

1. What is the 48-bit Ethernet address of your computer?

```
▼ Ethernet II, Src: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a), Dst: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e)
  ▼ Destination: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e)
    Address: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e)
    ....0. .... = LG bit: Globally unique address (factory default)
    ....0. .... = IG bit: Individual address (unicast)
  ▼ Source: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
    Address: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
    ....0. .... = LG bit: Globally unique address (factory default)
    ....0. .... = IG bit: Individual address (unicast)
```

My ethernet address: 30:9c:23:9d:2f:6a

2. What is the 48-bit destination address in the Ethernet frame? Is this the Ethernet address of gaia.cs.umass.edu? (Hint: the answer is no). What device has this as its Ethernet address? [Note: this is an important question, and one that students sometimes get wrong. Re-read pages 468-469 in the text and make sure you understand the answer here.]

```
▼ Ethernet II, Src: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a), Dst: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e)
  ▼ Destination: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e)
    Address: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e)
    ....0. .... = LG bit: Globally unique address (factory default)
    ....0. .... = IG bit: Individual address (unicast)
```

Destination address: 00:24:7b:8e:4a:8e

No, this is the ethernet address of my router to exit my subnet.

3. Give the hexadecimal value for the two-byte Frame type field. What upper layer protocol does this correspond to?

```
.....0
Type: IPv4 (0x0800)
Data (410 bytes)
```

0x0800, IPv4 protocol

4. How many bytes from the very start of the Ethernet frame does the ASCII “G” in “GET” appear in the Ethernet frame?

16

0000	00 24 7b 8e 4a 8e 30 9c 23 9d 2f 6a 08 00 45 00	·\$·J·0· #·/j·E·
0010	01 9a 2b ac 40 00 80 06 00 00 c0 a8 01 0b 80 77	··+·@········w
0020	f5 0c fb fa 00 50 63 76 c6 2b df 38 a0 c2 50 18	·····Pcv ·+·8··P·
0030	01 00 38 c4 00 00 47 45 54 20 2f 77 69 72 65 73	··8··GE T /wires
0040	68 61 72 6b 2d 6c 61 62 73 2f 48 54 54 50 2d 65	hark-lab s/HTTP-e

3 [

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 $(16 * 3) + 7 = 55$  bytes

5. What is the value of the Ethernet source address? Is this the address of your computer, or of `gaia.cs.umass.edu` (Hint: the answer is no). What device has this as its Ethernet address?

```
▼ Ethernet II, Src: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e), Dst: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
  ▼ Destination: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
    Address: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
    ....0. .... = LG bit: Globally unique address (factory default)
    ....0. .... = IG bit: Individual address (unicast)
  ▼ Source: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e)
    Address: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e)
    ....0. .... = LG bit: Globally unique address (factory default)
    ....0. .... = IG bit: Individual address (unicast)
  Type: IPv4 (0x0800)
```

Ethernet source address: 00:24:7b:8e:4a:8e

No, this is the address of my router again.

6. What is the destination address in the Ethernet frame? Is this the Ethernet address of your computer?

```
▼ Ethernet II, Src: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e), Dst: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
  ▼ Destination: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
    Address: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
    ....0. .... = LG bit: Globally unique address (factory default)
    ....0. .... = IG bit: Individual address (unicast)
```

Ethernet destination address: 30:9c:23:9d:2f:6a

Yes, this is the address of my computer.

7. Give the hexadecimal value for the two-byte Frame type field. What upper layer protocol does this correspond to?

```
Type: IPv4 (0x0800)
Data (1500 bytes)
```

0x0800, IPv4 protocol

8. How many bytes from the very start of the Ethernet frame does the ASCII “O” in “OK” (i.e., the HTTP response code) appear in the Ethernet frame?

16

30	9c	23	9d	2f	6a	00	24	7b	8e	4a	8e	08	00	45	00	00	#/j.\$ {J...E.
05	dc	a6	95	40	00	2e	06	69	4f	80	77	f5	0c	c0	a8	00	...@... iO.w...
01	0b	00	50	fb	fa	df	38	a0	c2	63	76	c7	9d	50	10	00	...P...8 ..cv..P.
00	ed	bc	91	00	00	48	54	54	50	2f	31	2e	31	20	32	00	...HT TP/1.1 2
30	30	20	4f	4b	0d	0a	44	61	74	65	3a	20	57	65	64	00	00 OK..D ate: Wed
2c	20	30	35	20	4a	75	6e	20	32	30	31	39	20	30	30	00	, 05 Jun 2019 00

