

A thick dark blue vertical bar runs along the left edge of the page. A blue arrow-shaped banner points to the right from this bar, containing the date. In the bottom-left corner, several thin, curved lines in dark blue and light grey sweep upwards and to the right.

7-11-2018

Tema4: Protocolo IP y encaminamiento

Escenario 1

Manuel Lora Román
MANUEL LORA ROMÁN

INDICE

Ejercicio _____	3
Configuración _____	4
Configuración de cada nodo _____	5
Configuración encaminamiento _____	8
Verificación de conectividad _____	9
Captura de tráfico en R0 _____	10

Ejercicio

Disponemos de Dos Host conectados a un router Linux.

Redes:

- 192.168.0.0/24
- 172.16.0.0/16

Tarea:

- Configurar los hosts y el router de forma que todos sean alcanzables.

Entrega:

- Esquema gráfico de la configuración.
- Comandos de configuración de cada nodo.
- Verificación de conectividad (ping) entre nodos.
- Captura de tráfico en el router durante una comunicación entre h1 y h2.

Configuración

Para hacernos una idea del ejercicio, lo plasmaremos en un diagrama, indicando las partes y su conexión:

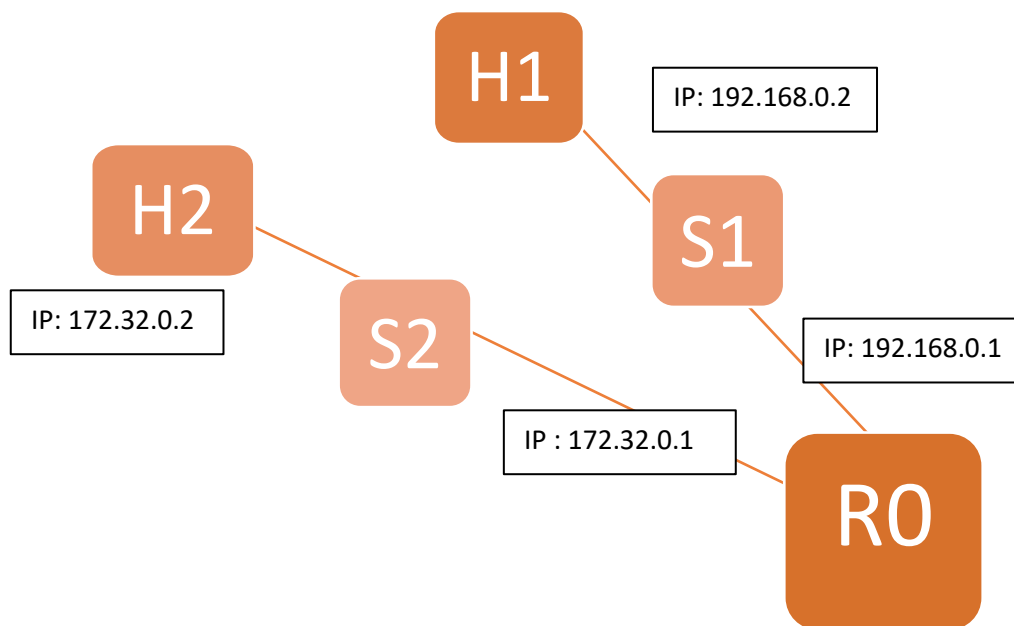


Ilustración 1

R0 → Router

S1, S2 → Switches

H1, H2 → Host

Configuración de cada nodo

En primer lugar, nos conectaremos a la red de mininet y para ello haremos lo siguiente:

```
debian@debian:~$ ssh -X -v mininet@172.22.1.73
```

Ilustración 1

Nos pedirá la contraseña, y una vez ya conectados, nos descargaremos el escenario1.py:

```
mininet@mininet-vm:~$ wget https://dit.gonzalonazareno.org/moodle/mod/resource/view.php?id=9915 --no-check-certificate
```

Ilustración 2

A continuación, ejecutaremos el escenario de la siguiente manera:

```
mininet@mininet-vm:~$ sudo python view.php?id=9915
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2 r0
*** Adding switches:
s1 s2
*** Adding links:
(h1, s1) (h2, s2) (s1, r0) (s2, r0)
*** Configuring hosts
h1 h2 r0
*** Starting controller
c0
*** Starting 2 switches
s1 s2 ...
*** Routing Table on Router:
Kernel IP routing table
Destination      Gateway          Genmask          Flags Metric Ref    Use Iface
*** Starting CLI:
mininet>
```

Ilustración 3

A continuación, abriremos los diferentes Host y el Router:

