Cuando implante IPv6... ¿se acabaron los problemas de seguridad?

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MikroTik CERTIFIED TRAINER

MUM Mikrotik User Meeting

1

Introducción

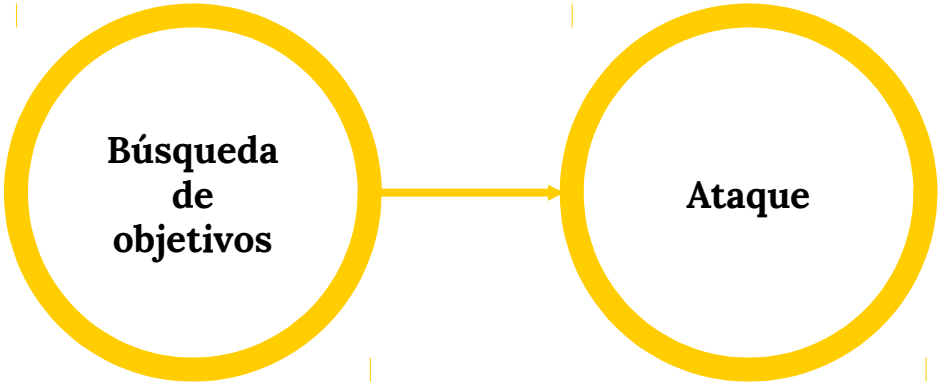
Seguridad en IPv6

Entre los objetivos de diseño principales de IPv6 se encuentran la seguridad y la auto-configuración

“

¿Cómo es un ataque?

Fases de un Ataque



2

Búsqueda de objetivos

¿Es fácil encontrar equipos con IPv6?

Búsqueda de objetivos

Búsqueda por ICMP en IPv4

- En IPv4 una búsqueda de equipos en una red /24 tarda...

¡menos de 10 segundos!

```
javi@jprieto:~$ sudo nmap -sP 14[redacted]4.0/24
[sudo] contraseña para javi:

Starting Nmap 7.60 ( https://nmap.org ) at 2018-08-30 10:54 CEST
Nmap scan report for [redacted].0
Host is up (0.36s latency).
Nmap scan report for [redacted].1
Host is up (0.059s latency).
Nmap scan report for [redacted].2
Host is up (0.066s latency).
Nmap scan report for [redacted].3
Host is up (0.084s latency).
Nmap scan report for [redacted].4
Host is up (0.066s latency).
Nmap scan report for [redacted]4.252
Host is up (0.36s latency).
Nmap scan report for [redacted].253
Host is up (0.36s latency).
Nmap scan report for [redacted].254
Host is up (0.36s latency).
Nmap scan report for [redacted].255
Host is up (0.36s latency).
Nmap done: 256 IP addresses (247 hosts up) scanned in 6.70 seconds
javi@jprieto:~$
```

Búsqueda por ICMPv6

$$2^{64} = 18 \cdot 10^{18}$$

¡Número de Hosts en una red /64!

244.000 años

Pero...

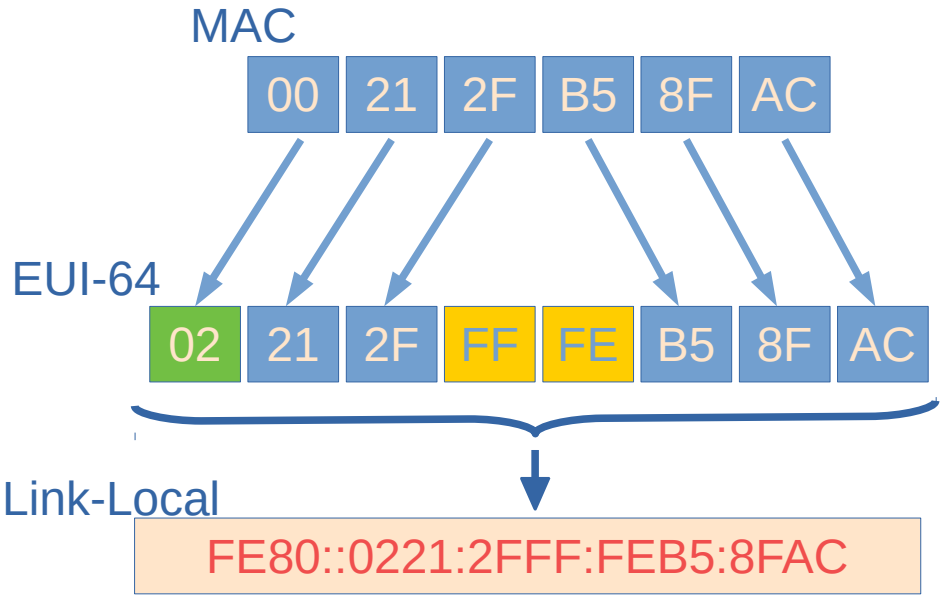
Entre los objetivos de diseño principales de IPv6 se encuentran la seguridad y la

auto-configuración

“

EUI-64

- El Identificador de Interfaz se genera a partir de la dirección MAC
- La dirección Link-Local y SLAAC se genera a partir del Identificador de Interfaz



