

CS 6043: Computer Networking

FALL 2017

PROJECT 3

Given: Nov. 15 (Wednesday), 2017

Due: Nov. 29 (Wednesday), 2017 (NO LATER THAN 11:59PM)

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Submission Instructions:

1. Submit only on-line files on Blackboard before midnight. No hard copy will be accepted.
2. For students who are working in a team, one submission for the team is sufficient.
3. Wireshark files for this project can be found in the zip file
“Project_3_Wireshark_Traces.zip”.

Total possible points: 10

Part I: IP

Load the file ‘IP_project_3.pcapng’ in Wireshark and answer the following questions. The trace was generated while executing three *traceroute* commands with three different UDP datagram sizes (56, 2000, and 3000 bytes) on a computer with IP 10.63.7.60. The IP address of the target host was 103.74.84.13. Include screenshots in each case.

- 1.1 (0.5 pts) Select any of the ICMP echo packets from the trace. Within the IPv4 packet header, what is the value in the upper layer protocol field?

Answer:

ICMP – Protocol Number 1

```

    > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
      Total Length: 56
      Identification: 0xd5d0 (54736)
    > Flags: 0x00
      Fragment offset: 0
      Time to live: 254
    > Protocol: ICMP (1) Protocol: ICMP (1)
      Header checksum: 0xab58 [validation disabled]
      [Header checksum status: Unverified]
      Source: 10.32.32.1
      Destination: 10.63.7.60
      ...

```

- 1.2 (1 pts) Select any of the UDP packets generated from the second *traceroute* command. How many bytes are in the IP header? How many bytes are in the payload of the IP datagram? Explain how you determined the number of payload bytes.

Answer:

56 bytes are present in IP header (20 bytes IP header + 8 bytes UDP header + 28 bytes of Payload). 36 bytes of payload is present in IP datagram (UDP header + payload).

74	2.699330	10.63.7.60
75	2.699336	10.63.7.60
76	2.699340	10.63.7.60
77	2.699344	10.63.7.60
78	2.699348	10.63.7.60
79	2.699352	10.63.7.60
80	2.699355	10.63.7.60
81	2.699359	10.63.7.60
82	2.699362	10.63.7.60
83	2.699379	10.63.7.60
84	2.699382	10.63.7.60
		103.74.84.13
		UDP
▼ Internet Protocol Version 4, Src: 10.63.7.60, Dst: 103.74.84.13		
0100 = Version: 4		
.... 0101 = Header Length: 20 bytes (5)		
> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)		
Total Length: 56 Total Length: 56		
Identification: 0x55e5 (21989)		
> Flags: 0x00		
Fragment offset: 0		
Time to live: 9		
Protocol: UDP (17)		
Header checksum: 0x8efe [validation disabled]		
[Header checksum status: Unverified]		
Source: 10.63.7.60		
Destination: 103.74.84.13		
[Source GeoIP: Unknown]		
[Destination GeoIP: Unknown]		
▼ User Datagram Protocol, Src Port: 55593, Dst Port: 33458		
Source Port: 55593		

The payload under UDP header is 28 bytes as seen in the snapshot

```
[Destination GeoIP: Unknown]
▼ User Datagram Protocol, Src Port: 55593, Dst Port: 33458
  Source Port: 55593
  > Destination Port: 33458
  Length: 36
  Checksum: 0xcd07 [unverified]
  [Checksum Status: Unverified]
  [Stream index: 34]
▼ Data (28 bytes)
  Data: 404142434445464748494a4b4c4d4e4f5051525354555657...
  [Length: 28]
```

1.3 (0.5 pts) Observe the UDP packets generated from the first *traceroute* command.

Which fields in the IP datagram always change from one datagram to the next within this series of messages sent by 10.63.7.60?

