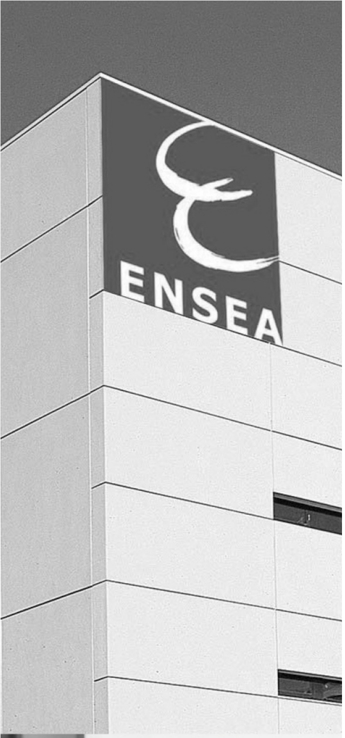

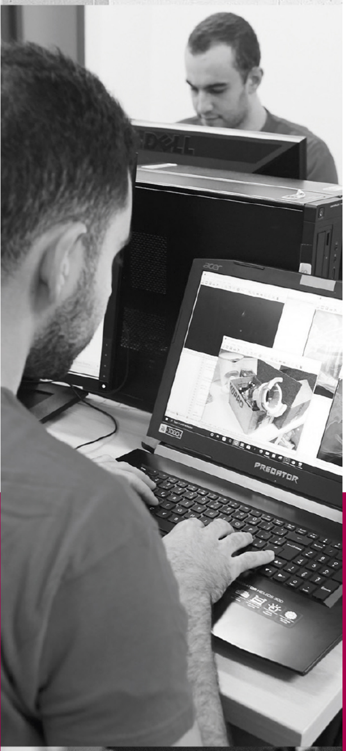

ENSEA

Beyond Engineering

TP1 ARCHITECTURE & PROTOCOLS

RTS TP1

Goals : To use basic network commands and capture with Wireshark

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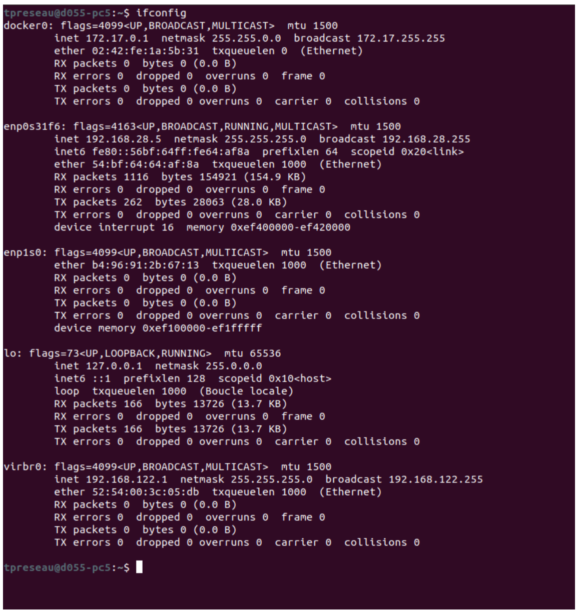
1. Basic commands

- How many interfaces does your machine have ?
  After launching the command ”ifconfig” the terminal displays the following interfaces :