Descubriendo Equipos con Dual Stack

- A partir de una búsqueda en IPv4, hallamos las direcciones IPv6

```
javi@jprieto:~$ sudo nmap -sP 192.168.1.0/24

Starting Nmap 7.60 ( https://nmap.org ) at 2018-08-31 10:08 CEST
Nmap scan report for _gateway (192.168.1.1)
Host is up (0.0014s latency).
MAC Address: CC:2D:E0:50:DA:9D (Unknown)
Nmap scan report for 192.168.1.2
Host is up (0.0016s latency).
MAC Address: 64:D1:54:F7:[illegible] (Routerboard.com)
Nmap scan report for 192.168.1.3
Host is up (0.0023s latency).
MAC Address: 4C:5E:0C:32:[illegible] (Routerboard.com)
Nmap scan report for 192.168.1.51
Host is up (0.093s latency).
MAC Address: B0:E2:35:32:[illegible] (Xiaomi Communications)
Nmap scan report for 192.168.1.60
Host is up (0.069s latency).
MAC Address: 00:FC:8B:38:[illegible] (Amazon Technologies)
Nmap scan report for jprieto (192.168.1.40)
Host is up.
Nmap done: 256 IP addresses (6 hosts up) scanned in 4.36 seconds
javi@jprieto:~$ ping6 fe80::b2e2:35ff:fe32:[illegible]%wlp3s0
PING fe80::b2e2:35ff:fe32:84a2%wlp3s0(fe80::b2e2:35ff:fe32:[illegible]%wlp3s0) 5
64 bytes from fe80::b2e2:35ff:fe32:[illegible]%wlp3s0: icmp_seq=1 ttl=64 time=19
64 bytes from fe80::b2e2:35ff:fe32:[illegible]%wlp3s0: icmp_seq=2 ttl=64 time=3.
^C
--- fe80::b2e2:35ff:fe32:[illegible]%wlp3s0 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 3.191/98.187/193.184/94.997 ms
javi@jprieto:~$ ping6 fe80::2fc:8bff:fe38:[illegible]%wlp3s0
PING fe80::2fc:8bff:fe38:d31f%wlp3s0(fe80::2fc:8bff:fe38:[illegible]%wlp3s0) 56
64 bytes from fe80::2fc:8bff:fe38:[illegible]%wlp3s0: icmp_seq=1 ttl=64 time=1.9
64 bytes from fe80::2fc:8bff:fe38:[illegible]%wlp3s0: icmp_seq=2 ttl=64 time=55.
^C
--- fe80::2fc:8bff:fe38:[illegible]f%wlp3s0 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 1.995/28.635/55.275/26.640 ms
```

¿Qué podemos hacer para no ser descubiertos?

Dificultando el escaner de red

RFC 7707

Método para generar un identificador de interfaz para SLAAC estable en una subred, pero que varía al cambiar de una red a otra

Filtrar ICMPv6 Echo Request

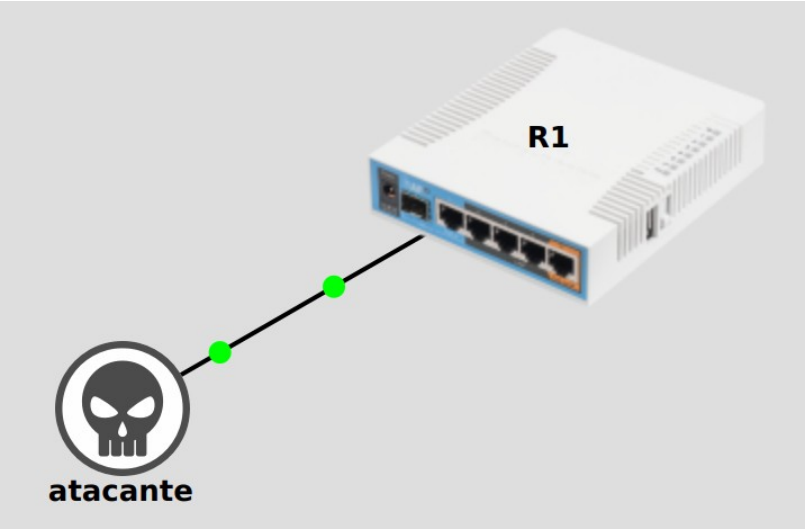
... con cuidado, pues perdemos una gran herramienta de diagnóstico

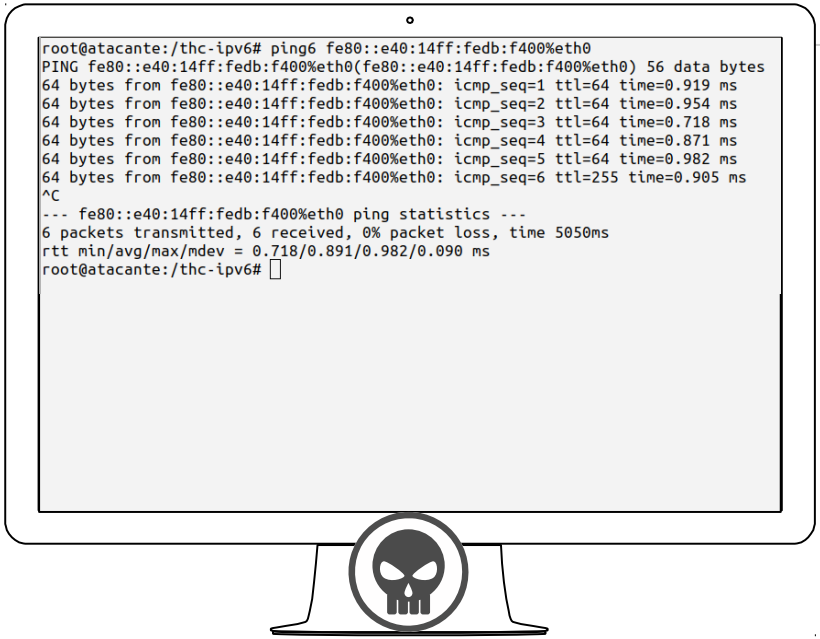
RFC 7707: Reconocimiento de Redes en IPv6

- Utilizar IID según RFC 7217
- IPS en el perímetro
- En VM configurar direcciones MAC manualmente
- Servidores DHCPv6 evitar asignación secuencial. RFC 7217
- Evitar direcciones manualmente configuradas (::0, ::1, ::2) que sean predecibles en la forma de ser asignadas
- Usar el tamaño de prefijo por “defecto” /64

