Internet Domain Name System

Lab 6

50.005 Computer System Engineering

Due: 15 Apr 08:30 AM (Week 12)

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INFORMATION SYSTEMS TECHNOLOGY AND DESIGN

Overview and Learning Objectives

In NS Module 4, we learnt about the role of the Domain Name System (DNS) in Internet naming and addressing. In this lab exercise, we will go deeper into DNS by using specialised network tools to perform and analyse DNS queries.

At the end of this lab exercise, you should be able to:

- Use `dig` to perform DNS queries (e.g. to look up an IP address)
- Read and interpret DNS records of different types
- Understand how a DNS query is resolved using hierarchy and recursion
- Observe and understand the effect of caching on DNS lookup times
- Use Wireshark to trace and read DNS packets sent to and from a machine

If you are using Ubuntu, `dig` should already be available on your system. To install Wireshark, run `sudo apt-get install wireshark` from the command line.

Submission

- The total marks for this Lab is 25 (Part 1: 10, Part 2: 5, Part 3: 10)
- Complete the activities and answer the questions in the handout **denoted in blue.** As usual, export and edit this document.
- Export as pdf and **ZIP** it (not rar, or any other compression algorithm)
- **Upload** to `@csesubmitbot` telegram bot using the command `/submitlab6`
- **CHECK** your submission by using the command `/checksubmission`

Part 1: Exploring DNS using dig

The Domain Information Groper (`dig`) is commonly used for performing DNS lookups. Here is an example of how it can be used to find information about the host `slashdot.org`. The results may differ if you run the same query on your machine.

```
dig slashdot.org

; <<>> DiG 9.10.6 <<>> slashdot.org
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 20463
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;slashdot.org.                  IN      A

;; ANSWER SECTION:
slashdot.org.           703     IN      A       216.105.38.15

;; Query time: 25 msec
;; SERVER: 192.168.2.1#53(192.168.2.1)
;; WHEN: Wed Jan 13 11:40:40 +08 2021
;; MSG SIZE  rcvd: 57
```

When the command `dig slashdot.org` is run, `dig` performs a DNS lookup and displays information about the request and the response it receives. At the bottom of the printout, we can see that the query was sent to the DNS server running on `192.168.2.1`, and that the query took 25 ms to complete. Most of the information that we are interested in can be found in the **`ANSWER SECTION`**.

The answer section for this query contains a DNS record:

`slashdot.org`	`703`	`IN`	`A`	`216.105.38.15`
Server Name	*Expiry*	*Class*	*Type*	*Data*

We can see that the result is of type A, an address record. It tells us that the IP address for the domain name slashdot.org is 216.105.38.15. The expiry time field indicates that this record is valid for 703 seconds. The value of the class field is usually **IN** (Internet) for all records.

If you'd like to know who's the authoritative NS for the queried domain, you can add the **trace** option: `dig slashdot.org +trace`
⇒ `trace means dig out who is responsible for providing authoritative response to names in slashdot.org. domain`

```
slashdot.org.           900     IN      A       216.105.38.15
slashdot.org.           86400   IN      NS      ns3.dnsmadeeasy.com.
slashdot.org.           86400   IN      NS      ns4.dnsmadeeasy.com.
slashdot.org.           86400   IN      NS      ns0.dnsmadeeasy.com.
slashdot.org.           86400   IN      NS      ns1.dnsmadeeasy.com.
slashdot.org.           86400   IN      NS      ns2.dnsmadeeasy.com.
;; Received 162 bytes from 208.80.125.2#53(ns3.dnsmadeeasy.com) in 22 ms
```

The records of type NS indicate the names of the DNS servers storing records for a particular domain. Here, we can see that the hosts `ns.3.dnsmadeeasy.com.` and etc are responsible for **providing authoritative responses to names in the slashdot.org domain**.

We can query a specific server for information about a host by using the `@` option. For example, to perform a lookup using the DNS server `ns3.dnsmadeeasy.com.`, we can run the command `dig @ns3.dnsmadeeasy.com. Slashdot.org`.

