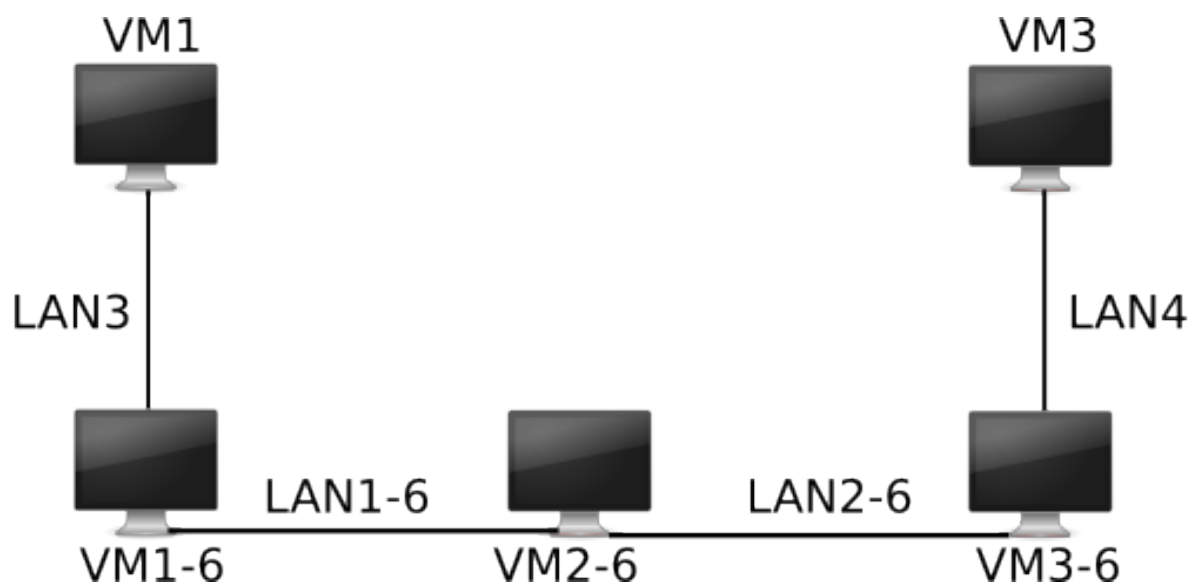


## Compte rendu du projet réseaux 2018/19

### 1 Situation Initiale

Parc :



Plan d'adressage :

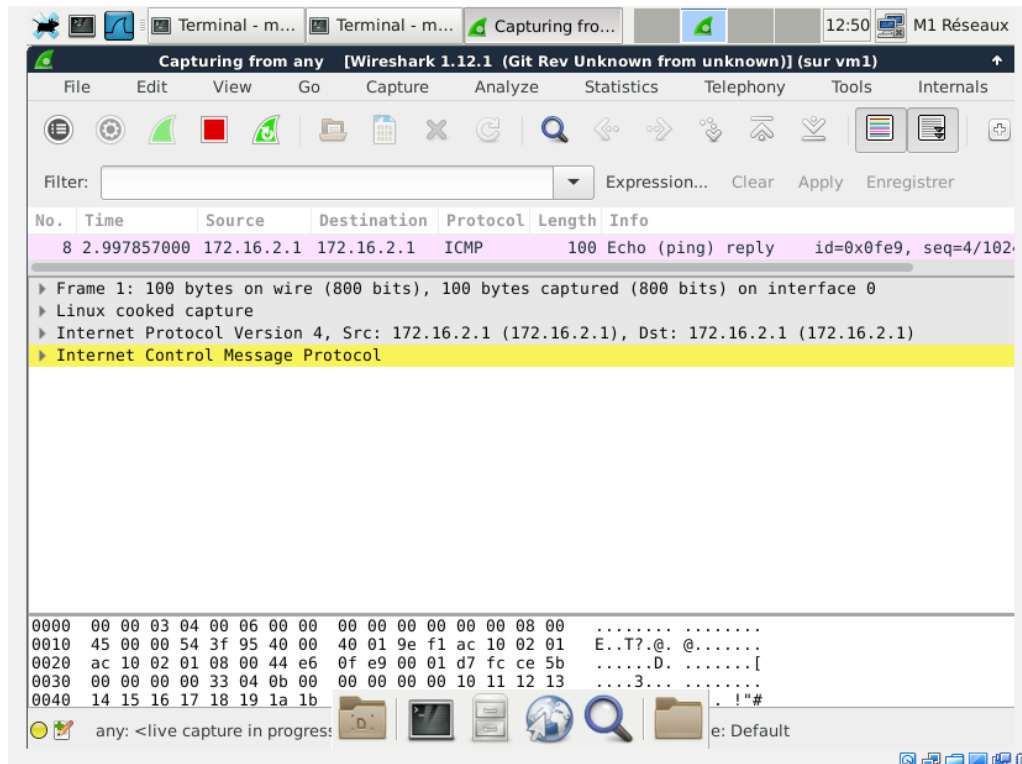
	LAN1	LAN2	LAN3	LAN4	LAN1-6	LAN2-6
réseau	172.16.2.128/28	172.16.2.160/28	172.16.2.144/28	172.16.2.176/28	fc00:1234:1::/64	fc00:1234:2::/64
VM1	172.16.2.131		172.16.2.151			
VM2	172.16.2.132	172.16.2.162				
VM3		172.16.2.163		172.16.2.183		
VM1-6			172.16.2.156		auto	
VM2-6					fc00:1234:1::26	fc00:1234:2::26
VM3-6				172.16.2.186		auto

