Comunicación de Datos II

Trabajo Práctico Especial

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Índice:

Consideraciones generales del TPE

- La topología a utilizar debe ser igual a la definida en la figura
- La configuración de direcciones y rutas en los distintos equipos debe especificarse en el servicio "user defined" de cada equipo.
- Para el correcto funcionamiento de la red, se debe deshabilitar todos los servicios de Quagga en los routers.
- Para configurar los equipos, se debe utilizar los comandos del paquete ip route 2 vistos en las teóricas.
- Se debe entregar un informe con la resolución de los distintos ítems. En dicho informe se debe colocar cada uno de los comandos colocados en los “user defined” de cada equipo, como también el resto de comandos ejecutados para la resolución de cada uno de los ejercicios.
- Se debe entregar dos archivos .imn. El primero con la topología y todas las configuraciones realizadas sobre los equipos sin la utilización del RADVD, y otro con la configuración de RADVD.

Características de la red a definir

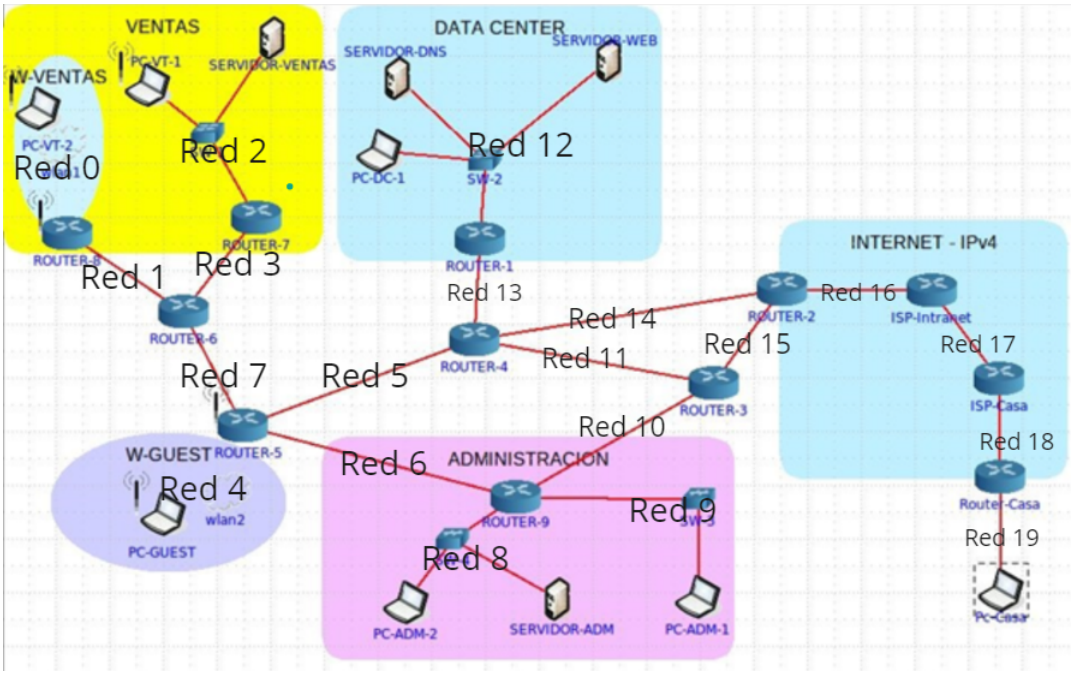
- Todos los equipos (incluye hosts y routers) deben poder comunicarse entre sí dentro de la intranet
- VENTAS debe poder comunicarse con otros equipos en la Internet
- El SERVIDOR-WEB debe poder ser accedido por cualquier equipo de la Internet, en la dirección (global) provista por el DNS (servidorweb.abc.com).
- El SERVIDOR-DNS debe tener una dirección global que permita que sea accedido desde afuera de la intranet.
- Desde la red inalámbrica de W-GUEST no debe ser posible acceder a equipos internos de la intranet, excepto al SERVIDOR-DNS y al SERVIDOR-WEB, pero por sus direcciones globales.
- Los paquetes que se procesen en el ROUTER-5 originados en W-GUEST deben pasar por el ROUTER-9, mientras que el resto del tráfico procesado en el ROUTER-5 se debe direccionar al ROUTER-4.
- Los paquetes TCP con destino fuera de la intranet deben pasar por el Router 3, mientras que el resto del tráfico dirigido fuera de la intranet no deben pasar por dicho equipo.
- Se debe poder acceder a cualquiera de los routers desde fuera de la intranet.
- Todas las interfaces de INTERNET sólo tienen direcciones IPv4. El resto de las interfaces sólo tienen direcciones IPv6.

Resolución de Ejercicios:

Ejercicio 1.

Suponiendo que nuestro proveedor nos asigna 2001:1200:0:21f0::/60

a. Identifique las redes que componen la intranet, nombrándolas como Red 1, Red 2, etc.



Redes de la intranet identificadas:

- Red 0: red w-ventas
- Red 1: red entre Router 8 y 6
- Red 2: red de ventas
- Red 3: red entre Router 7 y 6
- Red 4: red w-guest
- Red 5: red entre Router 4 y 5
- Red 6: red entre Router 5 y 9
- Red 7: red entre Router 6 y 5
- Red 8: red de Administración con PC-ADM-2 y Servidor-ADM
- Red 9: red de Administración con PC-ADM-1
- Red 10: red entre router 9 y 3
- Red 11: red entre router 4 y 3
- Red 12: red del Data Center
- Red 13: red entre Router 1 y 4
- Red 14: red entre router 4 y 2
- Red 15: red entre router 3 y 2
- Red 16: red entre Router 2 y el ISP-Intranet
- Red 17: red entre ISP-Intranet y el ISP-Casa
- Red 18: red entre el ISP-Casa y el Router-Casa
- Red 19: red del Router-Casa con la PC-Casa

b. Proponga una asignación de direcciones globales para la intranet. Indicarlas en una tabla que contenga los campos NOMBRE RED – DIRECCIÓN/PREFIJO.

Nombre de Red	Dirección/Prefijo
Red 0	2001:1200:0:21f1::/64
Red 1	2001:1200:0:21f0::/127
Red 2	2001:1200:0:21f2::/64
Red 3	2001:1200:0:21f0::2/127
Red 4	2001:1200:0:21f3::/64
Red 5	2001:1200:0:21f0::6/127
Red 6	2001:1200:0:21f0::8/127
Red 7	2001:1200:0:21f0::4/127
Red 8	2001:1200:0:21f4::/64
Red 9	2001:1200:0:21f5::/64
Red 10	2001:1200:0:21f0::12/127
Red 11	2001:1200:0:21f0::e/127
Red 12	2001:1200:0:21f6::/64
Red 13	2001:1200:0:21f0::a/127
Red 14	2001:1200:0:21f0::c/127
Red 15	2001:1200:0:21f0::10/127
Red 16	(IPv4 - próximamente definidas)
Red 17	(IPv4 - próximamente definidas)
Red 18	(IPv4 - próximamente definidas)
Red 19	2001:1234::/60

c. Indique en una tabla, las direcciones globales que tendrán los equipos que pueden comunicarse con otros en la Internet.

Nombre equipo	Dirección
PC-VT-1	2001:1200:0:21f2::2/64
Servidor-Ventas	2001:1200:0:21f2::3/64
Router-7 eth0	2001:1200:0:21f0::3/127
Router-7 eth1	2001:1200:0:21f2::1/64
PC-VT-2	2001:1200:0:21f1::1/64
Router-8 eth1	2001:1200:0:21f1::2/64
Router-8 eth0	2001:1200:0:21f0::/127
Router-6 eth0	2001:1200:0:21f0::4/127
Router-6 eth1	2001:1200:0:21f0::1/127
Router-6 eth2	2001:1200:0:21f0::2/127
Router-5 eth3	2001:1200:0:21f0::8/127
Router-5 eth1	2001:1200:0:21f0::5/127
Router-5 eth2	2001:1200:0:21f0::6/127
Servidor Web	2001:1200:0:21f6::4/64
Servidor DNS	2001:1200:0:21f6::3/64
Router-1 eth0	2001:1200:0:21f0::b/127
Router-1 eth1	2001:1200:0:21f6::1/64
Router-4 eth0	2001:1200:0:21f0::7/127
Router-4 eth1	2001:1200:0:21f0::f/127
Router-4 eth2	2001:1200:0:21f0::c/127
Router-4 eth3	2001:1200:0:21f0::a/127
Router-2 eth0	2001:1200:021f0::d/127
Router-2 eth1	2001:1200:0:21f0::10/127
Router-2 eth2	192.168.0.2/16
Router-3 eth0	2001:1200:0:21f0::13/127

Router-3 eth1	2001:1200:0:21f0::e/127
Router-3 eth2	2001:1200:0:21f0::11/127
Router-9 eth1	2001:1200:0:21f0::9/127
Router-9 eth3	2001:1200:0:21f0::12/127
ISP-Intranet eth0	192.168.0.1/16
ISP-Intranet eth1	192.169.0.2/16
ISP-Casa eth0	192.169.0.1/16
ISP-Casa eth1	192.170.0.2/16
Router-Casa eth0	192.170.0.1/16
Router-Casa eth1	2001:1200:0:21f7::1/64
Pc-Casa	2001:1200:0:21f7::2/64

Ejercicio 2.

Teniendo en cuenta facilidad para la administración, proponga una asignación de direcciones de alcance en el site.

Direcciones	ULA
Administración	
PC-ADM-2	fd00:0:0:1::1/64
SERVIDOR-ADM	fd00:0:0:1::2/64
ROUTER 9 ETH0	fd00:0:0:1::3/64
PC-ADM-1	fd00:0:0:2::1/64
ROUTER 9 ETH2	fd00:0:0:2::2/64
VENTAS	
PC-VT-1	fd00:0:0:3::1/64
SERVIDOR-VENTAS	fd00:0:0:3::2/64
ROUTER 7 ETH 1	fd00:0:0:3::3/64
PC-VT-2	fd00:0:0:4::1/64
ROUTER 8 ETH1	fd00:0:0:4::2/64

W-GUEST	
PC-GUEST	fd00:0:0:5::1/64
ROUTER-5 ETH 0	fd00:0:0:5::2/64
DATA-CENTER	
PC-DC-1	fd00:0:0:6::1/64
SERVIDOR-WEB	fd00:0:0:6::2/64
SERVIDOR-DNS	fd00:0:0:6::3/64
ROUTER-1 ETH 1	fd00:0:0:6::4/64
ROUTERS	
ROUTER 9 ETH1	fd00:0:0:7::1/64
ROUTER 5 ETH3	fd00:0:0:7::2/64
ROUTER 9 ETH3	fd00:0:0:8::1/64
ROUTER 3 ETH0	fd00:0:0:8::2/64
ROUTER 5 ETH2	fd00:0:0:9::1/64
ROUTER 4 ETH0	fd00:0:0:9::2/64
ROUTER 5 ETH1	fd00:0:0:a::1/64
ROUTER 6 ETH0	fd00:0:0:a::2/64
ROUTER 6 ETH1	fd00:0:0:b::1/64
ROUTER 8 ETH0	fd00:0:0:b::2/64
ROUTER 6 ETH2	fd00:0:0:c::1/64
ROUTER 7 ETH0	fd00:0:0:c::2/64
ROUTER 4 ETH3	fd00:0:0:d::1/64
ROUTER 1 ETH0	fd00:0:0:d::2/64
ROUTER 4 ETH2	fd00:0:0:e::1/64
ROUTER 2 ETH0	fd00:0:0:e::2/64
ROUTER 4 ETH1	fd00:0:0:f::1/64
ROUTER 3 ETH1	fd00:0:0:f::2/64
ROUTER 3 ETH2	fd00:0:0:10::1/64

ROUTER 2 ETH1	fd00:0:0:10::2/64

Ejercicio 3.