⇒ I want to dig info about slashdot.org from @ns3.dnsmadeeasy.com

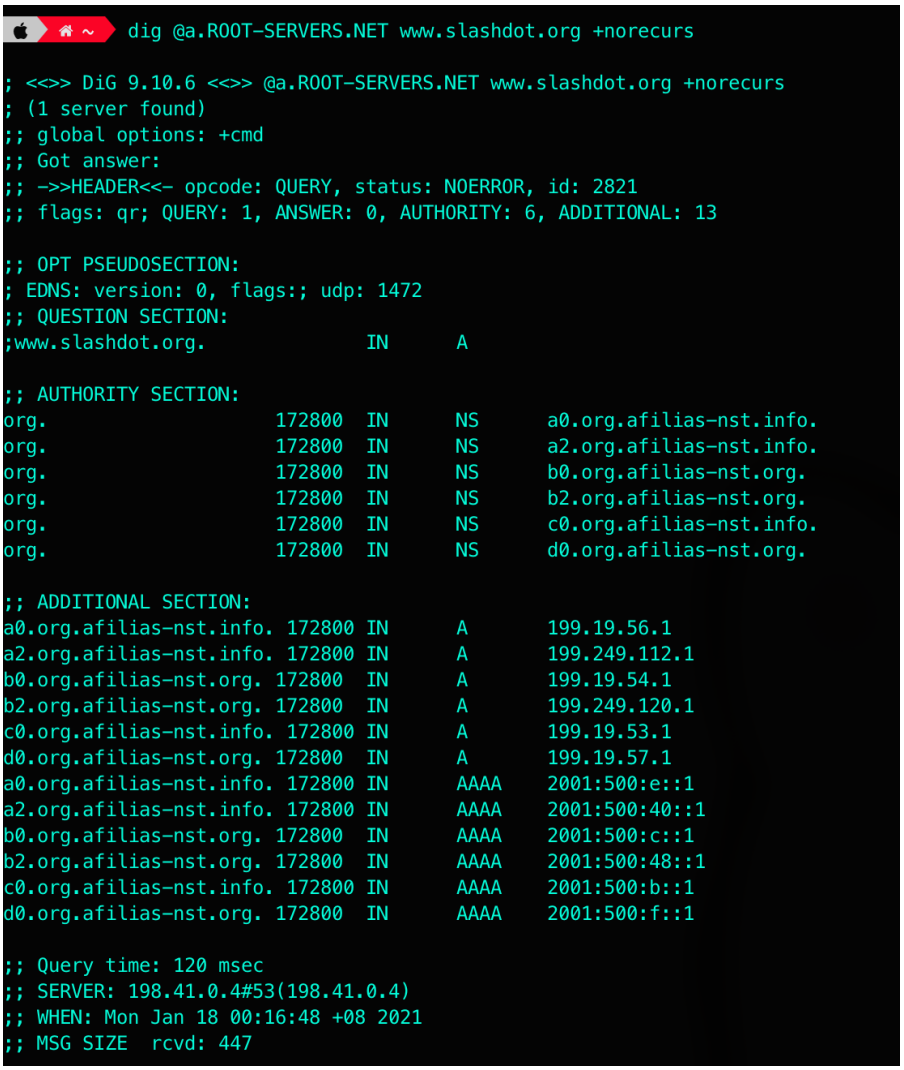
```
dig @ns3.dnsmadeeasy.com. slashdot.org.

; <<>> DiG 9.10.6 <<>> @ns3.dnsmadeeasy.com. slashdot.org.
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 18649
;; flags: qr aa rd; QUERY: 1, ANSWER: 1, AUTHORITY: 5, ADDITIONAL: 1
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1280
;; QUESTION SECTION:
;slashdot.org.                  IN      A

;; ANSWER SECTION:
slashdot.org.           900     IN      A       216.105.38.15

;; AUTHORITY SECTION:
slashdot.org.           86400   IN      NS      ns3.dnsmadeeasy.com.
slashdot.org.           86400   IN      NS      ns1.dnsmadeeasy.com.
slashdot.org.           86400   IN      NS      ns0.dnsmadeeasy.com.
slashdot.org.           86400   IN      NS      ns4.dnsmadeeasy.com.
slashdot.org.           86400   IN      NS      ns2.dnsmadeeasy.com.

;; Query time: 20 msec
;; SERVER: 208.80.125.2#53(208.80.125.2)
;; WHEN: Mon Jan 18 00:10:10 +08 2021
;; MSG SIZE  rcvd: 162
```

There are three flags under the header: `qr, aa,` and `rd`.

