Universidad Nacional de Luján
Departamento de Ciencias Básicas
Teleinformática y Redes

Material de Estudio

Ruteo Estático en Protocolo IP

Contenido

- Demostración de ruteo con protocolo IP – 2 redes
- Demostración de ruteo con protocolo IP – 3 redes
- Demostración de ruteo con protocolo IP - 2 redes de usuario,1 red de interconexión, sin rutas por defecto
- Demostración de ping destinado a la red
- Ejemplo de configuración de una red de mayor complejidad

- Versión 1.1 - Año 2001 –

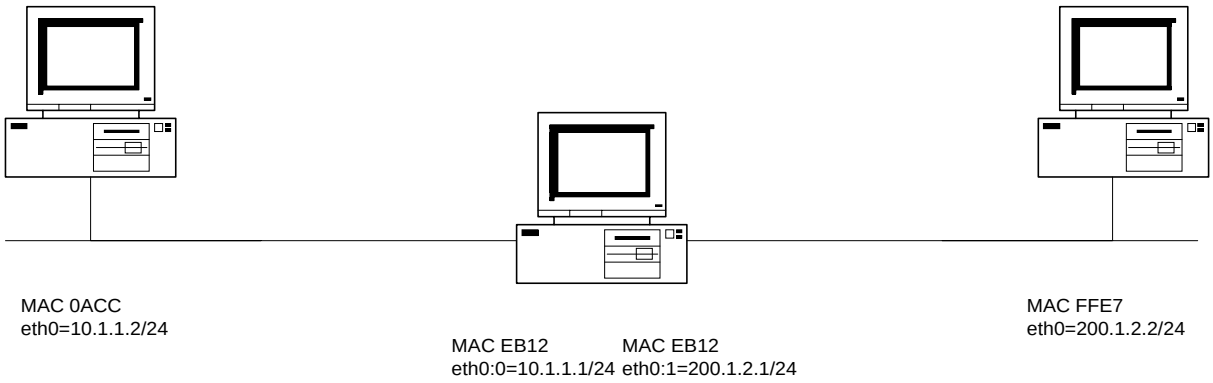
Universidad Nacional de Luján
Departamento de Ciencias Básicas
Asignatura: Teleinformática y Redes

EJERCICIO 1

Demostración de ruteo con protocolo IP – 2 redes

Nota: se trabajó sobre un único dominio de colisión, y en el router se definió con la modalidad de interfaz virtual.

Topología de trabajo



Configuración de los hosts

Host 10.1.1.2

```
Ifconfig eth0 10.1.1.2 netmask 255.255.255.0
Route add default gw 10.1.1.1

Tabla de ruteo resultante
Destino           GW          Mask              F     If
      10.1.1.0          *(0.0.0.0)  255.255.255.0     U     eth0
      loopback          *           255.0.0.0         U     lo
      default(0.0.0.0)  10.1.1.1    0.0.0.0           UG    eth0
```

Host 200.1.2.2

```
Ifconfig eth0 200.1.2.2 netmask 255.255.255.0
Route add default gw 200.1.2.1

Tabla de ruteo resultante
Destino           GW          Mask              F     If
      200.1.2.0         *(0.0.0.0)  255.255.255.0     U     eth0
      loopback          *           255.0.0.0         U     lo
      default(0.0.0.0)  200.1.2.1   0.0.0.0           UG    eth0
```

Router

```
Ifconfig 0.0.0.0
Ifconfig eth0:0 10.1.1.1 netmask 255.255.255.0
Ifconfig eth0:1 200.1.2.1 netmask 255.255.255.0

Tabla de ruteo resultante
Destino           GW          Mask              F     If
      200.1.2.0         *(0.0.0.0)  255.255.255.0     U     eth0
      10.1.1.0          *(0.0.0.0)  255.255.255.0     U     eth0
      loopback          *           255.0.0.0         U     lo
```

Ejercicio Nro 1 - Muestra Nro. 1

Acción: Se ejecuta el comando ping desde 200.1.2.2 a 10.1.1.2

Las columnas indican el host originante del mensaje.

Sec.	Host 0ACC/10.1.1.2	Router EB12 10.1.1.1/200.1.2.1	Host FFE7/200.1.2.2
674			MAC destino:FFFF ARP REQUEST por 200.1.2.1
033		MAC destino:FFE7 ARP REPLY por 200.1.2.1/EB12	
072			MAC destino EB12 IP de 200.1.2.2 a 10.1.1.2 ICMP echo request
673		MAC destino:FFFF ARP REQUEST por 10.1.1.2	
785	MAC destino:EB12 ARP REPLY por 10.1.1.2/0ACC		
971		MAC destino 0ACC IP de 200.1.2.2 a 10.1.1.2 ICMP echo request	
123	MAC destino EB12 IP de 10.1.1.2 a 200.1.2.2 ICMP echo reply		
512		MAC destino FFE7 IP de 10.1.1.2 a 200.1.2.2 ICMP echo reply	
843			MAC destino EB12 IP de 200.1.2.2 a 10.1.1.2 ICMP echo request
379		MAC destino 0ACC IP de 200.1.2.2 a 10.1.1.2 ICMP echo request	
507	MAC destino EB12 IP de 10.1.1.2 a 200.1.2.2 ICMP echo reply		

Convenciones

Verde frames del protocolo auxiliar ARP
Rojo datagramas reenviados por el router
Negro datagramas generados por hosts

PDUs capturadas en la muestra nro. 1

```
================================================================
                        Ethernet Header(991766000.761674)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          806H (arp)
Length:                 46
------------------------------------------------------------
                 ARP Header
------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        0:e0:7d:72:ff:e7
Sender IP:              200.1.2.2
Target hardware:        0:0:0:0:0:0
Target IP:              200.1.2.1
================================================================
```

```
                        Ethernet Header(991766000.762033)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          806H (arp)
Length:                 64
-------------------------------------------------------------
                  ARP Header
-------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        52:54:0:db:eb:12
Sender IP:              200.1.2.1
Target hardware:        0:e0:7d:72:ff:e7
Target IP:              200.1.2.2
=============================================================
                        Ethernet Header(991766000.762072)
-------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       87
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        42316
Source address          200.1.2.2
Destination address     10.1.1.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              167
Sequence number         0
Checksum:               29948
=============================================================
                        Ethernet Header(991766000.762597)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 150
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       94
Fragmentation offset:   0 (U=0, DF=0, MF=0)
```

```
Time to live:           255
Protocol:               1
Header checksum:        9813
Source address          200.1.2.1
Destination address     200.1.2.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               23285
=============================================================
                        Ethernet Header(991766000.762673)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          806H (arp)
Length:                 64
-------------------------------------------------------------
                  ARP Header
-------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        52:54:0:db:eb:12
Sender IP:              10.1.1.1
Target hardware:        0:0:0:0:0:0
Target IP:              10.1.1.2
=============================================================
                        Ethernet Header(991766000.762785)
-------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          806H (arp)
Length:                 64
-------------------------------------------------------------
                  ARP Header
-------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        0:48:54:68:a:cc
Sender IP:              10.1.1.2
Target hardware:        52:54:0:db:eb:12
Target IP:              10.1.1.1
=============================================================
                        Ethernet Header(991766000.762971)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 102
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       87
Fragmentation offset:   0 (U=0, DF=0, MF=0)
```

```
Time to live:           63
Protocol:               1
Header checksum:        42572
Source address          200.1.2.2
Destination address     10.1.1.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              167
Sequence number         0
Checksum:               29948
=================================================================
                        Ethernet Header(991766000.763123)
-----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
-----------------------------------------------------------------
                        IP Header
-----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       34
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        59008
Source address          10.1.1.2
Destination address     200.1.2.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              167
Sequence number         0
Checksum:               31996
=================================================================
                        Ethernet Header(991766000.763398)
-----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 150
-----------------------------------------------------------------
                        IP Header
-----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       95
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42069
```

```
Source address          10.1.1.1
Destination address     10.1.1.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               39924
============================================================
                        Ethernet Header(991766000.763512)
------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 102
------------------------------------------------------------
                        IP Header
------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       34
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           254
Protocol:               1
Header checksum:        59264
Source address          10.1.1.2
Destination address     200.1.2.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              167
Sequence number         0
Checksum:               31996
============================================================
                        Ethernet Header(991766001.760843)
------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
------------------------------------------------------------
                        IP Header
------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       88
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        42315
Source address          200.1.2.2
Destination address     10.1.1.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
```

```
Type:                   8 (echo request)
Code                    0
Identifier              167
Sequence number         1
Checksum:               21503
================================================================
                        Ethernet Header(991766001.761311)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 150
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       96
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        9811
Source address          200.1.2.1
Destination address     200.1.2.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               23285
================================================================
                        Ethernet Header(991766001.761379)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 102
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       88
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           63
Protocol:               1
Header checksum:        42571
Source address          200.1.2.2
Destination address     10.1.1.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              167
Sequence number         1
Checksum:               21503
```

```
================================================================
                        Ethernet Header(991766001.761507)
----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       35
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        59007
Source address          10.1.1.2
Destination address     200.1.2.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              167
Sequence number         1
Checksum:               23551
================================================================
                        Ethernet Header(991766001.761740)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 150
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       97
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42067
Source address          10.1.1.1
Destination address     10.1.1.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               39924
================================================================
                        Ethernet Header(991766001.761849)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
```

```
Protocol type:          800H (ip)
Length:                 102
------------------------------------------------------------
                        IP Header
------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       35
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           254
Protocol:               1
Header checksum:        59263
Source address          10.1.1.2
Destination address     200.1.2.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              167
Sequence number         1
Checksum:               23551
============================================================
                        Ethernet Header(991766002.760824)
------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
------------------------------------------------------------
                        IP Header
------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       89
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        42314
Source address          200.1.2.2
Destination address     10.1.1.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              167
Sequence number         2
Checksum:               25087
============================================================
                        Ethernet Header(991766002.761291)
------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 150
------------------------------------------------------------
```

```
                        IP Header
-----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       98
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        9809
Source address          200.1.2.1
Destination address     200.1.2.2
-----------------------------------------------------------
                        ICMP Header
-----------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               23285
===========================================================
```

***Ejercicio Nro 1 -* Muestra Nro. 2**

Acción: Se realiza una conexión ftp de control desde 200.1.2.2 a 10.1.1.2, se ejecuta el comando LS y se cierra la conexión

