## CS F303 - Computer Networks Assignment 1

Ekanshi Agrawal Kushagra Srivastava Kunal Verma Sandesh Thakar 2017A7PS0233H 2017A7PS0146H 2017A7PS0120H 2017A7PS0181H

## Question 4.

### 1 • List of applications generating background traffic

i) Sophos

```
No.
      ▼ Time
                                             Destination
                        Source
                                                                   Protocol Length Info
   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]
      [Next sequence number: 1 (relative sequence number)
Acknowledgment number: 1 (relative sequence number: 1 (relative sequence number: 1)

Header leads
                                          (relative sequence number)]
                                          (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]
       Ürgent pointer: 0
    ▶ [Timestamps]
```

#### ii) Canonical-core

```
22 36.222057260 35.222.85.5
                                                                                   172.16.229.69
                                                                                                                                                 54 80 - 45168 [ACK] Seq=240 Ack=89 Win=29312 Len=0
          23 111.764771739 172.16.229.69 91.189.89.199
24 116.935151136 IntelCor_14:86:6d All-HSRP-routers_e1
25 117.904216415 All-HSRP-routers_e1 IntelCor_14:86:6d 91.189.89.199
                                                                                                                                                90 NTP Version 4, client
42 Who has 172.16.225.1? Tell 172.16.229.69
                                                                                  91.189.89.199
All-HSRP-routers_e1
                                                                                                                                                90 NTP Version 4, client
42 Who has 172.16.225.17 Tell 172.16.229.69
60 172.16.225.1 is at 00:00:0c:07:ac:e1
                                                                                                                           ARP
          ARP
                                                                                                                           ARP
           29 208.264243824 172.16.229.69
                                                                                                                                                 90 NTP Version 4, client
                                                                                   91.189.89.199
► 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

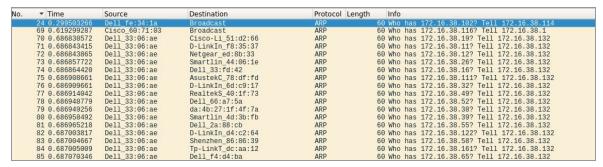
■ User Datagram Protocol. Src Port: 34158, Dst Port: 123
          er Datagram Protoco
Source Port: 34158
          Destination Port: 123
         Length: 56
Checksum: 0x92d3 [unverified]
[Checksum Status: Unverified]
[Stream index: 0]

➤ Network Time Protocol (NTP Version 4, client)

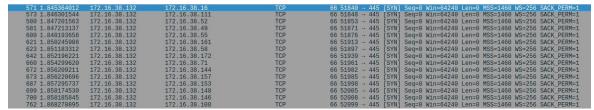
➤ Flags: 0x23, Leap Indicator: no warning, Version number: NTP Version 4, Mode: client Peer Clock Stratum: unspecified or invalid (0)
         Peer Polling Interval: invalid (0)
Peer Clock Precision: 1.000000 sec
Root Delay: 0 seconds
         Root Dispersion: 0 seconds
Reference ID: NULL
         Reference Timestamp: Jan 1, 1970 00:00:00.0000000000 UTC
Origin Timestamp: Jan 1, 1970 00:00:00.0000000000 UTC
Receive Timestamp: Jan 1, 1970 00:00:00.0000000000 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.



## iv) TCP Protocol - Handshakes



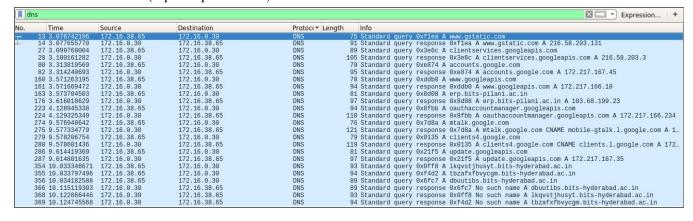
## 2 · Analysis of the webpage download

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)



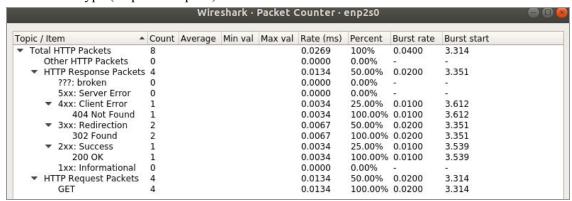
#### ii. Number of HTTP requests generated

HTTP requests generated and their counts:

Time	Source	Destination	Protoc(▼ Length	Info
81 3.314235096	172.16.38.65	10.2.102.21	HTTP 532	GET /psp/hcsprod/EMPLOYEE/HRMS/h/?ta
91 3.350615603	10.2.102.21	172.16.38.65	HTTP 74	HTTP/1.1 302 Moved Temporarily (tex
95 3.352483024	172.16.38.65	10.2.102.21	HTTP 700	GET /psp/hcsprod/EMPLOYEE/HRMS/h/?ta
101 3.392950021	10.2.102.21	172.16.38.65	HTTP 507	7 HTTP/1.1 302 Moved Temporarily (tex
114 3.465069445	172.16.38.65	10.2.102.21	HTTP 738	GET /psp/hcsprod/EMPLOYEE/HRMS/h/?ta