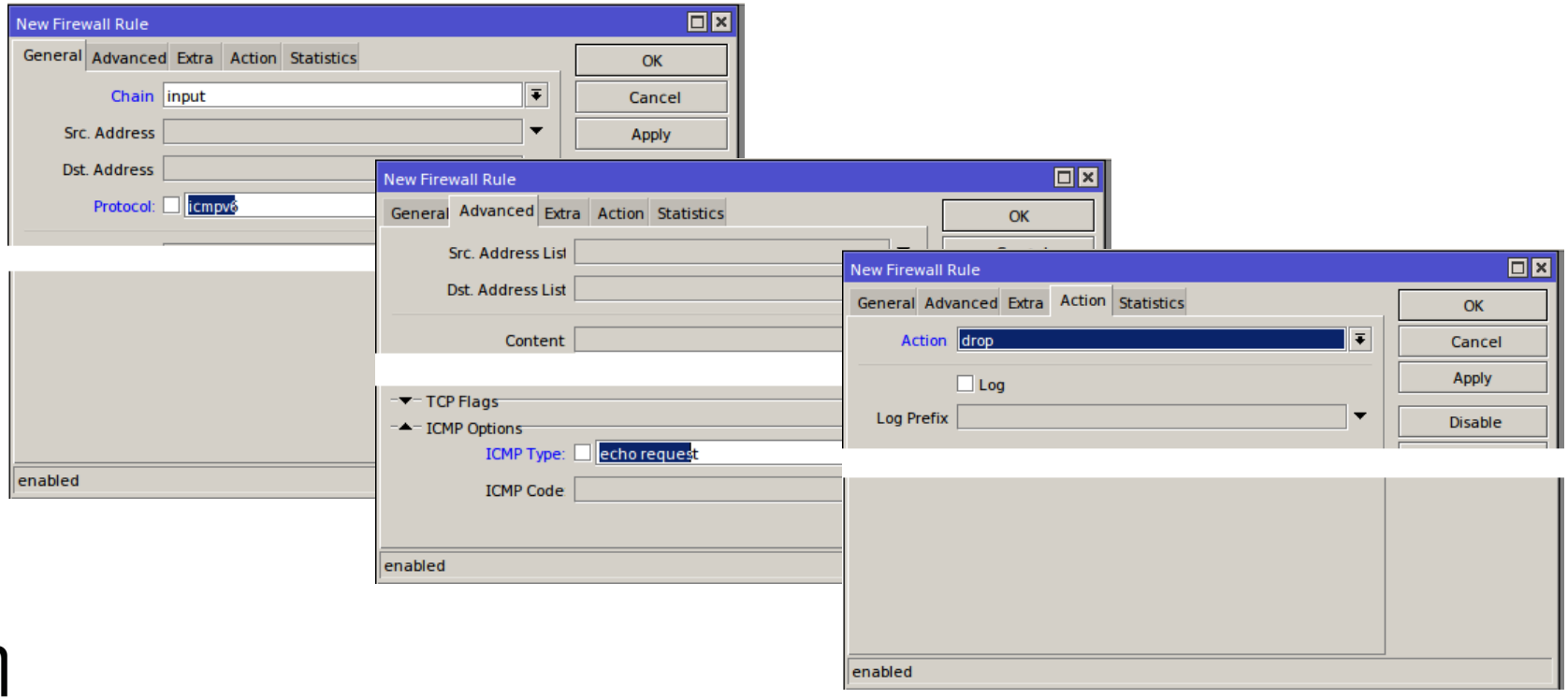
Evitando PING

Usando ping sin reglas de FW



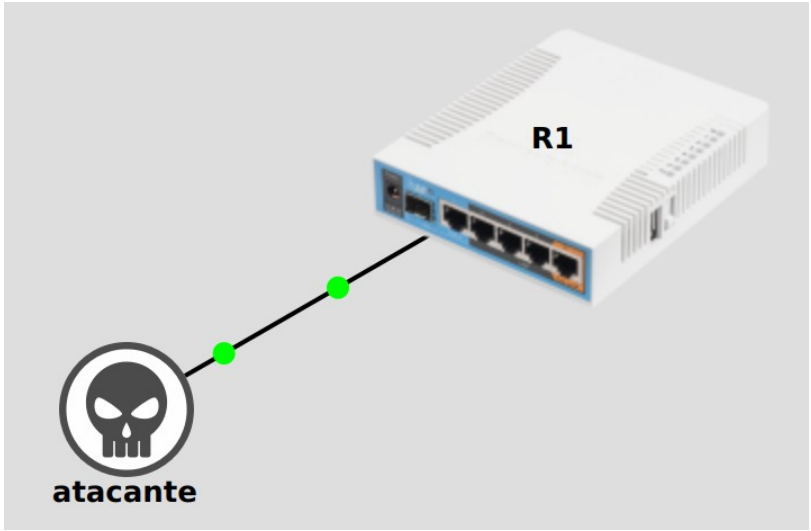


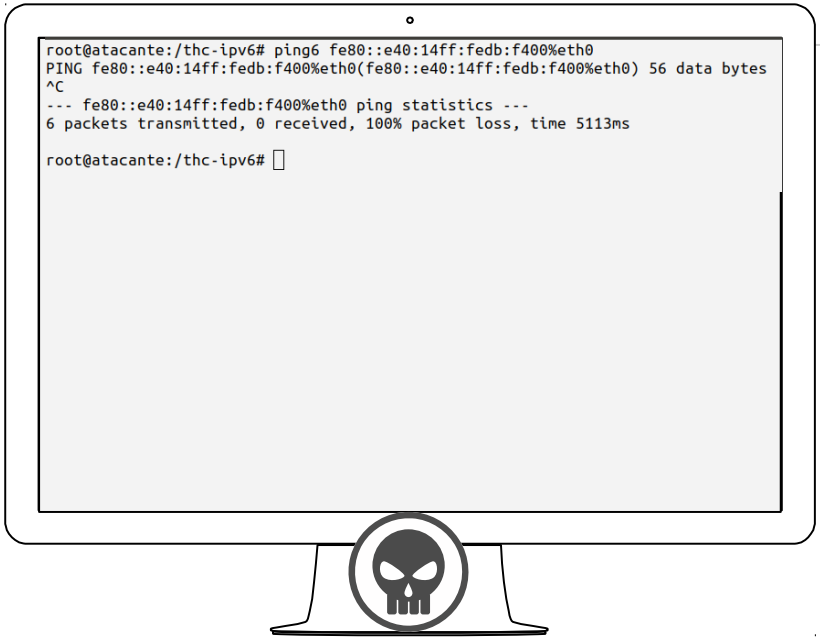
PING: Filtrado



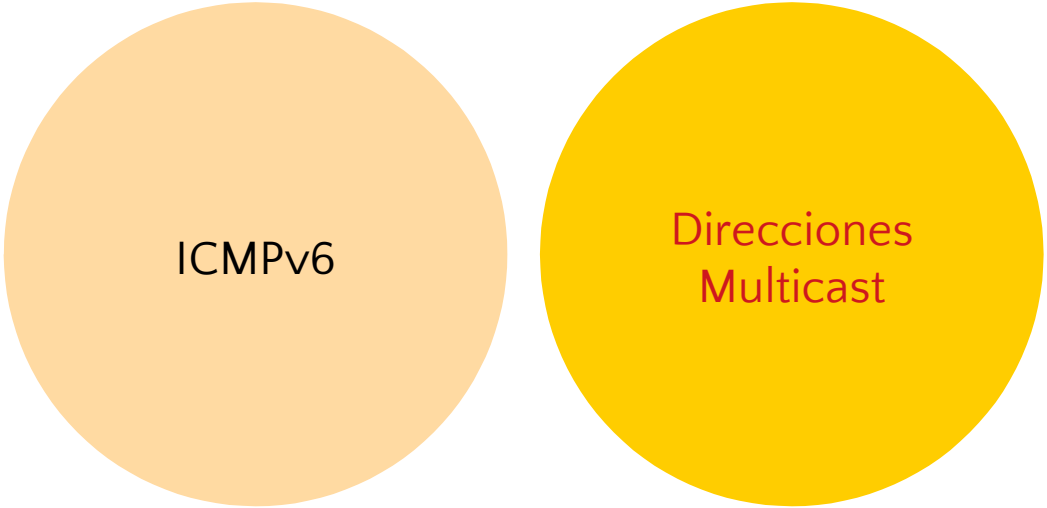
Evitando PING

Usando ping con reglas de FW





Búsqueda de objetivos

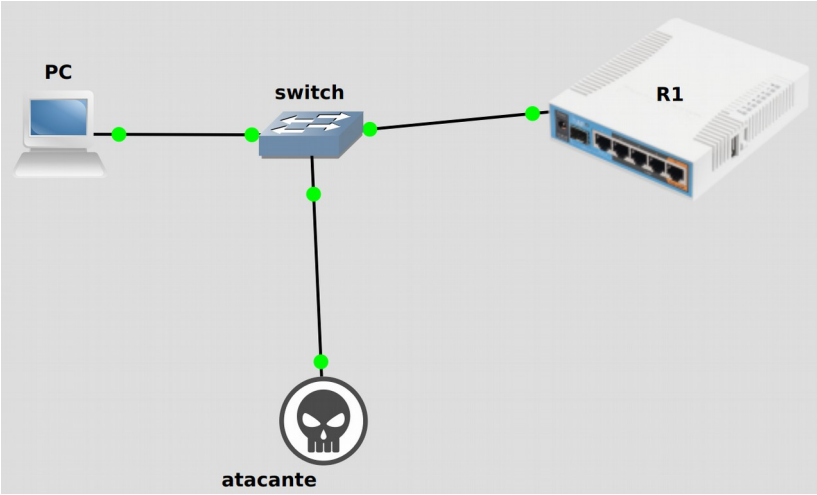


Direcciones Multicast

Dirección	Descripción
FF02::1	Todos los nodos de la red
FF02::2	Routers en la Subred Local
FF02::5	Routers OSPF
FF02::6	Routers OSPF Designados (DR)
FF02::9	Routers RIP
FF02::D	Routers PIM
FF02::1:2	Agentes DHCP

Encontrando nodos

Usando ping y alive6

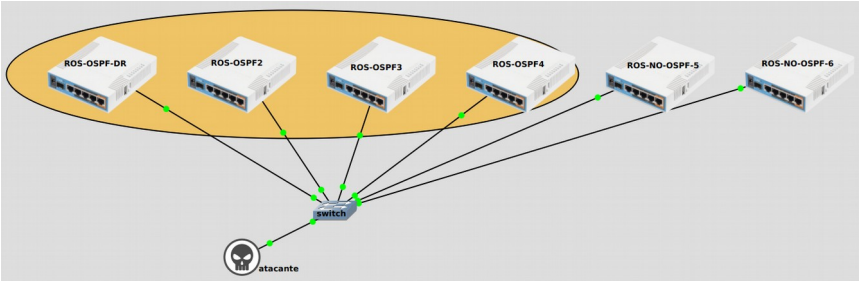


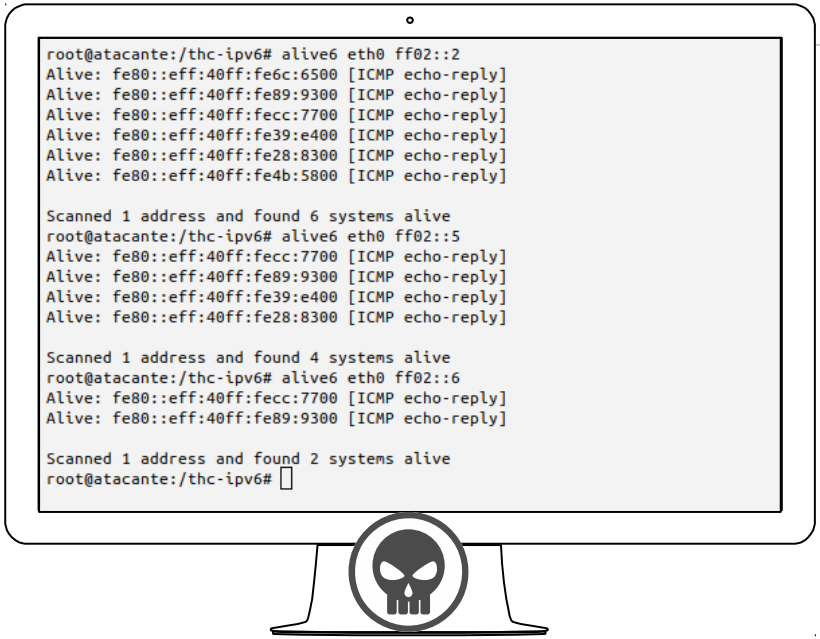

```
root@atacante:/thc-ipv6# ping ff02::1%eth0
PING ff02::1%eth0(ff02::1%eth0) 56 data bytes
64 bytes from fe80::24ec:bcff:fe35:b437%eth0: icmp_seq=1 ttl=64 time=0.024 ms
64 bytes from fe80::aca8:3aff:fe5f:2981%eth0: icmp_seq=1 ttl=64 time=0.281 ms (DUP!)