## 2 L'interface virtuel TUN

### 2.1 Configuration de l'interface

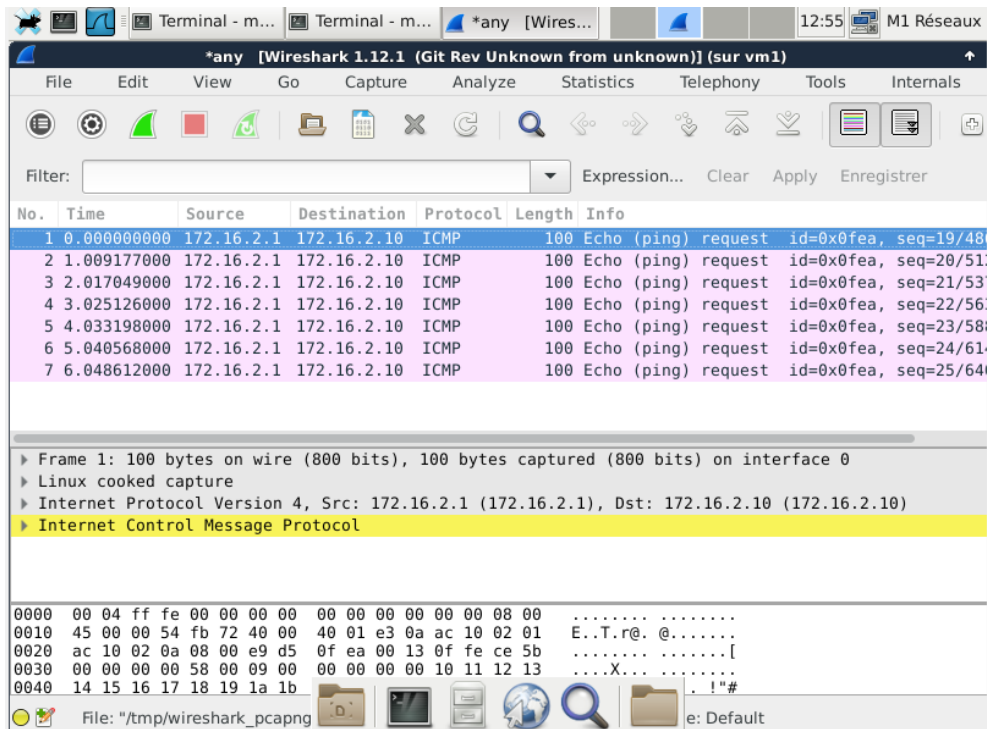
L'interface *tun0* est configuré avec l'adresse **172.16.2.1/28**. VM2 ayant disparu, il faut **retirer la route LAN1 de VM1**.