- This means that the message is a query (`qr`), and `dig` is requesting a recursive lookup (`rd` stands for *'recursion desired'*) and the server is the authoritative name server (`aa` stands for *'authoritative answer'*).
- Not all servers perform recursive lookups due to the heavier load involved, and so you don't see any `ra` flags here (`ra` stands for '*recursion available*').

`dig` only prints the final result of a recursive search, but you can mimic the individual steps involved by making a query with the `+norecurs` option enabled. For example, to send a non- recursive query to one of the root servers:

- Now you want to dig about slashdot.org from @root server, with no recursion



```
dig @a.ROOT-SERVERS.NET www.slashdot.org +norecurs

; <<>> DiG 9.10.6 <<>> @a.ROOT-SERVERS.NET www.slashdot.org +norecurs
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 2821
;; flags: qr; QUERY: 1, ANSWER: 0, AUTHORITY: 6, ADDITIONAL: 13

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1472
;; QUESTION SECTION:
;www.slashdot.org.              IN      A

;; AUTHORITY SECTION:
org.                    172800  IN      NS      a0.org.afilias-nst.info.
org.                    172800  IN      NS      a2.org.afilias-nst.info.
org.                    172800  IN      NS      b0.org.afilias-nst.org.
org.                    172800  IN      NS      b2.org.afilias-nst.org.
org.                    172800  IN      NS      c0.org.afilias-nst.info.
org.                    172800  IN      NS      d0.org.afilias-nst.org.

;; ADDITIONAL SECTION:
a0.org.afilias-nst.info. 172800 IN      A       199.19.56.1
a2.org.afilias-nst.info. 172800 IN      A       199.249.112.1
b0.org.afilias-nst.org. 172800  IN      A       199.19.54.1
b2.org.afilias-nst.org. 172800  IN      A       199.249.120.1
c0.org.afilias-nst.info. 172800 IN      A       199.19.53.1
d0.org.afilias-nst.org. 172800  IN      A       199.19.57.1
a0.org.afilias-nst.info. 172800 IN      AAAA    2001:500:e::1
a2.org.afilias-nst.info. 172800 IN      AAAA    2001:500:40::1
b0.org.afilias-nst.org. 172800  IN      AAAA    2001:500:c::1
b2.org.afilias-nst.org. 172800  IN      AAAA    2001:500:48::1
c0.org.afilias-nst.info. 172800 IN      AAAA    2001:500:b::1
d0.org.afilias-nst.org. 172800  IN      AAAA    2001:500:f::1

;; Query time: 120 msec
;; SERVER: 198.41.0.4#53(198.41.0.4)
;; WHEN: Mon Jan 18 00:16:48 +08 2021
;; MSG SIZE  rcvd: 447
```

As you can see, the server does not know the answer (there's 0 ANSWER) and instead provides information about the servers most likely to be able to provide an authoritative answer for the question. In this case, the best that the root server knows is the identities of the servers for the `org.` top-level domain.

Now answer the questions below.

Question 1 [1p]: Using dig, find the IP address for `thyme.lcs.mit.edu`. What is the IP address?