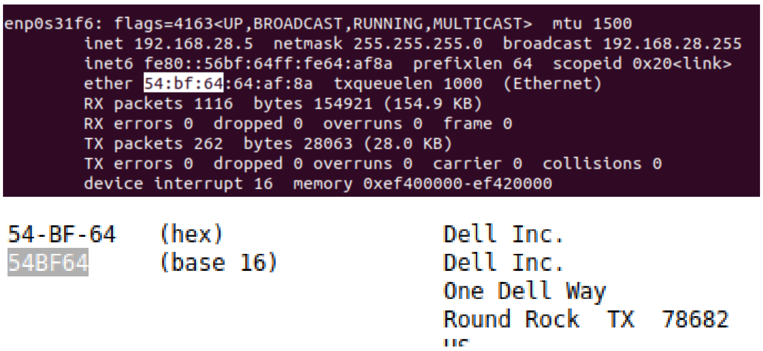
```
tpreseau@d055-pc5:~$ ifconfig
docker0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        inet 172.17.0.1  netmask 255.255.0.0  broadcast 172.17.255.255
        ether 02:42:fe:1a:5b:31  txqueuelen 0  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

enp0s31f6: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.28.5  netmask 255.255.255.0  broadcast 192.168.28.255
        inet6 fe80::56bf:64ff:fe64:af8a  prefixlen 64  scopeid 0x20<link>
        ether 54:bf:64:64:af:8a  txqueuelen 1000  (Ethernet)
        RX packets 1116  bytes 154921 (154.9 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 262  bytes 28063 (28.0 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt 16  memory 0xef400000-ef420000

enp1s0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        ether b4:96:91:2b:67:13  txqueuelen 1000  (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
        device memory 0xef100000-ef1fffff

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Boucle locale)
        RX packets 166  bytes 13726 (13.7 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 166  bytes 13726 (13.7 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

virbr0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        inet 192.168.122.1  netmask 255.255.255.0  broadcast 192.168.122.255
        ether 52:54:00:3c:05:db  txqueuelen 1000  (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

tpreseau@d055-pc5:~$ 
```

Figure 1 – Interfaces of the machines

  We can see that we have 5 interfaces :
  - docker0
  - enp0s31f6
  - enp1s0
  - lo
  - virbro

- Describe the enpXsY interface.
  The interface enpXsY refers to Ethernet. Actually, en refers to Ethernet, pX refers to the bus number X and sY refers to the slot Y.

- By consulting the OUI database, determine the manufacturer of your network card. (A copy of the OUI base is available on Moodle.)
  To find our network card manufacturer we need to get the 3 most significants hexadecimals from the Ethernet interface which is connected to internet. Then in the OUI base, we look for the same 6 hexadecimals. Then we find our manufacturer which is the following one (second picture) :



```
enp0s31f6: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.28.5  netmask 255.255.255.0  broadcast 192.168.28.255
        inet6 fe80::56bf:64ff:fe64:af8a  prefixlen 64  scopeid 0x20<link>
        ether 54:bf:64:64:af:8a  txqueuelen 1000  (Ethernet)
        RX packets 1116  bytes 154921 (154.9 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 262  bytes 28063 (28.0 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt 16  memory 0xef400000-ef420000
```

```
54-BF-64   (hex)           Dell Inc.
54BF64     (base 16)       Dell Inc.
                           One Dell Way
                           Round Rock  TX  78682
                           US
```

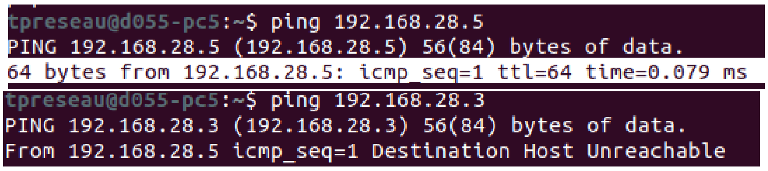
Figure 2 – Interface of Ethernet enp1s31f6

So the manufacturer of the network card is Dell Incorporated.

- Is the interface IPv6 compatible ?
  The interface is compatible with IPv6 because we can see that there is an IPv6 assigned.

- What is the network mask of enpXsY ? In which LAN is your machine located ?
  We can read the network mask in the enpXsY interface for IPv4 : the network mask is 255.255.255.0. To find the LAN where our machine is located, we must do the following calculation : inet AND mask = 192.168.28.5 AND 255.255.255.0. We can conclude that our machine is in the LAN : 192.168.28.0.

- Check if all the machines in the room are accessible from your machine using a ping.
  To check if the machines in the room are accessible, we can ping them. We know that the LAN is 192.168.28.0, so we can try to ping the machines in 192.168.28.1 to 192.168.28.8. We get two types of answer from the terminal :