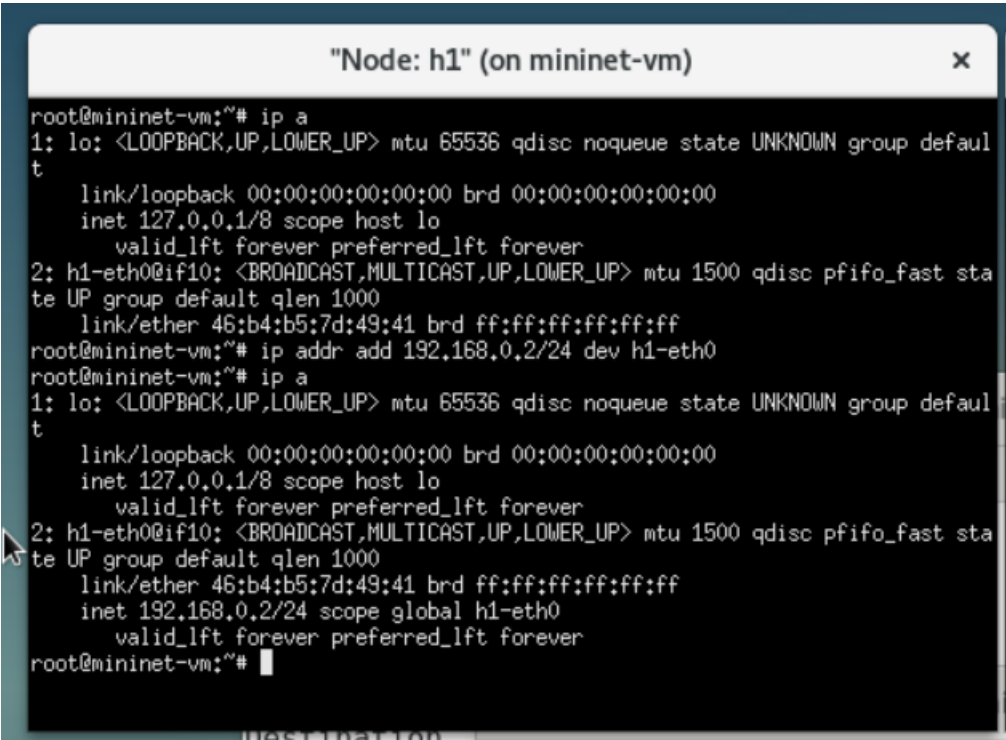
```
mininet> xterm h1 h2 r0
mininet> debug1: client_input_channel_open: ctype x11 rchan 2 win 65536 max 16384
debug1: client_request_x11: request from 127.0.0.1 50374
debug1: channel 1: new [x11]
debug1: confirm x11
debug1: client_input_channel_open: ctype x11 rchan 3 win 65536 max 16384
debug1: client_request_x11: request from 127.0.0.1 50376
debug1: channel 2: new [x11]
debug1: confirm x11
debug1: client_input_channel_open: ctype x11 rchan 4 win 65536 max 16384
debug1: client_request_x11: request from 127.0.0.1 50378
debug1: channel 3: new [x11]
debug1: confirm x11
```

Ilustración 4

Ya hecho esto, necesitamos configurar las direcciones Ip de cada Host y para ello usaremos el siguiente comando:

Ip a add {dirección Ip /máscara de red} dev {interfaz de red}

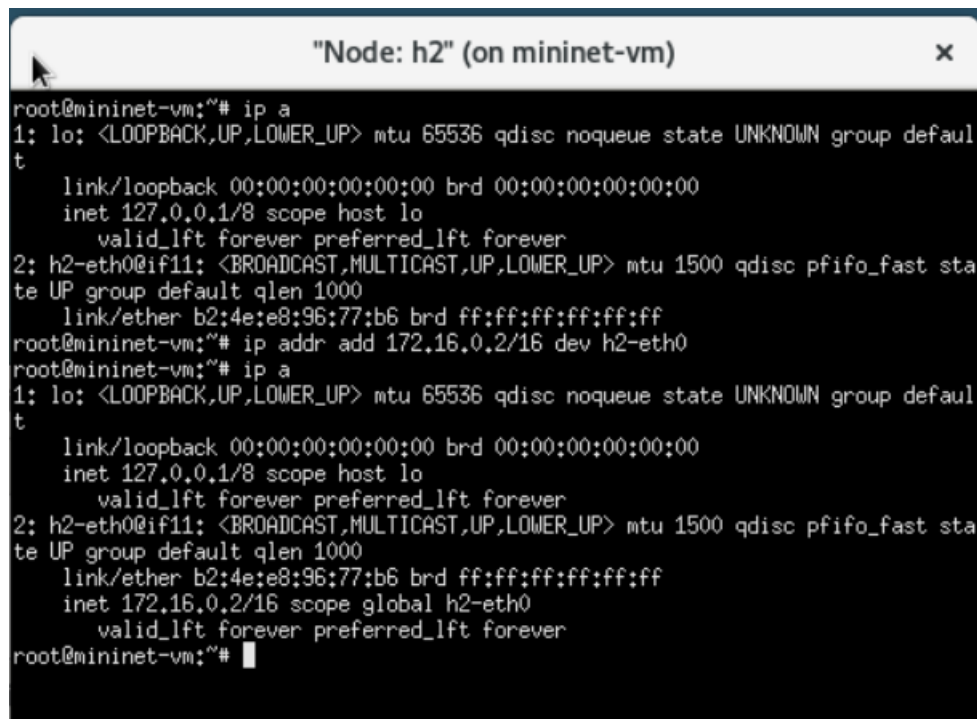
Por ejemplo, para el H1 sería:



```
Node: h1 (on mininet-vm)
root@mininet-vm:~# ip a
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
2: h1-eth0@if10: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 46:b4:b5:7d:49:41 brd ff:ff:ff:ff:ff:ff
root@mininet-vm:~# ip addr add 192.168.0.2/24 dev h1-eth0
root@mininet-vm:~# ip a
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
2: h1-eth0@if10: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 46:b4:b5:7d:49:41 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.2/24 scope global h1-eth0
        valid_lft forever preferred_lft forever
root@mininet-vm:~#
```