Your answer:

```
pprmountain@pprmountain-Lenovo-ideapad-5205-14IKB:~$ dig thyme.lcs.mit.edu

; <<>> DiG 9.11.3-1ubuntu1.14-Ubuntu <<>> thyme.lcs.mit.edu
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 52307
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;thyme.lcs.mit.edu.             IN      A

;; ANSWER SECTION:
thyme.lcs.mit.edu.      2252    IN      CNAME   mercury.lcs.mit.edu.
mercury.lcs.mit.edu.    2251    IN      A       18.26.0.122

;; Query time: 996 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Tue Apr 13 20:24:54 +08 2021
;; MSG SIZE  rcvd: 84
```

18.26.0.122

Question 2 [1p]: The dig answer for the previous question includes a record of type `CNAME`. What does `CNAME` mean?

Your answer:

CNAME stands for canonical name. It means that thyme.lcs.mit.edu.that has another name called mercury.lcs.mit.edu.

Question 3 [1p]: What is the expiration time for the `CNAME` record?

Your answer: 2252 seconds

Question 4: Run the following commands to find out what your computer receives when it looks up *'ai'* and *'ai.'* in the `mit.edu` domain. What are the two resulting IP addresses?

- `dig +domain=mit.edu ai`

  Your answer [1p]: No IP address.

- `dig +domain=mit.edu ai.`

  Your answer [1p]: IP address obtained, 209.59.119.34.

Question 5 [1p]: Why are the results for both queries different? Look up the manual for `dig` to find out what the `+domain` parameter does. Based on the output of the two commands, what is the difference between the DNS searches being performed for *'ai'* and *'ai.'*?

Your answer:

- **+domain sets search list to contain a single domain.**
- **The "ai" is resolved to "ai.mit.edu" which did not exist. No "." means that it will be searched through the domain list of "mit.edu". There's no IP address because "mit.edu" does not contain a record for "ai".**
- **But the "ai" is resolved to some other NS at 209.59.119.34. This is as if "dig ai." was ran. Without ".", it means that it will not be searched from the domain "mit.edu"**

Part 2: DNS Hierarchy

In the previous section, you ran `dig` without changing the default options. This causes `dig` to perform a recursive lookup if the DNS server being queried supports it. In this part, you will trace the intermediate steps involved in a performing recursive query by beginning at a root server and manually going through the DNS hierarchy to resolve a host name. You can obtain a list of all the root servers by running the command `dig . NS`.

Question 6 [1p]: Use `dig` to query one of the DNS root servers for the IP address of `lirone.csail.mit.edu` without using recursion. What is the command that you use to do this?

Your answer:

First, dig lirone.csail.mit.edu

```
pprmountain@pprmountain-Lenovo-ideapad-520S-14IKB:~$ dig lirone.csail.mit.edu

; <<>> DiG 9.11.3-1ubuntu1.14-Ubuntu <<>> lirone.csail.mit.edu
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 55350
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;lirone.csail.mit.edu.          IN      A

;; ANSWER SECTION:
lirone.csail.mit.edu.   1800    IN      A       128.52.129.186

;; Query time: 260 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Tue Apr 13 22:16:44 +08 2021
;; MSG SIZE  rcvd: 65
```

Then, dig @a.edu-servers.net lirone.csail.mit.edu +norecurse

```
pprmountain@pprmountain-Lenovo-Ideapad-520S-14IKB:~$ dig @a.edu-servers.net lirone.csail.mit.edu +norecurse

; <<>> DiG 9.11.3-1ubuntu1.14-Ubuntu <<>> @a.edu-servers.net lirone.csail.mit.edu +norecurse
; (2 servers found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 52656
;; flags: qr; QUERY: 1, ANSWER: 0, AUTHORITY: 8, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;lirone.csail.mit.edu.          IN      A

;; AUTHORITY SECTION:
mit.edu.                172800  IN      NS      usw2.akam.net.
mit.edu.                172800  IN      NS      asia1.akam.net.
mit.edu.                172800  IN      NS      asia2.akam.net.
mit.edu.                172800  IN      NS      use2.akam.net.
mit.edu.                172800  IN      NS      ns1-37.akam.net.
mit.edu.                172800  IN      NS      ns1-173.akam.net.
mit.edu.                172800  IN      NS      eur5.akam.net.
mit.edu.                172800  IN      NS      use5.akam.net.

;; Query time: 295 msec
;; SERVER: 2001:503:a83e::2:30#53(2001:503:a83e::2:30)
;; WHEN: Tue Apr 13 22:22:46 +08 2021
;; MSG SIZE  rcvd: 216
```

Question 7 [3p]: Go through the DNS hierarchy from the root until you have found the IP address of `lirone.csail.mit.edu`. You should disable recursion and follow the referrals manually. Which commands did you use, and what addresses did you find? You can provide screenshots for each step.