Answer:

Fields that changed between consecutive UDP packets include identification number, header checksum, and Time to Live (TTL). See snapshots

Packet number 17

17	2.691161	10.63.7.60	103.74.84.13	UDP
18	2.691168	10.63.7.60	103.74.84.13	UDP
19	2.691172	10.63.7.60	103.74.84.13	UDP
20	2.691176	10.63.7.60	103.74.84.13	UDP
21	2.691179	10.63.7.60	103.74.84.13	UDP
22	2.691183	10.63.7.60	103.74.84.13	UDP
23	2.691188	10.63.7.60	103.74.84.13	UDP
24	2.691191	10.63.7.60	103.74.84.13	UDP
25	2.691195	10.63.7.60	103.74.84.13	UDP
26	2.691198	10.63.7.60	103.74.84.13	UDP
27	2.691202	10.63.7.60	103.74.84.13	UDP
28	2.691206	10.63.7.60	103.74.84.13	UDP
29	2.691210	10.63.7.60	103.74.84.13	UDP
30	2.691213	10.63.7.60	103.74.84.13	UDP
31	2.691217	10.63.7.60	103.74.84.13	UDP

> Destination: Cisco_96:51:44 (00:19:aa:96:51:44)
 > Source: Dell_bd:32:d5 (34:17:eb:bd:32:d5)
 Type: IPv4 (0x0800)

▾ Internet Protocol Version 4, Src: 10.63.7.60, Dst: 103.74.84.13

0100	= Version: 4
.... 0101	= Header Length: 20 bytes (5)
>	Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length:	56
Identification:	0x55cd (21965)
>	Flags: 0x00
Fragment offset:	0
>	Time to live: 1
Protocol:	UDP (17)
Header checksum:	0x9716 [validation disabled]
[Header checksum status: Unverified]	
Source:	10.63.7.60
Destination:	103.74.84.13
[Source GeoIP: Unknown]	
[Destination GeoIP: Unknown]	
>	User Datagram Protocol, Src Port: 43591, Dst Port: 33434
>	Data (28 bytes)

Packet number 18

16	2.691050	10.25.3.2	10.63.7.60	DNS
17	2.691161	10.63.7.60	103.74.84.13	UDP
18	2.691168	10.63.7.60	103.74.84.13	UDP
19	2.691172	10.63.7.60	103.74.84.13	UDP
20	2.691176	10.63.7.60	103.74.84.13	UDP
21	2.691179	10.63.7.60	103.74.84.13	UDP
22	2.691183	10.63.7.60	103.74.84.13	UDP
23	2.691188	10.63.7.60	103.74.84.13	UDP
24	2.691191	10.63.7.60	103.74.84.13	UDP
25	2.691195	10.63.7.60	103.74.84.13	UDP
26	2.691198	10.63.7.60	103.74.84.13	UDP
27	2.691202	10.63.7.60	103.74.84.13	UDP
28	2.691206	10.63.7.60	103.74.84.13	UDP
29	2.691210	10.63.7.60	103.74.84.13	UDP
30	2.691213	10.63.7.60	103.74.84.13	UDP
31	2.691217	10.63.7.60	103.74.84.13	UDP

> Destination: Cisco_96:51:44 (00:19:aa:96:51:44)
 > Source: Dell_bd:32:d5 (34:17:eb:bd:32:d5)
 Type: IPv4 (0x0800)

▼ Internet Protocol Version 4, Src: 10.63.7.60, Dst: 103.74.84.13

- 0100 = Version: 4
- 0101 = Header Length: 20 bytes (5)
- > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
 Total Length: 56
 Identification: 0x55ce (21966)
- > Flags: 0x00
 Fragment offset: 0
- > Time to live: 1
 Protocol: UDP (17)
 Header checksum: 0x9715 [validation disabled]
 [Header checksum status: Unverified]
 Source: 10.63.7.60
 Destination: 103.74.84.13
 [Source GeoIP: Unknown]
 [Destination GeoIP: Unknown]
- > User Datagram Protocol, Src Port: 51897, Dst Port: 33435

After every 3 UDP packets, the TTL increases by 1.