Ilustración 5

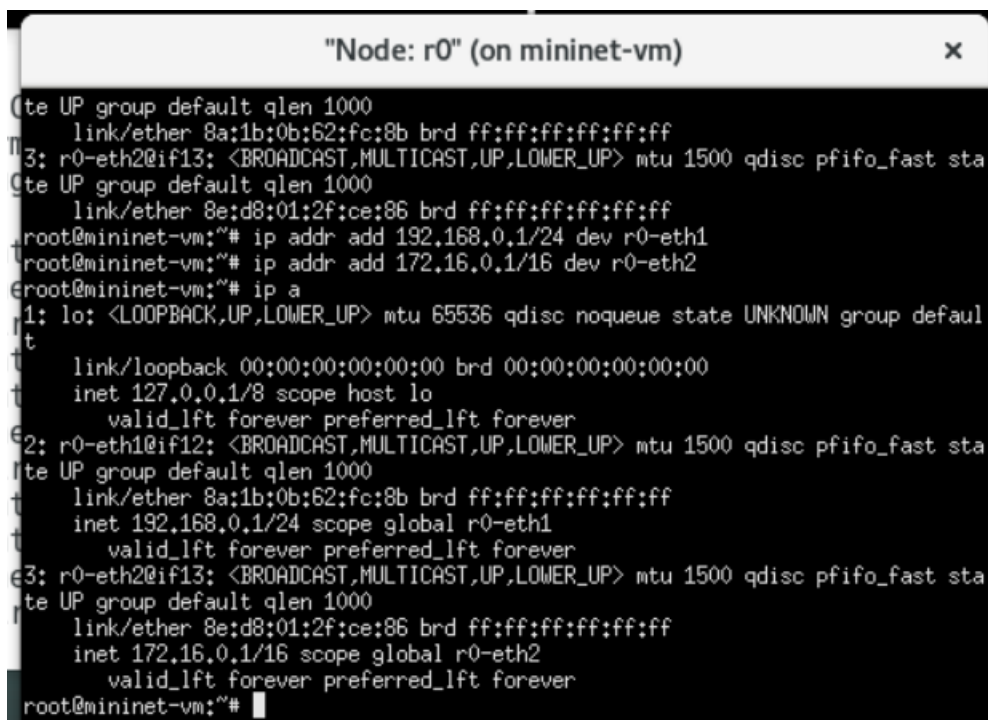
Y para H2:



```
root@mininet-vm:~# ip a
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
2: h2-eth0@if11: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether b2:4e:e8:96:77:b6 brd ff:ff:ff:ff:ff:ff
root@mininet-vm:~# ip addr add 172.16.0.2/16 dev h2-eth0
root@mininet-vm:~# ip a
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
2: h2-eth0@if11: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether b2:4e:e8:96:77:b6 brd ff:ff:ff:ff:ff:ff
    inet 172.16.0.2/16 scope global h2-eth0
        valid_lft forever preferred_lft forever
root@mininet-vm:~#
```

Ilustración 6

Y, por último, necesitamos configurar las diferentes interfaces de red que tiene el router R0. Usaremos el mismo comando:



```
te UP group default qlen 1000
    link/ether 8a:1b:0b:62:fc:8b brd ff:ff:ff:ff:ff:ff
3: r0-eth2@if13: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 8e:d8:01:2f:ce:86 brd ff:ff:ff:ff:ff:ff
root@mininet-vm:~# ip addr add 192.168.0.1/24 dev r0-eth1
root@mininet-vm:~# ip addr add 172.16.0.1/16 dev r0-eth2
root@mininet-vm:~# ip a
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
2: r0-eth1@if12: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 8a:1b:0b:62:fc:8b brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.1/24 scope global r0-eth1
        valid_lft forever preferred_lft forever
3: r0-eth2@if13: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 8e:d8:01:2f:ce:86 brd ff:ff:ff:ff:ff:ff
    inet 172.16.0.1/16 scope global r0-eth2
        valid_lft forever preferred_lft forever
root@mininet-vm:~#
```

Ilustración 7

Configuración encaminamiento

A continuación, con el siguiente comando crearemos la tabla de encaminamiento de cada nodo:

Ip r add {Ip de destino} via {Ip de origen}

En el caso de las tablas de encaminamiento de los Hosts, es mucho más cómodo usar:

Ip r add default via {Ip de destino}

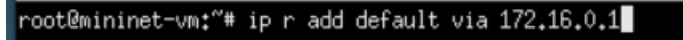
Para H1:



```
root@mininet-vm:~# ip r add default via 192.168.0.1
```

Ilustración 8

Y para H2:



```
root@mininet-vm:~# ip r add default via 172.16.0.1
```

Ilustración 9

Verificación de conectividad (ping)