Your answer:

First, dig @a.edu-servers.net lirone.csail.mit.edu +norecurse


```
pprmountain@pprmountain-Lenovo-Ideapad-520S-14IKB:~$ dig @a.edu-servers.net lirone.csail.mit.edu +norecurse

; <<>> DiG 9.11.3-1ubuntu1.14-Ubuntu <<>> @a.edu-servers.net lirone.csail.mit.edu +norecurse
; (2 servers found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 52656
;; flags: qr; QUERY: 1, ANSWER: 0, AUTHORITY: 8, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;lirone.csail.mit.edu.          IN      A

;; AUTHORITY SECTION:
mit.edu.                172800  IN      NS      usw2.akam.net.
mit.edu.                172800  IN      NS      asia1.akam.net.
mit.edu.                172800  IN      NS      asia2.akam.net.
mit.edu.                172800  IN      NS      use2.akam.net.
mit.edu.                172800  IN      NS      ns1-37.akam.net.
mit.edu.                172800  IN      NS      ns1-173.akam.net.
mit.edu.                172800  IN      NS      eur5.akam.net.
mit.edu.                172800  IN      NS      use5.akam.net.

;; Query time: 295 msec
;; SERVER: 2001:503:a83e::2:30#53(2001:503:a83e::2:30)
;; WHEN: Tue Apr 13 22:22:46 +08 2021
;; MSG SIZE  rcvd: 216
```

Then, dig @asia1.akam.net lirone.csail.mit.edu +norecurse

```
pprmountain@pprmountain-Lenovo-ideapad-520S-14IKB:~$ dig @asia1.akam.net lirone.csail.mit.edu +norecurse

; <<>> DiG 9.11.3-1ubuntu1.14-Ubuntu <<>> @asia1.akam.net lirone.csail.mit.edu +norecurse
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 9246
;; flags: qr; QUERY: 1, ANSWER: 0, AUTHORITY: 4, ADDITIONAL: 7

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;lirone.csail.mit.edu.          IN      A

;; AUTHORITY SECTION:
csail.mit.edu.          1800    IN      NS      auth-ns3.csail.mit.edu.
csail.mit.edu.          1800    IN      NS      auth-ns1.csail.mit.edu.
csail.mit.edu.          1800    IN      NS      auth-ns0.csail.mit.edu.
csail.mit.edu.          1800    IN      NS      auth-ns2.csail.mit.edu.

;; ADDITIONAL SECTION:
auth-ns0.csail.mit.edu. 1800    IN      A       128.30.2.123
auth-ns1.csail.mit.edu. 1800    IN      A       128.31.0.18
auth-ns2.csail.mit.edu. 1800    IN      A       128.52.32.80
auth-ns3.csail.mit.edu. 1800    IN      A       18.220.24.142
auth-ns0.csail.mit.edu. 1800    IN      AAAA    2603:400a:0:7d2::801e:27b
auth-ns3.csail.mit.edu. 1800    IN      AAAA    2600:1f16:ceb:1302::a

;; Query time: 41 msec
;; SERVER: 95.100.175.64#53(95.100.175.64)
;; WHEN: Tue Apr 13 22:27:08 +08 2021
;; MSG SIZE  rcvd: 261
```