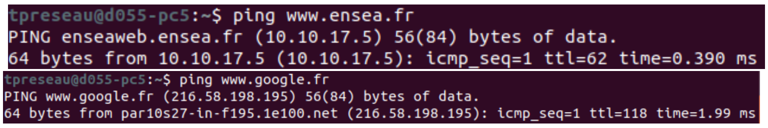
```
tpreseau@d055-pc5:~$ ping 192.168.28.5
PING 192.168.28.5 (192.168.28.5) 56(84) bytes of data.
64 bytes from 192.168.28.5: icmp_seq=1 ttl=64 time=0.079 ms
```

```
tpreseau@d055-pc5:~$ ping 192.168.28.3
PING 192.168.28.3 (192.168.28.3) 56(84) bytes of data.
From 192.168.28.5 icmp_seq=1 Destination Host Unreachable
```

Figure 3 – Different test of ping of the machine in the LAN

On the first picture, we can see that we reach the machine at the addresse : 192.168.28.5. The packets is transmitted. On the second picture, we can see that we can't ping the machine with the IP of 192.168.28.3. Indeed, this machine is turned off that explains why the packets has not been transmitted.

- Then ping external sites (eg : www.ensea.fr, www.google.fr).



```
tpreseau@d055-pc5:~$ ping www.ensea.fr
PING enseaweb.ensea.fr (10.10.17.5) 56(84) bytes of data.
64 bytes from 10.10.17.5 (10.10.17.5): icmp_seq=1 ttl=62 time=0.390 ms
tpreseau@d055-pc5:~$ ping www.google.fr
PING www.google.fr (216.58.198.195) 56(84) bytes of data.
64 bytes from par10s27-in-f195.1e100.net (216.58.198.195): icmp_seq=1 ttl=118 time=1.99 ms
```

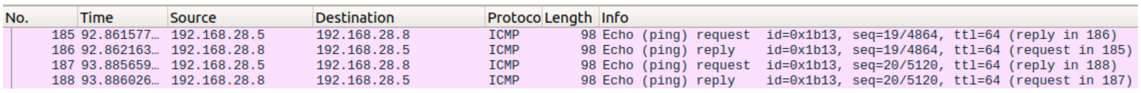
Figure 4 – Pings on www.ensea.fr and www.google.fr

By pinging external websites, we can observe that the IP address of www.ensea.fr is 10.10.17.5 and the IP address of www.google.fr is 216.58.198.195.

- Comment on your results (especially the TTL field).
  As we saw previously by pinging the ENSEA website and Google we can see different TTL (Time To Live) which is used to limit the data lives. When using a ping, this field means how many routers it crossed. So for the ENSEA website our computer crossed 62 routers and for Google 118 routers. We observe that the time needed to reach Google is greater than the ENSEA website.

2. Capture a ping

Here we ping another computer in the room and thanks to Wireshark we get the following frames :

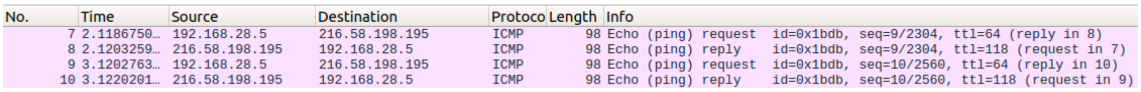


No.	Time	Source	Destination	Protoco	Length	Info
185	92.861577…	192.168.28.5	192.168.28.8	ICMP	98	Echo (ping) request id=0x1b13, seq=19/4864, ttl=64 (reply in 186)
186	92.862163…	192.168.28.8	192.168.28.5	ICMP	98	Echo (ping) reply id=0x1b13, seq=19/4864, ttl=64 (request in 185)
187	93.885659…	192.168.28.5	192.168.28.8	ICMP	98	Echo (ping) request id=0x1b13, seq=20/5120, ttl=64 (reply in 188)
188	93.886026…	192.168.28.8	192.168.28.5	ICMP	98	Echo (ping) reply id=0x1b13, seq=20/5120, ttl=64 (request in 187)

Figure 5 – Capture of a ping on Wireshark

As we can see on the previous picture, when we ping another computer we first send a request to the destination computer. When the wanted computer receive the request he sends back a reply. The whole procedure is made with ICMP protocol.