PDUs capturadas en la muestra nro. 2 *(Solamente se expone un extracto de la conexión, donde se muestra el inicio y el cierre de la conexión de control)*

```
================================================================
                        Ethernet Header(991766462.776258)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 78
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           60
Identification #:       91
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           64
Protocol:               6
Header checksum:        25947
Source address          200.1.2.2
Destination address     10.1.1.2
----------------------------------------------------------------
                        TCP Header
----------------------------------------------------------------
Source port:            1024
Destination port:       21 (ftp)
Sequence number:        1083307321
Acknowledgement number: 0
Header length:          40
Reserved bits:          0
Flags:                  SYN
Window size:            32120
Checksum:               14551
Urgent pointer:         0
Options:                Maximum segment size = 1460
Option 4:Timestamp = 230094 0
No op
Window scale = 0
================================================================
                        Ethernet Header(991766462.776790)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 126
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           108
Identification #:       102
```

```
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        9829
Source address          200.1.2.1
Destination address     200.1.2.2
-------------------------------------------------------
                        ICMP Header
-------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               42025
=======================================================================
                        Ethernet Header(991766462.776879)
-----------------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 78
-----------------------------------------------------------------------
                        IP Header
-----------------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           60
Identification #:       91
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           63
Protocol:               6
Header checksum:        26203
Source address          200.1.2.2
Destination address     10.1.1.2
-----------------------------------------------------------------------
                        TCP Header
-----------------------------------------------------------------------
Source port:            1024
Destination port:       21 (ftp)
Sequence number:        1083307321
Acknowledgement number: 0
Header length:          40
Reserved bits:          0
Flags:                  SYN
Window size:            32120
Checksum:               14551
Urgent pointer:         0
Options:                Maximum segment size = 1460
Option 4:Timestamp = 230094 0
No op
Window scale = 0
=======================================================================
                        Ethernet Header(991766462.777300)
-----------------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          806H (arp)
Length:                 64
-------------------------------------------------------
                  ARP Header
-------------------------------------------------------
Hardware type:          1
```

```
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        0:48:54:68:a:cc
Sender IP:              10.1.1.2
Target hardware:        0:0:0:0:0:0
Target IP:              10.1.1.1
================================================================
                        Ethernet Header(991766462.777472)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          806H (arp)
Length:                 64
----------------------------------------------------------
                  ARP Header
----------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        52:54:0:db:eb:12
Sender IP:              10.1.1.1
Target hardware:        0:48:54:68:a:cc
Target IP:              10.1.1.2
================================================================
                        Ethernet Header(991766462.777580)
----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 78
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           60
Identification #:       38
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           64
Protocol:               6
Header checksum:        26000
Source address          10.1.1.2
Destination address     200.1.2.2
----------------------------------------------------------------
                        TCP Header
----------------------------------------------------------------
Source port:            21 (ftp)
Destination port:       1024
Sequence number:        1553656264
Acknowledgement number: 1083307322
Header length:          40
Reserved bits:          0
Flags:                  SYN ACK
Window size:            16060
Checksum:               17760
Urgent pointer:         0
Options:                Maximum segment size = 1460
Option 4:Timestamp = 60350 230094
No op
Window scale = 0
```

```
================================================================
                        Ethernet Header(991766462.777830)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 126
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           108
Identification #:       103
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42085
Source address          10.1.1.1
Destination address     10.1.1.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               58664
================================================================
                        Ethernet Header(991766462.777926)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 78
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           60
Identification #:       38
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           63
Protocol:               6
Header checksum:        26256
Source address          10.1.1.2
Destination address     200.1.2.2
----------------------------------------------------------------
                        TCP Header
----------------------------------------------------------------
Source port:            21 (ftp)
Destination port:       1024
Sequence number:        1553656264
Acknowledgement number: 1083307322
Header length:          40
Reserved bits:          0
Flags:                  SYN ACK
Window size:            16060
Checksum:               17760
Urgent pointer:         0
```

```
Options:                Maximum segment size = 1460
Option 4:Timestamp = 60350 230094
No op
Window scale = 0
================================================================
                        Ethernet Header(991766462.778008)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 70
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           52
Identification #:       92
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           64
Protocol:               6
Header checksum:        25954
Source address          200.1.2.2
Destination address     10.1.1.2
----------------------------------------------------------------
                        TCP Header
----------------------------------------------------------------
Source port:            1024
Destination port:       21 (ftp)
Sequence number:        1083307322
Acknowledgement number: 1553656265
Header length:          32
Reserved bits:          0
Flags:                  ACK
Window size:            32120
Checksum:               13673
Urgent pointer:         0
Options:                No op
No op
Timestamp = 230094 60350
================================================================
                        Ethernet Header(991766462.778313)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 70
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           52
Identification #:       92
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           63
Protocol:               6
Header checksum:        26210
Source address          200.1.2.2
```

```
Destination address     10.1.1.2
-----------------------------------------------------------------
                        TCP Header
-----------------------------------------------------------------
Source port:            1024
Destination port:       21 (ftp)
Sequence number:        1083307322
Acknowledgement number: 1553656265
Header length:          32
Reserved bits:          0
Flags:                  ACK
Window size:            32120
Checksum:               13673
Urgent pointer:         0
Options:                No op
No op
Timestamp = 230094 60350
=================================================================
                        Ethernet Header(991766466.001605)
-----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 169
-----------------------------------------------------------------
                        IP Header
-----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        16 (precedence=0, D=1, T=0, R=0, U=0)
Total length:           151
Identification #:       75
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           64
Protocol:               6
Header checksum:        25856
Source address          10.1.1.2
Destination address     200.1.2.2
-----------------------------------------------------------------
                        TCP Header
-----------------------------------------------------------------
Source port:            21 (ftp)
Destination port:       1024
Sequence number:        1553656265
Acknowledgement number: 1083307322
Header length:          32
Reserved bits:          0
Flags:                  PSH ACK
Window size:            16060
Checksum:               19900
Urgent pointer:         0
Options:                No op
No op
Timestamp = 60673 230094
-----------------------------------------------------------------
32 32 30 20 64 61 72 6B 73 74 61 72 2E 65 78 61  220 darkstar.exa
6D 70 6C 65 2E 6E 65 74 20 46 54 50 20 73 65 72  mple.net FTP ser
76 65 72 20 28 56 65 72 73 69 6F 6E 20 77 75 2D  ver (Version wu-
32 2E 34 2E 32 2D 56 52 31 36 28 31 29 20 53 75  2.4.2-VR16(1) Su
6E 20 4D 61 79 20 39 20 32 30 3A 31 30 3A 30 33  n May 9 20:10:03
20 43 44 54 20 31 39 39 39 29 20 72 65 61 64      CDT 1999) read
```

```
================================================================
                        Ethernet Header(991766466.002100)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 169
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        16 (precedence=0, D=1, T=0, R=0, U=0)
Total length:           151
Identification #:       75
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           63
Protocol:               6
Header checksum:        26112
Source address          10.1.1.2
Destination address     200.1.2.2
----------------------------------------------------------------
                        TCP Header
----------------------------------------------------------------
Source port:            21 (ftp)
Destination port:       1024
Sequence number:        1553656265
Acknowledgement number: 1083307322
Header length:          32
Reserved bits:          0
Flags:                  PSH ACK
Window size:            16060
Checksum:               19900
Urgent pointer:         0
Options:                No op
No op
Timestamp = 60673 230094
----------------------------------------------------------------
32 32 30 20 64 61 72 6B 73 74 61 72 2E 65 78 61  220 darkstar.exa
6D 70 6C 65 2E 6E 65 74 20 46 54 50 20 73 65 72  mple.net FTP ser
76 65 72 20 28 56 65 72 73 69 6F 6E 20 77 75 2D  ver (Version wu-
32 2E 34 2E 32 2D 56 52 31 36 28 31 29 20 53 75  2.4.2-VR16(1) Su
6E 20 4D 61 79 20 39 20 32 30 3A 31 30 3A 30 33  n May 9 20:10:03
20 43 44 54 20 31 39 39 39 29 20 72 65 61 64      CDT 1999) read
================================================================
```

Finalización de la etapa de inicio de conexión, se corta de la secuencia de captura, y a continuación se puede observar la fase de cierre

```
================================================================
                        Ethernet Header(991766487.527233)
----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 217
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
```

```
Type of service:        16 (precedence=0, D=1, T=0, R=0, U=0)
Total length:           199
Identification #:       91
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           64
Protocol:               6
Header checksum:        25792
Source address          10.1.1.2
Destination address     200.1.2.2
-----------------------------------------------------------------
                        TCP Header
-----------------------------------------------------------------
Source port:            21 (ftp)
Destination port:       1024
Sequence number:        1553657159
Acknowledgement number: 1083307391
Header length:          32
Reserved bits:          0
Flags:                  FIN PSH ACK
Window size:            16060
Checksum:               64476
Urgent pointer:         0
Options:                No op
No op
Timestamp = 62825 232569
-----------------------------------------------------------------
32 32 31 2D 54 6F 74 61 6C 20 74 72 61 66 66 69  221-Total traffi
63 20 66 6F 72 20 74 68 69 73 20 73 65 73 73 69  c for this sessi
6F 6E 20 77 61 73 20 31 34 38 39 20 62 79 74 65  on was 1489 byte
73 20 69 6E 20 31 20 74 72 61 6E 73 66 65 72 73  s in 1 transfers
2E 0D 0A 32 32 31 2D 54 68 61 6E 6B 20 79 6F 75  ...221-Thank you
20 66 6F 72 20 75 73 69 6E 67 20 74 68 65 20 46   for using the F
54 50 20 73 65 72 76 69 63 65 20 6F 6E 20 64 61  TP service on da
72 6B 73 74 61 72 2E 65 78 61 6D 70 6C 65 2E 6E  rkstar.example.n
65 74 2E 0D 0A 32 32 31 20 47 6F 6F 64 62 79     et...221 Goodby
=================================================================
                        Ethernet Header(991766487.527532)
-----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 217
-----------------------------------------------------------------
                        IP Header
-----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        16 (precedence=0, D=1, T=0, R=0, U=0)
Total length:           199
Identification #:       91
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           63
Protocol:               6
Header checksum:        26048
Source address          10.1.1.2
Destination address     200.1.2.2
-----------------------------------------------------------------
                        TCP Header
-----------------------------------------------------------------
Source port:            21 (ftp)
Destination port:       1024
```

```
Sequence number:        1553657159
Acknowledgement number: 1083307391
Header length:          32
Reserved bits:          0
Flags:                  FIN PSH ACK
Window size:            16060
Checksum:               64476
Urgent pointer:         0
Options:                No op
No op
Timestamp = 62825 232569
----------------------------------------------------------------
32 32 31 2D 54 6F 74 61 6C 20 74 72 61 66 66 69  221-Total traffi
63 20 66 6F 72 20 74 68 69 73 20 73 65 73 73 69  c for this sessi
6F 6E 20 77 61 73 20 31 34 38 39 20 62 79 74 65  on was 1489 byte
73 20 69 6E 20 31 20 74 72 61 6E 73 66 65 72 73  s in 1 transfers
2E 0D 0A 32 32 31 2D 54 68 61 6E 6B 20 79 6F 75  ...221-Thank you
20 66 6F 72 20 75 73 69 6E 67 20 74 68 65 20 46   for using the F
54 50 20 73 65 72 76 69 63 65 20 6F 6E 20 64 61  TP service on da
72 6B 73 74 61 72 2E 65 78 61 6D 70 6C 65 2E 6E  rkstar.example.n
65 74 2E 0D 0A 32 32 31 20 47 6F 6F 64 62 79     et...221 Goodby
================================================================
                        Ethernet Header(991766487.527573)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 70
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        16 (precedence=0, D=1, T=0, R=0, U=0)
Total length:           52
Identification #:       152
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           64
Protocol:               6
Header checksum:        25878
Source address          200.1.2.2
Destination address     10.1.1.2
----------------------------------------------------------------
                        TCP Header
----------------------------------------------------------------
Source port:            1024
Destination port:       21 (ftp)
Sequence number:        1083307391
Acknowledgement number: 1553657307
Header length:          32
Reserved bits:          0
Flags:                  ACK
Window size:            32120
Checksum:               7612
Urgent pointer:         0
Options:                No op
No op
Timestamp = 232569 62825
================================================================
                        Ethernet Header(991766487.527874)
----------------------------------------------------------------
```

```
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 70
------------------------------------------------------------------
                        IP Header
------------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        16 (precedence=0, D=1, T=0, R=0, U=0)
Total length:           52
Identification #:       152
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           63
Protocol:               6
Header checksum:        26134
Source address          200.1.2.2
Destination address     10.1.1.2
------------------------------------------------------------------
                        TCP Header
------------------------------------------------------------------
Source port:            1024
Destination port:       21 (ftp)
Sequence number:        1083307391
Acknowledgement number: 1553657307
Header length:          32
Reserved bits:          0
Flags:                  ACK
Window size:            32120
Checksum:               7612
Urgent pointer:         0
Options:                No op
No op
Timestamp = 232569 62825
==================================================================
                        Ethernet Header(991766487.530185)
------------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 70
------------------------------------------------------------------
                        IP Header
------------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        16 (precedence=0, D=1, T=0, R=0, U=0)
Total length:           52
Identification #:       153
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           64
Protocol:               6
Header checksum:        25877
Source address          200.1.2.2
Destination address     10.1.1.2
------------------------------------------------------------------
                        TCP Header
------------------------------------------------------------------
Source port:            1024
Destination port:       21 (ftp)
Sequence number:        1083307391
```

```
Acknowledgement number: 1553657307
Header length:          32
Reserved bits:          0
Flags:                  FIN ACK
Window size:            32120
Checksum:               7611
Urgent pointer:         0
Options:                No op
No op
Timestamp = 232569 62825
================================================================
                        Ethernet Header(991766487.530478)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 70
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        16 (precedence=0, D=1, T=0, R=0, U=0)
Total length:           52
Identification #:       153
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           63
Protocol:               6
Header checksum:        26133
Source address          200.1.2.2
Destination address     10.1.1.2
----------------------------------------------------------------
                        TCP Header
----------------------------------------------------------------
Source port:            1024
Destination port:       21 (ftp)
Sequence number:        1083307391
Acknowledgement number: 1553657307
Header length:          32
Reserved bits:          0
Flags:                  FIN ACK
Window size:            32120
Checksum:               7611
Urgent pointer:         0
Options:                No op
No op
Timestamp = 232569 62825
================================================================
                        Ethernet Header(991766487.530739)
----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 70
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        16 (precedence=0, D=1, T=0, R=0, U=0)
Total length:           52
```

```
Identification #:       92
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           64
Protocol:               6
Header checksum:        25938
Source address          10.1.1.2
Destination address     200.1.2.2
-----------------------------------------------------------------
                        TCP Header
-----------------------------------------------------------------
Source port:            21 (ftp)
Destination port:       1024
Sequence number:        1553657307
Acknowledgement number: 1083307392
Header length:          32
Reserved bits:          0
Flags:                  ACK
Window size:            16060
Checksum:               23670
Urgent pointer:         0
Options:                No op
No op
Timestamp = 62826 232569
=================================================================
                        Ethernet Header(991766487.530890)
-----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 70
-----------------------------------------------------------------
                        IP Header
-----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        16 (precedence=0, D=1, T=0, R=0, U=0)
Total length:           52
Identification #:       92
Fragmentation offset:   0 (U=0, DF=1, MF=0)
Time to live:           63
Protocol:               6
Header checksum:        26194
Source address          10.1.1.2
Destination address     200.1.2.2
-----------------------------------------------------------------
                        TCP Header
-----------------------------------------------------------------
Source port:            21 (ftp)
Destination port:       1024
Sequence number:        1553657307
Acknowledgement number: 1083307392
Header length:          32
Reserved bits:          0
Flags:                  ACK
Window size:            16060
Checksum:               23670
Urgent pointer:         0
Options:                No op
No op
Timestamp = 62826 232569
```