64 bytes from fe80::e77:27ff:fe87:eb00%eth0: icmp_seq=1 ttl=255 time=0.594 ms (DUP!)
64 bytes from fe80::24ec:bcff:fe35:b437%eth0: icmp_seq=2 ttl=64 time=0.034 ms
64 bytes from fe80::aca8:3aff:fe5f:2981%eth0: icmp_seq=2 ttl=64 time=0.372 ms (DUP!)
64 bytes from fe80::e77:27ff:fe87:eb00%eth0: icmp_seq=2 ttl=255 time=0.891 ms (DUP!)
64 bytes from fe80::24ec:bcff:fe35:b437%eth0: icmp_seq=3 ttl=64 time=0.051 ms
64 bytes from fe80::aca8:3aff:fe5f:2981%eth0: icmp_seq=3 ttl=64 time=0.599 ms (DUP!)
64 bytes from fe80::e77:27ff:fe87:eb00%eth0: icmp_seq=3 ttl=255 time=1.11 ms (DUP!)
^C
--- ff02::1%eth0 ping statistics ---
3 packets transmitted, 3 received, +6 duplicates, 0% packet loss, time 2032ms
rtt min/avg/max/mdev = 0.024/0.439/1.111/0.369 ms
root@atacante:/thc-ipv6# alive6 eth0 ff02::1
Alive: fe80::aca8:3aff:fe5f:2981 [ICMP echo-reply]
Alive: fe80::e77:27ff:fe87:eb00 [ICMP echo-reply]

Scanned 1 address and found 2 systems alive
root@atacante:/thc-ipv6#
```