Configure manualmente las direcciones de los equipos

PC-VT-2:
ip -6 addr add fd00:0:0:4::1/64 dev eth0

Router-8:
ip -6 addr add fd00:0:0:4::2/64 dev eth1
ip -6 addr add fd00:0:0:b::2/64 dev eth0

Router-6:
ip -6 addr add fd00:0:0:a::2/64 dev eth0
ip -6 addr add fd00:0:0:b::1/64 dev eth1
ip -6 addr add fd00:0:0:c::1/64 dev eth2

Router-7:
ip -6 addr add fd00:0:0:3::3/64 dev eth1
ip -6 addr add fd00:0:0:c::2/64 dev eth0

PC-VT-1:
ip -6 addr add fd00:0:0:3::1/64 dev eth0

Servidor-Ventas:
ip -6 addr add fd00:0:0:3::2/64 dev eth0

Router-5:
ip -6 addr add fd00:0:0:5::2/64 dev eth0
ip -6 addr add fd00:0:0:a::1/64 dev eth1
ip -6 addr add fd00:0:0:9::1/64 dev eth2
ip -6 addr add fd00:0:0:7::2/64 dev eth3

PC-Guest:
ip -6 addr add fd00:0:0:5::1/64 dev eth0

Router-9:
ip -6 addr add fd00:0:0:1::3/64 dev eth0
ip -6 addr add fd00:0:0:7::1/64 dev eth1
ip -6 addr add fd00:0:0:2::2/64 dev eth2
ip -6 addr add fd00:0:0:8::1/64 dev eth3

PC-Adm-2:
ip -6 addr add fd00:0:0:1::1/64 dev eth0

Servidor Adm:
ip -6 addr add fd00:0:0:1::2/64 dev eth0

PC-ADM-1:
ip -6 addr add fd00:0:0:2::1/64 dev eth0

Router-3:
ip -6 addr add fd00:0:0:8::2/64 dev eth0
ip -6 addr add fd00:0:0:f::2/64 dev eth1
ip -6 addr add fd00:0:0:10::1/64 dev eth2

Router-4:
ip -6 addr add fd00:0:0:9::2/64 dev eth0
ip -6 addr add fd00:0:0:f::1/64 dev eth1
ip -6 addr add fd00:0:0:e::1/64 dev eth2
ip -6 addr add fd00:0:0:d::1/64 dev eth3

Router-1:
ip -6 addr add fd00:0:0:6::4/64 dev eth1
ip -6 addr add fd00:0:0:d::2/64 dev eth0

PC-DC-1:
ip -6 addr add fd00:0:0:6::1/64 dev eth0

Servidor DNS:
ip -6 addr add fd00:0:0:6::3/64 dev eth0

Servidor web:
ip -6 addr add fd00:0:0:6::2/64 dev eth0

Router 2:
ip -6 addr add fd00:0:0:e::2/64 dev eth0
ip -6 addr add fd00:0:0:10::2/64 dev eth1

Ejercicio 4.

Configure manualmente las rutas que permitan comunicarse a los equipos entre sí y con la PC-Casa

Router-1:
ip -6 route add default via 2001:1200:0:21f0::a dev eth0

Router-2:

```
ip -6 route add 2001:1200:0:21f0::8/127 via 2001:1200:0:21f0::11 dev eth1
ip -6 route add 2001:1200:0:21f0::e/127 via 2001:1200:0:21f0::11 dev eth1
ip -6 route add 2001:1200:0:21f0::10/127 via 2001:1200:0:21f0::11 dev eth1
ip -6 route add 2001:1200:0:21f0::12/127 via 2001:1200:0:21f0::11 dev eth1
ip -6 route add fd00:0:0:1::/64 via 2001:1200:0:21f0::11 dev eth1
ip -6 route add fd00:0:0:2::/64 via 2001:1200:0:21f0::11 dev eth1
ip -6 route add fd00:0:0:7::/64 via 2001:1200:0:21f0::11 dev eth1
ip -6 route add fd00:0:0:f::/64 via 2001:1200:0:21f0::11 dev eth1
ip -6 route add fd00:0:0:10::/64 via 2001:1200:0:21f0::11 dev eth1
ip -6 route add fd00:0:0:8::/64 via 2001:1200:0:21f0::11 dev eth1
ip route add 2001:1200::0:21f6::/64 via 2001:1200:0:21f0::c dev eth0
ip route add 2001:1200::0:21f6::/64 via 2001:1200:0:21f0::c dev eth0
ip route add 2001:1200::0:21f0::/124 via 2001:1200:0:21f0::c dev eth0
ip -6 route add 2001:1200:0:21f0::a/127 via 2001:1200:0:21f0::c dev eth0
ip -6 route add 2001:1200:0:21f0::c/127 via 2001:1200:0:21f0::c dev eth0
ip -6 route add fd00:0:0:3::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add fd00:0:0:4::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add fd00:0:0:5::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add fd00:0:0:6::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add fd00:0:0:b::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add fd00:0:0:c::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add fd00:0:0:a::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add fd00:0:0:9::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add fd00:0:0:d::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add 2001:1200:0:21f1::/62 via 2001:1200:0:21f0::c dev eth0
ip -6 route add 2001:1200:0:21f4::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add 2001:1200:0:21f5::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 route add 2001:1200:0:21f6::/64 via 2001:1200:0:21f0::c dev eth0
ip -6 rule add from fd00::/8 prohibit
ip route add default via 192.168.0.1 dev eth2
```

Router-3:

```
ip -6 route add 2001:1200:0:21f6::/64 via 2001:1200:0:21f0::f dev eth1
ip -6 route add 2001:1200:0:21f0::a/127 via 2001:1200:0:21f0::f dev eth1
ip -6 route add 2001:1200:0:21f0::c/127 via 2001:1200:0:21f0::f dev eth1
ip -6 route add 2001:1200:0:21f0::e/127 via 2001:1200:0:21f0::f dev eth1
ip -6 route add 2001:1200:0:21f0::6/127 via 2001:1200:0:21f0::f dev eth1
ip -6 route add 2001:1200:0:21f0::12/127 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add 2001:1200:0:21f0::/127 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add 2001:1200:0:21f0::2/127 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add 2001:1200:0:21f0::4/127 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add 2001:1200:0:21f0::8/127 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add 2001:1200:0:21f1::/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add 2001:1200:0:21f2::/64 via 2001:1200:0:21f0::12 dev eth0
```

```
ip -6 route add 2001:1200:0:21f3::/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add 2001:1200:0:21f4::/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add 2001:1200:0:21f5::/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add fd00:0:0:6::/64 via 2001:1200:0:21f0::f dev eth1
ip -6 route add fd00:0:0:d::/64 via 2001:1200:0:21f0::f dev eth1
ip -6 route add fd00:0:0:e::/64 via 2001:1200:0:21f0::f dev eth1
ip -6 route add fd00:0:0:f::/64 via 2001:1200:0:21f0::f dev eth1
ip -6 route add fd00:0:0:9::2/64 via 2001:1200:0:21f0::f dev eth1
ip -6 route add fd00:0:0:8::2/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add fd00:0:0:b::2/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add fd00:0:0:c::2/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add fd00:0:0:a::2/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add fd00:0:0:7::/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add fd00:0:0:4::/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add fd00:0:0:3::/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add fd00:0:0:5::/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add fd00:0:0:1::/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add fd00:0:0:2::/64 via 2001:1200:0:21f0::12 dev eth0
ip -6 route add default via 2001:1200:0:21f0::10 dev eth2
```

Router-4:

```
ip -6 route add fd00:0:0:6::/64 via 2001:1200:0:21f0::b dev eth3
ip -6 route add fd00:0:0:d::/64 via 2001:1200:0:21f0::b dev eth3
ip -6 route add fd00:0:0:f::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:8::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:10::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:2::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:1::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:7::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:b::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:c::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:a::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:4::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:3::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:5::/64 via 2001:1200:0:21f0::e dev eth1
ip -6 route add fd00:0:0:9::/64 via 2001:1200:0:21f0::6 dev eth0
ip6tables -A PREROUTING -t mangle -p tcp -j MARK --set-mark 10
ip -6 rule add priority 150 to 2000::/3 fwmark 10 table 150
ip -6 route add default via 2001:1200:0:21f0::e dev eth1 table 150
ip -6 rule add to 2001:1200:0:21f0::/60 table 100 priority 100
ip -6 route add 2001:1200:0:21f1::/64 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add 2001:1200:0:21f2::/64 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add 2001:1200:0:21f3::/64 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add 2001:1200:0:21f4::/64 via 2001:1200:0:21f0::e dev eth1 table 100
```

ip -6 route add 2001:1200:0:21f5::/64 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add 2001:1200:0:21f6::/64 via 2001:1200:0:21f0::b dev eth3 table 100
ip -6 route add 2001:1200:0:21f0::/127 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add 2001:1200:0:21f0::2/127 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add 2001:1200:0:21f0::4/127 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add 2001:1200:0:21f0::6/127 via 2001:1200:0:21f0::6 dev eth0 table 100
ip -6 route add 2001:1200:0:21f0::8/127 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add 2001:1200:0:21f0::10/127 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add 2001:1200:0:21f0::12/127 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add 2001:1200:0:21f0::a/127 via 2001:1200:0:21f0::b dev eth3 table 100
ip -6 route add 2001:1200:0:21f0::e/127 via 2001:1200:0:21f0::e dev eth1 table 100
ip -6 route add default via 2001:1200:0:21f0::d dev eth2