19	2.691172	10.63.7.60	103.74.84.13	UDP				
20	2.691176	10.63.7.60	103.74.84.13	UDP				
21	2.691179	10.63.7.60	103.74.84.13	UDP				
22	2.691183	10.63.7.60	103.74.84.13	UDP				
23	2.691188	10.63.7.60	103.74.84.13	UDP				
24	2.691191	10.63.7.60	103.74.84.13	UDP				
25	2.691195	10.63.7.60	103.74.84.13	UDP				
26	2.691198	10.63.7.60	103.74.84.13	UDP				
27	2.691202	10.63.7.60	103.74.84.13	UDP				
28	2.691206	10.63.7.60	103.74.84.13	UDP				
29	2.691210	10.63.7.60	103.74.84.13	UDP				
30	2.691213	10.63.7.60	103.74.84.13	UDP				
31	2.691217	10.63.7.60	103.74.84.13	UDP				
>	Destination: Cisco_96:51:44 (00:19:aa:96:51:44)							
>	Source: Dell_bd:32:d5 (34:17:eb:bd:32:d5)							
	Type: IPv4 (0x0800)							
>	Internet Protocol Version 4, Src: 10.63.7.60, Dst: 103.74.84.13							
0100	= Version: 4							
.... 0101	= Header Length: 20 bytes (5)							
>	Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)							
Total Length:	56							
Identification:	0x55d0 (21968)							
>	Flags: 0x00							
Fragment offset:	0							
>	Time to live: 2							
Protocol:	UDP (17)							
Header checksum:	0x9613 [validation disabled]							
[Header checksum status: Unverified]								
Source:	10.63.7.60							
Destination:	103.74.84.13							
[Source GeoIP: Unknown]								
[Destination GeoIP: Unknown]								

1.4 (1 pts) What is the value in the Identification field and the TTL field of the first ICMP packet (ping reply) received by 10.63.7.60?

Answer:

The value in identification field is 0x55d0 (21968) and TTL field is 1 as seen in the snapshot below.

23	2.691188	10.63.7.60	103.74.84.13	UDP
24	2.691191	10.63.7.60	103.74.84.13	UDP
25	2.691195	10.63.7.60	103.74.84.13	UDP
26	2.691198	10.63.7.60	103.74.84.13	UDP
27	2.691202	10.63.7.60	103.74.84.13	UDP
28	2.691206	10.63.7.60	103.74.84.13	UDP
29	2.691210	10.63.7.60	103.74.84.13	UDP
30	2.691213	10.63.7.60	103.74.84.13	UDP
31	2.691217	10.63.7.60	103.74.84.13	UDP
32	2.691221	10.63.7.60	103.74.84.13	UDP
33	2.691888	10.32.32.1	10.63.7.60	ICMP
34	2.691904	10.0.26.33	10.63.7.60	ICMP
35	2.691907	10.0.27.33	10.63.7.60	ICMP
36	2.691909	10.32.32.1	10.63.7.60	ICMP
[Destination GeoIP: Unknown]				
▼ Internet Control Message Protocol				
Type: 11 (Time-to-live exceeded)				
Code: 0 (Time to live exceeded in transit)				
Checksum: 0xfc4f [correct]				
[Checksum Status: Good]				
▼ Internet Protocol Version 4, Src: 10.63.7.60, Dst: 103.74.84.13				
0100 = Version: 4				
.... 0101 = Header Length: 20 bytes (5)				
> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)				
Total Length: 56				
Identification: 0x55d0 (21968)				
> Flags: 0x00				
Fragment offset: 0				
> Time to live: 1				
Protocol: UDP (17)				
Header checksum: 0x9713 [validation disabled]				
[Header checksum status: Unverified]				
Source: 10.63.7.60				
Destination: 103.74.84.13				
[Source GeoIP: Unknown]				

Part II: DHCP

Load the file ‘DHCP_project_3.pcapng’ in Wireshark and answer the following questions.

The trace was generated while releasing the host’s current IP address and renewing it multiple times (Release → Renew → Renew → Release → Renew). Include screenshots in each case.

[Hint: Apply display filter “bootp” in Wireshark to filter out DHCP packets]

2.1 (0.5 pts) What is the link-layer address and the hardware address length of the host?

Answer:

The MAC address length of the host is 48 bits and the address is c4:8e:8f:f7:e5:15.

```

▼ Ethernet II, Src: HonHaiPr_f7:e5:15 (c4:8e:8f:f7:e5:15), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  ▼ Destination: Broadcast (ff:ff:ff:ff:ff:ff)
    Address: Broadcast (ff:ff:ff:ff:ff:ff)
      .... ..1. .... .... .... .... = LG bit: Locally administered address (this is NOT the factory default)
      .... ..1. .... .... .... .... = IG bit: Group address (multicast/broadcast)
  ▼ Source: HonHaiPr_f7:e5:15 (c4:8e:8f:f7:e5:15)
    Address: HonHaiPr_f7:e5:15 (c4:8e:8f:f7:e5:15)
      .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
      .... ..0. .... .... .... .... = IG bit: Individual address (unicast)
  Type: IPv4 (0x0800)

```

2.2 (1 pts) What IP address is the DHCP server offering to your host in the first DHCP Offer message?

