=15032 Len=1104 TSval=18
154	3.526427079	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=673 Ack=14241 Win=64128 Len=0 TSval=3859718234
155	3.535664561	10.2.102.21	172.16.38.65	TCP	386	9000 → 51790	[PSH, ACK]	Seq=14241 Ack=673 Win=15032 Len=320 TSval=182
156	3.535700859	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=673 Ack=14561 Win=64128 Len=0 TSval=3859718243
158	3.538859119	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=673 Ack=15505 Win=64128 Len=0 TSval=3859718246
173	3.607849351	10.2.102.21	172.16.38.65	TCP	66	9000 → 51790	[ACK]	Seq=15505 Ack=1276 Win=15635 Len=0 TSval=182789647
175	3.611916176	172.16.38.65	10.2.102.21	TCP	66	51790 → 9000	[ACK]	Seq=1276 Ack=16794 Win=64128 Len=0 TSval=38597183

iv. Total time taken for download of the entire webpage measured as the time at which the first request was sent and the time when the last packet was received

First request: 3.093095520s

Last request: 3.611916176s

The total time taken to download the entire webpage is:

$3.611916176 - 3.093095520 = \underline{0.5188206476 \text{ seconds.}}$

v. Any TCP losses/retransmits noticed

Some losses and retransmits of TCP packets were observed.

147	3.948311288	172.16.38.65	10.2.102.21	TCP	54	60790 → 9000	[RST]	Seq=635 Win=0 Len=0
146	3.948299528	10.2.102.21	172.16.38.65	TCP	66	9000 → 60790	[ACK]	Seq=877 Ack=635 Win=15665 Len=0 TSval=622433653 TSecr=285676...
144	3.922403042	172.16.38.65	10.2.102.21	TCP	54	60790 → 9000	[RST]	Seq=634 Win=0 Len=0
143	3.922393512	10.2.102.21	172.16.38.65	TCP	66	9000 → 60790	[FIN, ACK]	Seq=876 Ack=634 Win=15665 Len=0 TSval=622433626 TSecr=2...
141	3.921200497	172.16.38.65	10.2.102.21	TCP	54	60790 → 9000	[RST]	Seq=634 Win=0 Len=0
139	3.921185542	172.16.38.65	10.2.102.21	TCP	54	60790 → 9000	[RST]	Seq=634 Win=0 Len=0
138	3.921129567	10.2.102.21	172.16.38.65	TCP	499	9000 → 60790	[PSH, ACK]	Seq=435 Ack=634 Win=15665 Len=433 TSval=622433626 TSecr...
137	3.920999918	172.16.38.65	10.2.102.21	TCP	66	60790 → 9000	[FIN, ACK]	Seq=634 Ack=435 Win=501 Len=0 TSval=2856769225 TSecr=62...
136	3.920849427	172.16.38.65	10.2.102.21	TCP	66	60790 → 9000	[ACK]	Seq=634 Ack=435 Win=501 Len=0 TSval=2856769225 TSecr=6224336...
135	3.920836719	10.2.102.21	172.16.38.65	TCP	500	9000 → 60790	[PSH, ACK]	Seq=1 Ack=634 Win=15665 Len=434 TSval=622433626 TSecr=2...
134	3.915150603	10.2.102.21	172.16.38.65	TCP	66	9000 → 60790	[ACK]	Seq=1 Ack=634 Win=15665 Len=0 TSval=622433621 TSecr=28567691...
133	3.908279995	172.16.38.65	10.2.102.21	TCP	66	60790 → 9000	[ACK]	Seq=1 Ack=1 Win=64256 Len=0 TSval=2856769213 TSecr=622433614
132	3.908253032	10.2.102.21	172.16.38.65	TCP	74	9000 → 60790	[SYN, ACK]	Seq=0 Ack=1 Win=14360 Len=0 MSS=1436 WS=1 SACK PERM=1 T...
130	3.878876574	172.16.38.65	10.2.102.21	TCP	74	60790 → 9000	[SYN]	Seq=0 Win=64240 Len=0 MSS=1460 SACK PERM=1 TSval=2856769183...