We can do the same thing with other websites :



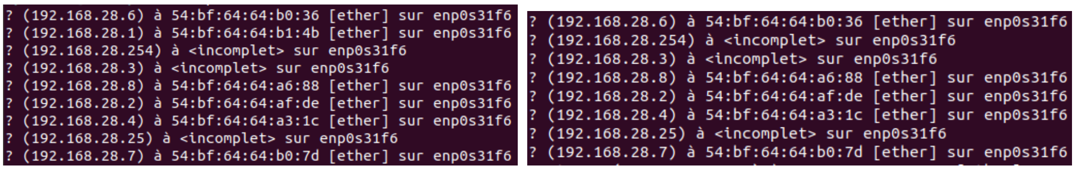
No.	Time	Source	Destination	Protoco	Length	Info
7	2.1186750…	192.168.28.5	216.58.198.195	ICMP	98	Echo (ping) request id=0x1bdb, seq=9/2304, ttl=64 (reply in 8)
8	2.1203259…	216.58.198.195	192.168.28.5	ICMP	98	Echo (ping) reply id=0x1bdb, seq=9/2304, ttl=118 (request in 7)
9	3.1202763…	192.168.28.5	216.58.198.195	ICMP	98	Echo (ping) request id=0x1bdb, seq=10/2560, ttl=64 (reply in 10)
10	3.1220201…	216.58.198.195	192.168.28.5	ICMP	98	Echo (ping) reply id=0x1bdb, seq=10/2560, ttl=118 (request in 9)

Figure 6 – Pings on www.ensea.fr and www.google.fr

3. ARP Request Capture

First, we need to do a filter on Wireshark to only retrieve ARP request to or from our machine. So in the filter we need to write : *arp and host 192.168.28.5*.

Then when we type *arp -a*, we can see a list of machine (like on the picture below). This list shows every machine that our computer knows. It allows to associate their MAC address and their IPv4 address. We'll show how to add a machine inside our ARP table. So first of all we'll need to delete one address of our table by using the following command : arp -d IPAddress

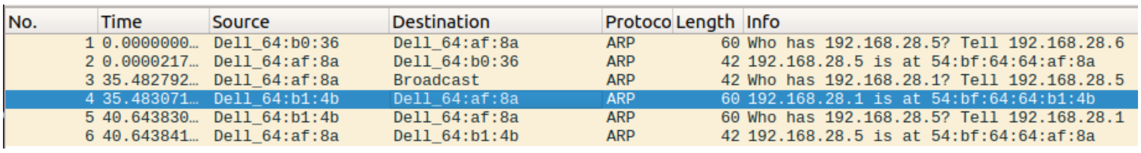


```
? (192.168.28.6) à 54:bf:64:64:b0:36 [ether] sur enp0s31f6
? (192.168.28.1) à 54:bf:64:64:b1:4b [ether] sur enp0s31f6
? (192.168.28.254) à <incomplet> sur enp0s31f6
? (192.168.28.3) à <incomplet> sur enp0s31f6
? (192.168.28.8) à 54:bf:64:64:a6:88 [ether] sur enp0s31f6
? (192.168.28.2) à 54:bf:64:64:af:de [ether] sur enp0s31f6
? (192.168.28.4) à 54:bf:64:64:a3:1c [ether] sur enp0s31f6
? (192.168.28.25) à <incomplet> sur enp0s31f6
? (192.168.28.7) à 54:bf:64:64:b0:7d [ether] sur enp0s31f6
```

```
? (192.168.28.6) à 54:bf:64:64:b0:36 [ether] sur enp0s31f6
? (192.168.28.254) à <incomplet> sur enp0s31f6
? (192.168.28.3) à <incomplet> sur enp0s31f6
? (192.168.28.8) à 54:bf:64:64:a6:88 [ether] sur enp0s31f6
? (192.168.28.2) à 54:bf:64:64:af:de [ether] sur enp0s31f6
? (192.168.28.4) à 54:bf:64:64:a3:1c [ether] sur enp0s31f6
? (192.168.28.25) à <incomplet> sur enp0s31f6
? (192.168.28.7) à 54:bf:64:64:b0:7d [ether] sur enp0s31f6
```

FIGURE 7 – Capture on Wireshark of machine's address resolution table before and after the command arp -d

As we can see between both captures, the IP : 192.168.28.1 has been removed. To add it again in the list, we just need to ping the address. We can observe the result on Wireshark.