Router-5:
ip -6 route add fd00:0:0:3::/64 via 2001:1200:0:21f0::4 dev eth1
ip -6 route add fd00:0:0:4::/64 via 2001:1200:0:21f0::4 dev eth1
ip -6 route add fd00:0:0:b::/64 via 2001:1200:0:21f0::4 dev eth1
ip -6 route add fd00:0:0:c::/64 via 2001:1200:0:21f0::4 dev eth1
ip -6 route add 2001:1200:0:21f0::4/127 via 2001:1200:0:21f0::4 dev eth1
ip -6 route add 2001:1200:0:21f0::/126 via 2001:1200:0:21f0::4 dev eth1
ip -6 route add 2001:1200:0:21f1::/64 via 2001:1200:0:21f0::4 dev eth1
ip -6 route add 2001:1200:0:21f2::/64 via 2001:1200:0:21f0::4 dev eth1
ip -6 rule add priority 100 from fd00:0:0:5::/64 table 100
ip -6 route add 2001:1200:0:21f6::3 via 2001:1200:0:21f0::9 dev eth3 table 100
ip -6 route add 2001:1200:0:21f6::4 via 2001:1200:0:21f0::9 dev eth3 table 100
ip -6 rule add priority 150 from fd00:0:0:5::/64 prohibit
ip -6 route add default via 2001:1200:0:21f0::7 dev eth2

Router-6:
ip -6 route add 2001:1200:0:21f0::/127 via 2001:1200:0:21f0:: dev eth1
ip -6 route add 2001:1200:0:21f1::/64 via 2001:1200:0:21f0:: dev eth1
ip -6 route add 2001:1200:0:21f0::2/127 via 2001:1200:0:21f0::3 dev eth2
ip -6 route add 2001:1200:0:21f2::/64 via 2001:1200:0:21f0::3 dev eth2
ip -6 route add fd00:0:0:b::/64 via 2001:1200:0:21f0:: dev eth1
ip -6 route add fd00:0:0:4::/64 via 2001:1200:0:21f0:: dev eth1
ip -6 route add fd00:0:0:c::/64 via 2001:1200:0:21f0::3 dev eth2
ip -6 route add fd00:0:0:3::/64 via 2001:1200:0:21f0::3 dev eth2
ip -6 route add default via 2001:1200:0:21f0::5 dev eth0

Router-7:
ip -6 route add default via 2001:1200:0:21f0::2 dev eth0

Router-8:
ip -6 route add default via 2001:1200:0:21f0::1 dev eth0

Router-9:
ip -6 route add fd00:0:0:7::/64 via 2001:1200:0:21f0::8/127 dev eth1
ip -6 route add fd00:0:0:9::/64 via 2001:1200:0:21f0::8/127 dev eth1
ip -6 route add fd00:0:0:a::/64 via 2001:1200:0:21f0::8/127 dev eth1
ip -6 route add fd00:0:0:c::/64 via 2001:1200:0:21f0::8/127 dev eth1
ip -6 route add fd00:0:0:b::/64 via 2001:1200:0:21f0::8/127 dev eth1
ip -6 route add fd00:0:0:3::/64 via 2001:1200:0:21f0::8/127 dev eth1
ip -6 route add fd00:0:0:4::/64 via 2001:1200:0:21f0::8/127 dev eth1
ip -6 route add fd00:0:0:5::/64 via 2001:1200:0:21f0::8/127 dev eth1
ip6tables -A PREROUTING -t mangle -p tcp -j MARK --set-mark 10
ip -6 rule add priority 150 to 2000::/3 fwmark 10 table 150
ip -6 route add default via 2001:1200:0:21f0::13 dev eth3 table 150
ip -6 rule add to 2001:1200:0:21f0::/60 table 100 priority 100
ip -6 route add 2001:1200:0:21f1::/64 via 2001:1200:0:21f0::8 dev eth1 table 100
ip -6 route add 2001:1200:0:21f2::/64 via 2001:1200:0:21f0::8 dev eth1 table 100
ip -6 route add 2001:1200:0:21f3::/64 via 2001:1200:0:21f0::8 dev eth1 table 100
ip -6 route add 2001:1200:0:21f0::/126 via 2001:1200:0:21f0::8 dev eth1 table 100
ip -6 route add 2001:1200:0:21f0::4/127 via 2001:1200:0:21f0::8 dev eth1 table 100
ip -6 route add 2001:1200:0:21f0::8/127 via 2001:1200:0:21f0::8 dev eth1 table 100
ip -6 route add default via 2001:1200:0:21f0::13 dev eth3 table 100
ip -6 route add default via 2001:1200:0:21f0::8 dev eth1

Ejercicio 5.

Configure el Router-2 y Router-Casa para establecer un túnel tipo sit (transporte de datagramas IPv6 sobre IPv4) entre la red de la empresa y la red hogareña.

Router-2:
ip route add default via 192.168.0.1 dev eth2
ip tunnel add site1 mode sit local 192.168.0.1 remote 192.170.0.1
ip link set site1 up
ip -6 route add default dev site1

Router-Casa:
ip route add default via 192.170.0.2 dev eth0
ip tunnel add site1 mode sit local 192.170.0.1 remote 192.168.0.2
ip link set site1 up
ip -6 route add default dev site1

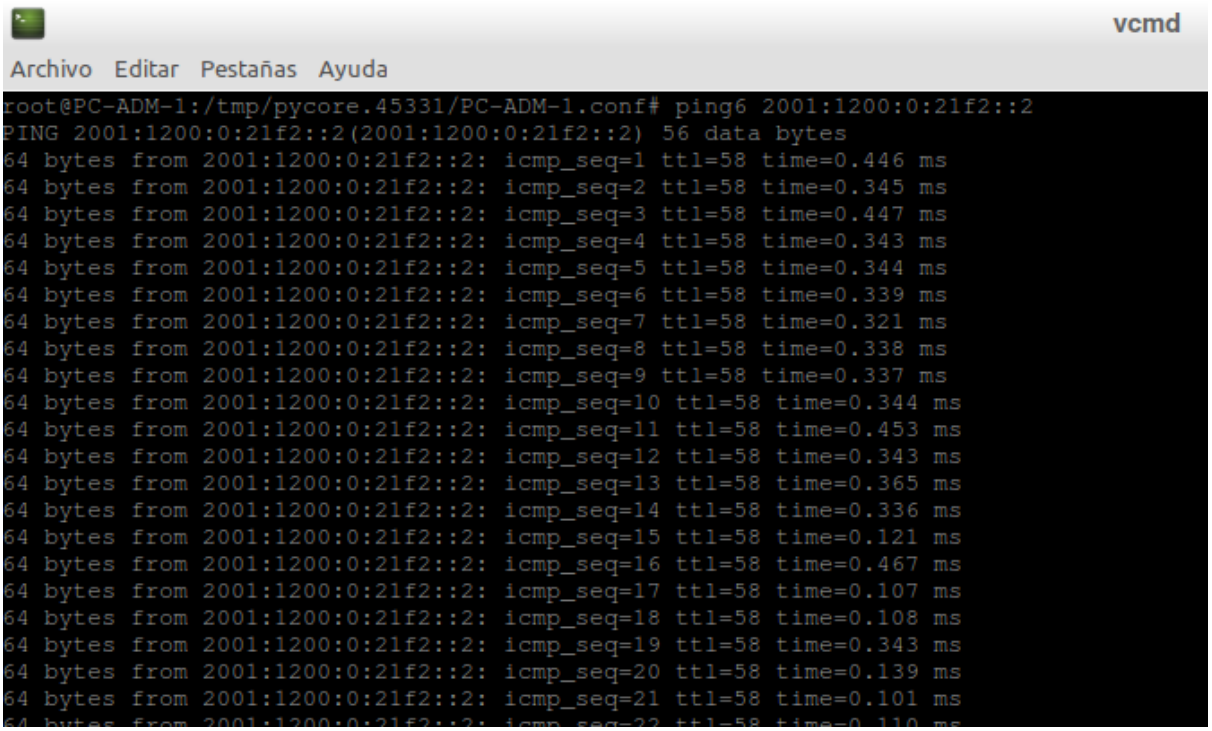
ISP-INTRANET:
ip route add default via 192.169.0.1 dev eth1

ISP-CASA:
ip route add default via 192.169.0.2 dev eth0

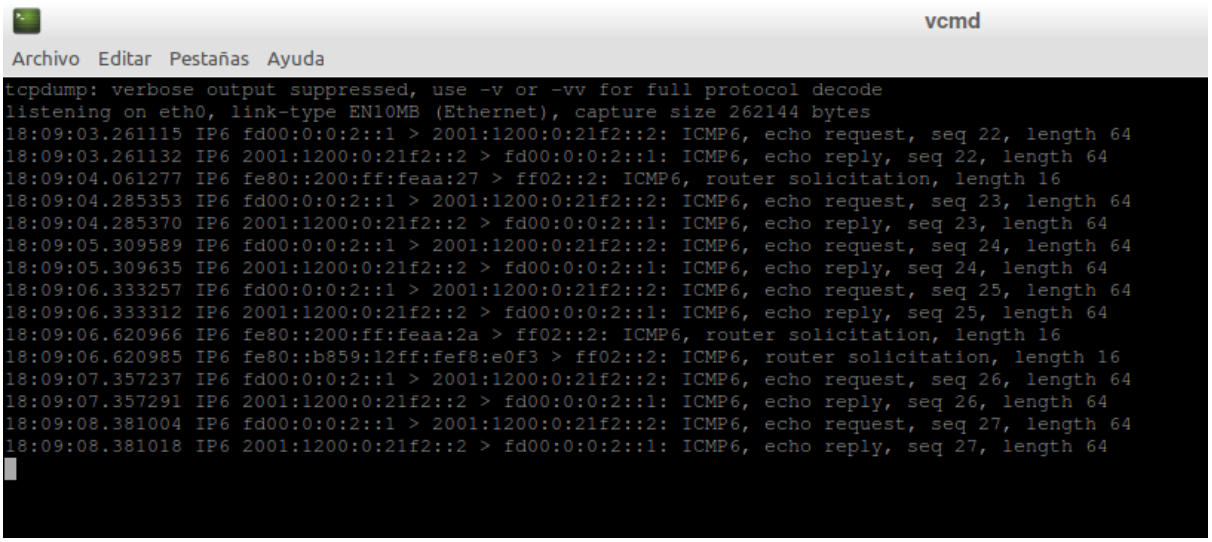
Ejercicio 6.