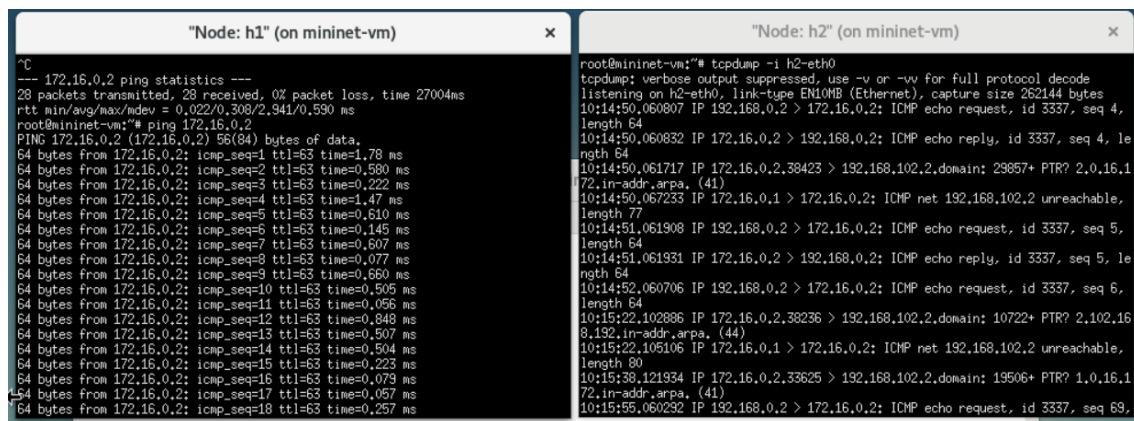
Una vez hecha la tabla de encaminamiento, usaremos el comando:

Ping {Ip de destino}

Para comprobar que, efectivamente, nos llegan los paquetes de datos, usaremos el comando:

Tcpdump -i {interfaz de red}

En primer lugar, mandaremos ping de H1 a H2:



The image shows two terminal windows side-by-side. The left window, titled '"Node: h1" (on mininet-vn)', displays the output of a ping command from node h1 to 172.16.0.2. It shows 28 packets transmitted with 0% loss and a round-trip time of approximately 2700ms. The right window, titled '"Node: h2" (on mininet-vn)', shows the output of a tcpdump command on interface h2-eth0, capturing the ICMP echo requests and replies between the two nodes. The output shows several successful echo requests and replies, as well as some unreachable messages.