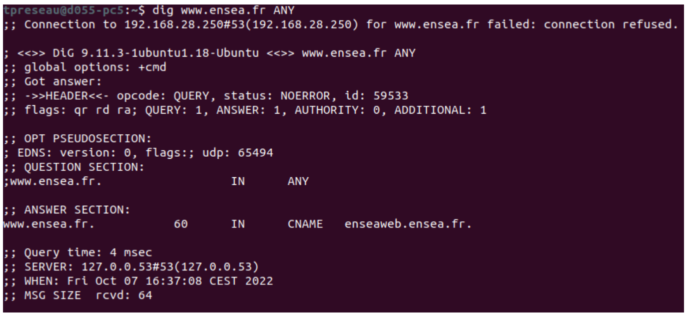


No.	Time	Source	Destination	Protoco	Length	Info
1	0.0000000…	Dell_64:b0:36	Dell_64:af:8a	ARP	60	Who has 192.168.28.5? Tell 192.168.28.6
2	0.0000217…	Dell_64:af:8a	Dell_64:b0:36	ARP	42	192.168.28.5 is at 54:bf:64:64:af:8a
3	35.482792…	Dell_64:af:8a	Broadcast	ARP	42	Who has 192.168.28.1? Tell 192.168.28.5
4	35.483071…	Dell_64:b1:4b	Dell_64:af:8a	ARP	60	192.168.28.1 is at 54:bf:64:64:b1:4b
5	40.643830…	Dell_64:b1:4b	Dell_64:af:8a	ARP	60	Who has 192.168.28.5? Tell 192.168.28.1
6	40.643841…	Dell_64:af:8a	Dell_64:b1:4b	ARP	42	192.168.28.5 is at 54:bf:64:64:af:8a

FIGURE 8 – Capture on Wireshark of a ping after a command arp -d

When we ping the address : 192.168.28.1, we can see that the computer cannot recognize it so it asks who has this address. To find it, the computer send a broadcast message to the LAN to identify the owner. Once found the address 192.168.28.1 is back in the ARP table.

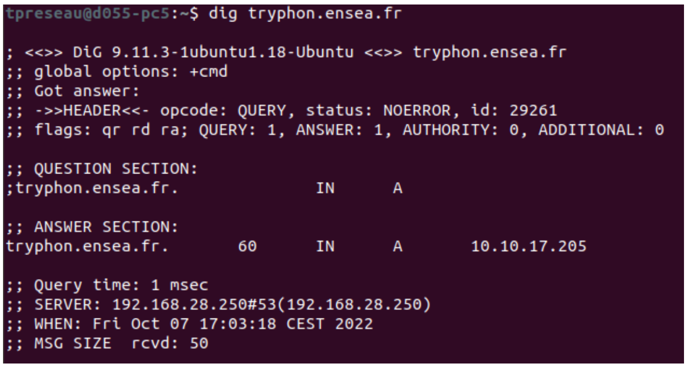
4. DNS Query Capture



```
tpreseau@d055-pc5:~$ dig www.ensea.fr ANY
;; Connection to 192.168.28.250#53(192.168.28.250) for www.ensea.fr failed: connection refused.

; <<>> DiG 9.11.3-1ubuntu1.18-Ubuntu <<>> www.ensea.fr ANY
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 59533
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;www.ensea.fr.                  IN      ANY

;; ANSWER SECTION:
www.ensea.fr.           60      IN      CNAME   enseaweb.ensea.fr.

;; Query time: 4 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Fri Oct 07 16:37:08 CEST 2022
;; MSG SIZE  rcvd: 64
```

Figure 9 – Capture of the web information of www.ensea.fr

With the command ”dig www.ensea.fr ANY”, we can get some information servers : tryphon.ensea.fr, blanche.ensea.fr, admindsn.ensea.fr, speedy-17.ensea.fr, daisy.ensea.fr. For each server, we get a number which corresponds to the TTL. We can see that the types of these servers are NS and SOA. If we execute the command ”tryphon.ensea.fr” we get the following capture :