Émission d'un *ping* vers 172.16.2.1 :

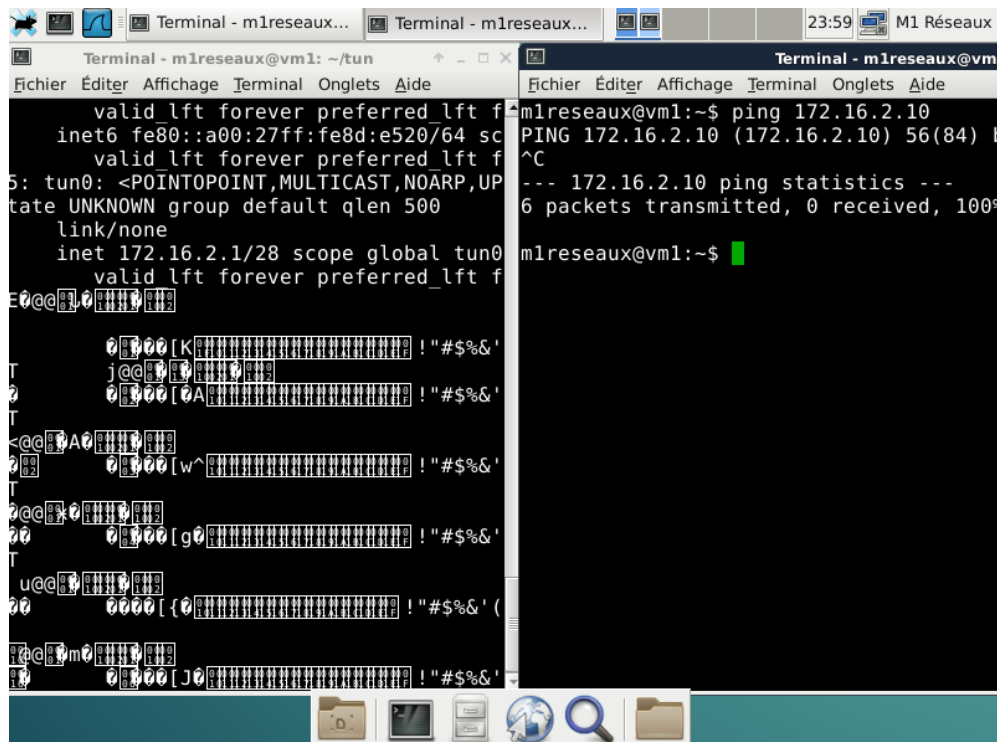


On constate que le *ping* fonctionne normalement, on émet et reçoit depuis 172.16.2.1.

Émission d'un *ping* vers 172.16.2.10 depuis 172.16.2.1 :



Le *ping* ne fonctionne pas, aucune réponse n'est renvoyée. Cependant la requête s'affiche dans le descripteur de fichier de *tun0*.



Le réseau *tun0* ne répond pas aux *ping* autres que 172.16.2.1 (son adresse donnée en configuration) mais il reçoit bien ces requêtes sur son descripteur de fichier.

## 2.2 Récupération des paquets

Après modification de la bibliothèque *iftun*, *ping* 172.16.2.1 n'affiche pas de nouvelles informations sur le descripteur de fichier.

Un ping 172.16.2.10 nous donne ce résultat :

The image shows two screenshots. The top screenshot is a terminal window titled 'Terminal - m1reseau...'. It displays a hex dump of network data. The bottom screenshot is a Wireshark 1.12.1 packet capture window. It shows a list of captured packets, with packet 13 selected. The packet details pane shows 'Internet Control Message Protocol' and 'Echo (ping) request'. The packet bytes pane shows the raw data in hex and ASCII.

```
00000f30 7f 00 00 ce f1 36 84 84 7f 00 00 00 00 08 00 45 |.....6.....E|
00000f40 00 00 54 4c 84 40 00 40 01 91 f9 ac 10 02 01 ac |..TL.@.@.....|
00000f50 10 02 0a 08 00 17 82 09 b2 00 0a 8b ec d0 5b 00 |.....[.|
00000f60 00 00 00 b5 a6 06 00 00 00 00 10 11 12 13 14 |.....|
00000f70 15 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 |.....!""$|
00000f80 25 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 |%&'()*+,-./01234|
00000f90 35 36 37 50 c4 3f 6b fe 7f 00 00 01 00 00 00 00 |567P.?k.....|
00000fa0 00 00 00 00 00 01 00 00 00 00 00 00 00 00 00 |.....|
00000fb0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
*
00001020 00 00 00 00 00 00 00 84 7f 00 00 30 c5 3f 6b fe |.....0.?k.|
00001030 7f 00 00 ce f1 36 84 84 7f 00 00 00 00 08 00 45 |.....6.....E|
00001040 00 00 54 4c b5 40 00 40 01 91 c8 ac 10 02 01 ac |..TL.@.@.....|
00001050 10 02 0a 08 00 7c 61 09 b2 00 0b 8c ec d0 5b 00 |.....|a.....|
00001060 00 00 00 4f c6 06 00 00 00 00 10 11 12 13 14 |.....0.....|
00001070 15 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 |.....!""$|
00001080 25 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 |%&'()*+,-./01234|
00001090 35 36 37 50 c4 3f 6b fe 7f 00 00 01 00 00 00 00 |567P.?k.....|
000010a0 00 00 00 00 00 01 00 00 00 00 00 00 00 00 00 |.....|
000010b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
*
00001120 00 00 00 00 00 00 00 84 7f 00 00 30 c5 3f 6b fe |.....0.?k.|
```