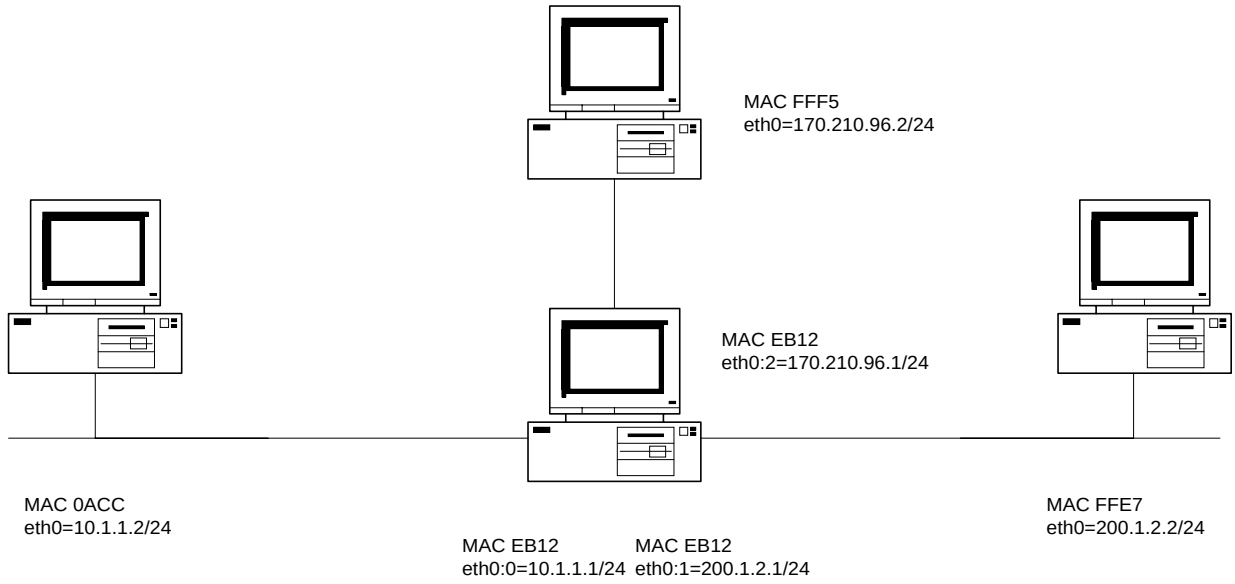
Universidad Nacional de Luján
Departamento de Ciencias Básicas
Asignatura: Teleinformática y Redes

EJERCICIO 2

Demostración de ruteo con protocolo IP – 3 redes

Nota: se trabajó sobre un único dominio de colisión, y en el router se definió con la modalidad de interfaz virtual.

Topología de trabajo



Configuración de los hosts

Host 170.210.96.2

```
Ifconfig eth0 170.210.96.2 netmask 255.255.255.0
Route add default gw 170.210.96.1

Tabla de ruteo resultante
Destino          GW               Mask             F     If
     170.210.96.0     *(0.0.0.0)       255.255.255.0    U     eth0
     loopback         *                255.0.0.0        U     lo
     default(0.0.0.0) 170.210.96.1     0.0.0.0          UG    eth0
```

Host 10.1.1.2

```
Ifconfig eth0 10.1.1.2 netmask 255.255.255.0
Route add default gw 10.1.1.1

Tabla de ruteo resultante
Destino          GW          Mask             F     If
     10.1.1.0         *(0.0.0.0)  255.255.255.0    U     eth0
     loopback         *           255.0.0.0        U     lo
     default(0.0.0.0) 10.1.1.1    0.0.0.0          UG    eth0
```

Host 200.1.2.2

```
Ifconfig eth0 200.1.2.2 netmask 255.255.255.0
Route add default gw 200.1.2.1
```

```
      Tabla de ruteo resultante
      Destino           GW          Mask              F     If
            200.1.2.0         *(0.0.0.0)  255.255.255.0     U     eth0
            loopback          *           255.0.0.0         U     lo
            default(0.0.0.0)  200.1.2.1   0.0.0.0           UG    eth0
```

Router

```
      Ifconfig 0.0.0.0
      Ifconfig eth0:0 10.1.1.1 netmask 255.255.255.0
      Ifconfig eth0:1 200.1.2.1 netmask 255.255.255.0
      Ifconfig eth0:2 170.210.96.1 netmask 255.255.255.0

      Tabla de ruteo resultante
      Destino           GW          Mask              F     If
            200.1.2.0         *(0.0.0.0)  255.255.255.0     U     eth0
            10.1.1.0          *(0.0.0.0)  255.255.255.0     U     eth0
            170.210.96.0      *(0.0.0.0)  255.255.255.0     U     eth0
            loopback          *           255.0.0.0         U     lo
```

Ejercicio Nro 2 - Muestra Nro. 1

Acción: Se ejecuta el comando ping desde 200.1.2.2 a 170.210.96.2

```
================================================================
                        Ethernet Header(991767629.528738)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          806H (arp)
Length:                 46
------------------------------------------------------------
                  ARP Header
------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        0:e0:7d:72:ff:e7
Sender IP:              200.1.2.2
Target hardware:        0:0:0:0:0:0
Target IP:              200.1.2.1
================================================================
                        Ethernet Header(991767629.529093)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          806H (arp)
Length:                 64
------------------------------------------------------------
                  ARP Header
------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        52:54:0:db:eb:12
Sender IP:              200.1.2.1
Target hardware:        0:e0:7d:72:ff:e7
Target IP:              200.1.2.2
```

```
================================================================
                        Ethernet Header(991767629.529133)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       191
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        42258
Source address          200.1.2.2
Destination address     170.210.96.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              215
Sequence number         0
Checksum:               43395
================================================================
                        Ethernet Header(991767629.529587)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 150
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       180
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        9727
Source address          200.1.2.1
Destination address     200.1.2.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               53415
================================================================
                        Ethernet Header(991767629.529662)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   ff:ff:ff:ff:ff:ff
```

```
Protocol type:          806H (arp)
Length:                 64
------------------------------------------------------------
                  ARP Header
------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        52:54:0:db:eb:12
Sender IP:              170.210.96.1
Target hardware:        0:0:0:0:0:0
Target IP:              170.210.96.2
============================================================
                        Ethernet Header(991767629.529860)
------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:f5
Hardware destination:   52:54:0:db:eb:12
Protocol type:          806H (arp)
Length:                 64
------------------------------------------------------------
                  ARP Header
------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        0:e0:7d:72:ff:f5
Sender IP:              170.210.96.2
Target hardware:        52:54:0:db:eb:12
Target IP:              170.210.96.1
============================================================
                        Ethernet Header(991767629.530046)
------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:f5
Protocol type:          800H (ip)
Length:                 102
------------------------------------------------------------
                        IP Header
------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       191
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           63
Protocol:               1
Header checksum:        42514
Source address          200.1.2.2
Destination address     170.210.96.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              215
Sequence number         0
Checksum:               43395
============================================================
                        Ethernet Header(991767629.530277)
------------------------------------------------------------
```

```
Hardware source:        0:e0:7d:72:ff:f5
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
------------------------------------------------------------------
                        IP Header
------------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       47
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        59041
Source address          170.210.96.2
Destination address     200.1.2.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              215
Sequence number         0
Checksum:               45443
==================================================================
                        Ethernet Header(991767629.530517)
------------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:f5
Protocol type:          800H (ip)
Length:                 150
------------------------------------------------------------------
                        IP Header
------------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       181
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42075
Source address          170.210.96.1
Destination address     170.210.96.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               4473
==================================================================
                        Ethernet Header(991767629.530626)
------------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 102
------------------------------------------------------------------
```

```
                        IP Header
---------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       47
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           254
Protocol:               1
Header checksum:        59297
Source address          170.210.96.2
Destination address     200.1.2.2
---------------------------------------------------------
                        ICMP Header
---------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              215
Sequence number         0
Checksum:               45443
===============================================================
                        Ethernet Header(991767630.530835)
---------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
---------------------------------------------------------------
                        IP Header
---------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       192
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        42257
Source address          200.1.2.2
Destination address     170.210.96.2
---------------------------------------------------------
                        ICMP Header
---------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              215
Sequence number         1
Checksum:               16251
===============================================================
                        Ethernet Header(991767630.531311)
---------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 150
---------------------------------------------------------------
                        IP Header
---------------------------------------------------------------
Version:                4
```

```
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       182
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        9725
Source address          200.1.2.1
Destination address     200.1.2.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               53415
=============================================================
                        Ethernet Header(991767630.531371)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:f5
Protocol type:          800H (ip)
Length:                 102
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       192
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           63
Protocol:               1
Header checksum:        42513
Source address          200.1.2.2
Destination address     170.210.96.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              215
Sequence number         1
Checksum:               16251
=============================================================
                        Ethernet Header(991767630.531629)
-------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:f5
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       48
Fragmentation offset:   0 (U=0, DF=0, MF=0)
```

```
Time to live:           255
Protocol:               1
Header checksum:        59040
Source address          170.210.96.2
Destination address     200.1.2.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              215
Sequence number         1
Checksum:               18299
=================================================================
                        Ethernet Header(991767630.531870)
-----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:f5
Protocol type:          800H (ip)
Length:                 150
-----------------------------------------------------------------
                        IP Header
-----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       183
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42073
Source address          170.210.96.1
Destination address     170.210.96.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               4473
=================================================================
                        Ethernet Header(991767630.531976)
-----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 102
-----------------------------------------------------------------
                        IP Header
-----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       48
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           254
Protocol:               1
Header checksum:        59296
Source address          170.210.96.2
Destination address     200.1.2.2
```

```
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              215
Sequence number         1
Checksum:               18299
```

Universidad Nacional de Luján
Departamento de Ciencias Básicas
Asignatura: Teleinformática y Redes

EJERCICIO 3

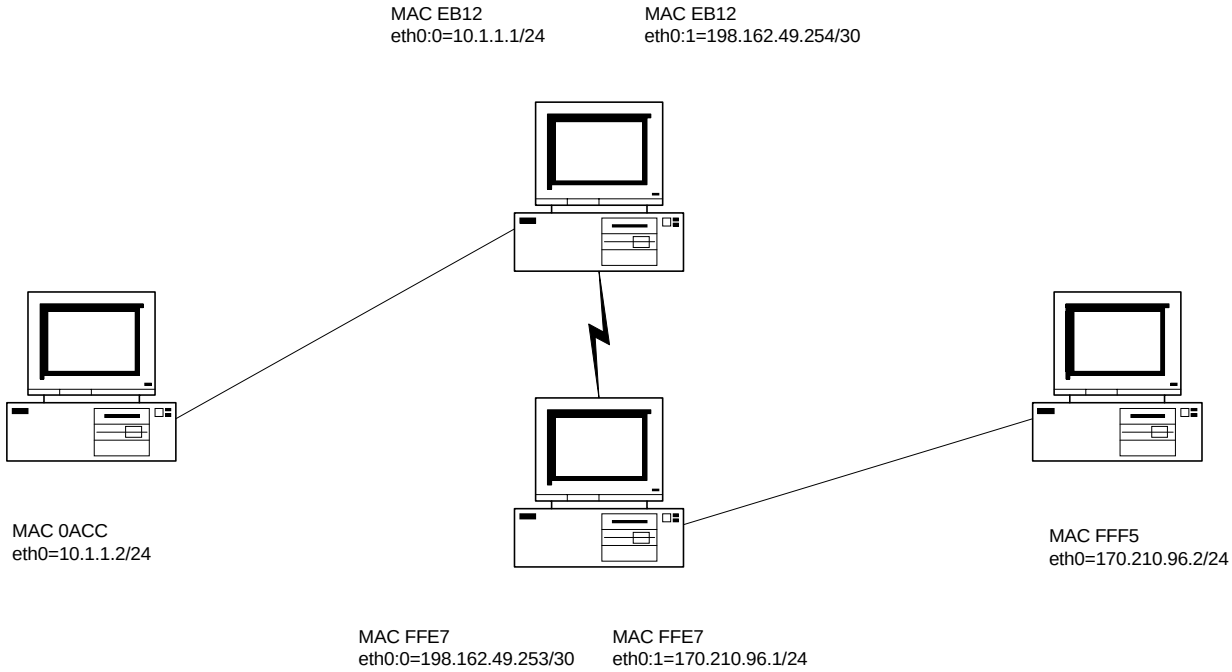
Demostración de ruteo con protocolo IP

2 redes de usuario, 1 red de interconexión, sin rutas por defecto

Nota: se trabajó sobre un único dominio de colisión, y en el router se definió con la modalidad de interfaz virtual.