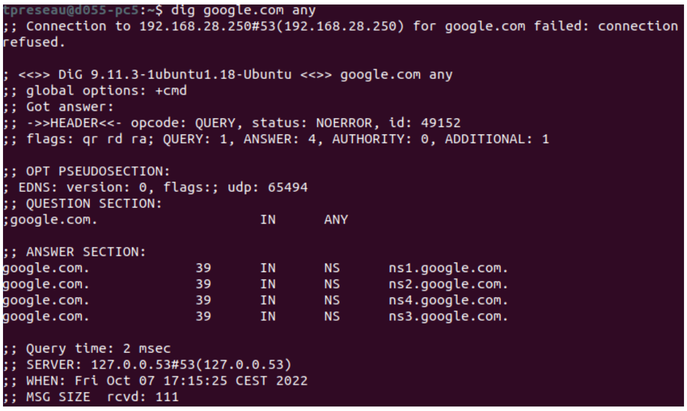
```
tpreseau@d055-pc5:~$ dig tryphon.ensea.fr

; <<>> DiG 9.11.3-1ubuntu1.18-Ubuntu <<>> tryphon.ensea.fr
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 29261
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;tryphon.ensea.fr.              IN      A

;; ANSWER SECTION:
tryphon.ensea.fr.       60      IN      A       10.10.17.205

;; Query time: 1 msec
;; SERVER: 192.168.28.250#53(192.168.28.250)
;; WHEN: Fri Oct 07 17:03:18 CEST 2022
;; MSG SIZE  rcvd: 50
```

Figure 10 – Capture of the web information of www.tryphon.ensea.fr

We can see that the type of the server is now A. Actually, we have differents types of servers in ENSEA :

- A : it is a server whose domain is directly linked to an IP address (IPv4).
- AAAA : it the same type as A but for IPv6
- NS (N Server) : It is a name of server. NS can regroup host names which must be type A.
- MX (Mail Exchanger) : It is the mail server.
- SOA :(Start Of Authority) : It is a server which stores the most important informations of the whole server like DNS addresses.

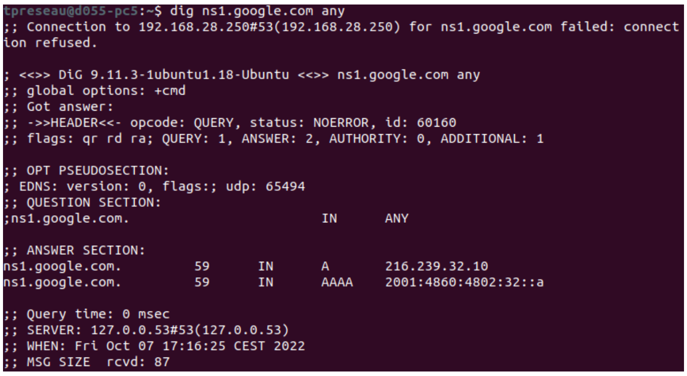
We can do the same for google.com and www.perdu.com :



```
tpreseau@d055-pc5:~$ dig google.com any
;; Connection to 192.168.28.250#53(192.168.28.250) for google.com failed: connection
refused.

; <<>> DiG 9.11.3-1ubuntu1.18-Ubuntu <<>> google.com any
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 49152
;; flags: qr rd ra; QUERY: 1, ANSWER: 4, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;google.com.                    IN      ANY

;; ANSWER SECTION:
google.com.             39      IN      NS      ns1.google.com.
google.com.             39      IN      NS      ns2.google.com.
google.com.             39      IN      NS      ns4.google.com.
google.com.             39      IN      NS      ns3.google.com.

;; Query time: 2 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Fri Oct 07 17:15:25 CEST 2022
;; MSG SIZE  rcvd: 111
```

Figure 11 – Capture of the web information of google.com

On this screen, we can see that the server is displayed as NS, so we can dig again these NS :