Wireshark packet capture details:

No.	Time	Source	Destination	Protocol	Length	Info
13	12.094865000	172.16.2.1	172.16.2.10	ICMP	100	Echo (ping) request id=0x09ff, seq
14	13.102840000	172.16.2.1	172.16.2.10	ICMP	100	Echo (ping) request id=0x09ff, seq
15	14.110942000	172.16.2.1	172.16.2.10	ICMP	100	Echo (ping) request id=0x09ff, seq
16	15.119412000	172.16.2.1	172.16.2.10	ICMP	100	Echo (ping) request id=0x09ff, seq
17	16.126637000	172.16.2.1	172.16.2.10	ICMP	100	Echo (ping) request id=0x09ff, seq
18	17.134872000	172.16.2.1	172.16.2.10	ICMP	100	Echo (ping) request id=0x09ff, seq
19	18.142580000	172.16.2.1	172.16.2.10	ICMP	100	Echo (ping) request id=0x09ff, seq
20	19.150954000	172.16.2.1	172.16.2.10	ICMP	100	Echo (ping) request id=0x09ff, seq
21	20.158730000	172.16.2.1	172.16.2.10	ICMP	100	Echo (ping) request id=0x09ff, seq

Frame 1: 100 bytes on wire (800 bits), 100 bytes captured (800 bits) on interface 0  
Linux cooked capture  
Internet Protocol Version 4, Src: 172.16.2.1 (172.16.2.1), Dst: 172.16.2.10 (172.16.2.10)  
Internet Control Message Protocol

```
0000 00 04 ff fe 00 00 00 00 00 00 00 00 08 00 .....|
0010 45 00 00 54 ba bf 40 00 40 01 23 be ac 10 02 01 E..T..@. @.#.....|
0020 ac 10 02 0a 08 00 11 4c 09 ff 00 01 44 ee d0 5b .....L ....D..|
0030 00 00 00 00 06 97 02 00 00 00 00 00 10 11 12 13 .....|
0040 14 15 16 17 18 19 1a 1b .....!""$
```

D'après la documentation, si le flag `IFF_NO_PI` est activé on ne donne plus d'information sur le paquet dans l'en-tête. Si le flag n'est pas présent alors on a comme format de trame : 2 octets pour les flags et 2 octets pour le protocole dans l'en-tête de la trame.

### **3 Un tunnel simple pour Ipv4**

#### **3.1 Redirection du trafic sortant**

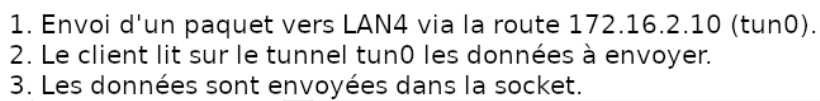
Après création de la bibliothèque *extremite*. Lorsque nous écrivons dans le descripteur du tunnel depuis VM1-6, le trafic est reçu puis écrit dans le tunnel de VM3-6.

Pour tester la connectivité, nous pouvons vérifier le contenu des trames envoyé par le tunnel à l'envoi et à la réception à l'aide de Wireshark.

#### **3.2 Intégration Finale du Tunnel**

La bibliothèque *extremite* autorise désormais le flux bidirectionnel. Les communications sont asynchrones puisque VM1 et VM3 peuvent s'envoyer des *ping* mutuellement et simultanément.