En este ejercicio no se utilizan rutas por defecto

Topología de trabajo



Configuración de los hosts

Host 170.210.96.2

```
Ifconfig eth0 170.210.96.2 netmask 255.255.255.0
Route add –net 10.1.1.0 gw 170.210.96.1 netmask 255.255.255.0 eth0

Tabla de ruteo resultante
Destino          GW               Mask             F     If
     170.210.96.0     *(0.0.0.0)       255.255.255.0    U     eth0
     10.1.1.0         170.210.96.1     255.255.255.0    UG    eth0
     loopback         *                255.0.0.0        U     lo
```

Host 10.1.1.2

```
Ifconfig eth0 10.1.1.2 netmask 255.255.255.0
Route add –net 170.210.96.0 gw 10.1.1.1 netmask 255.255.255.0 eth0

Tabla de ruteo resultante
Destino          GW          Mask             F     If
     10.1.1.0         *(0.0.0.0)  255.255.255.0    U     eth0
```

```
            170.210.96.0      10.1.1.1     255.255.255.0     UG    eth0
            loopback          *            255.0.0.0         U     lo
```

Router 10.1.1.0/198.162.49.252

```
      Ifconfig 0.0.0.0
      Ifconfig eth0:0 10.1.1.1 netmask 255.255.255.0
      Ifconfig eth0:1 198.162.49.254 netmask 255.255.255.252


      Tabla de ruteo resultante
      Destino           GW                Mask              F     If
            198.162.49.252    *(0.0.0.0)        255.255.255.0     U     eth0
            10.1.1.0          *(0.0.0.0)        255.255.255.0     U     eth0
            170.210.96.0      198.162.49.253    255.255.255.0     UG    eth0
            loopback          *                 255.0.0.0         U     lo
```

Router 170.210.96.0/198.162.49.252

```
      Ifconfig 0.0.0.0
      Ifconfig eth0:0 170.210.96.1 netmask 255.255.255.0
      Ifconfig eth0:1 198.162.49.253 netmask 255.255.255.252


      Tabla de ruteo resultante
      Destino           GW                Mask              F     If
            198.162.49.252    *(0.0.0.0)        255.255.255.0     U     eth0
            170.210.96.0      *(0.0.0.0)        255.255.255.0     U     eth0
            10.1.1.0          198.162.49.254    255.255.255.0     UG    eth0
            loopback          *                 255.0.0.0         U     lo
```

Acción: Se ejecuta el comando ping desde 10.1.1.2 a 170.210.96.2

Las columnas indican el host originante del mensaje.

Sec	**Host 0ACC/10.1.1.2**	**Router EB12 10.1.1.1/ 192.168.49.254**	**Router FFE7 198.162.49.253/ 170.210.96.1**	**Host FFF5/170.210.96.2**
332	MAC destino:FFFF ARP REQUEST por 10.1.1.1			
705		MAC destino:0ACC ARP REPLY por 10.1.1.1/EB12		
730	MAC destino EB12 IP de 10.1.1.2 a 170.210.96.2 ICMP echo request			
275		MAC destino:FFFF ARP REQUEST por 198.162.49.253		
496			MAC destino:EB12 ARP REPLY por 198.162.49.253/FFE7	
674		MAC destino FFE7 IP de 10.1.1.2 a 170.210.96.2 ICMP echo request		
891			MAC destino:FFFF ARP REQUEST por 170.210.96.2	
086				MAC destino:FFE7 ARP REPLY por 170.210.96.2/FFF5

298			MAC destino FFF5 IP de 10.1.1.2 a 170.210.96.2 ICMP echo reply	
568				MAC destino FFE7 IP de 170.210.96.2 a 10.1.1.2 ICMP echo reply
971			MAC destino EB12 IP de 170.210.96.2 a 10.1.1.2 ICMP echo reply	
165		MAC destino 0ACC IP de 170.210.96.2 a 10.1.1.2 ICMP echo reply		
356	MAC destino EB12 IP de 10.1.1.2 a 170.210.96.2 ICMP echo request			

Convenciones

Verde frames del protocolo auxiliar ARP
Rojo datagramas reenviados por un router
Negro datagramas generados por hosts

Ejercicio Nro 3 - Muestra Nro. 1

Acción: Se ejecuta el comando ping desde 10.1.1.2 a 170.210.96.2

```
================================================================
                        Ethernet Header(991769531.417332)
----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          806H (arp)
Length:                 46
------------------------------------------------------------
                ARP Header
------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        0:48:54:68:a:cc
Sender IP:              10.1.1.2
Target hardware:        0:0:0:0:0:0
Target IP:              10.1.1.1
================================================================
                        Ethernet Header(991769531.417705)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          806H (arp)
Length:                 68
------------------------------------------------------------
                ARP Header
------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        52:54:0:db:eb:12
Sender IP:              10.1.1.1
```

```
Target hardware:        0:48:54:68:a:cc
Target IP:              10.1.1.2
================================================================
                        Ethernet Header(991769531.417730)
----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       34
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        25776
Source address          10.1.1.2
Destination address     170.210.96.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              103
Sequence number         0
Checksum:               58927
================================================================
                        Ethernet Header(991769531.418189)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 154
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       42
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42122
Source address          10.1.1.1
Destination address     10.1.1.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               860
================================================================
                        Ethernet Header(991769531.418275)
----------------------------------------------------------------
```

```
Hardware source:        52:54:0:db:eb:12
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          806H (arp)
Length:                 68
-------------------------------------------------------------
                  ARP Header
-------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        52:54:0:db:eb:12
Sender IP:              198.162.49.254
Target hardware:        0:0:0:0:0:0
Target IP:              198.162.49.253
=============================================================
                        Ethernet Header(991769531.418496)
-------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          806H (arp)
Length:                 68
-------------------------------------------------------------
                  ARP Header
-------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        0:e0:7d:72:ff:e7
Sender IP:              198.162.49.253
Target hardware:        52:54:0:db:eb:12
Target IP:              198.162.49.254
=============================================================
                        Ethernet Header(991769531.418674)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 106
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       34
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           63
Protocol:               1
Header checksum:        26032
Source address          10.1.1.2
Destination address     170.210.96.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              103
Sequence number         0
Checksum:               58927
=============================================================
```

```
                        Ethernet Header(991769531.418891)
-------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          806H (arp)
Length:                 68
-------------------------------------------------------------
                  ARP Header
-------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        0:e0:7d:72:ff:e7
Sender IP:              170.210.96.1
Target hardware:        0:0:0:0:0:0
Target IP:              170.210.96.2
=============================================================
                        Ethernet Header(991769531.419086)
-------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:f5
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          806H (arp)
Length:                 68
-------------------------------------------------------------
                  ARP Header
-------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        0:e0:7d:72:ff:f5
Sender IP:              170.210.96.2
Target hardware:        0:e0:7d:72:ff:e7
Target IP:              170.210.96.1
=============================================================
                        Ethernet Header(991769531.419298)
-------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   0:e0:7d:72:ff:f5
Protocol type:          800H (ip)
Length:                 106
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       34
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           62
Protocol:               1
Header checksum:        26288
Source address          10.1.1.2
Destination address     170.210.96.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              103
Sequence number         0
```

```
Checksum:               58927
================================================================
                        Ethernet Header(991769531.419568)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:f5
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 106
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       34
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42415
Source address          170.210.96.2
Destination address     10.1.1.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              103
Sequence number         0
Checksum:               60975
================================================================
                        Ethernet Header(991769531.419843)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   0:e0:7d:72:ff:f5
Protocol type:          800H (ip)
Length:                 154
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       42
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42214
Source address          170.210.96.1
Destination address     170.210.96.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               42696
================================================================
                        Ethernet Header(991769531.419971)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
```

```
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 106
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       34
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           254
Protocol:               1
Header checksum:        42671
Source address          170.210.96.2
Destination address     10.1.1.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              103
Sequence number         0
Checksum:               60975
================================================================
                        Ethernet Header(991769531.420165)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 106
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       34
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           253
Protocol:               1
Header checksum:        42927
Source address          170.210.96.2
Destination address     10.1.1.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              103
Sequence number         0
Checksum:               60975
================================================================
                        Ethernet Header(991769532.415356)
----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
```

```
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       35
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        25775
Source address          10.1.1.2
Destination address     170.210.96.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              103
Sequence number         1
Checksum:               22327
================================================================
                        Ethernet Header(991769532.415726)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 154
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       43
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42121
Source address          10.1.1.1
Destination address     10.1.1.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               860
================================================================
                        Ethernet Header(991769532.415841)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 106
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
```

```
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       35
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           63
Protocol:               1
Header checksum:        26031
Source address          10.1.1.2
Destination address     170.210.96.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              103
Sequence number         1
Checksum:               22327
=================================================================
                        Ethernet Header(991769532.416081)
-----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   0:e0:7d:72:ff:f5
Protocol type:          800H (ip)
Length:                 106
-----------------------------------------------------------------
                        IP Header
-----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       35
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           62
Protocol:               1
Header checksum:        26287
Source address          10.1.1.2
Destination address     170.210.96.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              103
Sequence number         1
Checksum:               22327
=================================================================
                        Ethernet Header(991769532.416330)
-----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:f5
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 106
-----------------------------------------------------------------
                        IP Header
-----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       35
```

```
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42414
Source address          170.210.96.2
Destination address     10.1.1.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              103
Sequence number         1
Checksum:               24375
=============================================================
                        Ethernet Header(991769532.416605)
-------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   0:e0:7d:72:ff:f5
Protocol type:          800H (ip)
Length:                 154
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       43
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42213
Source address          170.210.96.1
Destination address     170.210.96.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               42696
=============================================================
                        Ethernet Header(991769532.416729)
-------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 106
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       35
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           254
Protocol:               1
Header checksum:        42670
Source address          170.210.96.2
```

```
Destination address     10.1.1.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              103
Sequence number         1
Checksum:               24375
=============================================================
                        Ethernet Header(991769532.416920)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 106
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       35
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           253
Protocol:               1
Header checksum:        42926
Source address          170.210.96.2
Destination address     10.1.1.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              103
Sequence number         1
Checksum:               24375
=============================================================
                        Ethernet Header(991769533.415348)
-------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 102
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       36
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        25774
Source address          10.1.1.2
Destination address     170.210.96.2
-------------------------------------------------------------
                        ICMP Header
```

```
-------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              103
Sequence number         2
Checksum:               23863
=============================================================
                        Ethernet Header(991769533.415708)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 154
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       44
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42120
Source address          10.1.1.1
Destination address     10.1.1.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               860
=============================================================
                        Ethernet Header(991769533.415822)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 106
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       36
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           63
Protocol:               1
Header checksum:        26030
Source address          10.1.1.2
Destination address     170.210.96.2
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              103
Sequence number         2
```

```
Checksum:               23863
================================================================
                        Ethernet Header(991769533.416034)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   0:e0:7d:72:ff:f5
Protocol type:          800H (ip)
Length:                 106
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       36
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           62
Protocol:               1
Header checksum:        26286
Source address          10.1.1.2
Destination address     170.210.96.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              103
Sequence number         2
Checksum:               23863
================================================================
                        Ethernet Header(991769533.416250)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:f5
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 106
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       36
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42413
Source address          170.210.96.2
Destination address     10.1.1.2
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              103
Sequence number         2
Checksum:               25911
================================================================
                        Ethernet Header(991769533.416509)
```

```
------------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   0:e0:7d:72:ff:f5
Protocol type:          800H (ip)
Length:                 154
------------------------------------------------------------------
                        IP Header
------------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        192 (precedence=6, D=0, T=0, R=0, U=0)
Total length:           132
Identification #:       44
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42212
Source address          170.210.96.1
Destination address     170.210.96.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   5 (redirect)
Code:                   1 (host)
Checksum:               42696
==================================================================
                        Ethernet Header(991769533.416634)
------------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          800H (ip)
Length:                 106
------------------------------------------------------------------
                        IP Header
------------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       36
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           254
Protocol:               1
Header checksum:        42669
Source address          170.210.96.2
Destination address     10.1.1.2
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              103
Sequence number         2
Checksum:               25911
==================================================================
                        Ethernet Header(991769533.416842)
------------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
Protocol type:          800H (ip)
Length:                 106
```

```
---------------------------------------------------------------
                        IP Header
---------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       36
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           253
Protocol:               1
Header checksum:        42925
Source address          170.210.96.2
Destination address     10.1.1.2
-----------------------------------------------------------
                        ICMP Header
-----------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              103
Sequence number         2
Checksum:               25911
===============================================================
                        Ethernet Header(991769536.412786)
---------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          806H (arp)
Length:                 68
-----------------------------------------------------------
                  ARP Header
-----------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        0:e0:7d:72:ff:e7
Sender IP:              198.162.49.253
Target hardware:        0:0:0:0:0:0
Target IP:              198.162.49.254
===============================================================
                        Ethernet Header(991769536.412954)
---------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          806H (arp)
Length:                 68
-----------------------------------------------------------
                  ARP Header
-----------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        52:54:0:db:eb:12
Sender IP:              198.162.49.254
Target hardware:        0:e0:7d:72:ff:e7
Target IP:              198.162.49.253
===============================================================
                        Ethernet Header(991769536.413718)
---------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:48:54:68:a:cc
```

```
Protocol type:          806H (arp)
Length:                 68
------------------------------------------------------------
                  ARP Header
------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        52:54:0:db:eb:12
Sender IP:              10.1.1.1
Target hardware:        0:0:0:0:0:0
Target IP:              10.1.1.2
================================================================
                        Ethernet Header(991769536.413737)
----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   52:54:0:db:eb:12
Protocol type:          806H (arp)
Length:                 46
------------------------------------------------------------
                  ARP Header
------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        0:48:54:68:a:cc
Sender IP:              10.1.1.2
Target hardware:        52:54:0:db:eb:12
Target IP:              10.1.1.1
================================================================
                        Ethernet Header(991769536.418780)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:f5
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          806H (arp)
Length:                 68
------------------------------------------------------------
                  ARP Header
------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        0:e0:7d:72:ff:f5
Sender IP:              170.210.96.2
Target hardware:        0:0:0:0:0:0
Target IP:              170.210.96.1
```