Arranque la emulación y compruebe la conectividad resultante en la intranet utilizando el comando ping6. Probar la conectividad entre PC-ADM-1 y PC-VT-1, entre PC-ADM-1 y SERVIDOR-WEB, y entre el PC-GUEST y SERVIDOR-DNS. Tenga en cuenta la utilización del TCPDump provisto por el emulador para verificar el tráfico en cada interfaz

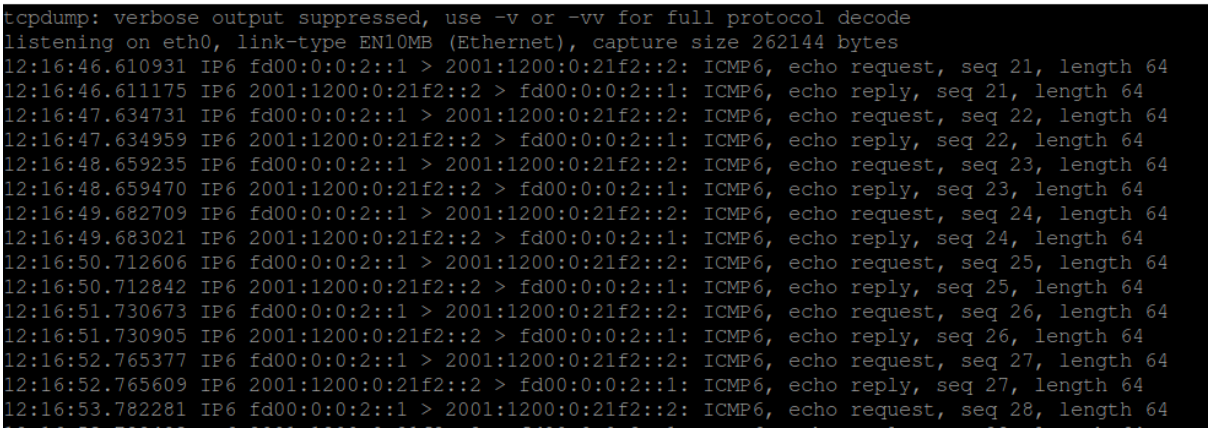
Conectividad entre PC-ADM-1 y PC-VT-1:



Captura Comando Ping6

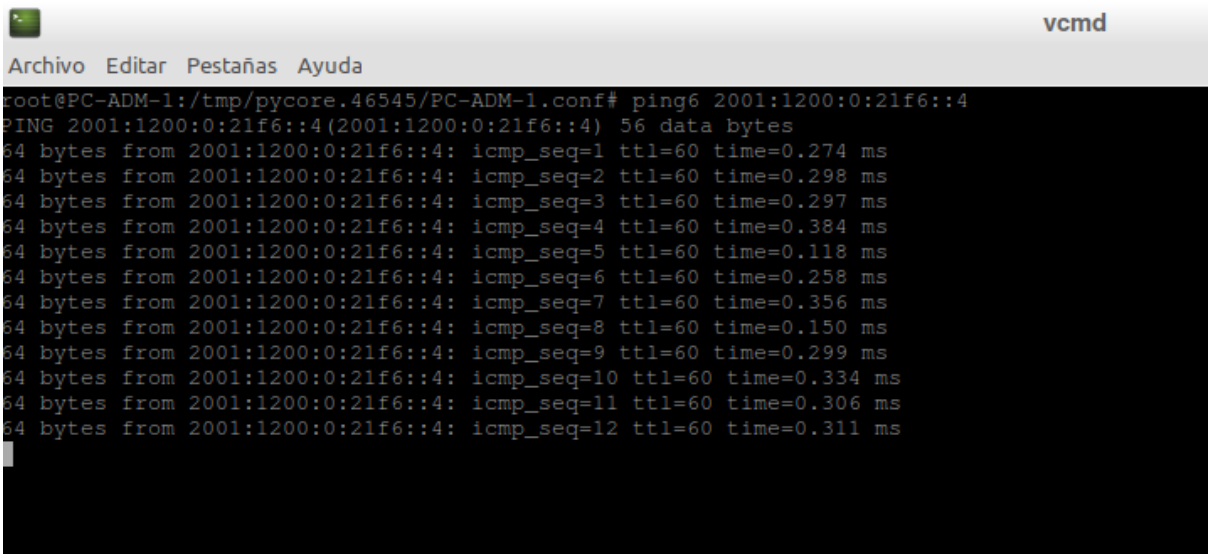


Captura TCPDump eth0 PC-VT-1

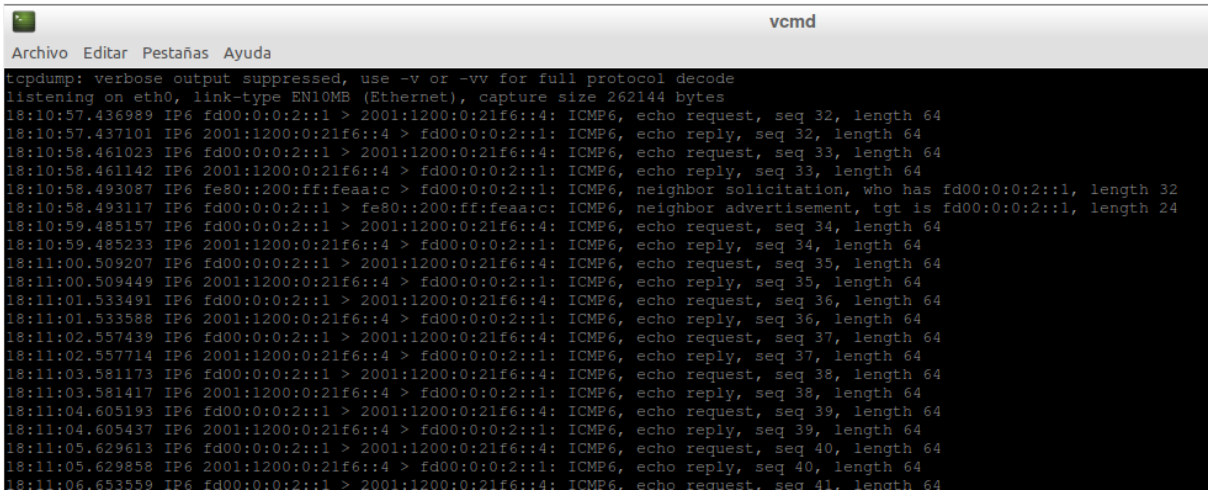


Captura TCPDump eth0 PC-ADM-1

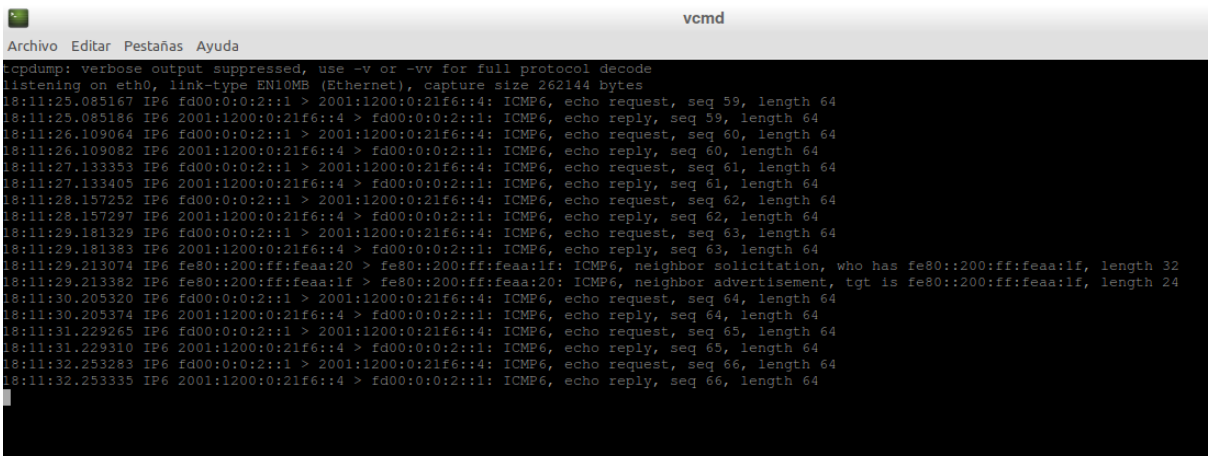
Conectividad entre PC-ADM-1 y SERVIDOR-WEB



Captura comando Ping6



TCPDump PC-ADM-1



TCPDump Servidor Web

Conectividad PC-GUEST y SERVIDOR-DNS:

```
root@PC-GUEST:/tmp/pycore.43585/PC-GUEST.conf# ping6 2001:1200:0:21f6::3
PING 2001:1200:0:21f6::3(2001:1200:0:21f6::3) 56 data bytes
64 bytes from 2001:1200:0:21f6::3: icmp_seq=1 ttl=59 time=87.2 ms
64 bytes from 2001:1200:0:21f6::3: icmp_seq=2 ttl=59 time=41.1 ms
64 bytes from 2001:1200:0:21f6::3: icmp_seq=3 ttl=59 time=42.7 ms
64 bytes from 2001:1200:0:21f6::3: icmp_seq=4 ttl=59 time=45.8 ms
64 bytes from 2001:1200:0:21f6::3: icmp_seq=5 ttl=59 time=42.2 ms
64 bytes from 2001:1200:0:21f6::3: icmp_seq=6 ttl=59 time=45.6 ms
64 bytes from 2001:1200:0:21f6::3: icmp_seq=7 ttl=59 time=55.8 ms
64 bytes from 2001:1200:0:21f6::3: icmp_seq=8 ttl=59 time=50.2 ms
64 bytes from 2001:1200:0:21f6::3: icmp_seq=9 ttl=59 time=48.1 ms
```

Captura comando Ping6

```
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
12:23:50.888919 IP6 fd00:0:0:5::1 > 2001:1200:0:21f6::3: ICMP6, echo request, seq 109, length 64
12:23:50.933065 IP6 2001:1200:0:21f6::3 > fd00:0:0:5::1: ICMP6, echo reply, seq 109, length 64
12:23:51.890367 IP6 fd00:0:0:5::1 > 2001:1200:0:21f6::3: ICMP6, echo request, seq 110, length 64
12:23:51.932238 IP6 2001:1200:0:21f6::3 > fd00:0:0:5::1: ICMP6, echo reply, seq 110, length 64
12:23:52.892794 IP6 fd00:0:0:5::1 > 2001:1200:0:21f6::3: ICMP6, echo request, seq 111, length 64
12:23:52.933523 IP6 2001:1200:0:21f6::3 > fd00:0:0:5::1: ICMP6, echo reply, seq 111, length 64
12:23:53.894419 IP6 fd00:0:0:5::1 > 2001:1200:0:21f6::3: ICMP6, echo request, seq 112, length 64
12:23:53.935076 IP6 2001:1200:0:21f6::3 > fd00:0:0:5::1: ICMP6, echo reply, seq 112, length 64
12:23:54.896607 IP6 fd00:0:0:5::1 > 2001:1200:0:21f6::3: ICMP6, echo request, seq 113, length 64
```

TCPDump PC-GUEST

```
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
12:25:39.171090 IP6 fd00:0:0:5::1 > 2001:1200:0:21f6::3: ICMP6, echo request, seq 217, length 64
12:25:39.171155 IP6 2001:1200:0:21f6::3 > fd00:0:0:5::1: ICMP6, echo reply, seq 217, length 64
12:25:40.172355 IP6 fd00:0:0:5::1 > 2001:1200:0:21f6::3: ICMP6, echo request, seq 218, length 64
12:25:40.172393 IP6 2001:1200:0:21f6::3 > fd00:0:0:5::1: ICMP6, echo reply, seq 218, length 64
12:25:41.174657 IP6 fd00:0:0:5::1 > 2001:1200:0:21f6::3: ICMP6, echo request, seq 219, length 64
12:25:41.174729 IP6 2001:1200:0:21f6::3 > fd00:0:0:5::1: ICMP6, echo reply, seq 219, length 64
12:25:42.173726 IP6 fd00:0:0:5::1 > 2001:1200:0:21f6::3: ICMP6, echo request, seq 220, length 64
12:25:42.173804 IP6 2001:1200:0:21f6::3 > fd00:0:0:5::1: ICMP6, echo reply, seq 220, length 64
12:25:43.175998 IP6 fd00:0:0:5::1 > 2001:1200:0:21f6::3: ICMP6, echo request, seq 221, length 64
12:25:43.176033 IP6 2001:1200:0:21f6::3 > fd00:0:0:5::1: ICMP6, echo reply, seq 221, length 64
```

TCPDump Servidor DNS

Ejercicio 7.