## PARCOURS D'UN PAQUET PARTANT DE LAN3 VERS LAN4



## 4 Validation fonctionnelle

### 4.1 Configuration

Exécution de *ip addr* et *ip route* sur :

- VM1 :

```
Terminal - mlreseaux@vm1: ~ (sur vm1)
mlreseaux@vm1:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:f8:33:b7 brd ff:ff:ff:ff:ff:ff
   inet 10.0.2.15/24 brd 10.0.2.255 scope global eth0
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:fe80:33b7/64 scope link
       valid_lft forever preferred_lft forever
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:1f:b5:11 brd ff:ff:ff:ff:ff:ff
   inet 172.16.2.131/28 brd 172.16.2.143 scope global eth1
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:fe1f:b511/64 scope link
       valid_lft forever preferred_lft forever
4: eth2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:bb:77:9f brd ff:ff:ff:ff:ff:ff
   inet 172.16.2.151/28 brd 172.16.2.159 scope global eth2
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:febb:779f/64 scope link
       valid_lft forever preferred_lft forever
mlreseaux@vm1:~$ ip route
default via 10.0.2.2 dev eth0
10.0.2.0/24 dev eth0 proto kernel scope link src 10.0.2.15
172.16.2.128/28 dev eth1 proto kernel scope link src 172.16.2.131
172.16.2.144/28 dev eth2 proto kernel scope link src 172.16.2.151
172.16.2.176/28 via 172.16.2.156 dev eth2
mlreseaux@vm1:~$
```

- VM1-6 :

```
Terminal - mlreseaux@vm1-6: ~ (sur vm1-6)
mlreseaux@vm1-6:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:f8:33:b7 brd ff:ff:ff:ff:ff:ff
   inet 10.0.2.15/24 brd 10.0.2.255 scope global eth0
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:fe80:33b7/64 scope link
       valid_lft forever preferred_lft forever
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:33:c3:3d brd ff:ff:ff:ff:ff:ff
   inet 172.16.2.156/28 brd 172.16.2.159 scope global eth1
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:fe33:c33d/64 scope link
       valid_lft forever preferred_lft forever
4: eth2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:01:aa:3b brd ff:ff:ff:ff:ff:ff
   inet6 fc00:1234:1::16/64 scope global
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:fe01:aa3b/64 scope link
       valid_lft forever preferred_lft forever
7: tun0: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UNKNOWN group default qlen 500
   link/none
   inet 172.16.2.1/28 scope global tun0
       valid_lft forever preferred_lft forever
mlreseaux@vm1-6:~$ ip route
default via 10.0.2.2 dev eth0
10.0.2.0/24 dev eth0 proto kernel scope link src 10.0.2.15
172.16.2.0/28 dev tun0 proto kernel scope link src 172.16.2.1
172.16.2.144/28 dev eth1 proto kernel scope link src 172.16.2.156
172.16.2.176/28 via 172.16.2.10 dev tun0
mlreseaux@vm1-6:~$
```



- VM2-6 :

```

Terminal - mlreseau@vm2-6: ~ (sur vm2-6)
Fichier Éditer Affichage Terminal Onglets Aide
mlreseau@vm2-6:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:f8:33:b7 brd ff:ff:ff:ff:ff:ff
   inet 10.0.2.15/24 brd 10.0.2.255 scope global eth0
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:fe8:33b7/64 scope link
       valid_lft forever preferred_lft forever
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:bc:2f:b7 brd ff:ff:ff:ff:ff:ff
   inet6 fc00:1234:1::26/64 scope global
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:feb:2fb7/64 scope link
       valid_lft forever preferred_lft forever
4: eth2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:d8:6c:a1 brd ff:ff:ff:ff:ff:ff
   inet6 fc00:1234:2::26/64 scope global
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:fed8:6ca1/64 scope link
       valid_lft forever preferred_lft forever
mlreseau@vm2-6:~$ ip route
10.0.2.0/24 dev eth0 proto kernel scope link src 10.0.2.15
mlreseau@vm2-6:~$