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EJERCICIO 4

Demostración de ping destinado a la red

Nota: se trabajó sobre un único dominio de colisión y una única red IP 10.1.1.0/24

Acción: En 10.1.1.3 se ejecutó ping a la red 10.1.1.255

¿Qué pasó? 10.1.1.3 no utilizó ARP, sino que envió el mensaje ICMP echo request en una trama ethernet dirigida a la dirección de broadcast de nivel 2. Cada host de la red correspondiente utilizó ARP (creemos que no era necesario) para resolver la dirección del host peticionante, y finalmente cada host envió un echo reply direccionado vía unicast a 10.1.1.3.

Las columnas indican el host originante del mensaje.

Sec	Host EB12/10.1.1.1	Host 0ACC/10.1.1.2	Host FFE7/10.1.1.3
549			MAC destino FFFF IP de 10.1.1.3 a 10.1.1.255 ICMP echo request
879		MAC destino:FFFF ARP REQUEST por 10.1.1.3	
928			MAC destino 0ACC ARP REPLY por 10.1.1.3/FFE7
059	MAC destino:FFFF ARP REQUEST por 10.1.1.3		
107			MAC destino:EB12 ARP REPLY por 10.1.1.3/FFE7
252		MAC destino FFE7 IP de 10.1.1.2 a 10.1.1.3 ICMP echo reply	
505	MAC destino FFE7 IP de 10.1.1.1 a 10.1.1.3 ICMP echo reply		
880			MAC destino FFFF IP de 10.1.1.3 a 10.1.1.255 ICMP echo request

Convenciones

Verde frames del protocolo auxiliar ARP
Negro datagramas generados por hosts

Ejercicio Nro 4 - Muestra Nro. 1

```
================================================================
                        Ethernet Header(991769822.677549)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          800H (ip)
Length:                 102
----------------------------------------------------------------
```

```
                        IP Header
---------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       212
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        25298
Source address          10.1.1.3
Destination address     10.1.1.255
-----------------------------------------------------------
                        ICMP Header
-----------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              127
Sequence number         0
Checksum:               6966
===============================================================
                        Ethernet Header(991769822.677879)
---------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          806H (arp)
Length:                 64
-----------------------------------------------------------
                  ARP Header
-----------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        0:48:54:68:a:cc
Sender IP:              10.1.1.2
Target hardware:        0:0:0:0:0:0
Target IP:              10.1.1.3
===============================================================
                        Ethernet Header(991769822.677928)
---------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   0:48:54:68:a:cc
Protocol type:          806H (arp)
Length:                 46
-----------------------------------------------------------
                  ARP Header
-----------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        0:e0:7d:72:ff:e7
Sender IP:              10.1.1.3
Target hardware:        0:48:54:68:a:cc
Target IP:              10.1.1.2
===============================================================
                        Ethernet Header(991769822.678059)
---------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          806H (arp)
```

```
Length:                 64
-------------------------------------------------------------
                  ARP Header
-------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              1 (ARP request)
Sender hardware:        52:54:0:db:eb:12
Sender IP:              10.1.1.1
Target hardware:        0:0:0:0:0:0
Target IP:              10.1.1.3
=============================================================
                        Ethernet Header(991769822.678107)
-------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   52:54:0:db:eb:12
Protocol type:          806H (arp)
Length:                 46
-------------------------------------------------------------
                  ARP Header
-------------------------------------------------------------
Hardware type:          1
Protocol:               2048
Operation:              2 (ARP reply)
Sender hardware:        0:e0:7d:72:ff:e7
Sender IP:              10.1.1.3
Target hardware:        52:54:0:db:eb:12
Target IP:              10.1.1.1
=============================================================
                        Ethernet Header(991769822.678252)
-------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 102
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       59
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42343
Source address          10.1.1.2
Destination address     10.1.1.3
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              127
Sequence number         0
Checksum:               9014
=============================================================
                        Ethernet Header(991769822.678505)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
```

```
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 102
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       56
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42347
Source address          10.1.1.1
Destination address     10.1.1.3
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              127
Sequence number         0
Checksum:               9014
================================================================
                        Ethernet Header(991769823.674880)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          800H (ip)
Length:                 102
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       214
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        25296
Source address          10.1.1.3
Destination address     10.1.1.255
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              127
Sequence number         1
Checksum:               22848
================================================================
                        Ethernet Header(991769823.675187)
----------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 102
```

```
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       60
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42342
Source address          10.1.1.2
Destination address     10.1.1.3
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              127
Sequence number         1
Checksum:               24896
================================================================
                        Ethernet Header(991769823.675284)
----------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 102
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       57
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42346
Source address          10.1.1.1
Destination address     10.1.1.3
----------------------------------------------------------
                        ICMP Header
----------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              127
Sequence number         1
Checksum:               24896
================================================================
                        Ethernet Header(991769824.674872)
----------------------------------------------------------------
Hardware source:        0:e0:7d:72:ff:e7
Hardware destination:   ff:ff:ff:ff:ff:ff
Protocol type:          800H (ip)
Length:                 102
----------------------------------------------------------------
                        IP Header
----------------------------------------------------------------
```

```
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       216
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           64
Protocol:               1
Header checksum:        25294
Source address          10.1.1.3
Destination address     10.1.1.255
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   8 (echo request)
Code                    0
Identifier              127
Sequence number         2
Checksum:               24128
=============================================================
                        Ethernet Header(991769824.675175)
-------------------------------------------------------------
Hardware source:        0:48:54:68:a:cc
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 102
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
Total length:           84
Identification #:       61
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42341
Source address          10.1.1.2
Destination address     10.1.1.3
-------------------------------------------------------------
                        ICMP Header
-------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              127
Sequence number         2
Checksum:               26176
=============================================================
                        Ethernet Header(991769824.675336)
-------------------------------------------------------------
Hardware source:        52:54:0:db:eb:12
Hardware destination:   0:e0:7d:72:ff:e7
Protocol type:          800H (ip)
Length:                 102
-------------------------------------------------------------
                        IP Header
-------------------------------------------------------------
Version:                4
Header length:          20
Type of service:        0 (precedence=0, D=0, T=0, R=0, U=0)
```

```
Total length:           84
Identification #:       58
Fragmentation offset:   0 (U=0, DF=0, MF=0)
Time to live:           255
Protocol:               1
Header checksum:        42345
Source address          10.1.1.1
Destination address     10.1.1.3
------------------------------------------------------------
                        ICMP Header
------------------------------------------------------------
Type:                   0 (echo reply)
Code                    0
Identifier              127
Sequence number         2
Checksum:               26176
```

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Ejercicio 5

Ejemplo de configuración de una red de mayor complejidad

En esta sección se describe la configuración de una interred basada en la pila de protocolos TCP/IP. A nivel de enlace se trabajará con dos tecnologías, a saber: vínculos seriales (sobre dos redes) bajo protocolo SLIP y protocolo Ethernet en 5 redes. Seis de las redes poseen hosts conectados, mientras que la séptima funciona como una red de interconexión (tipo backbone, a la que podría asociarse una tecnología tipo Fast Ethernet).

El direccionamiento del nivel de red se realiza a través de la división de la dirección clase B 129.50.0.0 mediante la técnica de subnetting, resultando:

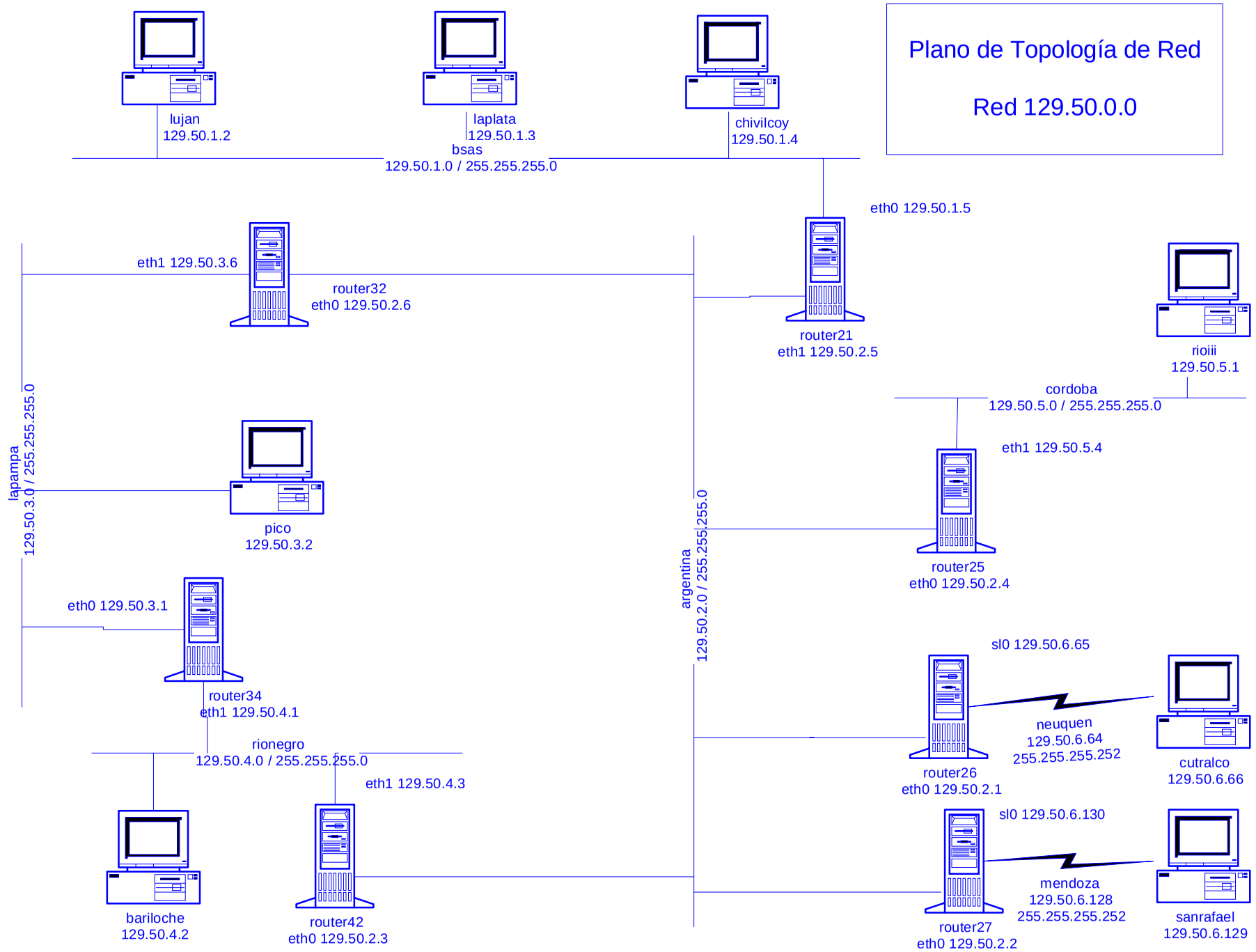
Número de Red	Nombre	Dirección de Red	Máscara de Red
1	Bsas	129.50.1.0	255.255.255.0
2	Argentina	129.50.2.0	255.255.255.0
3	Lapampa	129.50.3.0	255.255.255.0
4	Rionegro	129.50.4.0	255.255.255.0
5	Corboba	129.50.5.0	255.255.255.0
6	Neuquen	129.50.6.64	255.255.255.252
7	mendoza	129.50.6.128	255.255.255.252

La siguiente tabla muestra los ruteadores (implementados como PC-routers, bajo Sistema Operativo Linux, distribución Slackware, Kernel 2.2.15) y las redes que vinculan físicamente

Nombre	1er. Interfaz	2da. interfaz
router21	eth0:129.50.1.5	eth1:129.50.2.5
router25	eth0:129.50.2.4	eth1:129.50.5.4
router26	eth0:129.50.2.1	sl0:129.50.6.65
router27	eth0:129.50.2.2	sl0:129.50.6.130
router32	eth0:129.50.2.6	eth1:129.50.3.6
router34	eth0:129.50.3.1	eth1:129.50.4.1
router42	eth0:129.50.2.3	eth1:129.50.4.3

Mnemónicamente, a los nombres de ruteadores se le agregaron las redes que vinculan. Con respecto a la asignación de direcciones a las interfaces de enlace, se siguió la norma de asociar a la primera interfaz la dirección de red menor. Finalmente se hizo coincidir el número de host en cada interfaz del ruteador.