Answer:

192.168.200.212

```

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Seconds elapsed: 0  

> Bootp flags: 0x0000 (Unicast)  

Client IP address: 0.0.0.0  

Your (client) IP address: 192.168.200.212  

Next server IP address: 0.0.0.0  

Relay agent IP address: 0.0.0.0  

Client MAC address: HonHaiPr_f7:e5:15 (c4:8e:8f:f7:e5:15)  

Client hardware address padding: 000000000000000000000000  

Server host name not given  

Boot file name not given  

Magic cookie: DHCP  

> Option: (53) DHCP Message Type (Offer)  

> Option: (54) DHCP Server Identifier

```

2.3 (1 pts) Explain the purpose of the lease time. How long is the lease time in your trace?

Answer:

Lease time is used by DHCP server to assign time for which the IP address can be used by the client. Once the lease time is over, the client needs to renew its IP address.

The IP address lease time offered by DHCP server is 86400s or 1 day.

```

> Option: (53) DHCP Message Type (Offer)  

> Option: (54) DHCP Server Identifier  

▼ Option: (51) IP Address Lease Time  

  Length: 4  

  IP Address Lease Time: (86400s) 1 day  

> Option: (1) Subnet Mask  

> Option: (31) Router

```

2.4 (1 pts) Clear the *bootp* display filter. Were any ARP packets sent or received in the trace? If so, explain the purpose of those ARP packets with a screenshotted example.

Answer:

The ARP request is sent by the DHCP server running on IP 192.168.200.1. Since the ARP request has both source and destination address, it looks like DHCP server want's to know if the IP address 192.168.200.212 is associated with the MAC address c4:8e:8f:f7:e5:15.

The same ARP request is sent 3 times but there is no ARP response which indicates to DHCP server that the IP address 192.168.200.212 doesn't belong to any interface.

```
.... .0. .... .... .... = LG bit: Globally unique address (factory default)
.... .0. .... .... .... = IG bit: Individual address (unicast)
Type: ARP (0x0806)
✓ Address Resolution Protocol (request)
  Hardware type: Ethernet (1)
  Protocol type: IPv4 (0x0800)
  Hardware size: 6
  Protocol size: 4
  Opcode: request (1)
  Sender MAC address: ZyxelCom_ee:4d:9f (e8:37:7a:ee:4d:9f)
  Sender IP address: 192.168.200.1
  Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
  Target IP address: 192.168.200.212
```

Part III: Ethernet, ARP

Load the file ‘Eth_ARP_project_3.pcapng’ in Wireshark and answer the following questions. The trace was generated while a web page was accessed (<http://gaia.cs.umass.edu/wireshark-labs/HTTP-ethereal-lab-file3.html>). Include screenshots in each case.

[Hint: For some of the questions, it might be helpful to disable IP or higher layer protocols. To do this, go to *Analyze->Enabled Protocols*]

3.1 (1 pts) What is the 48-bit destination address in the Ethernet frame? Is this the Ethernet address of gaia.cs.umass.edu? Explain why you answered yes or no.

Answer:

The first Ethernet frame is the ARP request sent by host with IP address 192.168.1.105 to destination IP address 192.168.1.1 which is the routers LAN interface address. The source MAC address in the Ethernet frame is 00:d0:59:a9:3d:68, and the destination is the broadcast address ff:ff:ff:ff:ff:ff as the source host doesn't know the MAC address of routers LAN interface. Once the host obtains the MAC address, it would send the Ethernet packet to the router and the packet would be routed to gaia.cs.umass.edu. The destination IP address in the ARP Ethernet frame doesn't belong to gaia.cs.umass.edu. It's the routers IP address. In order to connect with gaia.cs.umass.edu, the host needs routers MAC address to send the next TCP packet through the router and establish connection with gaia.cs.umass.edu.

```

[Coloring Rule String: arp]
▼ Ethernet II, Src: AmbitMic_a9:3d:68 (00:d0:59:a9:3d:68), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  ▼ Destination: Broadcast (ff:ff:ff:ff:ff:ff)
    Address: Broadcast (ff:ff:ff:ff:ff:ff)
      .... ..1. .... .... .... = LG bit: Locally administered address (this is NOT the factory default)
      .... ...1. .... .... .... = IG bit: Group address (multicast/broadcast)
  ▼ Source: AmbitMic_a9:3d:68 (00:d0:59:a9:3d:68)
    Address: AmbitMic_a9:3d:68 (00:d0:59:a9:3d:68)
      .... ..0. .... .... .... = LG bit: Globally unique address (factory default)
      .... ...0. .... .... .... = IG bit: Individual address (unicast)
    Type: ARP (0x0806)
  ▼ Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: AmbitMic_a9:3d:68 (00:d0:59:a9:3d:68)
    Sender IP address: 192.168.1.105
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 192.168.1.1