```

- VM3-6 :

```

Terminal - mlreseau@vm3-6: ~ (sur vm3-6)
Fichier Éditer Affichage Terminal Onglets Aide
mlreseau@vm3-6:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:f8:33:b7 brd ff:ff:ff:ff:ff:ff
   inet 10.0.2.15/24 brd 10.0.2.255 scope global eth0
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:fe8:33b7/64 scope link
       valid_lft forever preferred_lft forever
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:1d:03:d5 brd ff:ff:ff:ff:ff:ff
   inet 172.16.2.186/28 brd 172.16.2.191 scope global eth1
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:fe1d:3d5/64 scope link
       valid_lft forever preferred_lft forever
4: eth2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
   link/ether 08:00:27:42:49:e4 brd ff:ff:ff:ff:ff:ff
   inet6 fc00:1234:2::36/64 scope global
       valid_lft forever preferred_lft forever
   inet6 fe80::a00:27ff:fe42:49e4/64 scope link
       valid_lft forever preferred_lft forever
8: tun0: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UNKNOWN group default qlen 500
   link/none
   inet 172.16.2.1/28 scope global tun0
       valid_lft forever preferred_lft forever
mlreseau@vm3-6:~$ ip route
default via 10.0.2.2 dev eth0
10.0.2.0/24 dev eth0 proto kernel scope link src 10.0.2.15
172.16.2.0/28 dev tun0 proto kernel scope link src 172.16.2.1
172.16.2.144/28 via 172.16.2.10 dev tun0
172.16.2.176/28 dev eth1 proto kernel scope link src 172.16.2.186
mlreseau@vm3-6:~$

```



## 4.2 Couche 3

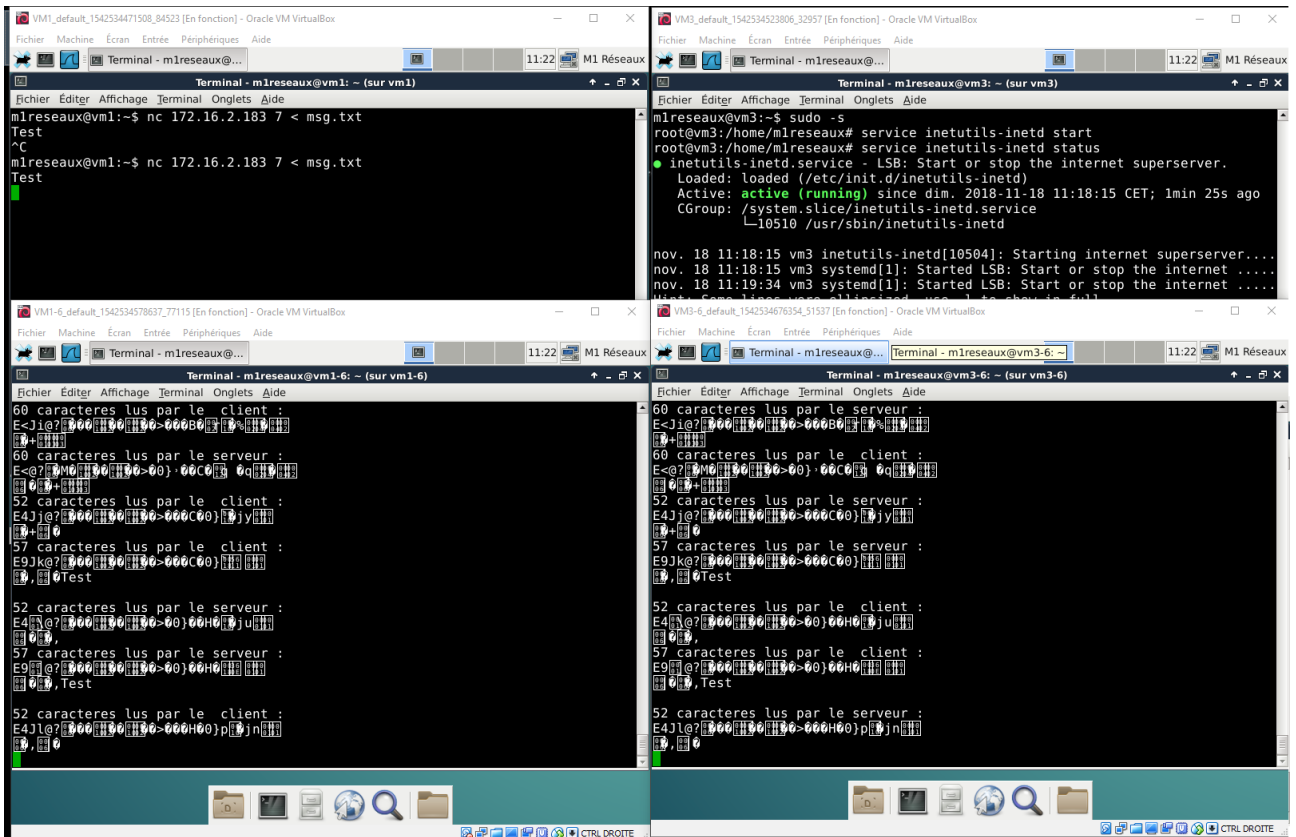
Exécution de *ping* 172.16.2.183 sur VM1 :

The image displays four sequential screenshots of a Kali Linux virtual machine environment, illustrating a Denial of Service (DoS) attack using a script named 'mireseaux'.