La asignación de nombres, direcciones y máscaras de red en los hosts se indican en el siguiente plano de la red.


Plano de Topología de Red
Red 129.50.0.0
lujan
129.50.1.2
laplata
129.50.1.3
chivilcoy
129.50.1.4
bsas
129.50.1.0 / 255.255.255.0
eth0 129.50.1.5
router21
eth1 129.50.2.5
rioiii
129.50.5.1
cordoba
129.50.5.0 / 255.255.255.0
eth1 129.50.5.4
router25
eth0 129.50.2.4
eth1 129.50.3.6
router32
eth0 129.50.2.6
lapampa
129.50.3.0 / 255.255.255.0
pico
129.50.3.2
eth0 129.50.3.1
router34
eth1 129.50.4.1
rionegro
129.50.4.0 / 255.255.255.0
eth1 129.50.4.3
bariloche
129.50.4.2
router42
eth0 129.50.2.3
argentina
129.50.2.0 / 255.255.255.0
sl0 129.50.6.65
neuquen
129.50.6.64
255.255.255.252
cutralco
129.50.6.66
router26
eth0 129.50.2.1
sl0 129.50.6.130
mendoza
129.50.6.128
255.255.255.252
sanrafael
129.50.6.129
router27
eth0 129.50.2.2

1- Comandos de configuración de red

El siguiente procedimiento está ajustado para el sistema operativo Linux, distribución Slackware, con permisos de usuario administrador (root).

Establecimiento del nombre del host

Edición del archivo /etc/HOSTNAME e inserción del nombre y dominio asociado (FQDN).

Edición del archivo de registro de redes

Debe editarse el archivo /etc/networks y añadirse los registros necesarios, bajo la siguiente sintaxis: número IP de red (tabulador) nombre de la red.

Edición del archivo de registro de hosts

Debe editarse el archivo /etc/hosts y añadirse los registros necesarios, bajo la siguiente sintaxis: número IP de host (tabulador) nombre de host y dominio asociado (tabulador) nombre de host sin dominio asociado.

Configuración de la interfaz

Con el comando ifconfig, para cada interfaz de nivel de enlace, debe configurarse la interfaz de red bajo la siguiente sintaxis: ifconfig (nombre de la interfaz) (número IP de host) netmask (máscara de red) broadcast (dirección de difusión de la red). En el caso de ser interfaces Ethernet la primera será eth0, la segunda eth1 y así sucesivamente; para interfaces seriales tipo SLIP la primera será sl0, la segunda sl1 y así sucesivamente.

Configuración de rutas de red

Con el comando route deben ingresarse al sistema operativo cada una de las rutas desprendidas de la política de ruteo diseñada. La sintaxis asociada es la siguiente: route add –net (número de red) gw (dirección Ip del gateway asociado) metric (valor decimal de peso de la métrica) (nombre de la interfaz de nivel de enlace por la cual deben entregarse los datagramas)

Configuración de la política de resolución de nombres

En este punto hay que definir el orden de evaluación de los mecanismos de resolución de nombres (mediante tabla estática /etc/hosts o mediante DNS). A tales efectos se debe editar el archivo /etc/host.conf. Ejemplo para este caso:

```
order hosts, bind
```

Además, es necesario configurar la dirección del DNS para cada hosts. Esto se especifica en el archivo /etc/resolv.conf, por ejemplo:

```
search tyr.unlu.edu.ar
nameservidor 129.50.4.2
```

Comandos de configuración de la interfaz slip

La configuración de las interfaces slip requieren del comando slattach, cuya sintaxis es la siguiente:

```
slattach -s <velocidad del enlace> -p <protocolo> tty
```

Por ejemplo:

```
slattach -s 57600 -p slip /dev/cua0 &
 (Esto se debe hacer en ambos extremos del enlace)
```

Luego, es necesario configurar (“levantar”) la interfaz (usando ifconfig):

```
ifconfig sl0 129.50.6.65 pointopoint 129.50.6.66 up
```

En nuestro modelo de red existen dos enlaces seriales. Uno en la red neuquen (129.50.6.64) y otro en la red mendoza (129.50.6.128). Para lo cual en cada interfaz serial (generalmente sl0) deben configurarse el enlace y la definición de interfaz de red como muestra el ejemplo.

Ejemplo de tabla de rutas

Se instaló una porción de la red enunciada, que consta de un ruteador (router34) y dos hosts (pico y bariloche). En router34, una vez configurado, se ejecutó el comando route –n y se obtuvo la siguiente salida:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
129.50.4.0      0.0.0.0         255.255.255.0   U     0      0        0 eth1
129.50.3.0      0.0.0.0         255.255.255.0   U     0      0        0 eth0
127.0.0.0       0.0.0.0         255.0.0.0       U     0      0        0 lo
```

La columna destination indica la red a alcanzar. Gateway es la dirección de la interfaz de ruteo, donde 0.0.0.0 indica el propio equipo. Genmask hace referencia a la máscara de la red de destino. Flags indicadores, donde U signifca ruta habilitada, H el destino es un hosts, G se especifica cuando la ruta no se alcanza directamente, D ruta aprendida dinamicamente, M ruta modificada dinámicamente y ¡ ruta rechazada. Metric es el peso decimal que se le asigna a la ruta como parámetro de selección en caso de alternativas. Ref no utilizado en Linux. Use cantidad de veces que se uso la ruta. Iface es la asociación con la interfaz de nivel de enlace.

En nuestro ejemplo, la primer línea indica que a la red 129.50.4.0 se la accede directamente por la interfaz eth1.

Ejemplo de tabla ARP

Del ruteador router34 se extrajo una instancia de su tabla ARP como se muestra a continuación:

```
? (129.50.4.1) at 00:80:AD:40:4E:63 [ether] on eth1
? (129.50.3.1) at 00:00:B4:5B:A4:2E [ether] on eth0
```

La primer entrada hace referencia a que la dirección de interfaz de red 129.50.4.1 le corresponde la dirección MAC 00:80:AD:40:4E:63 y pertenece al dominio de broadcast de nivel de enlace de la interfaz eth1.

Ejemplo de tabla servicios bien conocidos

Esta tabla describe los servicios disponibles para un sistema TCP/IP, asociándolo a un puerto bien conocido donde se ofrecen. A efectos demostrativos solo se muestran algunas líneas. Se encuentra en /etc/services.

```
# services
echo              7/tcp
echo              7/udp
ftp-data          20/tcp
ftp               21/tcp
telnet            23/tcp
smtp              25/tcp
time              37/tcp
time              37/udp
```

La primer columna denota el nombre del servicio, seguido del número de puerto y protocolo de transporte asociado.

Ejemplo de tabla de protocolos

Este archivo describe los protocolos y sus códigos asociados que están disponibles para un sistema TCP/IP. Se encuentra en /etc/protocols.

```
# protocols

ip    0     IP    # internet protocol, pseudo protocol number
icmp  1     ICMP  # internet control message protocol
igmp  2     IGMP  # internet group multicast protocol
ggp   3     GGP   # gateway-gateway protocol
tcp   6     TCP   # transmission control protocol
pup   12    PUP   # PARC universal packet protocol
udp   17    UDP   # user datagram protocol
idp   22    IDP   # WhatsThis?
raw   255   RAW   # RAW IP interfaz

# End of protocols.
```

Esta tabla como la anterior son consultadas por las aplicaciones a la hora de la generar mensajes, dado que necesitan asociar un mnemónico con su correspondiente numérico.

2- Configuración de Servicios de Aplicación

En la red presentada se instalaron y configuraron los siguientes servicios de aplicación:

Bajo sistema operativo Linux, en el host bariloche (129.50.4.2) servidor HTTP (Apache versión 1.3.6) y servidor DNS (Bind versión 4).

Bajo sistema operativo Microsoft Windows 95, en el host pico (129.50.3.2) se instaló un cliente HTTP (Netscape Navigator versión 4.61) y el software de interfaz SOCKS versión 5 (SocksCaps versión 1.03 ,de la empresa NEC)

Bajo sistema operativo Linux, se instaló en el ruteador router34 un servidor SOCKS versión 5, de la empresa NEC.

Configuración del servidor HTTP

Se instaló, con la utilidad pkgtool, la versión de servidor Apache distribuida en el curso. La misma generó una estructura de directorios a partir del camino /var/lib/apache. Se editó el archivo de configuración

(/var/lib/apache/conf/httpd.conf) a los efectos de definir el nombre de servidor (directiva ServidorName). El resto de las opciones se dejaron con sus valores por defectos, ya que no se requerían cambios para la realización del presente trabajo. Además se incorporó la script de arranque como parte de los servicios a iniciar durante el booteo.

Configuración del servidor de nombres

Se definió una única zona para toda la red propuesta bajo el dominio tyr.unlu.edu.ar. Se instaló, con la utilidad pkgtool, la versión de servidor Bind distribuida en el curso. Se incorporó una script de arranque como parte de los servicios a iniciar durante el booteo. La configuración de los distintos archivos que componen la base de datos se describe en el siguiente instructivo de configuración:

En nuestra instalación, el directorio /var/named contiene los archivos de configuración. El archivo named.boot define el directorio (directory) en el cual residen el resto de los archivos de configuración de zonas. Además indica los dominios sobre los cuales el servidor de nombres tiene autoridad (primary) ó es réplica (secondary). También se hace referencia a la lista de punteros a los root-servers, mediante la directiva cache. Cada entrada está ligada a un archivo que se denota en la tercer columna. En nuestra instalación named.boot se ve así:

```
directory /var/named
cache       .                       named.ca
primary     tyr.unlu.edu.ar         named.hosts
primary     0.0.127.IN-ADDR.ARPA    named.local
primary     50.129.IN-ADDR.ARPA     named.rev
```

El archivo named.ca contiene una lista de asociaciones nombre-dirección correspondiente a los servidores de nombre raíz para vinculaciones con dominios de alto nivel, a los efectos de poder comenzar la resolución de nombres no pertenecientes a nuestro dominio.

```
;.                99999999 IN NS          NS.NIC.DDN.MIL
;NS.NIC.DDN.MIL   99999999 IN A           26.3.0.103
;.                99999999 IN NS          NS.NASA.GOV
;NS.NASA.GOV      99999999 IN A           128.102.16.10
```

Nota: Debido a que nuestra red no tiene vinculación con Internet, no se requiere acceso a root-servers, por lo cual se han comentado todas las entradas.

Named.host es un archivo que indica quien tiene autoridad sobre el dominio tyr.unlu.edu.ar (en nuestro caso bariloche), definiendo una serie de parámetros para el control de las replicas y contacto administrativo. Luego, mediante registros tipo A se vinculan los nombres de hosts con su dirección de red. CNAME permite definir un alias sobre entradas tipo A. En nuestro caso el host bariloche tiene asociado dos alias que son www y dns.

```
@     IN    SOA   bariloche.tyr.unlu.edu.ar.
ght.bariloche.tyr.unlu.edu.ar. (
            20000708001       ;serial
            86400             ;refresh: 1 vez x dia
            3600              ;retry: 1 x hora
            3600000           ;expire: 42 dias
            604800      )     ;minimum: 1 semana
IN    NS    bariloche
localhost.  IN    A           127.0.0.1

;Descripción de los distintos registros para
bariloche   IN    A           129.50.4.2
```

```
pico        IN    A          129.50.3.2
dns         IN    CNAME      bariloche
www         IN    CNAME      bariloche
lujan       IN    A          129.50.1.2
laplata     IN    A          129.50.1.3
chivilcoy   IN    A          129.50.1.4
rioiii      IN    A          129.50.5.1
cutralco    IN    A          129.50.6.66
sanrafael   IN    A          129.50.6.129
```

Nota: Si se agrega un host a la red deberá agregarse la correspondiente entrada tipo A en este archivo, como también sus alias (CNAME) si hubiera. En caso de definir servidor de mail el tipo de registro es MX y una entrada posible sería

```
lujan       IN    MX    10    lujan
```

Aquí se definió que el host lujan maneja mail para el dominio tyr.unlu.edu.ar.

Named.local. Este archivo indica que la resolución inversa para el localhost corresponde a un determinado servidor de nombres (es él mismo) y se define un puntero.

