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A. What is Kali's main interface's MAC address? (The main interface is probably called eth0, but check ifconfig to be sure.)

00:0c:29:66:26:86

B. What is Kali's main interface's IP address?

172.16.151.128

C. What is Metasploitable's main interface's MAC address?

00:0c:29:46:ba:a6

D. What is Metasploitable's main interface's IP address?

172.16.151.131

E. Show Kali's routing table. (Use "netstat -r" to see it with symbolic names, or "netstat -rn" to see it with numerical addresses.)

```
┌──(kali㉿kali)-[~]
└─$ netstat -r
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
default         172.16.151.2    0.0.0.0         UG        0 0          0 eth0
172.16.151.0    0.0.0.0         255.255.255.0   U         0 0          0 eth0
```

F. Show Kali's ARP cache. (Use "arp" or "arp -n".)

```
┌──(kali㉿kali)-[~]
└─$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
172.16.151.2             ether   00:50:56:e2:87:36   C                     eth0
```

G. Show Metasploitable's routing table.

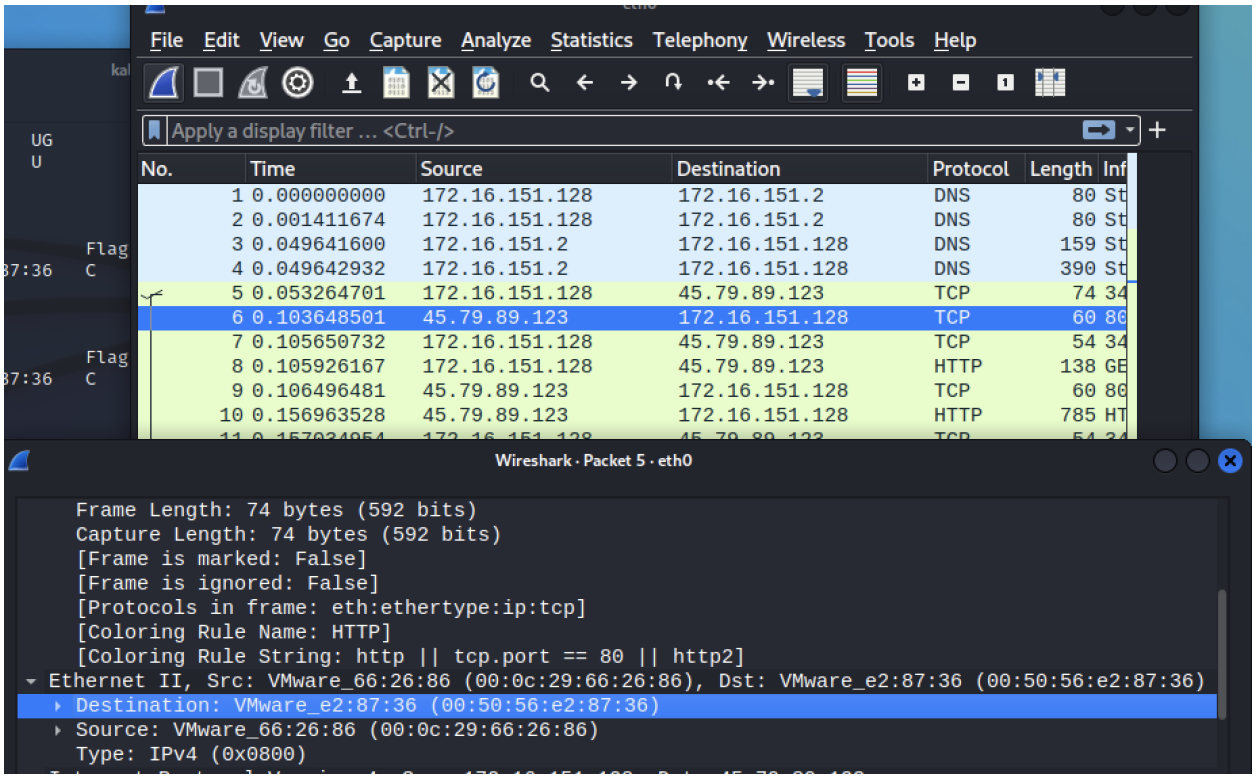
```
msfadmin@metasploitable:~$ netstat -r
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
172.16.151.0    *               255.255.255.0   U         0 0          0 eth0
default         172.16.151.2    0.0.0.0         UG        0 0          0 eth0
```

H. Show Metasploitable's ARP cache.

```
msfadmin@metasploitable:~$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
172.16.151.128           ether   00:0C:29:66:26:86   C                     eth0
172.16.151.254           ether   00:50:56:FD:20:82   C                     eth0
172.16.151.2             ether   00:50:56:E2:87:36   C                     eth0
```

I. Suppose the user of Metasploitable wants to get the CS338 sandbox page via the command "curl http://cs338.jeffondich.com/". To which MAC address should Metasploitable send the TCP SYN packet to get the whole HTTP query started? Explain why.