Encontrando routers

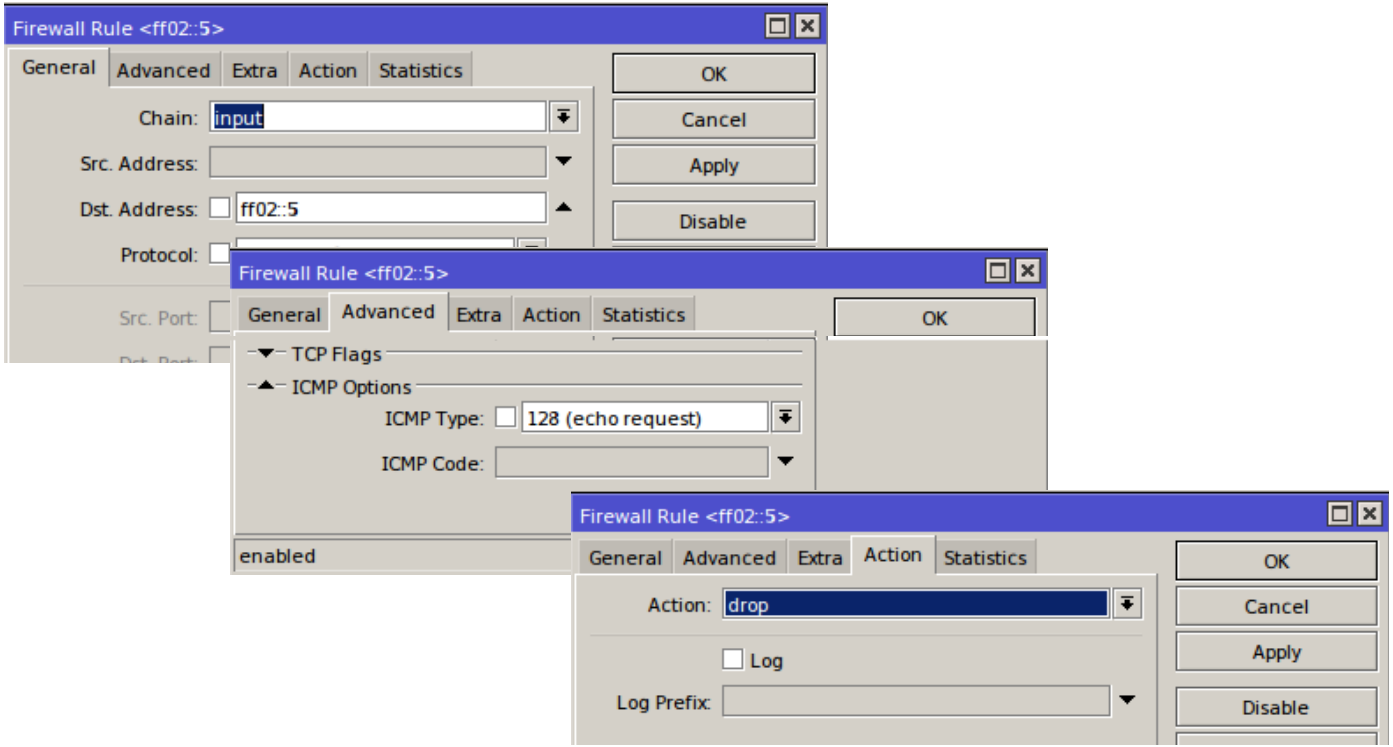
Usando ping y alive6





¿Cómo impedimos que nos encuentren?

Multicast: Filtrado de Echo Request

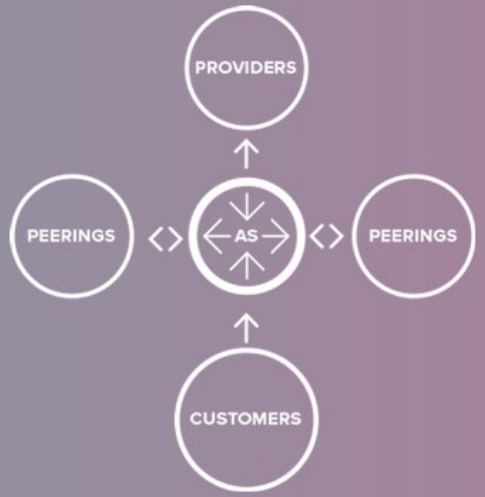


Búsqueda de objetivos

RADAR QRATORLABS | Tools | AS Rating | Blog | FAQ | Search: AS Number, IP, Domain, AS Name

AS Relation Model

Our portal represents various analytical data regarding the relation types between autonomous systems (AS). For each AS we openly display its current links as well as the dynamics of their changes. This information is updated daily.