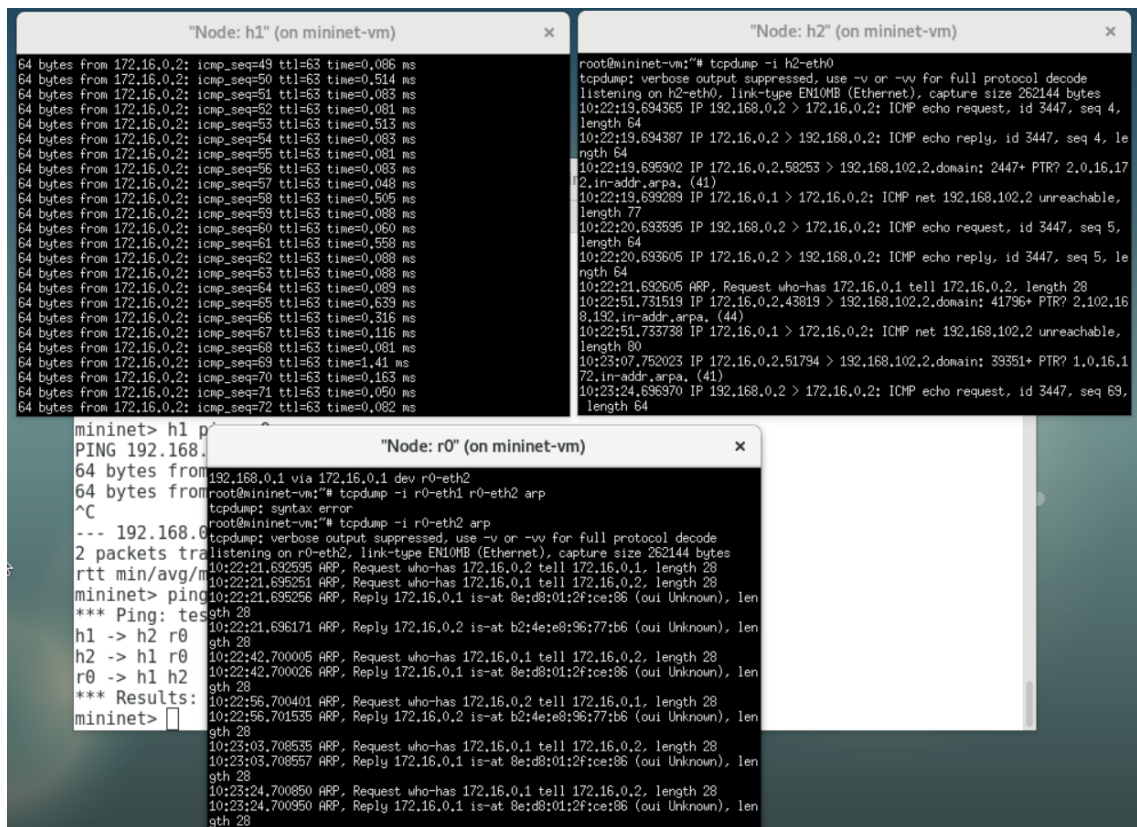
```
--- 172.16.0.2 ping statistics ---
28 packets transmitted, 28 received, 0% packet loss, time 27004ms
rtt min/avg/max/mdev = 0.022/0.308/2.341/0.590 ms
root@mininet-vn:~# ping 172.16.0.2
PING 172.16.0.2 (172.16.0.2) 56(84) bytes of data:
64 bytes from 172.16.0.2: icmp_seq=1 ttl=63 time=1.78 ms
64 bytes from 172.16.0.2: icmp_seq=2 ttl=63 time=0.580 ms
64 bytes from 172.16.0.2: icmp_seq=3 ttl=63 time=0.222 ms
64 bytes from 172.16.0.2: icmp_seq=4 ttl=63 time=1.47 ms
64 bytes from 172.16.0.2: icmp_seq=5 ttl=63 time=0.610 ms
64 bytes from 172.16.0.2: icmp_seq=6 ttl=63 time=0.145 ms
64 bytes from 172.16.0.2: icmp_seq=7 ttl=63 time=0.607 ms
64 bytes from 172.16.0.2: icmp_seq=8 ttl=63 time=0.077 ms
64 bytes from 172.16.0.2: icmp_seq=9 ttl=63 time=0.660 ms
64 bytes from 172.16.0.2: icmp_seq=10 ttl=63 time=0.505 ms
64 bytes from 172.16.0.2: icmp_seq=11 ttl=63 time=0.056 ms
64 bytes from 172.16.0.2: icmp_seq=12 ttl=63 time=0.848 ms
64 bytes from 172.16.0.2: icmp_seq=13 ttl=63 time=0.507 ms
64 bytes from 172.16.0.2: icmp_seq=14 ttl=63 time=0.504 ms
64 bytes from 172.16.0.2: icmp_seq=15 ttl=63 time=0.223 ms
64 bytes from 172.16.0.2: icmp_seq=16 ttl=63 time=0.079 ms
64 bytes from 172.16.0.2: icmp_seq=17 ttl=63 time=0.067 ms
64 bytes from 172.16.0.2: icmp_seq=18 ttl=63 time=0.257 ms
```

```
root@mininet-vn:~# tcpdump -i h2-eth0
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on h2-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
10:14:50.060807 IP 192.168.0.2 > 172.16.0.2: ICMP echo request, id 3337, seq 4,
length 64
10:14:50.060832 IP 172.16.0.2 > 192.168.0.2: ICMP echo reply, id 3337, seq 4, le
ngth 64
10:14:50.061717 IP 172.16.0.2.38423 > 192.168.102.2.domain: 29857+ PTR? 2.0.16.1
72.in-addr.arpa. (41)
10:14:50.067233 IP 172.16.0.1 > 172.16.0.2: ICMP net 192.168.102.2 unreachable,
length 77
10:14:51.061908 IP 192.168.0.2 > 172.16.0.2: ICMP echo request, id 3337, seq 5,
length 64
10:14:51.061931 IP 172.16.0.2 > 192.168.0.2: ICMP echo reply, id 3337, seq 5, le
ngth 64
10:14:52.060706 IP 192.168.0.2 > 172.16.0.2: ICMP echo request, id 3337, seq 6,
length 64
10:15:22.102886 IP 172.16.0.2.38236 > 192.168.102.2.domain: 10722+ PTR? 2.102.16
8.192.in-addr.arpa. (44)
10:15:22.105106 IP 172.16.0.1 > 172.16.0.2: ICMP net 192.168.102.2 unreachable,
length 60
10:15:38.121934 IP 172.16.0.2.33625 > 192.168.102.2.domain: 19506+ PTR? 1.0.16.1
72.in-addr.arpa. (41)
10:15:55.060292 IP 192.168.0.2 > 172.16.0.2: ICMP echo request, id 3337, seq 69,
```

Ilustración 10

Captura de tráfico en R0

Para comprobar la conectividad, vamos a hacer un Tcpcdump en el router para comprobar la entrada y salida de los paquetes de datos:



The image shows three terminal windows from a Mininet VM environment. The top-left window, titled '"Node: h1" (on mininet-vm)', displays a series of ICMP echo requests and replies between 172.16.0.2 and 192.168.0.2. The top-right window, titled '"Node: h2" (on mininet-vm)', shows a tcpdump capture on h2-eth0, displaying various network packets including ICMP echo requests, replies, and ARP requests. The bottom window, titled '"Node: r0" (on mininet-vm)', shows a tcpdump capture on r0-eth2, displaying ARP requests and replies. The main terminal window in the foreground shows the execution of a ping command from h1 to h2 via r0, with the command 'mininet> h1 ping 192.168.0.2' and the output 'PING 192.168.0.2: 64 bytes from 192.168.0.1 via 172.16.0.1 dev r0-eth2: 64 bytes from 192.168.0.1: icmp_seq=1 ttl=63 time=0.086 ms'. The output continues with '--- 192.168.0.2: 64 bytes from 192.168.0.1 via 172.16.0.1 dev r0-eth2: 64 bytes from 192.168.0.1: icmp_seq=2 ttl=63 time=0.083 ms' and '2 packets transmitted, 2 received, 0% packet loss, time 4000ms'.

```
"Node: h1" (on mininet-vm) x
64 bytes from 172.16.0.2: icmp_seq=49 ttl=63 time=0.086 ms
64 bytes from 172.16.0.2: icmp_seq=50 ttl=63 time=0.514 ms
64 bytes from 172.16.0.2: icmp_seq=51 ttl=63 time=0.083 ms
64 bytes from 172.16.0.2: icmp_seq=52 ttl=63 time=0.081 ms
64 bytes from 172.16.0.2: icmp_seq=53 ttl=63 time=0.513 ms
64 bytes from 172.16.0.2: icmp_seq=54 ttl=63 time=0.083 ms
64 bytes from 172.16.0.2: icmp_seq=55 ttl=63 time=0.081 ms
64 bytes from 172.16.0.2: icmp_seq=56 ttl=63 time=0.083 ms
64 bytes from 172.16.0.2: icmp_seq=57 ttl=63 time=0.048 ms
64 bytes from 172.16.0.2: icmp_seq=58 ttl=63 time=0.505 ms
64 bytes from 172.16.0.2: icmp_seq=59 ttl=63 time=0.088 ms
64 bytes from 172.16.0.2: icmp_seq=60 ttl=63 time=0.060 ms
64 bytes from 172.16.0.2: icmp_seq=61 ttl=63 time=0.558 ms
64 bytes from 172.16.0.2: icmp_seq=62 ttl=63 time=0.088 ms
64 bytes from 172.16.0.2: icmp_seq=63 ttl=63 time=0.088 ms
64 bytes from 172.16.0.2: icmp_seq=64 ttl=63 time=0.089 ms
64 bytes from 172.16.0.2: icmp_seq=65 ttl=63 time=0.633 ms
64 bytes from 172.16.0.2: icmp_seq=66 ttl=63 time=0.315 ms
64 bytes from 172.16.0.2: icmp_seq=67 ttl=63 time=0.115 ms
64 bytes from 172.16.0.2: icmp_seq=68 ttl=63 time=0.081 ms
64 bytes from 172.16.0.2: icmp_seq=69 ttl=63 time=1.41 ms
64 bytes from 172.16.0.2: icmp_seq=70 ttl=63 time=0.163 ms
64 bytes from 172.16.0.2: icmp_seq=71 ttl=63 time=0.050 ms
64 bytes from 172.16.0.2: icmp_seq=72 ttl=63 time=0.082 ms

mininet> h1 ping 192.168.0.2
PING 192.168.0.2: 64 bytes from 192.168.0.1 via 172.16.0.1 dev r0-eth2:
64 bytes from 192.168.0.1: icmp_seq=1 ttl=63 time=0.086 ms
^C
--- 192.168.0.2: 64 bytes from 192.168.0.1 via 172.16.0.1 dev r0-eth2:
64 bytes from 192.168.0.1: icmp_seq=2 ttl=63 time=0.083 ms
2 packets transmitted, 2 received, 0% packet loss, time 4000ms
rtt min/avg/max = 0.048/0.279/1.41 ms
mininet> ping 192.168.0.2
*** Ping: test 192.168.0.2: 64 bytes from 192.168.0.1 via 172.16.0.1 dev r0-eth2:
h1 -> h2 r0: 64 bytes from 192.168.0.1: icmp_seq=1 ttl=63 time=0.086 ms
h2 -> h1 r0: 64 bytes from 192.168.0.1: icmp_seq=2 ttl=63 time=0.083 ms
r0 -> h1 h2: 64 bytes from 192.168.0.1: icmp_seq=3 ttl=63 time=0.081 ms
*** Results: 2/2=100%
mininet>
```

```
"Node: h2" (on mininet-vm) x
root@mininet-vm:~# tcpdump -i h2-eth0
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on h2-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
10:22:19.694365 IP 192.168.0.2 > 172.16.0.2: ICMP echo request, id 3447, seq 4,
length 64
10:22:19.694387 IP 172.16.0.2 > 192.168.0.2: ICMP echo reply, id 3447, seq 4, le
ngth 64
10:22:19.695902 IP 172.16.0.2.58253 > 192.168.102.2.domain: 2447+ PTR? 2.0.16.17
2.in-addr.arpa. (41)
10:22:19.699289 IP 172.16.0.1 > 172.16.0.2: ICMP net 192.168.102.2 unreachable,
length 77
10:22:20.693595 IP 192.168.0.2 > 172.16.0.2: ICMP echo request, id 3447, seq 5,
length 64
10:22:20.693605 IP 172.16.0.2 > 192.168.0.2: ICMP echo reply, id 3447, seq 5, le
ngth 64
10:22:21.692605 ARP, Request who-has 172.16.0.1 tell 172.16.0.2, length 28
10:22:51.731513 IP 172.16.0.2.43819 > 192.168.102.2.domain: 41796+ PTR? 2.102.16
8.192.in-addr.arpa. (44)
10:22:51.733738 IP 172.16.0.1 > 172.16.0.2: ICMP net 192.168.102.2 unreachable,
length 80
10:23:07.752023 IP 172.16.0.2.51794 > 192.168.102.2.domain: 39351+ PTR? 1.0.16.1
72.in-addr.arpa. (41)
10:23:24.696970 IP 192.168.0.2 > 172.16.0.2: ICMP echo request, id 3447, seq 69,
length 64

"Node: r0" (on mininet-vm) x
root@mininet-vm:~# tcpdump -i r0-eth1 r0-eth2 arp
tcpdump: syntax error
root@mininet-vm:~# tcpdump -i r0-eth2 arp
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on r0-eth2, link-type EN10MB (Ethernet), capture size 262144 bytes
10:22:21.692595 ARP, Request who-has 172.16.0.2 tell 172.16.0.1, length 28
10:22:21.695251 ARP, Request who-has 172.16.0.1 tell 172.16.0.2, length 28
10:22:21.695256 ARP, Reply 172.16.0.1 is-at 8e:d8:01:2f:ce:86 (oui Unknown), len
gth 28
10:22:21.696171 ARP, Reply 172.16.0.2 is-at b2:4e:e8:96:77:b6 (oui Unknown), len
gth 28
10:22:42.700005 ARP, Request who-has 172.16.0.1 tell 172.16.0.2, length 28
10:22:42.700026 ARP, Reply 172.16.0.1 is-at 8e:d8:01:2f:ce:86 (oui Unknown), len
gth 28
10:22:56.700401 ARP, Request who-has 172.16.0.2 tell 172.16.0.1, length 28
10:22:56.701535 ARP, Reply 172.16.0.2 is-at b2:4e:e8:96:77:b6 (oui Unknown), len
gth 28
10:23:03.708535 ARP, Request who-has 172.16.0.1 tell 172.16.0.2, length 28
10:23:03.708557 ARP, Reply 172.16.0.1 is-at 8e:d8:01:2f:ce:86 (oui Unknown), len
gth 28
10:23:24.700850 ARP, Request who-has 172.16.0.1 tell 172.16.0.2, length 28
10:23:24.700950 ARP, Reply 172.16.0.1 is-at 8e:d8:01:2f:ce:86 (oui Unknown), len
gth 28
```