```

3.2 (1 pts) Give the hexadecimal value for the two-byte ‘frame type’ field for frame number 10. What upper layer protocol does this correspond to?

Answer:

The upper layer protocol hex value is 0x800 and the corresponding upper layer protocol is IPv4.

6	13.542...	Telebit_73:8d:ce	Broadcast	ARP
7	17.444...	192.168.1.105	128.119.245.12	TCP
8	17.465...	128.119.245.12	192.168.1.105	TCP
9	17.465...	192.168.1.105	128.119.245.12	TCP
→ 10	17.466...	192.168.1.105	128.119.245.12	HTTP
11	17.494...	128.119.245.12	192.168.1.105	TCP
12	17.498...	128.119.245.12	192.168.1.105	TCP
13	17.500...	128.119.245.12	192.168.1.105	TCP
14	17.500...	192.168.1.105	128.119.245.12	TCP
15	17.527...	128.119.245.12	192.168.1.105	TCP
16	17.527...	128.119.245.12	192.168.1.105	HTTP
17	17.527...	192.168.1.105	128.119.245.12	TCP

```

[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ethertype:ip:tcp:http]
[Coloring Rule Name: HTTP]
[Coloring Rule String: http || tcp.port == 80 || http2]
▼ Ethernet II, Src: AmbitMic_a9:3d:68 (00:d0:59:a9:3d:68), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
  ▼ Destination: LinksysG_da:af:73 (00:06:25:da:af:73)
    Address: LinksysG_da:af:73 (00:06:25:da:af:73)
      .... ..0. .... .... .... = LG bit: Globally unique address (factory default)
      .... ...0. .... .... .... = IG bit: Individual address (unicast)
  ▼ Source: AmbitMic_a9:3d:68 (00:d0:59:a9:3d:68)
    Address: AmbitMic_a9:3d:68 (00:d0:59:a9:3d:68)
      .... ..0. .... .... .... = LG bit: Globally unique address (factory default)
      .... ...0. .... .... .... = IG bit: Individual address (unicast)
    Type: IPv4 (0x0800)
  ▼ Internet Protocol Version 4, Src: 192.168.1.105, Dst: 128.119.245.12
    Version: 4

```

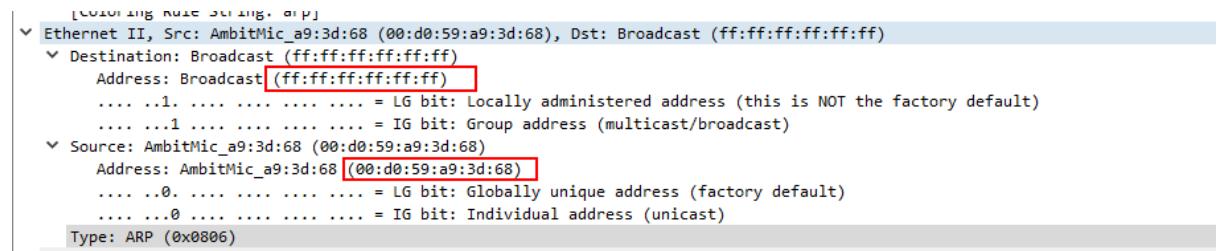
3.3 (0.5 pts) What are the hexadecimal values for the source and destination addresses in the Ethernet frame containing the ARP request message?

Answer:

The hexadecimal values for source and destination addresses in the Ethernet frame containing the ARP request message are the MAC addresses of the sending host and the broadcast.

Sending host: 00:d0:59:a9:3d:68

Broadcast: ff:ff:ff:ff:ff:ff



3.4 (1 pts) Does the ARP reply message contain the IP address of the requesting host? If yes, what is it?

Answer:

The ARP reply message contains the IP address of the requesting host. The IP address is 192.168.1.105.