Then, dig @auth-ns0.csail.mit.edu lirone.csail.mit.edu +norecurse
This gives an A record with IP address 128.52.129.186

```
pprmountain@pprmountain-Lenovo-ideapad-520S-14IKB:~$ dig @auth-ns0.csail.mit.edu lirone.csail.mit.edu +norecurse

; <<>> DiG 9.11.3-1ubuntu1.14-Ubuntu <<>> @auth-ns0.csail.mit.edu lirone.csail.mit.edu +norecurse
; (2 servers found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 52056
;; flags: qr aa; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
; COOKIE: b5017aeaa6c39d4d010000006075aa57578a2dd0728e97e3 (good)
;; QUESTION SECTION:
;lirone.csail.mit.edu.          IN      A

;; ANSWER SECTION:
lirone.csail.mit.edu.   1800    IN      A       128.52.129.186

;; Query time: 301 msec
;; SERVER: 2603:400a:0:7d2::801e:27b#53(2603:400a:0:7d2::801e:27b)
;; WHEN: Tue Apr 13 22:27:35 +08 2021
;; MSG SIZE  rcvd: 93
```

Part 3: DNS Caching

Question 8: Without using recursion, query your default (local) DNS server for information about `www.dmoz.org` and answer the following questions.

- **[1p]** What is the command that you used?
- **[1p]** Did your default server have the answer in its cache? How did you know?

- **[1p]** How long did the query take?

If the information was cached, find another host name that was not cached and complete all the questions in this section using that host.

You can set your default DNS server as your router (your ISP might do that too). Why can your router support DNS (layer 5, application layer protocol) when "routers" are supposed to support up to Network layer only?

Your answer:

The command was "dig www.dmoz.org +norecurse".

```
pprmountain@pprmountain-Lenovo-ideapad-520S-14IKB:~$ dig www.dmoz.org +norecurse

; <<>> DiG 9.11.3-1ubuntu1.14-Ubuntu <<>> www.dmoz.org +norecurse
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: REFUSED, id: 49794
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;www.dmoz.org.                  IN      A

;; Query time: 0 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Tue Apr 13 22:29:53 +08 2021
;; MSG SIZE  rcvd: 41
```

No answer in cache. The answer section is missing.

The query time was 0msec.

Question 9 [1p]: Query your default DNS server for information about the host in the previous question, using the recursion option this time. How long did the query take?

Your answer:

```
pprmountain@pprmountain-Lenovo-ideapad-520S-14IKB:~$ dig www.dmoz.org

; <<>> DiG 9.11.3-1ubuntu1.14-Ubuntu <<>> www.dmoz.org
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 14904
;; flags: qr rd ra; QUERY: 1, ANSWER: 3, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;www.dmoz.org.                  IN      A

;; ANSWER SECTION:
www.dmoz.org.           1914    IN      CNAME   dmoz-static-pages.s3-website-us-east-1.amazonaws.com.
dmoz-static-pages.s3-website-us-east-1.amazonaws.com. 60 IN CNAME s3-website-us-east-1.amazonaws.com.
s3-website-us-east-1.amazonaws.com. 0 IN A      52.217.100.67

;; Query time: 12 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Tue Apr 13 22:32:14 +08 2021
;; MSG SIZE  rcvd: 137
```

It took 12 msec.

Question 10 [1p]: Query your default DNS server for information about the same host without using recursion. How long did the query take? Has the cache served its purpose? Explain why.

Your answer:

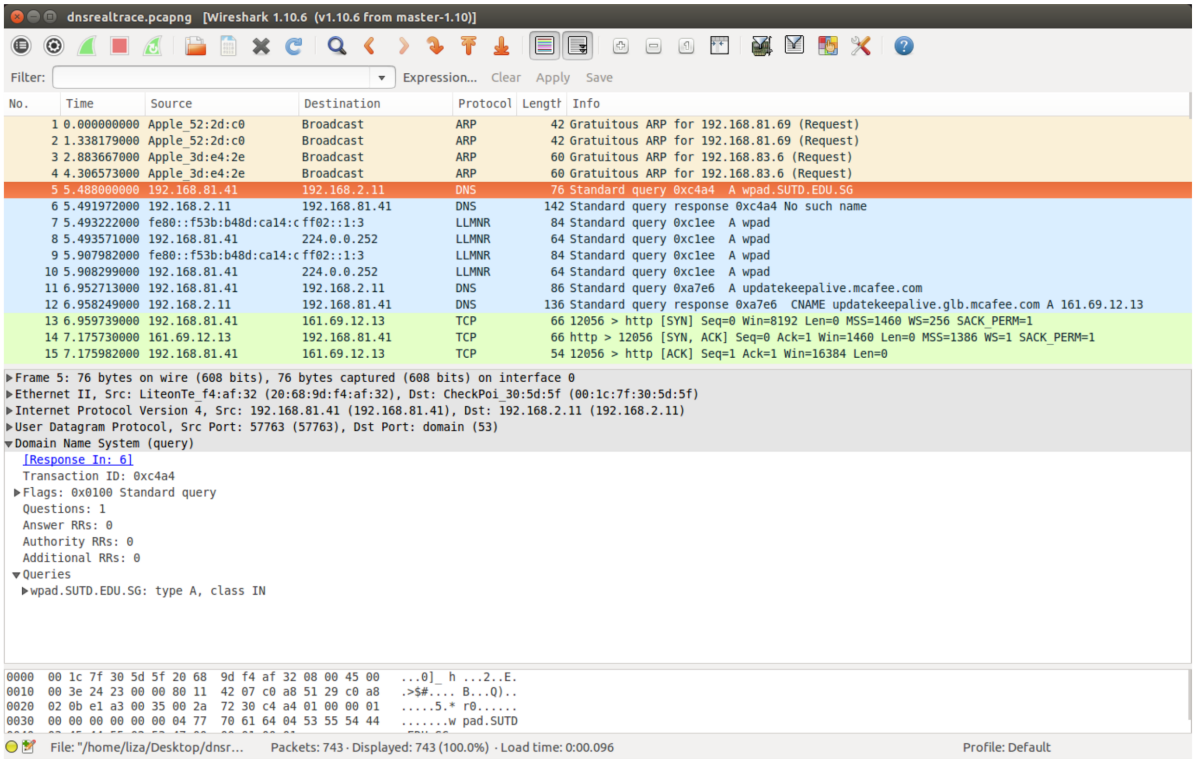
Cached served its purpose. An answer section was produced.

Query was completed in a shorter time.

Part 4: Tracing DNS using Wireshark

Wireshark is a powerful tool used to capture packets sent over a network and analyse the content of the packets retrieved. The file *dnsrealtrace.pcapng* contains a trace of the packets sent and received when a web page is downloaded from a web server over the SUTD network. In the process of downloading the web page, DNS is used to find the IP address of the server.

Open the *dnsrealtrace.pcapng* in Wireshark and answer the following questions. You can refer to Wireshark tutorial here before proceeding.



Question 11 [1p]: Locate the DNS query and response messages. Are they sent over UDP or TCP?

Your answer:

```
▸User Datagram Protocol, Src Port: 57763 (57763), Dst Port: domain (53)
```

UDP, because it says User Datagram Protocol here.

Question 12 [2p]: What is the destination port for the DNS query message? What is the source port of the DNS response message?

Your answer:

Src Port: 57763

Dst Port: 53

Question 13 [2p]: What is the IP address to which the DNS query message was sent? Use `ifconfig` to determine the IPv4 address of your local DNS server. Are these two addresses the same?

Your answer:

```
▸Internet Protocol Version 4, Src: 192.168.81.41 (192.168.81.41), Dst: 192.168.2.11 (192.168.2.11)
```

The Dst is 192.168.2.11

```
nameserver 127.0.0.53
options edns0
```

They are not the same.

Question 14 [2p]: Examine the second DNS query message. What type of DNS query is it? Does the query message contain any answers?