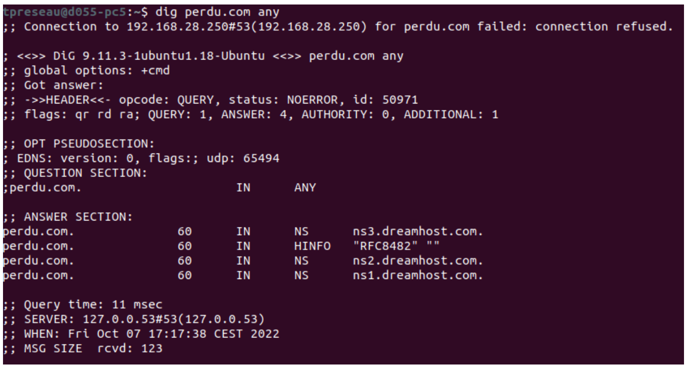


```
tpreseau@d055-pc5:~$ dig ns1.google.com any
;; Connection to 192.168.28.250#53(192.168.28.250) for ns1.google.com failed: connect
ion refused.

; <<>> DiG 9.11.3-1ubuntu1.18-Ubuntu <<>> ns1.google.com any
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 60160
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;ns1.google.com.                        IN      ANY

;; ANSWER SECTION:
ns1.google.com.         59      IN      A       216.239.32.10
ns1.google.com.         59      IN      AAAA    2001:4860:4802:32::a

;; Query time: 0 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Fri Oct 07 17:16:25 CEST 2022
;; MSG SIZE  rcvd: 87
```

Figure 12 – Capture of the web information of www.ns1.google.fr

In the previous picture we can see that Google has a server domain with IPv4 (A server) and IPv6 (AAAA server). With this dig, we get IP address of the domain perdu.com : 216.58.204.110. When we are in a browser and we type 216.58.204.110 in the research bar we recognize the Google website page.

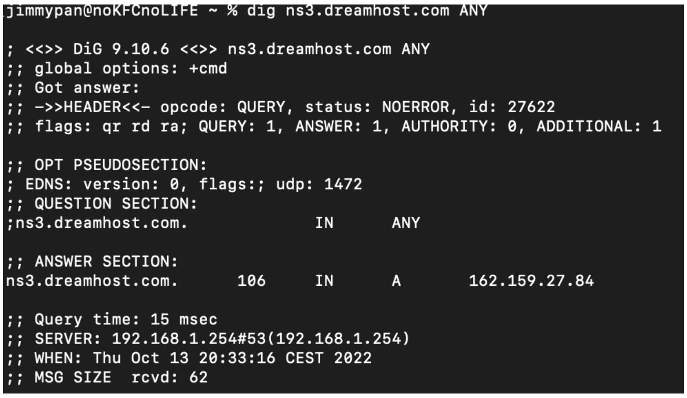
Let's do the same for perdu.com



```
tpreseau@d055-pc5:~$ dig perdu.com any
;; Connection to 192.168.28.250#53(192.168.28.250) for perdu.com failed: connection refused.

; <<>> DiG 9.11.3-1ubuntu1.18-Ubuntu <<>> perdu.com any
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 50971
;; flags: qr rd ra; QUERY: 1, ANSWER: 4, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;perdu.com.                     IN      ANY

;; ANSWER SECTION:
perdu.com.              60      IN      NS      ns3.dreamhost.com.
perdu.com.              60      IN      HINFO   "RFC8482" ""
perdu.com.              60      IN      NS      ns2.dreamhost.com.
perdu.com.              60      IN      NS      ns1.dreamhost.com.

;; Query time: 11 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Fri Oct 07 17:17:38 CEST 2022
;; MSG SIZE  rcvd: 123
```

Figure 13 – Capture of the web information of www.perdu.com

We can see many NS server. We can dig again for one of these NS :

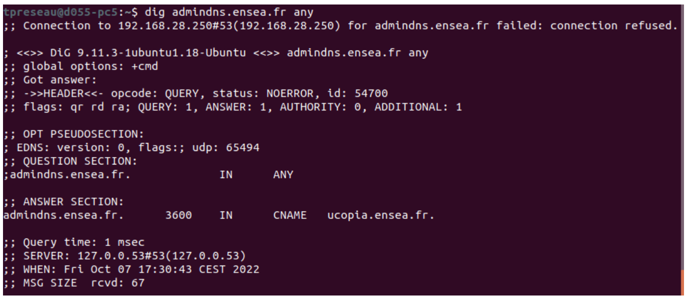


```
jimmypan@noKFCnoLIFE ~ % dig ns3.dreamhost.com ANY

; <<>> DiG 9.10.6 <<>> ns3.dreamhost.com ANY
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 27622
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1472
;; QUESTION SECTION:
;ns3.dreamhost.com.             IN      ANY

;; ANSWER SECTION:
ns3.dreamhost.com.      106     IN      A       162.159.27.84

;; Query time: 15 msec
;; SERVER: 192.168.1.254#53(192.168.1.254)
;; WHEN: Thu Oct 13 20:33:16 CEST 2022
;; MSG SIZE  rcvd: 62
```

Figure 14 – Capture of the information of www.ns3.dreamhost.com

With this dig, we get IP address of the domain perdu.com : 162.159.27.84. When we are in a browser and we type the IP 162.159.27.84 in the research bar, the browser cannot charge the webpage. Indeed, the IP 162.159.27.84 is used by many domain name. We cannot go to perdu.com because many other websites are also using the same IP address.