Ilustración 11

"Node: h1" (on mininet-vm) x

```

root@mininet-vm:~# tcpdump -i h1-eth0
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on h1-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
10:24:44.001508 IP 172.16.0.2 > 192.168.0.2: ICMP echo request, id 3481, seq 1, length 64
10:24:44.001517 IP 192.168.0.2 > 172.16.0.2: ICMP echo reply, id 3481, seq 1, length 64
10:24:44.001714 IP 192.168.0.2.36063 > 192.168.102.2.domain: 6984+ PTR? 2.0.168.192.in-addr.arpa. (42)
10:24:44.003319 IP 192.168.0.1 > 192.168.0.2: ICMP net 192.168.102.2 unreachable, length 78
10:24:45.003408 IP 172.16.0.2 > 192.168.0.2: ICMP echo request, id 3481, seq 2, length 64
10:24:45.003415 IP 192.168.0.2 > 172.16.0.2: ICMP echo reply, id 3481, seq 2, length 64
10:24:46.004746 IP 172.16.0.2 > 192.168.0.2: ICMP echo request, id 3481, seq 3, length 64
10:25:16.038354 IP 192.168.0.2.47039 > 192.168.102.2.domain: 36259+ PTR? 2.102.168.192.in-addr.arpa. (44)
10:25:16.041775 IP 192.168.0.1 > 192.168.0.2: ICMP net 192.168.102.2 unreachable, length 80
10:25:32.067227 IP 192.168.0.2.50433 > 192.168.102.2.domain: 27785+ PTR? 1.0.168.192.in-addr.arpa. (42)
10:25:49.004821 IP 172.16.0.2 > 192.168.0.2: ICMP echo request, id 3481, seq 66, length 64
64 bytes from 192.168.0.2: icmp_seq=59 ttl=63 time=0.044 ms
64 bytes from 192.168.0.2: icmp_seq=60 ttl=63 time=0.080 ms
64 bytes from 192.168.0.2: icmp_seq=61 ttl=63 time=0.081 ms
64 bytes from 192.168.0.2: icmp_seq=62 ttl=63 time=0.502 ms
64 bytes from 192.168.0.2: icmp_seq=63 ttl=63 time=0.494 ms
64 bytes from 192.168.0.2: icmp_seq=64 ttl=63 time=0.143 ms
64 bytes from 192.168.0.2: icmp_seq=65 ttl=63 time=0.082 ms
64 bytes from 192.168.0.2: icmp_seq=66 ttl=63 time=1.46 ms
64 bytes from 192.168.0.2: icmp_seq=67 ttl=63 time=2.00 ms
64 bytes from 192.168.0.2: icmp_seq=68 ttl=63 time=0.087 ms
64 bytes from 192.168.0.2: icmp_seq=69 ttl=63 time=0.092 ms
64 bytes from 192.168.0.2: icmp_seq=70 ttl=63 time=1.42 ms
64 bytes from 192.168.0.2: icmp_seq=71 ttl=63 time=0.065 ms
64 bytes from 192.168.0.2: icmp_seq=72 ttl=63 time=0.089 ms
64 bytes from 192.168.0.2: icmp_seq=73 ttl=63 time=0.083 ms
64 bytes from 192.168.0.2: icmp_seq=74 ttl=63 time=0.071 ms
64 bytes from 192.168.0.2: icmp_seq=75 ttl=63 time=2.50 ms
64 bytes from 192.168.0.2: icmp_seq=76 ttl=63 time=0.065 ms
64 bytes from 192.168.0.2: icmp_seq=77 ttl=63 time=0.084 ms
--- 192.168.0.2 ping statistics ---
77 packets transmitted, 77 received, 0% packet loss, time 76012ms
rtt min/avg/max/mdev = 0.021/0.280/2.598/0.502 ms
root@mininet-vm:~#