Metasploitable will send the TCP SYN packet to VMware MAC (00:50:56:e2:87:36), as this is our “gateway” to the internet. We tested this by running curl on kali with wireshark opened.



J. Fire up Wireshark on Kali. Start capturing packets for "tcp port http". On Metasploitable, execute "curl http://cs338.jeffondich.com/". On Kali, stop capturing. Do you see an HTTP response on Metasploitable? Do you see any captured packets in Wireshark on Kali?

We see an HTTP response on Metasploitable, which is the HTML source code of http://cs338.jeffondich.com/. We did not see any captured packets in Wireshark on Kali.

K. Now, it's time to be Mal (who will, today, merely eavesdrop). Use Ettercap to do ARP spoofing (also known as ARP Cache Poisoning) with Metasploitable as your target. There are many online tutorials on how to do this (here's one). Find one you like, and start spoofing your target. NOTE: most of these tutorials are showing an old user interface for Ettercap, which may make them confusing. The steps you're trying to take within Ettercap are:
    a. Start sniffing (not bridged sniffing) on eth0

b. Scan for Hosts
c. View the Hosts list
d. Select your Metasploit VM from the Host List
e. Add that host as Target 1
f. Start ARP Poisoning (including Sniff Remote Connections)
g. Do your stuff with wireshark and Metasploit
h. Stop ARP Poisoning

Done! See question O for screenshots.

L. Show Metasploitable's ARP cache. How has it changed?

We now have 172.16.151.1 added into the list of addresses. All the MAC addresses also changed to Kali's MAC address.

```
msfadmin@metasploitable:~$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
172.16.151.1             ether   00:0C:29:66:26:86   C                     eth0
172.16.151.254           ether   00:0C:29:66:26:86   C                     eth0
172.16.151.2             ether   00:0C:29:66:26:86   C                     eth0
172.16.151.128           ether   00:0C:29:66:26:86   C                     eth0
```

M. Without actually doing it yet, predict what will happen if you execute "curl http://cs338.jeffondich.com/" on Metasploitable now. Specifically, to what MAC address will Metasploitable send the TCP SYN packet? Explain why.