Describa las direcciones de las interfaces.

Conectividad entre PC-ADM-1 y PC-VT-1:

La interfaz eth0 de PC-ADM-1 tiene la dirección ULA fd00::0:0:2::1/64 pertenece a la red fd00::0:0:2::/64.

La interfaz eth0 de PC-VT-1 tiene la dirección global 2001:1200:0:21f2::2/64 pertenece a la red 2001:1200:0:21f2::/64.

Conectividad entre PC-ADM-1 y SERVIDOR-WEB

La interfaz eth0 de PC-ADM-1 tiene la dirección ULA fd00:0:0:2::1/64 pertenece a la red fd00:0:0:2::/64

La interfaz eth0 del Servidor-Web tiene la dirección global 2001:1200:0:21f6::4/64 pertenece a la red 2001:1200:0:21f6::/64

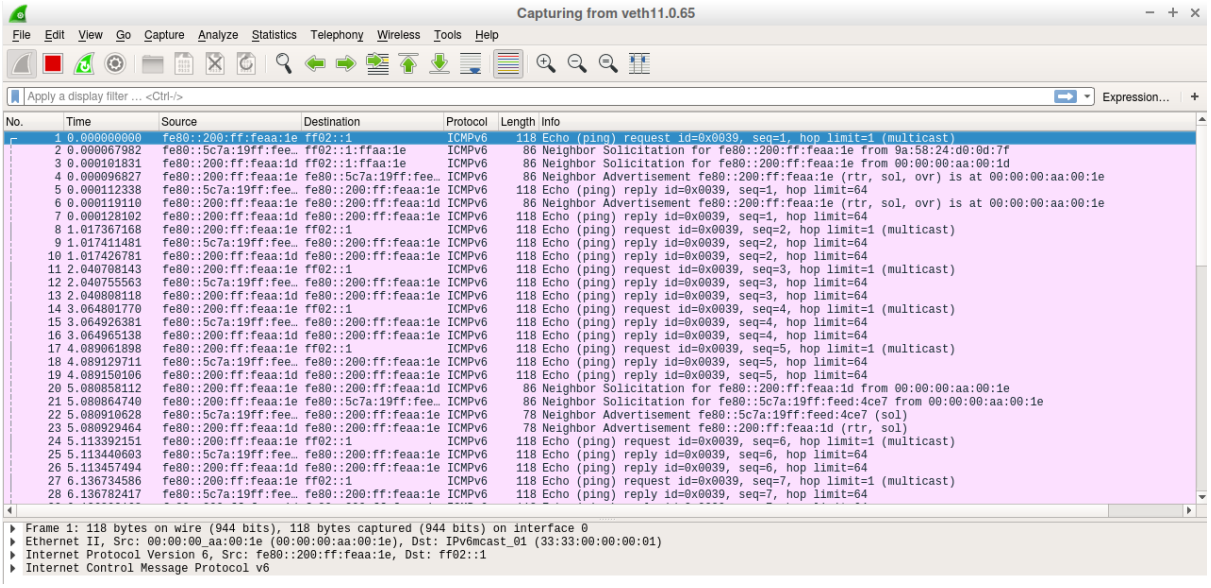
Conectividad PC-GUEST y SERVIDOR-DNS:

La interfaz eth0 de PC-Guest tiene la dirección ULA fd00:0:0:5::1/64 pertenece a la red fd00:0:0:5::/64

La interfaz eth0 de Servidor-Dns tiene la dirección global 2001:1200:0:21f6::3/64 pertenece a la red 2001:1200:0:21f6::/64

Ejercicio 8.

Desde Router-1, ejecute: “ping6 ff02::1%eth0”. Analice los paquetes utilizando Wireshark.

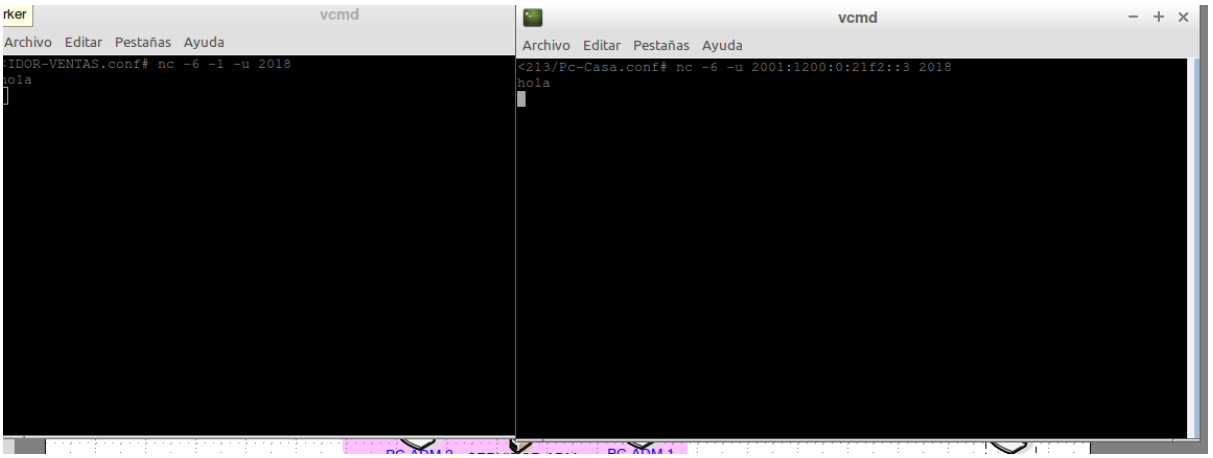


Captura de Router-1 eth1 - Wireshark

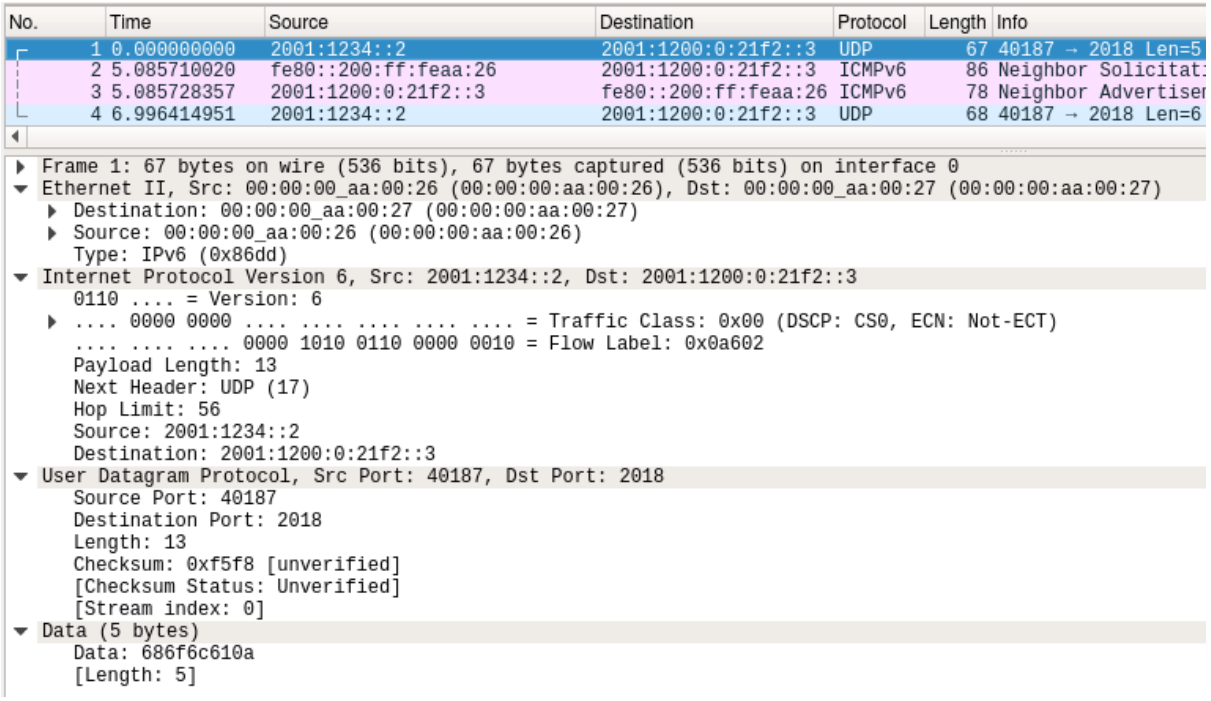
Mediante “ping6 ff02::1%eth0”, lo que se hace es enviar un multicast a todos los equipos de la red local. Como en el caso de nuestro caso, el Router-1, su interfaz eth0 se conecta con únicamente otro router (Router-4) lo que sucede es que se enviará un multicast a este Router-4 únicamente.
En caso que se utilizara el comando “ping6 ff02::1%eth1” el multicast sería enviado a toda la red del Data Center.
Lo que se analiza en la captura adjunta es como el inciso lo indica el comando “ping6 ff02::1%eth0” en el Router-1. Como primera instancia podemos ver cómo el Router-1 envía un ping request hacia todos los equipos de la red local, en este caso únicamente será hacia Router-4. Luego podemos ver como se reciben los “ping reply” por parte de los equipos de la red local.

Ejercicio 9.

Realice comunicaciones usando netcat usando UDP a nivel site entre el SERVIDOR-VENTAS y Pc-Casa. Adjunte capturas de Wireshark de la comunicación realizada, y explique cada uno de los niveles. Tenga en cuenta los comandos nc -6 –l –u {puerto} para el servidor y nc -6 –u {dirección} {puerto}.



A la izquierda se puede observar la consola del Servidor-Ventas y a la derecha, por otra parte, se observa la consola de la PC-Casa (fuera de la intranet).