- Top Left Screenshot:** Shows the terminal window of the victim machine (vm1). The user runs the command `ping 172.16.2.183`, which results in a 100% packet loss and a time of 2999ms. This indicates that the victim machine is already unreachable.
- Top Right Screenshot:** Shows the terminal window of the attacker's machine (vm3-6). The user runs the command `ping 172.16.2.183`, which results in a 100% packet loss and a time of 2002ms. This indicates that the attacker's machine is also unreachable.
- Bottom Left Screenshot:** Shows the terminal window of the victim machine (vm1). The user runs the command `ip netns exec ns1 nslookup 172.16.2.183`, which results in a 100% packet loss and a time of 2999ms. This indicates that the victim machine is still unreachable.
- Bottom Right Screenshot:** Shows the terminal window of the attacker's machine (vm3-6). The user runs the command `ip netns exec ns1 nslookup 172.16.2.183`, which results in a 100% packet loss and a time of 2002ms. This indicates that the attacker's machine is also unreachable.

### 4.3 Couche 4

Création depuis VM1 du fichier *msg.txt* et envoi sur le service *echo* de VM3 :



## 4.4 Couche 4 : bande passante

Voici les tests de performances effectués pour différents tampons :

- `iperf3 -c 172.16.2.183 -n 1 -l 10 :`

```
mi@reseau:~$ iperf3 -c 172.16.2.183 -n 1 -l 10
Connecting to host 172.16.2.183 port 5201
[ 4] local 172.16.2.151 port 47347 connected to 172.16.2.183 port 5201
[ ID] Interval      Transfer    Bandwidth  Retr  Cwnd
[ 4] 0.00-0.00 sec    100 Bytes  15.4 Mb/s   0    14.1 KBytes
[ ID] Interval      Transfer    Bandwidth  Retr
[ 4] 0.00-0.00 sec    100 Bytes  15.4 Mb/s   0
[ 4] 0.00-0.00 sec    100 Bytes  15.4 Mb/s   0      sender
[ 4] 0.00-0.00 sec    100 Bytes  15.4 Mb/s   0      receiver
iperf Done.
mi@reseau:~$
```

```
mi@reseau:~$ iperf3 -c 172.16.2.183 -n 1 -l 10
Connecting to host 172.16.2.183 port 5201
[ 5] local 172.16.2.151 port 47346 connected to 172.16.2.183 port 5201
[ ID] Interval      Transfer    Bandwidth  Retr  Cwnd
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0    14.1 KBytes
[ ID] Interval      Transfer    Bandwidth  Retr
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0      sender
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0      receiver
iperf Done.
mi@reseau:~$
```

```
mi@reseau:~$ iperf3 -c 172.16.2.183 -n 1 -l 10
Connecting to host 172.16.2.183 port 5201
[ 5] local 172.16.2.151 port 47346 connected to 172.16.2.183 port 5201
[ ID] Interval      Transfer    Bandwidth  Retr  Cwnd
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0    14.1 KBytes
[ ID] Interval      Transfer    Bandwidth  Retr
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0      sender
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0      receiver
iperf Done.
mi@reseau:~$
```