```
@     IN    SOA   bariloche.tyr.unlu.edu.ar.
ght.bariloche.tyr.unlu.edu.ar. (
            1           ;serial
            360000            ;refresh: 100 hs
            3600        ;retry: 1 x hora
            3600000           ;expire: 42 dias
            604800 )    ;minimum: 1 semana
IN    NS    bariloche
1     IN    PTR   localhost.
```

Named.rev. Este archivo contiene el mapeo inverso de direcciones IP, indicando que el host bariloche da respuestas con autoridad. En el registro tipo SOA se adjuntan datos de contacto administrativo y control de réplicas. Los registro tipo PTR definen punteros que vinculan direcciones de red con mnemónicos.

```
@       IN      SOA     bariloche.tyr.unlu.edu.ar.
ght.bariloche.tyr.unlu.edu.ar. (
            20000708001 ;serial
            86400       ;refresh: 1 vez x dia
            3600        ;retry: 1 x hora
            3600000           ;expire: 42 dias
            604800      )     ;minimum: 1 semana
IN    NS    bariloche
2.4         IN    PTR         bariloche
2.3         IN    PTR         pico
2.1         IN    PTR         lujan
4.1         IN    PTR         chivilcoy
3.1         IN    PTR         laplata
1.5         IN    PTR         rioiii
66.6        IN    PTR         cutralco
129.6       IN    PTR         sanrafael
```

La instrucción de arranque del servidor de nombres es:

```
named –b /var/named/named.boot
```

Por cualquier modificación a los datos, el demonio debe ser relanzado a los efectos de que lea nuevamente los archivos de configuración. Por lo cual es común utilizar el siguiente comando:

```
Kill –HUP (pid del proceso named)
```

En nuestro caso, si se decidiera implementar en la red 129.50.0.0 una estrategia de réplica del servidor de nombres, se definiría en un host (por ejemplo lujan) un servidor secundario cuyo archivo named.boot con el siguiente contenido:

```
directory /var/named
cache       .                       named.ca
secondary   tyr.unlu.edu.ar         named.hosts.r
primary     0.0.127.IN-ADDR.ARPA    named.local.r
secondary   50.129.IN-ADDR.ARPA     named.rev.r
```

Configuración del cliente

Al host pico (estación de trabajo con sistema operativo Microsoft Windows 95) se le asignó (por panel de control/red) la dirección IP 129.50.3.2. Se asignó un gateway por defecto correspondiente al router34 en 129.50.3.1. y finalmente se instanció el servidor de nombres (129.50.4.2) y dominio asociado (tyr.unlu.edu.ar).

Nota: En este hosts se instaló la aplicación Nestcape Navigator como parte de los requerimientos para resolución del trabajo práctico e instrumento de prueba de los servicios instalados (servidor HTTP y servidor de nombres).

3- Conexión a Internet

En el supuesto caso de querer vincular la red 129.50.0.0 con Internet, en un host ó ruteador de la misma deberá instalarse un enlace vinculante. Por ejemplo en el host bariloche a través de la interfaz sl0 IP 100.100.100.65 (netmask 255.255.255.252). Es importante denotar que la capacidad IP-FORWARDING debe habilitarse en bariloche (pasando de ser multihomed host a ruteador). En los hosts internos debe agregarse una ruta por defecto (default gateway) de manera tal que si un datagrama no pertenece a una de las redes internas, debe enviarse a través de bariloche a Internet.

```
route add default gw 129.50.4.2 netmask 0.0.0.0 metric 1
```

Nota: Debe considerarse que en el nuevo ruteador bariloche existe la necesidad de implementar algún mecanismo de filtrado (tipo ipchains en Linux) de manera que no rutee al exterior los posibles datagramas pertenecientes a la red interna. Además, este software podría ser utilizado como un firewall elemental de filtrado de paquetes (por dirección, protocolo y servicios) debido a que las direcciones internas de la red pasan a ser públicas para Internet.

4- Configuración de protocolo SOCKS5 sobre la Red TCP/IP

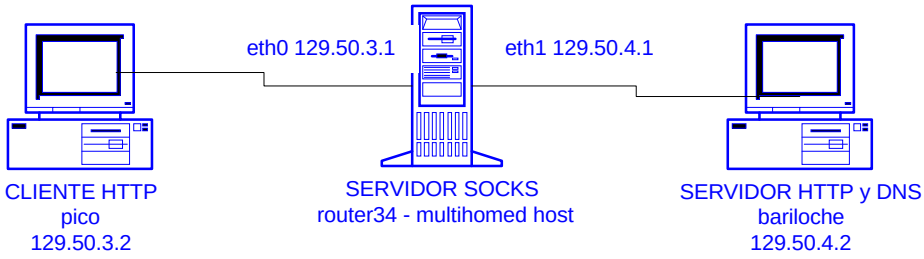


Diagrama de la subred implementada

El objetivo de la implementación, presentada en el diagrama anterior, es brindar un acceso seguro a otras redes por parte de equipos pertenecientes a la red 129.50.3.0. Para lo cual al equipo denominado router34 se le deshabilitó la función del IP-Forwarding, convirtiéndolo en un multihomed host. Aademás, se instaló el software con capacidad de servidor SOCKS versión 5 desarrollado por la firma NEC (accesible en la URL http://www.SOCKS.nec.com). La instalación se realizó siguiendo las instrucciones adjuntas al software, donde básicamente se configuró la distribución fuente, se compiló, se distribuyó en los directorios predeterminados y finalmente se configuró el software de acuerdo a las necesidades propias. La configuración del servidor se realiza sobre el archivo /etc/socks5.conf, en nuestro caso se utilizó la siguiente:

```
auth - - -                    # Permite cualquier tipo de autenticación
                              # inclusive ninguna.
permit - - 129.50.3. - - -    # Permite que todos los hosts de la red
                              # 129.50.3 puedan tener servicio de proxy,
                              # negando acceso a servicios proxy a cual-
                              # quier hosts de otra red
set SOCKS5_V4SUPPORT          # Brinda servicios de SOCKS versión 4 a
                              # clientes que lo soliciten.
```

El servidor SOCKS se ejecutó bajo línea de comando con la siguiente orden:

```
<dir.de instalación>#./socks5 –b 1080 –d 2 –s
```

Donde –b 1080 le indica que atienda en el puerto 1080 y –d 2 determina el nivel de información provista por el módulo de debugger en archivos de logs y –s indica que las líneas de debug deben ser redirigidas a la salida estándar de errores (monitor en nuestro caso).

En el equipo pico, operando sobre sistema operativo Microsoft Windows 95, se instaló el software cliente HTTP denominado Navigator, de la empresa Netscape. Dado que la versión instalada (4.61) solo soporta el protocolo SOCKS versión 4 fue necesario incluir un agente residente que capture las peticiones del Navigator y las traduzca a peticiones SOCKS 5. Este software es provisto por la empresa NEC (accesible en la URL http://www.SOCKS.nec.com) y se denomina SocksCaps. Luego de instalado, se lo configuró indicando los siguientes parámetros: dirección IP y número de puerto del servidor SOCKS, indicación de quien resuelve la conversión de nombres (si es local o a través del servidor SOCKS), si se lleva un registro de logs sobre peticiones realizadas, aplicaciones sobre las cuales va a actuar. En definitiva, bajo Windows, SocksCaps a través de librerías dinámicas (DLL) provee un servicio transparente (para la aplicación cliente) de acceso a servidores de aplicación a través de un servidor SOCKS. Esta tarea se denomina *Socksification*.

5- Configuración de hosts y ruteadores de la red

*** TABLA DE HOSTS

-Archivo /etc/hosts

```
        129.50.1.2      lujan.tyr.unlu.edu.ar         lujan
        129.50.1.3      laplata.tyr.unlu.edu.ar       laplata
        129.50.1.4      chivilcoy.tyr.unlu.edu.ar     chivilcoy
        129.50.3.2      pico.tyr.unlu.edu.ar          pico
        129.50.4.2      bariloche.tyr.unlu.edu.ar     bariloche
        129.50.5.1      rioiii.tyr.unlu.edu.ar        rioiii
        129.50.6.66     cutralco.tyr.unlu.edu.ar      cutralco
        129.50.6.129    sanrafael.tyr.unlu.edu.ar     sanrafael
```

*** DEFINICION DE RUTEADORES

*** Nombre de host: router21**

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

```
        129.50.1.0      bsas
        129.50.2.0      argentina
        129.50.3.0      lapampa
        129.50.4.0      rionegro
        129.50.5.0      cordoba
        129.50.6.64     neuquen
        129.50.1.128    mendoza
```

-Interfaces

```
        --Eth0:
        ifconfig eth0 129.50.1.5 netmask 255.255.255.0 broadcast 129.50.1.255

        --Eth1:
        ifconfig eth1 129.50.2.5 netmask 255.255.255.0 broadcast 129.50.2.255
```

-Rutas

```
        route add -net 129.50.1.0                 netmask 255.255.255.0          eth0
        route add -net 129.50.2.0                 netmask 255.255.255.0          eth1
        route add -net 129.50.3.0   gw 129.50.2.6 netmask 255.255.255.0 metric 1 eth1
        route add -net 129.50.3.0   gw 129.50.2.3 netmask 255.255.255.0 metric 2 eth1
        route add -net 129.50.4.0   gw 129.50.2.3 netmask 255.255.255.0 metric 1 eth1
        route add -net 129.50.4.0   gw 129.50.2.6 netmask 255.255.255.0 metric 2 eth1
        route add -net 129.50.5.0   gw 129.50.2.4 netmask 255.255.255.0 metric 1 eth1
        route add -net 129.50.5.0   gw 129.50.2.6 netmask 255.255.255.0 metric 4 eth1
        route add -net 129.50.6.64  gw 129.50.2.1 netmask 255.255.255.252 metric 1 eth1
        route add -net 129.50.6.64  gw 129.50.2.6 netmask 255.255.255.252 metric 4 eth1
        route add -net 129.50.6.128 gw 129.50.2.2 netmask 255.255.255.252 metric 1 eth1
        route add -net 129.50.6.128 gw 129.50.2.6 netmask 255.255.255.252 metric 4 eth1
```

* Nombre de host: router32

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

```
129.50.1.0      bsas
129.50.2.0      argentina
129.50.3.0      lapampa
129.50.4.0      rionegro
129.50.5.0      cordoba
129.50.6.64     neuquen
129.50.1.128    mendoza
```

-Interfaces

--Eth0:

```
ifconfig eth0 129.50.2.6 netmask 255.255.255.0 broadcast 129.50.2.255

--Eth1:
ifconfig eth1 129.50.3.6 netmask 255.255.255.0 broadcast 129.50.3.255

-Rutas

route add -net 129.50.2.0                netmask 255.255.255.0          eth0
route add -net 129.50.3.0                netmask 255.255.255.0          eth1
route add -net 129.50.1.0   gw 129.50.2.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.1.0   gw 129.50.3.1 netmask 255.255.255.0 metric 3 eth1
route add -net 129.50.5.0   gw 129.50.2.4 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.5.0   gw 129.50.3.1 netmask 255.255.255.0 metric 3 eth1
route add -net 129.50.6.64  gw 129.50.2.1 netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.64  gw 129.50.3.1 netmask 255.255.255.252 metric 3 eth1
route add -net 129.50.6.128 gw 129.50.2.2 netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.128 gw 129.50.3.1 netmask 255.255.255.252 metric 3 eth1
route add -net 129.50.4.0   gw 129.50.2.3 netmask 255.255.255.0   metric 1 eth0
route add -net 129.50.4.0   gw 129.50.3.1 netmask 255.255.255.0   metric 1 eth1

* Nombre de host: router34

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.3.1 netmask 255.255.255.0 broadcast 129.50.3.255

--Eth1:
ifconfig eth1 129.50.4.1 netmask 255.255.255.0 broadcast 129.50.4.255

-Rutas

route add -net 129.50.3.0                netmask 255.255.255.0          eth0
route add -net 129.50.4.0                netmask 255.255.255.0          eth1
route add -net 129.50.1.0   gw 129.50.3.6 netmask 255.255.255.0 metric 2 eth0
route add -net 129.50.1.0   gw 129.50.4.3 netmask 255.255.255.0 metric 2 eth1
route add -net 129.50.2.0   gw 129.50.3.6 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.2.0   gw 129.50.4.3 netmask 255.255.255.0 metric 1 eth1
route add -net 129.50.5.0   gw 129.50.3.6 netmask 255.255.255.0   metric 2 eth0
route add -net 129.50.5.0   gw 129.50.4.3 netmask 255.255.255.0   metric 2 eth1
route add -net 129.50.6.64  gw 129.50.3.6 netmask 255.255.255.252 metric 2 eth0
route add -net 129.50.6.64  gw 129.50.4.3 netmask 255.255.255.252 metric 2 eth1
route add -net 129.50.6.128 gw 129.50.3.6 netmask 255.255.255.252 metric 2 eth0
route add -net 129.50.6.128 gw 129.50.4.3 netmask 255.255.255.252 metric 2 eth1