4

4

$(16 \times 4) + 4 = 68$  bytes

**9. Write down the contents of your computer's ARP cache. What is the meaning of each column value?**

```
C:\Users\Joel>arp -a -v

Interface: 127.0.0.1 --- 0x1
  Internet Address      Physical Address      Type
  224.0.0.22            224.0.0.251          static
  230.0.0.1             239.255.255.250      static

Interface: 169.254.255.255 --- 0x8
  Internet Address      Physical Address      Type
  169.254.255.255       ff-ff-ff-ff-ff-ff    static
  224.0.0.22            01-00-5e-00-00-16    static
  224.0.0.251           01-00-5e-00-00-fb    static
  224.0.0.252           01-00-5e-00-00-fc    static
  239.255.255.250       01-00-5e-7f-ff-fa    static
  255.255.255.255       ff-ff-ff-ff-ff-ff    static

Interface: 192.168.1.11 --- 0xb
  Internet Address      Physical Address      Type
  169.254.38.221        00-00-00-00-00-00    invalid
  169.254.245.28        00-00-00-00-00-00    invalid
  192.168.1.1           00-24-7b-8e-4a-8e    dynamic
  192.168.1.2           00-00-00-00-00-00    invalid
  192.168.1.4           00-d9-d1-b6-55-d9    dynamic
  192.168.1.5           00-00-00-00-00-00    invalid
  192.168.1.6           00-00-00-00-00-00    invalid
  192.168.1.7           00-00-00-00-00-00    invalid
  192.168.1.160         00-00-00-00-00-00    invalid
  192.168.1.229         00-00-00-00-00-00    invalid
  192.168.1.255         ff-ff-ff-ff-ff-ff    static
  224.0.0.22            01-00-5e-00-00-16    static
  224.0.0.251           01-00-5e-00-00-fb    static
  224.0.0.252           01-00-5e-00-00-fc    static
  239.255.255.250       01-00-5e-7f-ff-fa    static
  255.255.255.255       ff-ff-ff-ff-ff-ff    static

Interface: 169.254.38.221 --- 0x23
  Internet Address      Physical Address      Type
  169.254.255.255       ff-ff-ff-ff-ff-ff    static
  224.0.0.22            01-00-5e-00-00-16    static
  224.0.0.251           01-00-5e-00-00-fb    static
  224.0.0.252           01-00-5e-00-00-fc    static
  239.255.255.250       01-00-5e-7f-ff-fa    static
  255.255.255.255       ff-ff-ff-ff-ff-ff    static
```

ARP cache contents are seen above.

Internet address = IP address

Physical address = MAC address

Type = protocol type

**10. What are the hexadecimal values for the source and destination addresses in the Ethernet frame containing the ARP request message?**

```
▼ Ethernet II, Src: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e), Dst: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
  ▼ Destination: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
    Address: Micro-St_9d:2f:6a (30:9c:23:9d:2f:6a)
    .... ..0. .... = LG bit: Globally unique address (factory default)
    .... ..0 .... = IG bit: Individual address (unicast)
  ▼ Source: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e)
    Address: Actionte_8e:4a:8e (00:24:7b:8e:4a:8e)
```

Destination address: 30:9c:23:9d:2f:6a



Source address: 00:24:7b:8e:4a:8e

11. Give the hexadecimal value for the two-byte Ethernet Frame type field. What upper layer protocol does this correspond to?

Type: ARP (0x0806)  
Padding: 000000000000  
Address Resolution Protocol  
0x0806, ARP protocol

12. a) How many bytes from the very beginning of the Ethernet frame does the ARP opcode field begin?

30	9c	23	9d	2f	6a	00	24	7b	8e	4a	8e	08	06	00	01
08	00	06	04	00	01	00	24	7b	8e	4a	8e	c0	a8	01	01
00	00	00	00	00	00	c0	a8	01	0b	00	00	00	00	00	00
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

$$(16 * 1) + 5 = 21 \text{ bytes}$$

b) What is the value of the opcode field within the ARP-payload part of the Ethernet frame in which an ARP request is made?

Protocol size: 4  
Opcode: request (1)

Opcode value: 1

c) Does the ARP message contain the IP address of the sender?

Opcode: request (1)  
Sender MAC address: Actionte\_8e:4a:8e (00:24:7b:8e:4a:8e)  
Sender IP address: 192.168.1.1  
Target MAC address: 00:00:00:00:00:00 (00:00:00:00:00:00)  
Target IP address: 192.168.1.11

Yes, 192.168.1.1

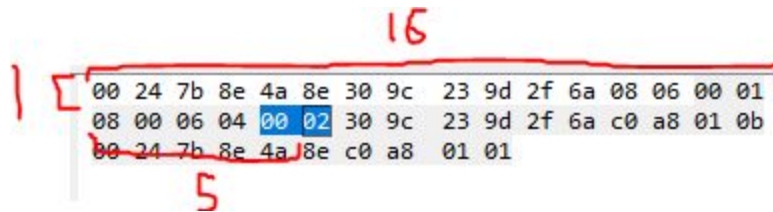
d) Where in the ARP request does the “question” appear – the Ethernet address of the machine whose corresponding IP address is being queried?