```

"Node: h2" (on mininet-vm) x

```

mininet> h1 p
PING 192.168.0.2:
64 bytes from 192.168.0.2: icmp_seq=59 ttl=63 time=0.044 ms
64 bytes from 192.168.0.2: icmp_seq=60 ttl=63 time=0.080 ms
64 bytes from 192.168.0.2: icmp_seq=61 ttl=63 time=0.081 ms
64 bytes from 192.168.0.2: icmp_seq=62 ttl=63 time=0.502 ms
64 bytes from 192.168.0.2: icmp_seq=63 ttl=63 time=0.494 ms
64 bytes from 192.168.0.2: icmp_seq=64 ttl=63 time=0.143 ms
64 bytes from 192.168.0.2: icmp_seq=65 ttl=63 time=0.082 ms
64 bytes from 192.168.0.2: icmp_seq=66 ttl=63 time=1.46 ms
64 bytes from 192.168.0.2: icmp_seq=67 ttl=63 time=2.00 ms
64 bytes from 192.168.0.2: icmp_seq=68 ttl=63 time=0.087 ms
64 bytes from 192.168.0.2: icmp_seq=69 ttl=63 time=0.092 ms
64 bytes from 192.168.0.2: icmp_seq=70 ttl=63 time=1.42 ms
64 bytes from 192.168.0.2: icmp_seq=71 ttl=63 time=0.065 ms
64 bytes from 192.168.0.2: icmp_seq=72 ttl=63 time=0.089 ms
64 bytes from 192.168.0.2: icmp_seq=73 ttl=63 time=0.083 ms
64 bytes from 192.168.0.2: icmp_seq=74 ttl=63 time=0.071 ms
64 bytes from 192.168.0.2: icmp_seq=75 ttl=63 time=2.50 ms
64 bytes from 192.168.0.2: icmp_seq=76 ttl=63 time=0.065 ms
64 bytes from 192.168.0.2: icmp_seq=77 ttl=63 time=0.084 ms
--- 192.168.0.2 ping statistics ---
77 packets transmitted, 77 received, 0% packet loss, time 76012ms
rtt min/avg/max/mdev = 0.021/0.280/2.598/0.502 ms
root@mininet-vm:~#

```

"Node: r0" (on mininet-vm) x

```

mininet> h1 p
PING 192.168.0.2:
64 bytes from 192.168.0.2: icmp_seq=59 ttl=63 time=0.044 ms
64 bytes from 192.168.0.2: icmp_seq=60 ttl=63 time=0.080 ms
64 bytes from 192.168.0.2: icmp_seq=61 ttl=63 time=0.081 ms
64 bytes from 192.168.0.2: icmp_seq=62 ttl=63 time=0.502 ms
64 bytes from 192.168.0.2: icmp_seq=63 ttl=63 time=0.494 ms
64 bytes from 192.168.0.2: icmp_seq=64 ttl=63 time=0.143 ms
64 bytes from 192.168.0.2: icmp_seq=65 ttl=63 time=0.082 ms
64 bytes from 192.168.0.2: icmp_seq=66 ttl=63 time=1.46 ms
64 bytes from 192.168.0.2: icmp_seq=67 ttl=63 time=2.00 ms
64 bytes from 192.168.0.2: icmp_seq=68 ttl=63 time=0.087 ms
64 bytes from 192.168.0.2: icmp_seq=69 ttl=63 time=0.092 ms
64 bytes from 192.168.0.2: icmp_seq=70 ttl=63 time=1.42 ms
64 bytes from 192.168.0.2: icmp_seq=71 ttl=63 time=0.065 ms
64 bytes from 192.168.0.2: icmp_seq=72 ttl=63 time=0.089 ms
64 bytes from 192.168.0.2: icmp_seq=73 ttl=63 time=0.083 ms
64 bytes from 192.168.0.2: icmp_seq=74 ttl=63 time=0.071 ms
64 bytes from 192.168.0.2: icmp_seq=75 ttl=63 time=2.50 ms
64 bytes from 192.168.0.2: icmp_seq=76 ttl=63 time=0.065 ms
64 bytes from 192.168.0.2: icmp_seq=77 ttl=63 time=0.084 ms
--- 192.168.0.2 ping statistics ---
77 packets transmitted, 77 received, 0% packet loss, time 76012ms
rtt min/avg/max/mdev = 0.021/0.280/2.598/0.502 ms
root@mininet-vm:~#

```

Ilustración 12