157 3.538810880	10.2.102.21	172.16.38.65	HTTP 1016	HTTP/1.1 200 OK (text/html)
164 3.574068797	172.16.38.65	10.2.102.21	HTTP 669	GET /favicon.ico HTTP/1.1
174 3.611888341	10.2.102.21	172.16.38.65	HTTP 1355	HTTP/1.1 404 Not Found (text/html)



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



#### iii. Number of TCP connections opened

Two TCP connections were established:



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=385
26 3.093146514	172.16.38.65	10.2.102.21	TCP	74 51784 - 9000 SYN Seg=0 Win=64240 Len=0 MSS=1460 SACK PERM=1 TSval=385
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
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
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 Seg=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
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 TSe
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 TSe
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
94 3.350876426	172.16.38.65	10.2.102.21	TCP	66 51782 - 9000 [FIN, ACK] Seq=467 Ack=830 Win=64128 Len=0 TSval=385971805
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 TSec
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
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 TSe
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=385971810
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=385
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
105 3.396832914	172.16.38.65	10.2.102.21	TCP	54 51784 9000 [RST] Seq=635 Win=0 Len=0
L 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_
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=182789549
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 TSe
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=182789
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 TS
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=18278
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 TS
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=18278

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 TSV	al=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=142	4 TSval=182
144 3.521167908	172.16.38.65	10.2.102.21	TCP	66 51790 → 9000 [ACK] Seg=673 Ack=7441 Win=64128 Len=0 TSval=	
145 3.522195453	10.2.102.21	172.16.38.65	TCP	1490 9000 - 51790 [PSH, ACK] Seg=7441 Ack=673 Win=15032 Len=142	
146 3.522202624	172.16.38.65	10,2,102,21	TCP	66 51790 → 9000 [ACK] Seg=673 Ack=8865 Win=64128 Len=0 TSval=	
147 3.523309262	10.2.102.21	172.16.38.65	TCP	1490 9000 - 51790 [PSH, ACK] Seq=8865 Ack=673 Win=15032 Len=142	
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	
149 3.524399880	10.2.102.21	172.16.38.65	TCP	1490 9000 - 51790 [ACK] Seg=10289 Ack=673 Win=15032 Len=1424 TS	
150 3.524411540	172.16.38.65	10.2.102.21	TCP	66 51790 → 9000 [ACK] Seg=673 Ack=11713 Win=64128 Len=0 TSval	
151 3.525543607	10.2.102.21	172.16.38.65	TCP	1490 9000 - 51790 [PSH, ACK] Seq=11713 Ack=673 Win=15032 Len=14	
152 3.525553936	172.16.38.65	10.2.102.21	TCP	66 51790 → 9000 [ACK] Seg=673 Ack=13137 Win=64128 Len=0 TSval	
153 3.526408687	10.2.102.21	172.16.38.65	TCP	1170 9000 - 51790 [PSH, ACK] Seg=13137 Ack=673 Win=15032 Len=11	
154 3.526427079	172.16.38.65	10.2.102.21	TCP	66 51790 → 9000 [ACK] Seg=673 Ack=14241 Win=64128 Len=0 TSval	
155 3.535664561	10.2.102.21	172.16.38.65	TCP	386 9000 - 51790 [PSH, ACK] Seq=14241 Ack=673 Win=15032 Len=32	
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	
158 3.538859119	172.16.38.65	10.2.102.21	TCP	66 51790 → 9000 [ACK] Seg=673 Ack=15505 Win=64128 Len=0 TSval	
173 3.607849351	10.2.102.21	172.16.38.65	TCP	66 9000 → 51790 [ACK] Seg=15505 Ack=1276 Win=15635 Len=0 TSva.	
175 3.611916176	172.16.38.65	10.2.102.21	TCP	66 51790 → 9000 [ACK] Seg=1276 Ack=16794 Win=64128 Len=0 TSva.	

# 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 = 0.5188206476 seconds.

## v. Any TCP losses/retransmits noticed

Some losses and retransmits of TCP packets were observed.

			-		
1	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
1988	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 60798 - 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 - 60798 [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 60798 - 9000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2856769183
1					