0000	30	9c	23	9d	2f	6a	00	24	7b	8e	4a	8e	08	06	00	01	0	#	/	j	\$	{	.	J	.....
0010	08	00	06	04	00	01	00	24	7b	8e	4a	8e	c0	a8	01	01	.....	.	.	.	.	.	.	.	.....
0020	00	00	00	00	00	00	c0	a8	01	0b	00	00	00	00	00	00	.....	.	.	.	.	.	.	.....	
0030	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....	.	.	.	.	.	.	.....	

It starts at byte 33, just after the sender IP address and before the target IP address.

13. Now find the ARP reply that was sent in response to the ARP request.

a) How many bytes from the very beginning of the Ethernet frame does the ARP opcode field begin?



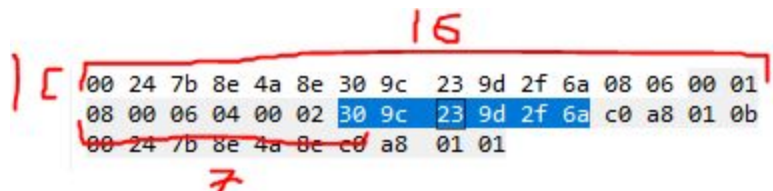
$$(16 * 1) + 5 = 21 \text{ bytes}$$

b) What is the value of the opcode field within the ARP-payload part of the Ethernet frame in which an ARP response is made?

Protocol size: 4  
Opcode: reply (2)  
Sender MAC address: M

Opcode value: 2

c) Where in the ARP message does the “answer” to the earlier ARP request appear – the IP address of the machine having the Ethernet address whose corresponding IP address is being queried?



$$(16 * 1) + 7 = 23 \text{ bytes}$$

Occurs at 23 bytes just after opcode and before sender IP address

14. What are the hexadecimal values for the source and destination addresses in the Ethernet frame containing the ARP reply message?

Ethernet II, Src: Micro-St\_9d:2f:6a (30:9c:23:9d:2f:6a)  
Destination: Actionte\_8e:4a:8e (00:24:7b:8e:4a:8e)  
Address: Actionte\_8e:4a:8e (00:24:7b:8e:4a:8e)  
.... .. = LG bit: Globally  
.... .. = IG bit: Individual  
Source: Micro-St\_9d:2f:6a (30:9c:23:9d:2f:6a)  
Address: Micro-St\_9d:2f:6a (30:9c:23:9d:2f:6a)

Destination address: 00:24:7b:8e:4a:8e

Source address: 30:9c:23:9d:2f:6a

15. Open the ethernet-ethereal-trace-1 trace file in

<http://gaia.cs.umass.edu/wireshark-labs/wireshark-traces.zip>. The first and second ARP packets in this trace correspond to an ARP request sent by the computer running Wireshark, and the ARP reply sent to the computer running Wireshark by

the computer with the ARP-requested Ethernet address. But there is yet another computer on this network, as indicated by packet 6 – another ARP request. Why is there no ARP reply (sent in response to the ARP request in packet 6) in the packet trace?

The requested ethernet address didn't match the local machine's MAC address.

**EC-1.** The arp command: `arp -s InetAddr EtherAddr` allows you to manually add an entry to the ARP cache that resolves the IP address `InetAddr` to the physical address `EtherAddr`. What would happen if, when you manually added an entry, you entered the correct IP address, but the wrong Ethernet address for that remote interface?

This would prevent that remote interface from correctly sending out any requests or responses. Luckily this arp entry could be manually deleted, flushing the entire cache or will simply letting it time out to remedy the mistake.

**EC-2.** What is the default amount of time that an entry remains in your ARP cache before being removed. You can determine this empirically (by monitoring the cache contents) or by looking this up in your operation system documentation. Indicate how/where you determined this value.

```
C:\WINDOWS\system32>netsh interface ipv4 show interfaces
```

Idx	Met	MTU	State	Name
1	75	4294967295	connected	Loopback Pseudo-Interface 1
11	25	1500	connected	Ethernet
8	25	1500	connected	Npcap Loopback Adapter
35	25	65536	connected	Ethernet 3

```
C:\WINDOWS\system32>netsh interface ipv4 show interface 35
```

Interface Ethernet 3 Parameters

IfLuid	: ethernet_32779
IfIndex	: 35
State	: connected
Metric	: 25
Link MTU	: 65536 bytes
Reachable Time	: 30500 ms
Base Reachable Time	: 30000 ms
Retransmission Interval	: 1000 ms
DAD Transmits	: 3
Site Prefix Length	: 64
Site Id	: 1

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My specific timeout duration for ARP caches is 30500 ms. This was determined by running the commands listed at:

<https://superuser.com/questions/1345144/what-is-the-default-cache-refresh-rate-of-windows-8-and-ubuntu>