- `iperf3 -c 172.16.2.183 -n 1 -l 2K :`

```
mi@reseau:~$ iperf3 -c 172.16.2.183 -n 1 -l 2K
Connecting to host 172.16.2.183 port 5201
[ 4] local 172.16.2.151 port 47349 connected to 172.16.2.183 port 5201
[ ID] Interval      Transfer    Bandwidth  Retr  Cwnd
[ 4] 0.00-0.00 sec    20.0 KBytes  1.15 Gb/s   0    14.1 KBytes
[ ID] Interval      Transfer    Bandwidth  Retr
[ 4] 0.00-0.00 sec    20.0 KBytes  1.15 Gb/s   0
[ 4] 0.00-0.00 sec    20.0 KBytes  1.15 Gb/s   0      sender
[ 4] 0.00-0.00 sec    20.0 KBytes  1.15 Gb/s   0      receiver
iperf Done.
mi@reseau:~$
```

```
mi@reseau:~$ iperf3 -c 172.16.2.183 -n 1 -l 2K
Connecting to host 172.16.2.183 port 5201
[ 5] local 172.16.2.151 port 47346 connected to 172.16.2.183 port 5201
[ ID] Interval      Transfer    Bandwidth  Retr  Cwnd
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0    14.1 KBytes
[ ID] Interval      Transfer    Bandwidth  Retr
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0      sender
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0      receiver
iperf Done.
mi@reseau:~$
```

```
mi@reseau:~$ iperf3 -c 172.16.2.183 -n 1 -l 2K
Connecting to host 172.16.2.183 port 5201
[ 5] local 172.16.2.151 port 47346 connected to 172.16.2.183 port 5201
[ ID] Interval      Transfer    Bandwidth  Retr  Cwnd
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0    14.1 KBytes
[ ID] Interval      Transfer    Bandwidth  Retr
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0      sender
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0      receiver
iperf Done.
mi@reseau:~$
```

```
mi@reseau:~$ iperf3 -c 172.16.2.183 -n 1 -l 2K
Connecting to host 172.16.2.183 port 5201
[ 5] local 172.16.2.151 port 47346 connected to 172.16.2.183 port 5201
[ ID] Interval      Transfer    Bandwidth  Retr  Cwnd
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0    14.1 KBytes
[ ID] Interval      Transfer    Bandwidth  Retr
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0      sender
[ 5] 0.00-0.25 sec    100 Bytes  3.26 Kb/s   0      receiver
iperf Done.
mi@reseau:~$
```

- `iperf3 -c 172.16.2.183 -n 1 -l 128K :`

```

Terminal - m1reseau@vm1: ~ (sur vm1)
[ 4] 0.00-0.00 sec 0.00 Bytes 0.00 bits/sec receiver
iperf Done.
m1reseau@vm1:~$
m1reseau@vm1:~$
m1reseau@vm1:~$ iperf3 -c 172.16.2.183 -n 1 -l 128K
Connecting to host 172.16.2.183, port 5201
[ 4] local 172.16.2.151 port 47351 connected to 172.16.2.183 port 5201
[ ID] Interval Transfer Bandwidth Retr Cwnd
[ 4] 0.00-0.00 sec 84.8 KBytes 5.95 Gbits/sec 0 14.1 KBytes
[ ID] Interval Transfer Bandwidth Retr sender receiver
[ 4] 0.00-0.00 sec 84.8 KBytes 5.95 Gbits/sec 0
[ 4] 0.00-0.00 sec 0.00 Bytes 0.00 bits/sec 0
iperf Done.
m1reseau@vm1:~$

```

- `iperf3 -c 172.16.2.183 -n 1 -l 1M :`

```

Terminal - m1reseau@vm1: ~ (sur vm1)
[ 4] 0.00-0.00 sec 84.8 KBytes 5.95 Gbits/sec 0 sender
[ 4] 0.00-0.00 sec 0.00 Bytes 0.00 bits/sec 0 receiver
iperf Done.
m1reseau@vm1:~$
m1reseau@vm1:~$
m1reseau@vm1:~$ iperf3 -c 172.16.2.183 -n 1 -l 1M
Connecting to host 172.16.2.183, port 5201
[ 4] local 172.16.2.151 port 47353 connected to 172.16.2.183 port 5201
[ ID] Interval Transfer Bandwidth Retr Cwnd
[ 4] 0.00-0.00 sec 84.8 KBytes 9.50 Gbits/sec 0 14.1 KBytes
[ ID] Interval Transfer Bandwidth Retr sender receiver
[ 4] 0.00-0.00 sec 84.8 KBytes 9.50 Gbits/sec 0
[ 4] 0.00-0.00 sec 0.00 Bytes 0.00 bits/sec 0
iperf Done.
m1reseau@vm1:~$

```

## 5 Améliorations

### 5.1 Configuration *salt*

En lançant notre programme *extremite* sur les deux VMs (VM1-6 et VM3-6) via *salt* il est possible de mettre en place une gestion de tunnel. Les difficultés peuvent être le manque de portabilité du programme. En effet, la création des routes dépend du parc et donc ne peut pas être automatisé de la même manière.