En NetCat, cuando un mensaje es enviado se utiliza el protocolo UDP por lo que siempre que la PC-Casa envíe un mensaje, el servidor recibirá un paquete UDP.
Éste paquete pasa por distintos niveles:
Nivel Ethernet: se tiene en primer lugar las direcciones MAC de origen(Source) y

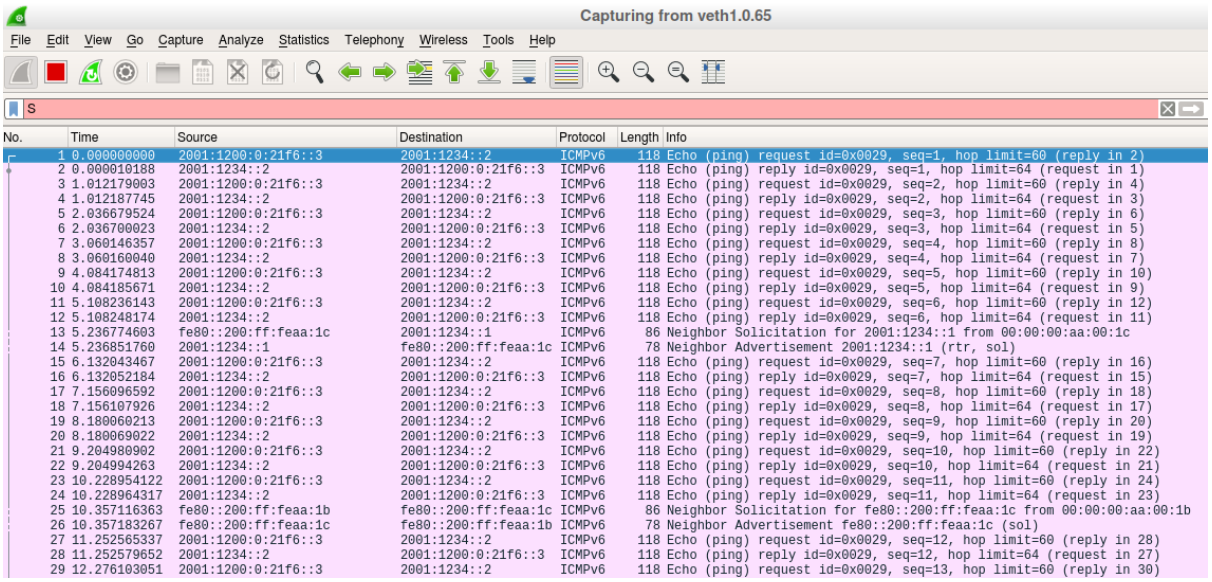
destino(destination)
Nivel IP: se poseen las direcciones IPv6 de origen(Src) y destino(Dst) e información sobre el paquete como por ejemplo el siguiente header ipv6 (next header que indica, en el caso de ser un mensaje el protocolo utilizado que será UDP) y hop limit.
User Datagram Protocol (Nivel de Transporte): contiene información de los puertos de origen y destino, además de la longitud del header UDP y checksum.
Data: contiene los datos que se envían dentro del datagram.

Ejercicio 10.

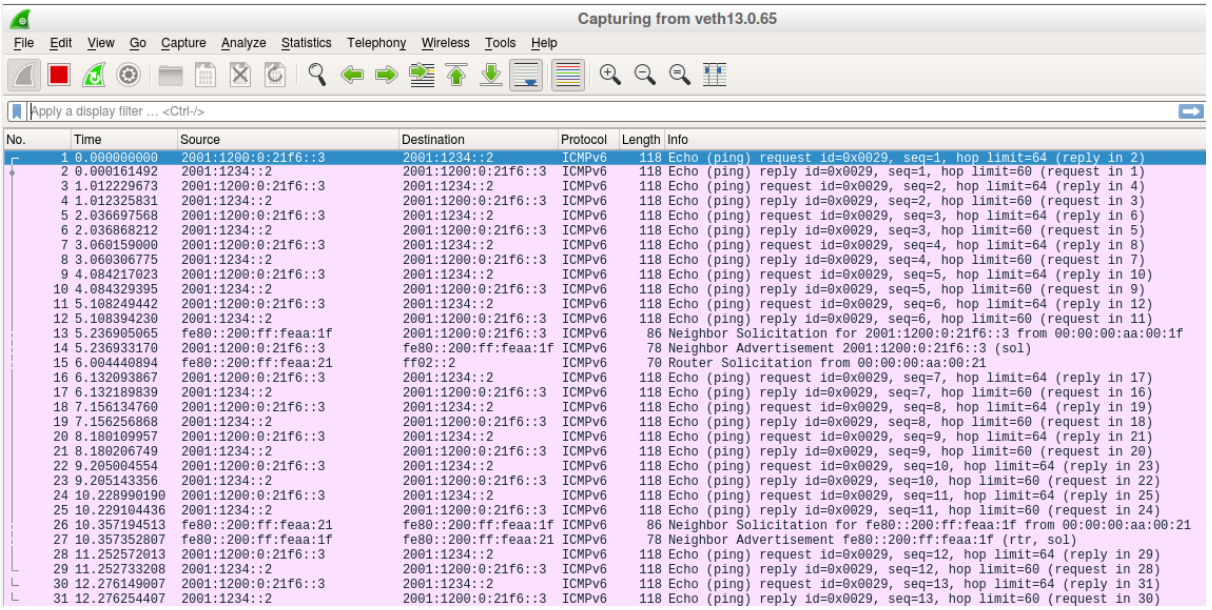
Compruebe la conectividad utilizando ping6 y traceroute6 entre equipos internos de la intranet y las direcciones externas. Probar la conectividad entre PC-Casa y SERVIDOR-DNS y PC-VT-1 y PC-Casa. En cada caso, utilizar Wireshark para verificar la encapsulación de IPv6 en IPv4 (tunel en los equipos de la Internet)

Conectividad entre PC-Casa y Servidor-DNS:

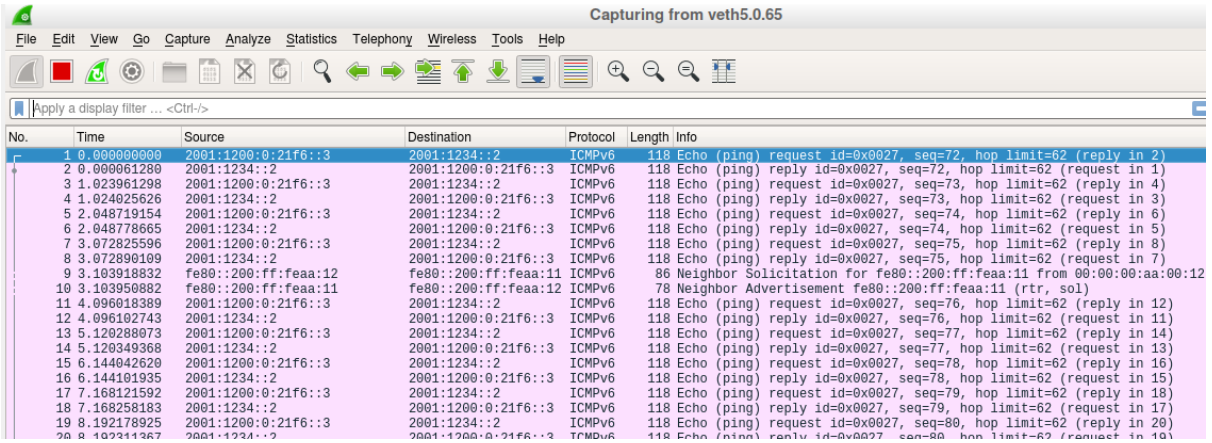
- Ping6:



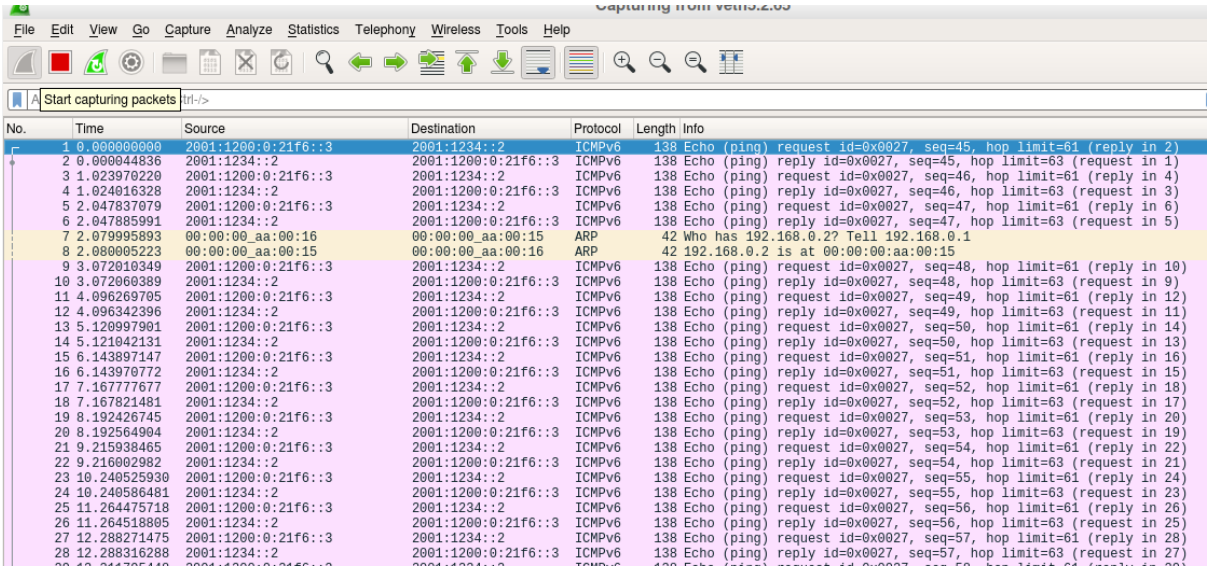
Wireshark PC-Casa



Servidor-DNS



Router-2 eth0 (ipv6)

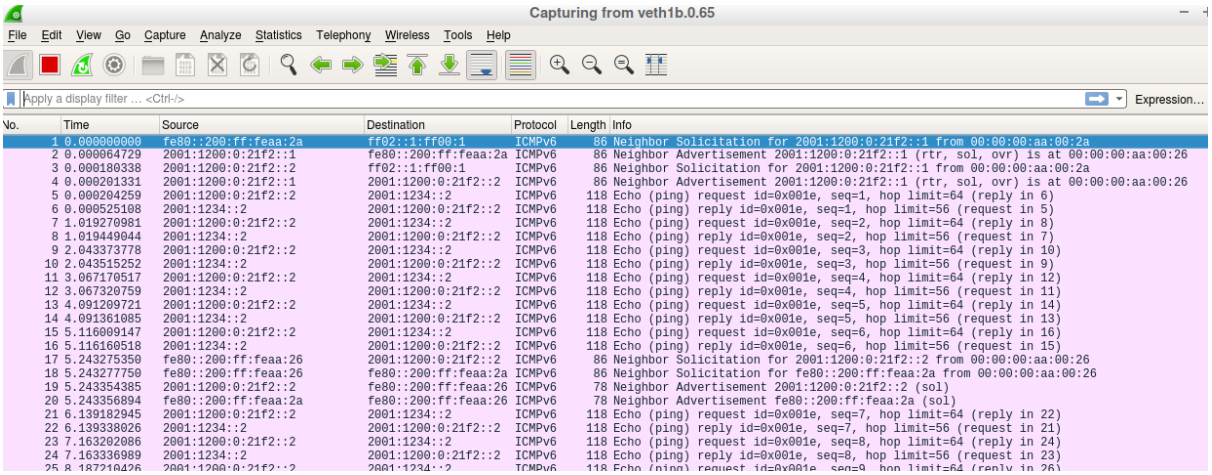


Router-2 eth2 (ipv4)