CONTACT US

AS Relation Model | Radar Monitor | Reverse LG | AS Rating

RADAR QRATORLABS

AS16509

AMAZON-02

Amazon.com, Inc.

35th place in IPv4 connectivity rating

↓ Last month: -5 positions

40th place in IPv6 connectivity rating

↑ Last month: +11 position

Overview

Graph

CURRENT (742) | NEW (59) | LEFT (7) | RETURNING (49)

Prefix	ROA	R
2400:6500::/32	Valid	V
2400:6500:ff00::/48	Valid	V
2400:6700::/32	Valid	V
2400:6700:ff00::/48	Valid	V
2403:b300::/32	Valid	V
2403:b300:ff00::/48	Valid	V
2406:da00:2000::/40	Valid	V
2406:da00:6000::/40	Valid	V

3

Ataques en IPv6

Sacando partido a la información obtenida

IPv6. Consideraciones de Seguridad*

Eavesdropping (escuchas)

Elementos en el camino pueden observar los paquetes

Replay (repetición)

Un atacante puede grabar una secuencia de paquetes y volver a transmitirlas al destinatario

Inserción de paquetes

El atacante crea un paquete con un conjunto de propiedades seleccionadas y los inyecta en la red

Borrado de paquetes

El atacante elimina paquetes del canal

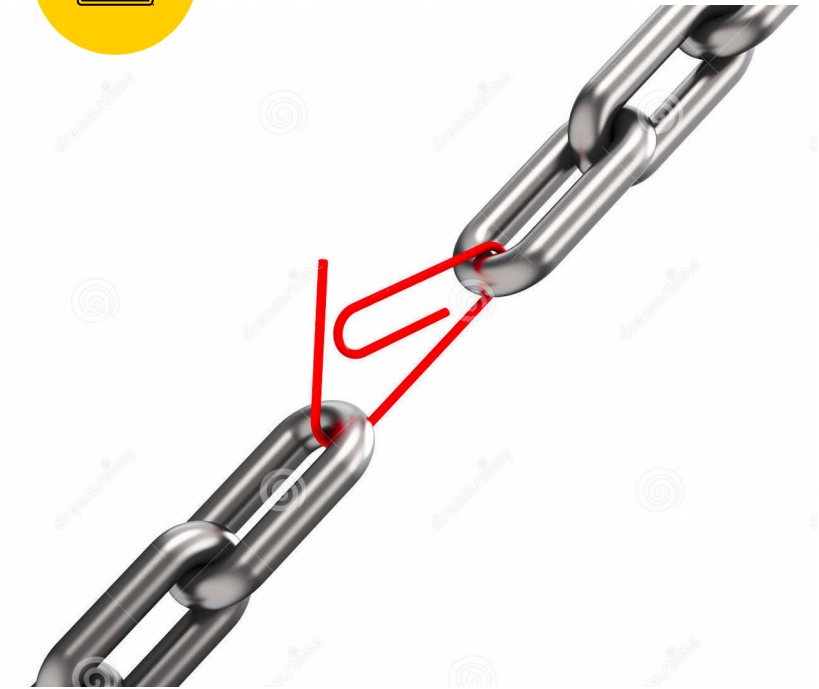
Modificación de paquetes

El atacante elimina paquetes del canal, los modifica y los reinyecta a la red

Man in The Middle

El atacante modifica la comunicación para aparecer como receptor al emisor y viceversa

*RFC 8200-IPv6 Specification



¿Son realmente importantes estas consideraciones de seguridad?

ICMPv6

NS: Neighbor Solicitation

ICMPv6 tipo 135

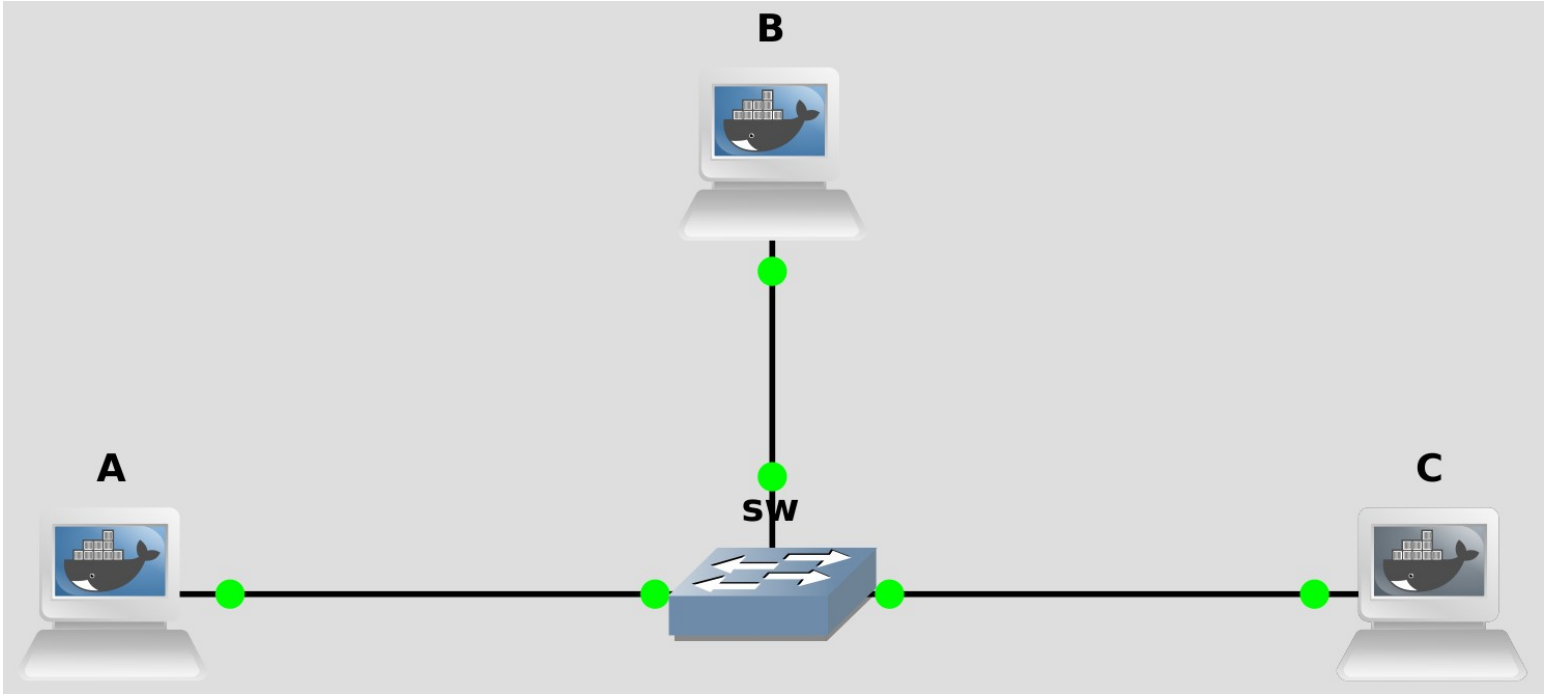
Sirve para preguntar la dirección MAC de una determinada IPv6