Your answer:

```
▾ Flags: 0x8583 Standard query response, No such name
    1... .... .... .... = Response: Message is a response
    .000 0... .... .... = Opcode: Standard query (0)
    .... .1.. .... .... = Authoritative: Server is an authority fo
    .... ..0. .... .... = Truncated: Message is not truncated
    .... ...1 .... .... = Recursion desired: Do query recursively
```

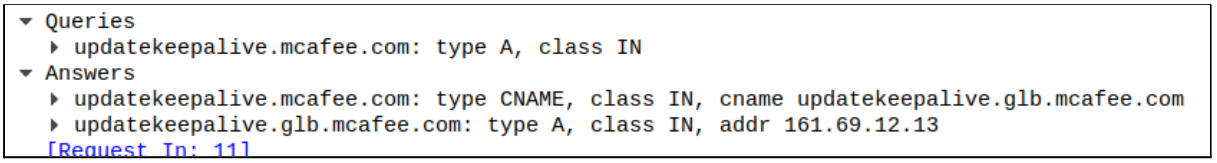
It is recursive DNS query.

It does not contain any answers.

Question 15 [2p]: Examine the second DNS response message. How many answers are provided? What does each of these answers contain?

Your answer:

2 answers are provided.

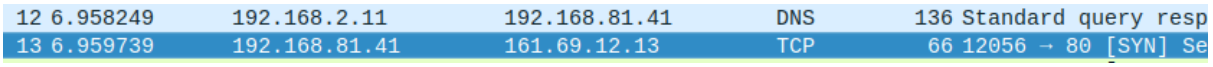


First answer was a CNAME type of RR pointing to updatekeepalive.glb.mcafee.com

The second answer was a A type RR pointing to the IP address 161.69.12.13

Question 16 [1p]: Locate a TCP SYN packet sent by your host subsequent to the above DNS response. This packet opens a TCP connection between your host and the web server. Does the destination IP address of the SYN packet correspond to any of the IP addresses provided in the DNS response message?

Your answer:

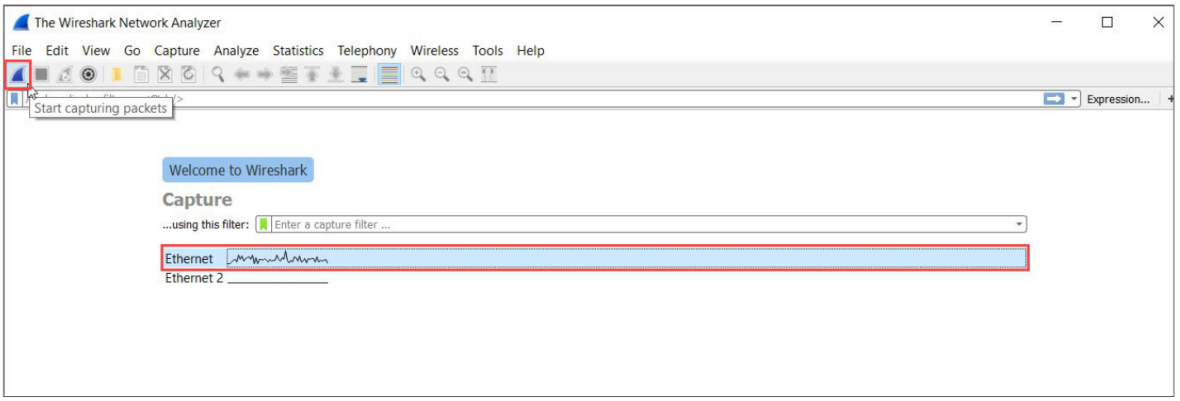


The destination IP of the sent packet was 161.69.12.13, which was the IP address of updatekeepalive.glb.mcafee.com.

Optional Activity:

Capturing packets for packet analysis: Steps:

1. Once Wireshark is installed, launch the program to begin.
2. Once the program is launched, select the network interface to capture and click on the *sharkfin* icon at the top left of the application right under the menu bar to begin capturing packets.



3. To explore the interface, mention the interface (e.g. eth0, wlan) in the capture option.
4. There are display filters to analyse the packets.
    - Protocols: TCP, UDP, ARP, SMTP, etc.
    - Protocol Fields: port, src.addr, length, etc. (E.g. ip.src == 192.168.1.1)
5. For more detailed instructions on Wireshark, refer to https://www.wireshark.org/