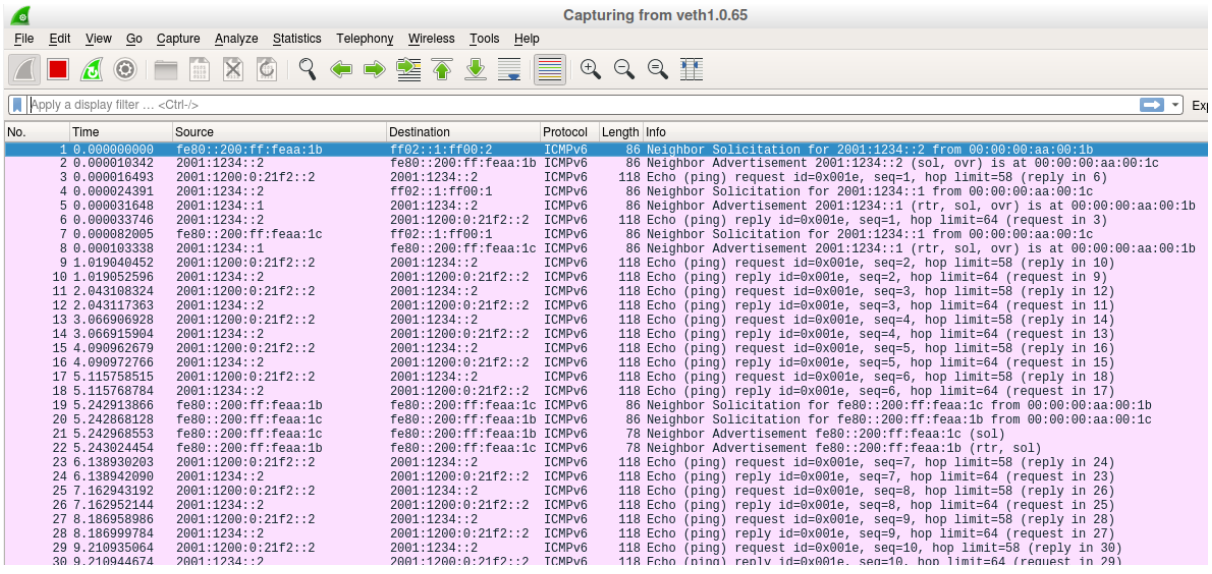
Por el lado de las capturas de Wireshark de PC-Casa y Servidor-DNS podemos ver que el ping es efectivo en términos de ipv6.
Mientras que por el lado de las capturas de Wireshark de Router-2 eth0 (ipv6) nos muestra que los paquetes son efectivamente tratados como ipv6. Pero en las capturas Router-2 eth2 (ipv4) podemos ver que los paquetes son tratados como ipv4, además de aparecer el protocolo ARP.

Conectividad entre PC-VT-1 y PC-Casa:

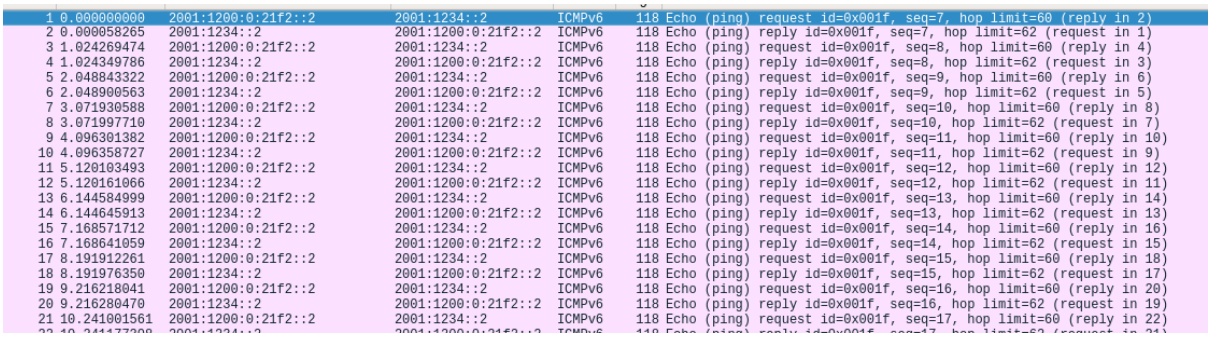
- Ping6:



Wireshark PC-VT-1

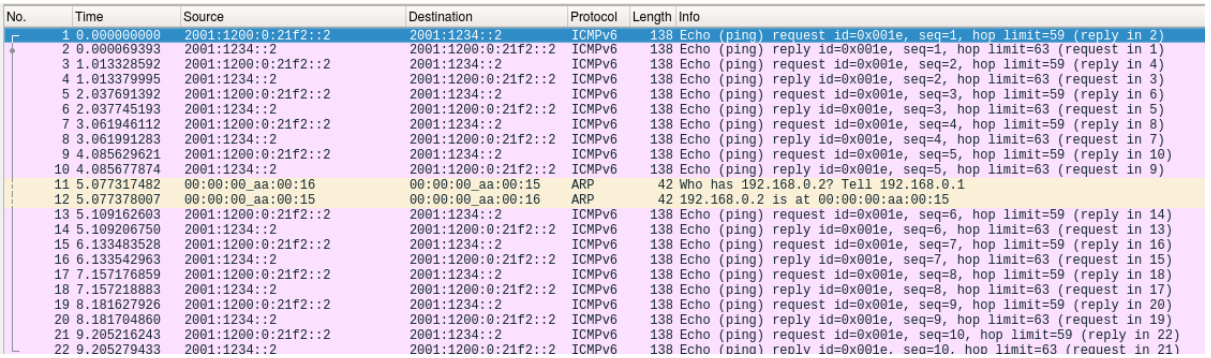


Wireshark PC-Casa



1	0.000000000	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=7, hop limit=60 (reply in 2)
2	0.000058265	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	118 Echo (ping) reply id=0x001f, seq=7, hop limit=62 (request in 1)
3	1.024269474	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=8, hop limit=60 (reply in 4)
4	1.024349786	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	118 Echo (ping) reply id=0x001f, seq=8, hop limit=62 (request in 3)
5	2.048843322	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=9, hop limit=60 (reply in 6)
6	2.048900563	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	118 Echo (ping) reply id=0x001f, seq=9, hop limit=62 (request in 5)
7	3.071930588	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=10, hop limit=60 (reply in 8)
8	3.071997710	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	118 Echo (ping) reply id=0x001f, seq=10, hop limit=62 (request in 7)
9	4.096301382	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=11, hop limit=60 (reply in 10)
10	4.096358727	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	118 Echo (ping) reply id=0x001f, seq=11, hop limit=62 (request in 9)
11	5.120103493	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=12, hop limit=60 (reply in 12)
12	5.120161066	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	118 Echo (ping) reply id=0x001f, seq=12, hop limit=62 (request in 11)
13	6.144584999	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=13, hop limit=60 (reply in 14)
14	6.144645013	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	118 Echo (ping) reply id=0x001f, seq=13, hop limit=62 (request in 13)
15	7.168571712	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=14, hop limit=60 (reply in 16)
16	7.168641059	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	118 Echo (ping) reply id=0x001f, seq=14, hop limit=62 (request in 15)
17	8.191912261	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=15, hop limit=60 (reply in 18)
18	8.191976350	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	118 Echo (ping) reply id=0x001f, seq=15, hop limit=62 (request in 17)
19	9.216218041	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=16, hop limit=60 (reply in 20)
20	9.216280470	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	118 Echo (ping) reply id=0x001f, seq=16, hop limit=62 (request in 19)
21	10.241001561	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	118 Echo (ping) request id=0x001f, seq=17, hop limit=60 (reply in 22)

Router-2 eth0 (ipv6)



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	138	Echo (ping) request id=0x001e, seq=1, hop limit=59 (reply in 2)
2	0.000069393	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	138	Echo (ping) reply id=0x001e, seq=1, hop limit=63 (request in 1)
3	1.013328592	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	138	Echo (ping) request id=0x001e, seq=2, hop limit=59 (reply in 4)
4	1.013379995	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	138	Echo (ping) reply id=0x001e, seq=2, hop limit=63 (request in 3)
5	2.037691392	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	138	Echo (ping) request id=0x001e, seq=3, hop limit=59 (reply in 6)
6	2.037745193	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	138	Echo (ping) reply id=0x001e, seq=3, hop limit=63 (request in 5)
7	3.061946112	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	138	Echo (ping) request id=0x001e, seq=4, hop limit=59 (reply in 8)
8	3.061991283	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	138	Echo (ping) reply id=0x001e, seq=4, hop limit=63 (request in 7)
9	4.085629621	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	138	Echo (ping) request id=0x001e, seq=5, hop limit=59 (reply in 10)
10	4.085677874	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	138	Echo (ping) reply id=0x001e, seq=5, hop limit=63 (request in 9)
11	5.077317482	00:00:00_aa:00:16	00:00:00_aa:00:15	ARP	42	Who has 192.168.0.2? Tell 192.168.0.1
12	5.077378007	00:00:00_aa:00:15	00:00:00_aa:00:16	ARP	42	192.168.0.2 is at 00:00:00:aa:00:15
13	5.109162603	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	138	Echo (ping) request id=0x001e, seq=6, hop limit=59 (reply in 14)
14	5.109206750	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	138	Echo (ping) reply id=0x001e, seq=6, hop limit=63 (request in 13)
15	6.133483528	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	138	Echo (ping) request id=0x001e, seq=7, hop limit=59 (reply in 16)
16	6.133542963	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	138	Echo (ping) reply id=0x001e, seq=7, hop limit=63 (request in 15)
17	7.157176859	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	138	Echo (ping) request id=0x001e, seq=8, hop limit=59 (reply in 18)
18	7.157218883	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	138	Echo (ping) reply id=0x001e, seq=8, hop limit=63 (request in 17)
19	8.181627926	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	138	Echo (ping) request id=0x001e, seq=9, hop limit=59 (reply in 20)
20	8.181704860	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	138	Echo (ping) reply id=0x001e, seq=9, hop limit=63 (request in 19)
21	9.205216243	2001:1200:0:21f2::2	2001:1234::2	ICMPv6	138	Echo (ping) request id=0x001e, seq=10, hop limit=59 (reply in 22)
22	9.205279433	2001:1234::2	2001:1200:0:21f2::2	ICMPv6	138	Echo (ping) reply id=0x001e, seq=10, hop limit=63 (request in 21)