NA: Neighbor Advertisement

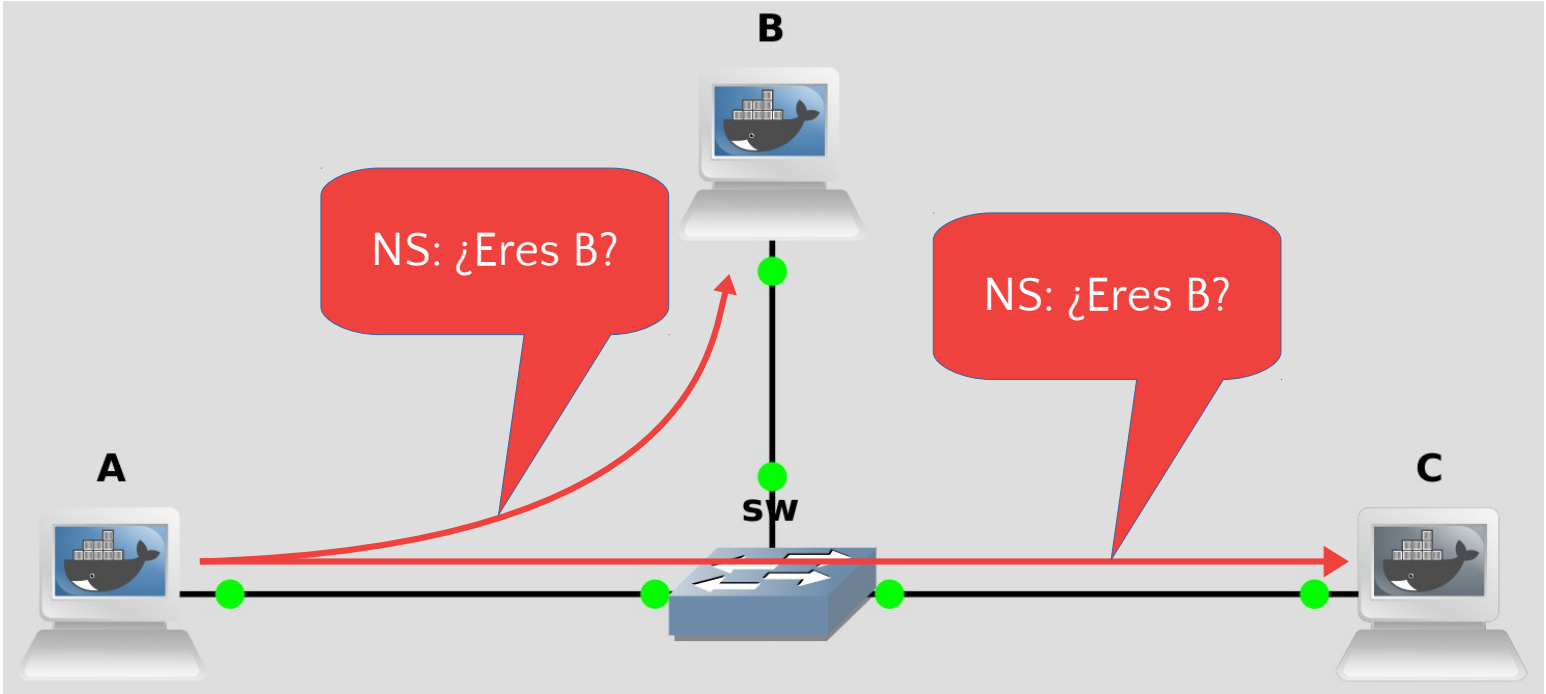
ICMPv6 tipo 136

Sirve para publicar la dirección MAC de una determinada IPv6

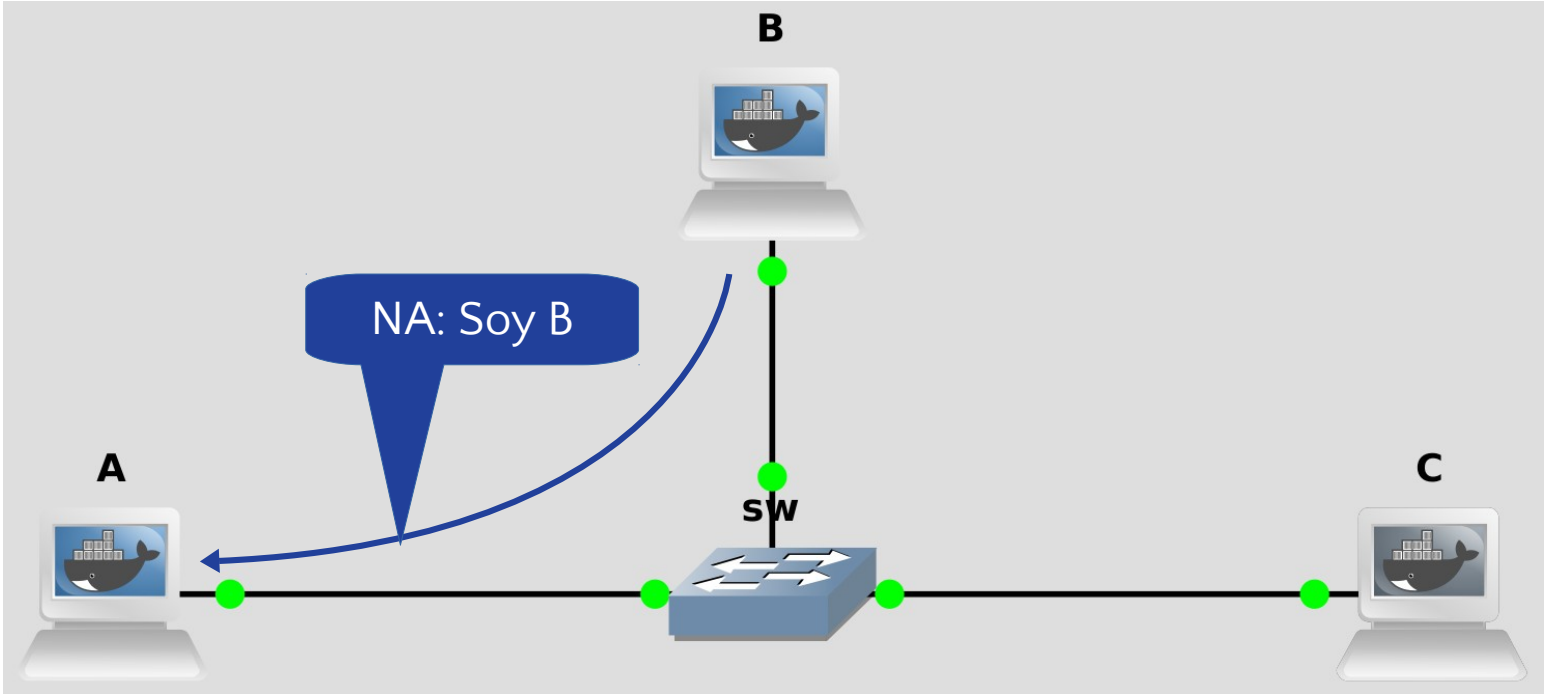