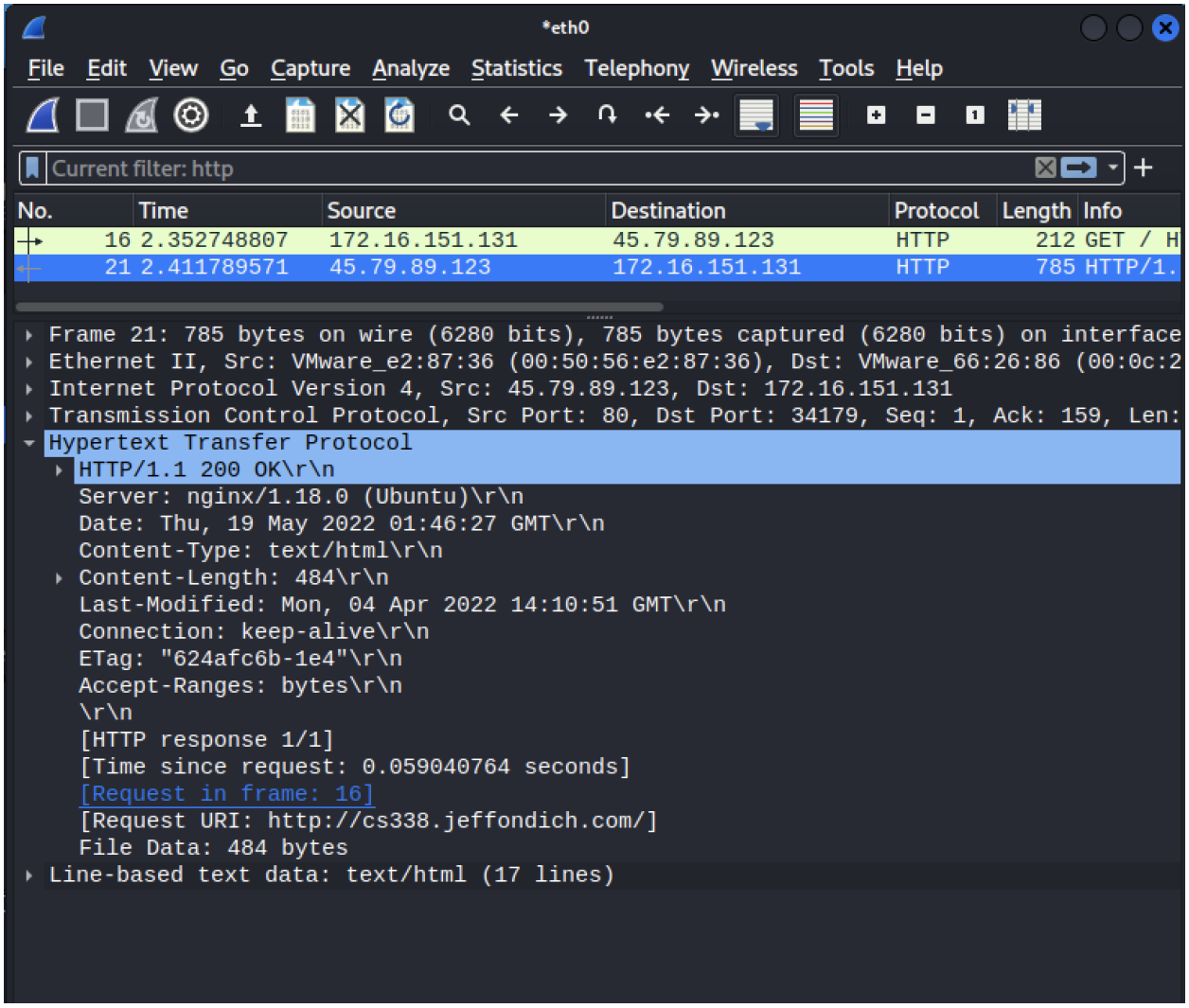
We predict Metasploitable will send the TCP SYN packet to 00:0c:29:66:26:86, which is Kali's MAC address. This will happen because we introduced a person in the middle between Metasploitable and the gateway.

N. Start Wireshark capturing "tcp port http" again.

OK

O. Execute "curl http://cs338.jeffondich.com/" on Metasploitable. On Kali, stop capturing. Do you see an HTTP response on Metasploitable? Do you see captured packets in Wireshark? Can you tell from Kali what messages went back and forth between Metasploitable and cs338.jeffondich.com?

Now that we have Ettercap running, we can see packets sent between Metasploitable and cs338.jeffondich.com. We can see everything: Metasploitable sent an HTTP request to http://cs338.jeffondich.com/, then http://cs338.jeffondich.com/ sent back an HTTP response to Metasploitable. Looking at the screenshot, we can see everything that is in the HTTP response (the content of the page, the length of the page, the type of request, etc.).