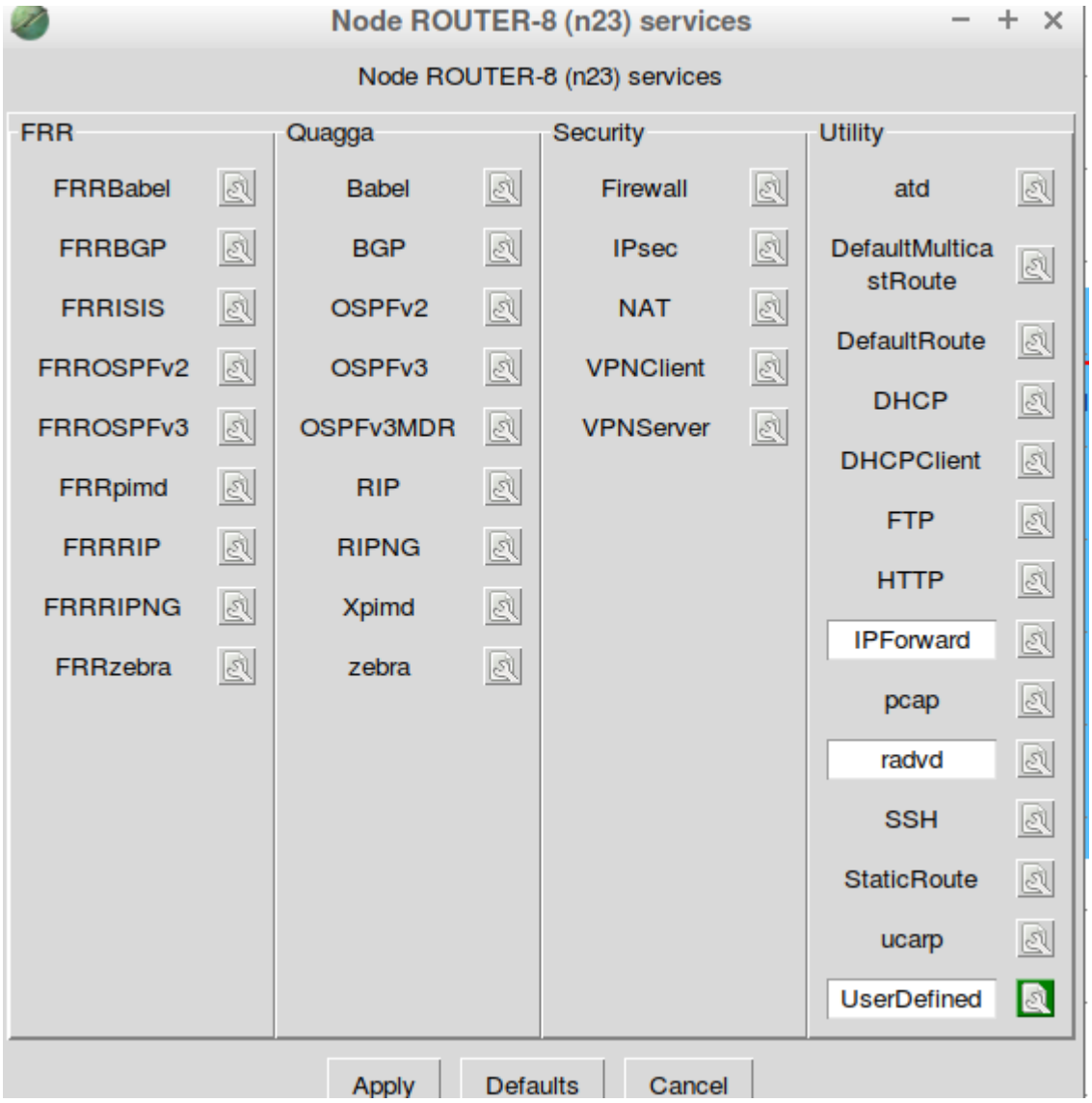
Router-2 eth2 (ipv4)

La descripción de los paquetes es igual a la descripción de conectividad entre PC-Casa y Servidor-DNS.

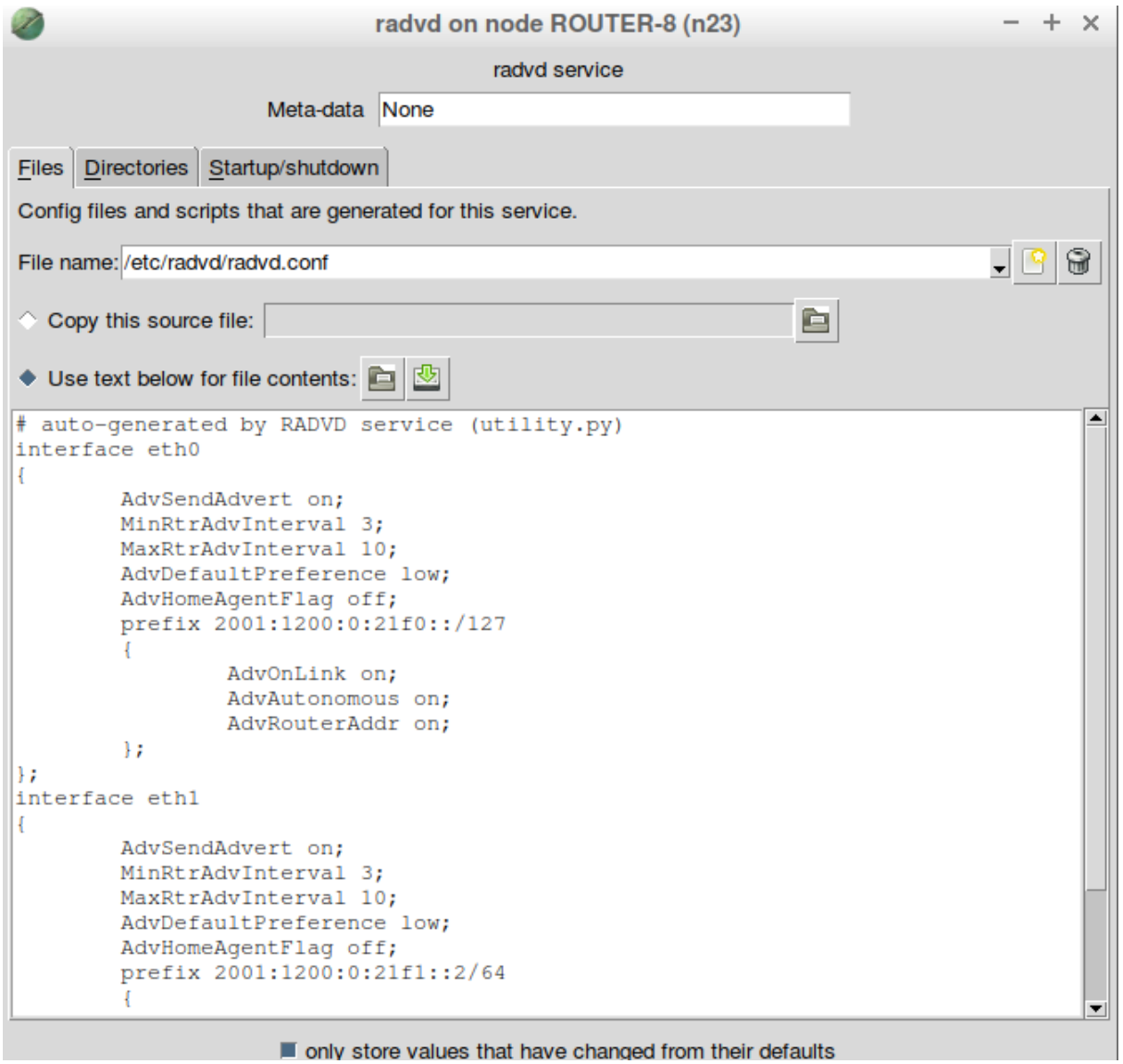
Ejercicio 11.

Configure los routers para que anuncien prefijos y de esta manera evitar configurar manualmente los equipos (RADVD). Tenga en cuenta las direcciones de los equipos que deben tener direcciones fijas. (implementar en un archivo .imn separado al resto).

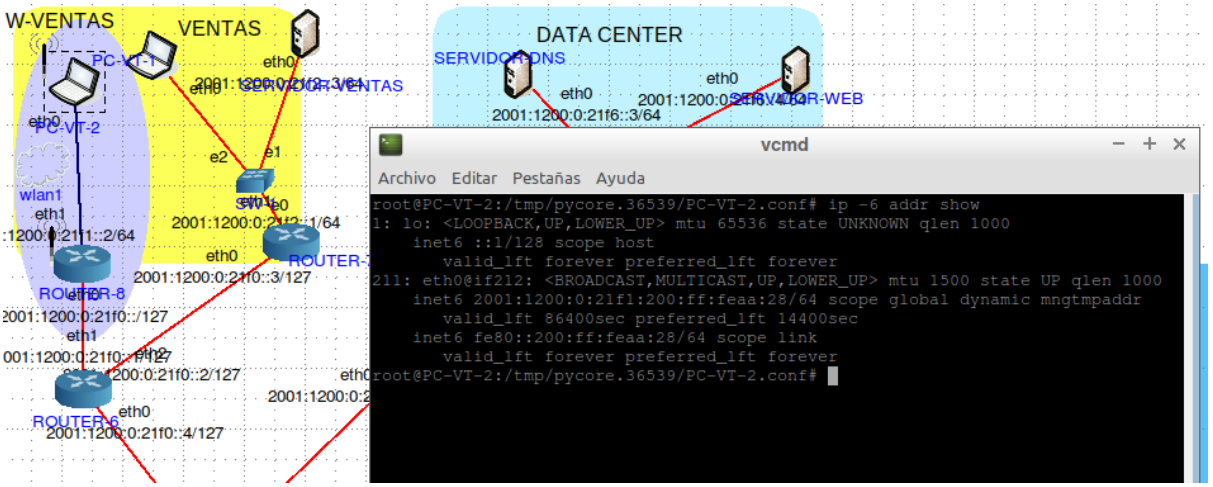
Para evitar la configuración manual de los host en las redes, existe el servicio de RADVD. El procedimiento para activarlo es el siguiente:
En primer lugar este servicio debe ser instalado (sudo apt install radvd), luego se deben borrar las direcciones que tienen los hosts de las diversas redes a aplicarlo. Después a cada router administrador de la red se le activa en la pestaña de servicios la opción “radvd”. Si entramos en esa opción se mostrará cómo radvd asigna las ips por interfaz.
Para comprobarlo basta con iniciar la simulación, y dentro de un equipo host de la red a la que se aplicó RADVD se le pone el comando “ip -6 addr show” para ver su ip asignada.
Se adjuntó un .imn con la implementación.



Captura de muestra de servicios de Router-8 con RADVD activado.



Captura del código generado por RADVD.



Captura ejemplo muestra de la dirección asignada automáticamente por el servicio RADVD del Router-8 a la PC-VT-2.