* Nombre de host: router42

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.2.3 netmask 255.255.255.0 broadcast 129.50.2.255

--Eth1:
```

```
ifconfig eth1 129.50.4.3 netmask 255.255.255.0 broadcast 129.50.4.255

-Rutas

route add -net 129.50.2.0                 netmask 255.255.255.0          eth0
route add -net 129.50.4.0                 netmask 255.255.255.0          eth1
route add -net 129.50.1.0   gw 129.50.2.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.1.0   gw 129.50.4.1 netmask 255.255.255.0 metric 3 eth1
route add -net 129.50.3.0   gw 129.50.2.6 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.3.0   gw 129.50.4.1 netmask 255.255.255.0 metric 1 eth1
route add -net 129.50.5.0   gw 129.50.2.4 netmask 255.255.255.0   metric 1 eth0
route add -net 129.50.5.0   gw 129.50.4.1 netmask 255.255.255.0   metric 3 eth1
route add -net 129.50.6.64  gw 129.50.2.1 netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.64  gw 129.50.4.1 netmask 255.255.255.252 metric 3 eth1
route add -net 129.50.6.128 gw 129.50.2.2 netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.128 gw 129.50.4.1 netmask 255.255.255.252 metric 3 eth1

* Nombre de host: router25

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.2.4 netmask 255.255.255.0 broadcast 129.50.2.255

--Eth1:
ifconfig eth1 129.50.5.4 netmask 255.255.255.0 broadcast 129.50.5.255

-Rutas

route add -net 129.50.2.0                 netmask 255.255.255.0          eth0
route add -net 129.50.5.0                 netmask 255.255.255.0          eth1
route add -net 129.50.1.0   gw 129.50.2.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.1.0   gw 129.50.2.3 netmask 255.255.255.0 metric 4 eth0
route add -net 129.50.3.0   gw 129.50.2.6 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.3.0   gw 129.50.2.3 netmask 255.255.255.0 metric 2 eth0
route add -net 129.50.4.0   gw 129.50.2.3 netmask 255.255.255.0   metric 1 eth0
route add -net 129.50.4.0   gw 129.50.2.6 netmask 255.255.255.0   metric 2 eth0
route add -net 129.50.6.64  gw 129.50.2.1 netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.64  gw 129.50.2.6 netmask 255.255.255.252 metric 4 eth0
route add -net 129.50.6.128 gw 129.50.2.2 netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.128 gw 129.50.2.6 netmask 255.255.255.252 metric 4 eth0

* Nombre de host: router26

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.2.1 netmask 255.255.255.0 broadcast 129.50.2.255

--Sl0:
ifconfig sl0 129.50.6.65 netmask 255.255.255.252 broadcast 129.50.6.67

-Rutas
```

```
route add -net 129.50.2.0                   netmask 255.255.255.0           eth0
route add -net 129.50.6.64                  netmask 255.255.255.252         sl0
route add -net 129.50.1.0   gw 129.50.2.5   netmask 255.255.255.0   metric 1 eth0
route add -net 129.50.1.0   gw 129.50.2.3   netmask 255.255.255.0   metric 4 eth0
route add -net 129.50.3.0   gw 129.50.2.6   netmask 255.255.255.0   metric 1 eth0
route add -net 129.50.3.0   gw 129.50.2.3   netmask 255.255.255.0   metric 2 eth0
route add -net 129.50.4.0   gw 129.50.2.3   netmask 255.255.255.0   metric 1 eth0
route add -net 129.50.4.0   gw 129.50.2.6   netmask 255.255.255.0   metric 2 eth0
route add -net 129.50.6.64  gw 129.50.2.1   netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.64  gw 129.50.2.6   netmask 255.255.255.252 metric 4 eth0
route add -net 129.50.6.128 gw 129.50.2.2   netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.128 gw 129.50.2.6   netmask 255.255.255.252 metric 4 eth0

* Nombre de host: router27

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.2.2  netmask 255.255.255.0 broadcast 129.50.2.255

--Sl0:
ifconfig sl0 129.50.6.130 netmask 255.255.255.252 broadcast 129.50.6.131

-Rutas

route add -net 129.50.2.0                   netmask 255.255.255.0           eth0
route add -net 129.50.6.128                 netmask 255.255.255.252         sl0
route add -net 129.50.1.0   gw 129.50.2.5   netmask 255.255.255.0   metric 1 eth0
route add -net 129.50.1.0   gw 129.50.2.3   netmask 255.255.255.0   metric 4 eth0
route add -net 129.50.3.0   gw 129.50.2.6   netmask 255.255.255.0   metric 1 eth0
route add -net 129.50.3.0   gw 129.50.2.3   netmask 255.255.255.0   metric 2 eth0
route add -net 129.50.4.0   gw 129.50.2.3   netmask 255.255.255.0   metric 1 eth0
route add -net 129.50.4.0   gw 129.50.2.6   netmask 255.255.255.0   metric 2 eth0
route add -net 129.50.6.64  gw 129.50.2.1   netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.64  gw 129.50.2.6   netmask 255.255.255.252 metric 4 eth0
route add -net 129.50.6.128 gw 129.50.2.2   netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.128 gw 129.50.2.6   netmask 255.255.255.252 metric 4 eth0
```

*** DEFINICION DE HOSTS

```
* Hosts en red 129.50.1.0 (red bsas)

* Nombre de host: lujan

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.1.2 netmask 255.255.255.0 broadcast 129.50.1.255

-Rutas
```

```
route add -net 129.50.1.0                 netmask 255.255.255.0          eth0
route add -net 129.50.2.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.3.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.4.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.5.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.6.64  gw 129.50.1.5 netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.128 gw 129.50.1.5 netmask 255.255.255.252 metric 1 eth0

* Nombre de host: laplata

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.1.3 netmask 255.255.255.0 broadcast 129.50.1.255

-Rutas

route add -net 129.50.1.0                 netmask 255.255.255.0          eth0
route add -net 129.50.2.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.3.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.4.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.5.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.6.64  gw 129.50.1.5 netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.128 gw 129.50.1.5 netmask 255.255.255.252 metric 1 eth0

* Nombre de host: chivilcoy

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.1.4 netmask 255.255.255.0 broadcast 129.50.1.255

-Rutas

route add -net 129.50.1.0                 netmask 255.255.255.0          eth0
route add -net 129.50.2.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.3.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.4.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.5.0   gw 129.50.1.5 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.6.64  gw 129.50.1.5 netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.128 gw 129.50.1.5 netmask 255.255.255.252 metric 1 eth0

* Hosts en red 129.50.3.0 (red lapampa)

* Nombre de host: pico

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
```

```
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.3.2 netmask 255.255.255.0 broadcast 129.50.3.255

-Rutas

route add -net 129.50.3.0                 netmask 255.255.255.0          eth0
route add -net 129.50.1.0   gw 129.50.3.6 netmask 255.255.255.0 metric 2 eth0
route add -net 129.50.1.0   gw 129.50.3.1 netmask 255.255.255.0 metric 3 eth0
route add -net 129.50.2.0   gw 129.50.3.6 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.2.0   gw 129.50.3.1 netmask 255.255.255.0 metric 2 eth0
route add -net 129.50.4.0   gw 129.50.3.1 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.4.0   gw 129.50.3.6 netmask 255.255.255.0 metric 2 eth0
route add -net 129.50.5.0   gw 129.50.3.6 netmask 255.255.255.0 metric 2 eth0
route add -net 129.50.5.0   gw 129.50.3.1 netmask 255.255.255.0 metric 3 eth0
route add -net 129.50.6.64  gw 129.50.3.6 netmask 255.255.255.252 metric 2 eth0
route add -net 129.50.6.64  gw 129.50.3.1 netmask 255.255.255.252 metric 3 eth0
route add -net 129.50.6.128 gw 129.50.3.6 netmask 255.255.255.252 metric 2 eth0
route add -net 129.50.6.128 gw 129.50.3.1 netmask 255.255.255.252 metric 3 eth0

* Hosts en red 129.50.4.0 (red rionegro)

* Nombre de host: bariloche

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.4.2 netmask 255.255.255.0 broadcast 129.50.4.255

-Rutas

route add -net 129.50.4.0                 netmask 255.255.255.0          eth0
route add -net 129.50.1.0   gw 129.50.4.1 netmask 255.255.255.0 metric 3 eth0
route add -net 129.50.1.0   gw 129.50.4.3 netmask 255.255.255.0 metric 2 eth0
route add -net 129.50.2.0   gw 129.50.4.3 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.2.0   gw 129.50.4.1 netmask 255.255.255.0 metric 2 eth0
route add -net 129.50.3.0   gw 129.50.4.1 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.3.0   gw 129.50.4.3 netmask 255.255.255.0 metric 2 eth0
route add -net 129.50.5.0   gw 129.50.4.3 netmask 255.255.255.0 metric 2 eth0
route add -net 129.50.5.0   gw 129.50.4.1 netmask 255.255.255.0 metric 3 eth0
route add -net 129.50.6.64  gw 129.50.4.3 netmask 255.255.255.252 metric 2 eth0
route add -net 129.50.6.64  gw 129.50.4.1 netmask 255.255.255.252 metric 3 eth0
route add -net 129.50.6.128 gw 129.50.4.3 netmask 255.255.255.252 metric 2 eth0
route add -net 129.50.6.128 gw 129.50.4.1 netmask 255.255.255.252 metric 3 eth0

* Hosts en red 129.50.5.0 (red cordoba)

* Nombre de host: rioiii

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
```

```
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Eth0:
ifconfig eth0 129.50.5.1 netmask 255.255.255.0 broadcast 129.50.5.255

-Rutas

route add -net 129.50.5.0                netmask 255.255.255.0          eth0
route add -net 129.50.1.0   gw 129.50.5.4 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.2.0   gw 129.50.5.4 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.3.0   gw 129.50.5.4 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.4.0   gw 129.50.5.4 netmask 255.255.255.0 metric 1 eth0
route add -net 129.50.6.64  gw 129.50.5.4 netmask 255.255.255.252 metric 1 eth0
route add -net 129.50.6.128 gw 129.50.5.4 netmask 255.255.255.252 metric 1 eth0

* Hosts en red 129.50.6.64 (red neuquen)

* Nombre de host: cutralco

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Sl0:
ifconfig sl0 129.50.6.66 netmask 255.255.255.252 broadcast 129.50.6.67

-Rutas

route add -net 129.50.6.64                  netmask 255.255.255.252          sl0
route add -net 129.50.1.0   gw 129.50.6.65  netmask 255.255.255.0 metric 1 sl0
route add -net 129.50.2.0   gw 129.50.6.65  netmask 255.255.255.0 metric 1 sl0
route add -net 129.50.3.0   gw 129.50.6.65  netmask 255.255.255.0 metric 1 sl0
route add -net 129.50.4.0   gw 129.50.6.65  netmask 255.255.255.0 metric 1 sl0
route add -net 129.50.5.0   gw 129.50.6.65  netmask 255.255.255.0 metric 1 sl0
route add -net 129.50.6.128 gw 129.50.6.65  netmask 255.255.255.252 metric 1 sl0

* Hosts en red 129.50.6.64 (red mendoza)

* Nombre de host: sanrafael

-Dominio: tyr.unlu.edu.ar

-Archivo /etc/networks

129.50.1.0     bsas
129.50.2.0     argentina
129.50.3.0     lapampa
129.50.4.0     rionegro
129.50.5.0     cordoba
129.50.6.64    neuquen
129.50.1.128   mendoza

-Interfaces

--Sl0:
ifconfig sl0 129.50.6.129 netmask 255.255.255.252 broadcast 129.50.6.131

-Rutas

route add -net 129.50.6.128                 netmask 255.255.255.252          sl0
route add -net 129.50.1.0   gw 129.50.6.130 netmask 255.255.255.0 metric 1 sl0
route add -net 129.50.2.0   gw 129.50.6.130 netmask 255.255.255.0 metric 1 sl0
route add -net 129.50.3.0   gw 129.50.6.130 netmask 255.255.255.0 metric 1 sl0
route add -net 129.50.4.0   gw 129.50.6.130 netmask 255.255.255.0 metric 1 sl0
```

```
route add -net 129.50.5.0   gw 129.50.6.130 netmask 255.255.255.0 metric 1 sl0
route add -net 129.50.6.64  gw 129.50.6.130 netmask 255.255.255.252 metric 1 sl0
```