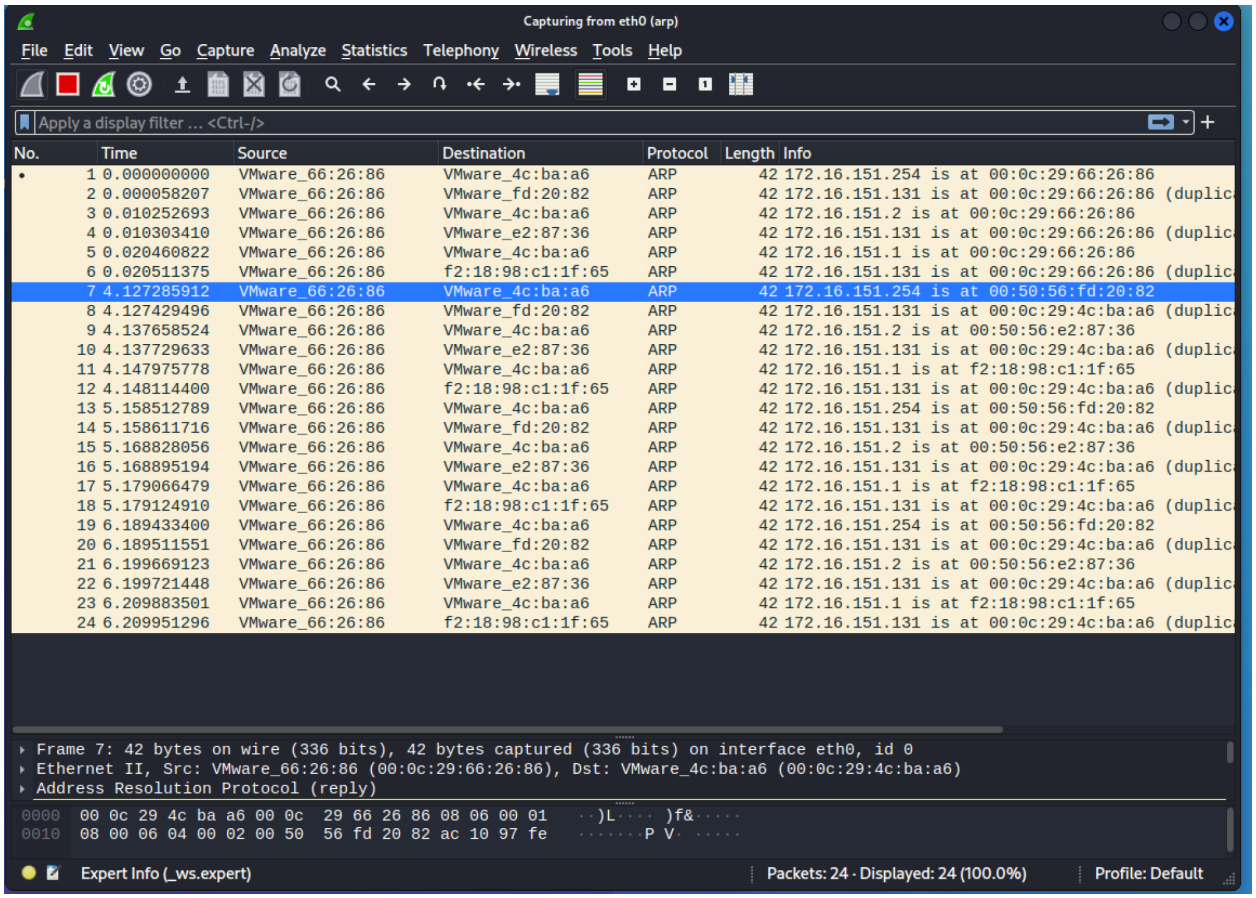


P. Explain in detail what happened. How did Kali change Metasploitable's ARP cache? (If you want to watch the attack in action, try stopping the PITM/MITM attack by selecting "Stop mitm attack(s)" from Ettercap's Mitm menu, starting a Wireshark capture for "arp", and restarting the ARP poisoning attack in Ettercap.)

Basically, Kali MAC address was linked to the legitimate gateway IP address.

From the screenshot, the first 6 packets were when we had Ettercap Mitm on, and starting from the 7th packet is when we had Ettercap turned off. When it was on, Kali sent an ARP packet to the 4 different MAC addresses (sent to 4c:ba:a6 3 times) and told those addresses where the MAC addresses of the IPs 172.16.151.254, 172.16.151.131, 172.16.151.2, and/or 172.16.151.1 are at. In the info, we see that the ARP packets are telling those addresses that their MAC address is 00:0c:29:66:26:86 which is Kali's MAC address.

When we closed Ettercap Mitm, Kali repeated the same protocol, but instead of telling all the addresses to look at Kali's MAC address, it told the addresses to look at their own MAC addresses instead.



Q. If you wanted to design an ARP spoofing detector, what would you have your detector do? (As you think about this, consider under what circumstances your detector might generate false positives.)

The ARP cache is a good indication that we are undergoing a spoofing attack. Therefore, if we detect more than one IP address mapped to the same MAC in the cache (see questions H and L) we can say that an attack is most likely happening. This method will generate false positives when the network configurations are outdated, such that there may be old devices and old IPs/MACs in the cache. We can also detect this kind of attack by monitoring a specific pattern of ARP packets, which are trying to modify the sources and destinations. We do this by looking at the Info field (see screenshot).