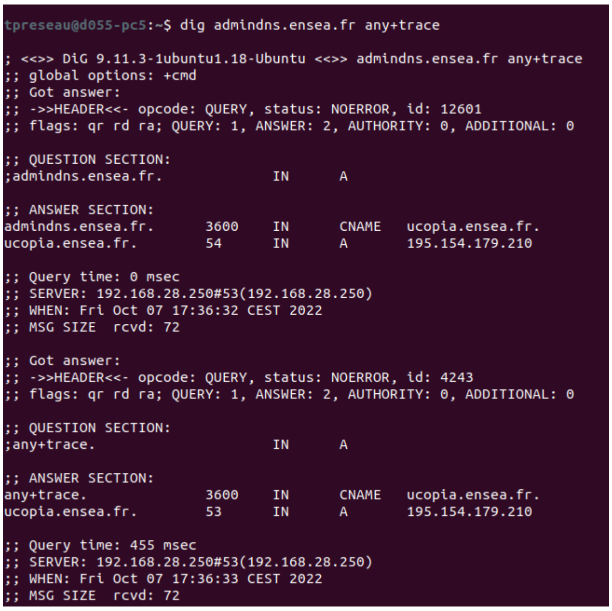
Now we are trying for the school's DNS servers.



```
tpreseau@d055-pc5:~$ dig admindns.ensea.fr any
;; Connection to 192.168.28.250#53(192.168.28.250) for admindns.ensea.fr failed: connection refused.

; <<>> DiG 9.11.3-1ubuntu1.18-Ubuntu <<>> admindns.ensea.fr any
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 54700
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;admindns.ensea.fr.             IN      ANY

;; ANSWER SECTION:
admindns.ensea.fr.      3600    IN      CNAME   ucopia.ensea.fr.

;; Query time: 1 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Fri Oct 07 17:30:43 CEST 2022
;; MSG SIZE  rcvd: 67
```

Figure 15 – Capture of the information of the DNS of ENSEA

When we use the dig command to the school's DNS server, we can see that we only get the canonical name (CNAM) of the domain. We can conclude that the server's IP address is translated in a name. So if we want to get more information about the server we can use +trace function which gives us the following picture :



```
tpreseau@d055-pc5:~$ dig admindns.ensea.fr any+trace

; <<>> DiG 9.11.3-1ubuntu1.18-Ubuntu <<>> admindns.ensea.fr any+trace
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 12601
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;admindns.ensea.fr.             IN      A

;; ANSWER SECTION:
admindns.ensea.fr.      3600    IN      CNAME   ucopia.ensea.fr.
ucopia.ensea.fr.        54      IN      A       195.154.179.210

;; Query time: 0 msec
;; SERVER: 192.168.28.250#53(192.168.28.250)
;; WHEN: Fri Oct 07 17:36:32 CEST 2022
;; MSG SIZE  rcvd: 72

;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 4243
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;any+trace.                     IN      A

;; ANSWER SECTION:
any+trace.              3600    IN      CNAME   ucopia.ensea.fr.
ucopia.ensea.fr.        53      IN      A       195.154.179.210

;; Query time: 455 msec
;; SERVER: 192.168.28.250#53(192.168.28.250)
;; WHEN: Fri Oct 07 17:36:33 CEST 2022
;; MSG SIZE  rcvd: 72
```

Figure 16 – Capture of the information of ENSEA website with trace option

When we use this function we can see that we have one more information. It is the server's IP address which is 195.154.179.210. We can deduce that the DNS protocol allows to do a mapping with the name of domain and his IP address. So it allows the user to not type the server's IP address to connect to the website. He will be connected just by typing the name of the domain.