ICMPv6 NS y NA



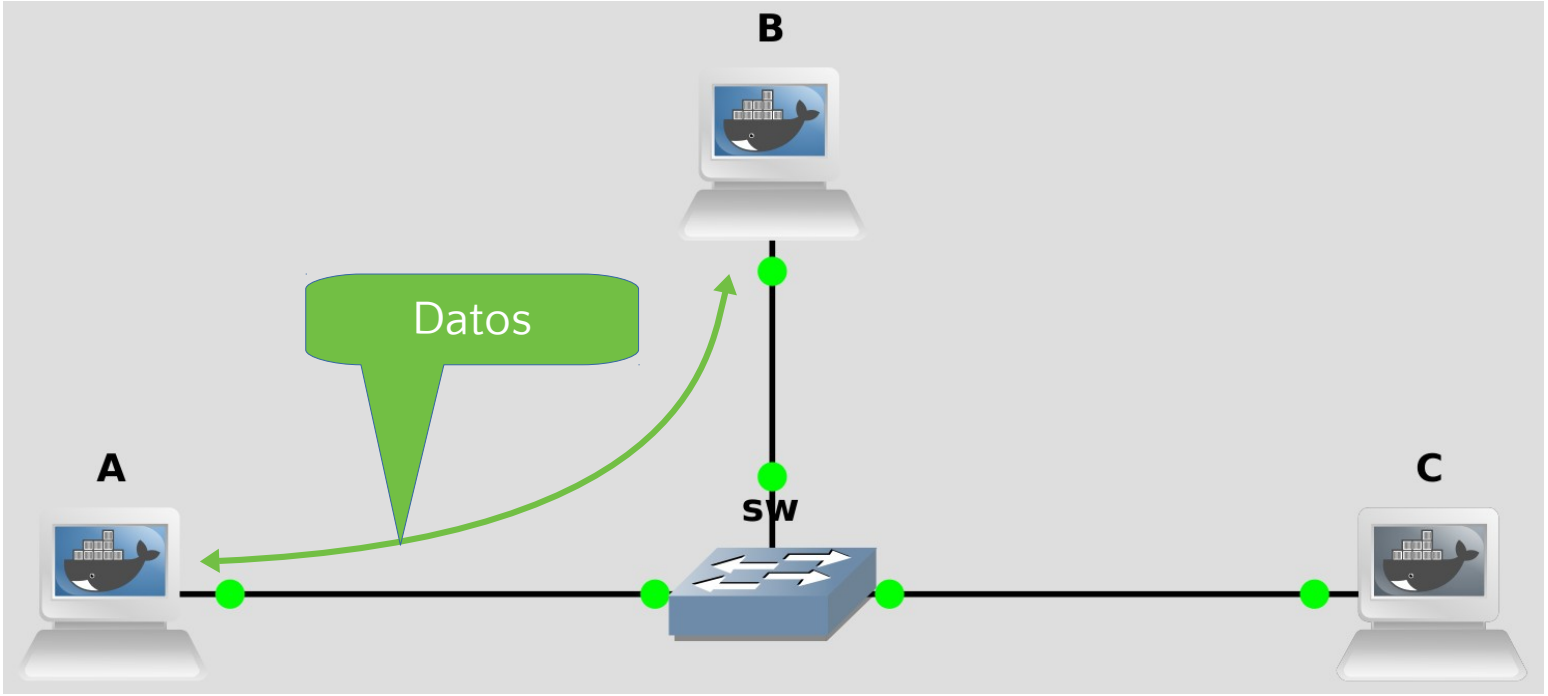
ICMPv6 NS y NA

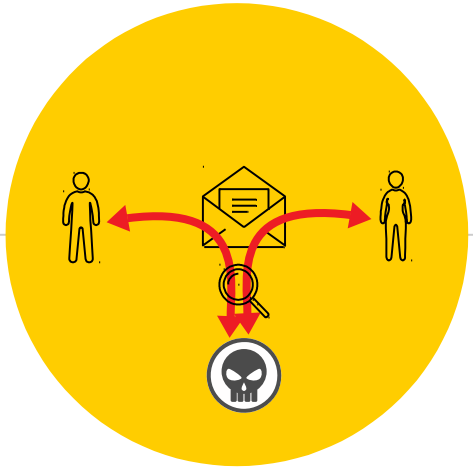


ICMPv6 NS y NA



ICMPv6 NS y NA

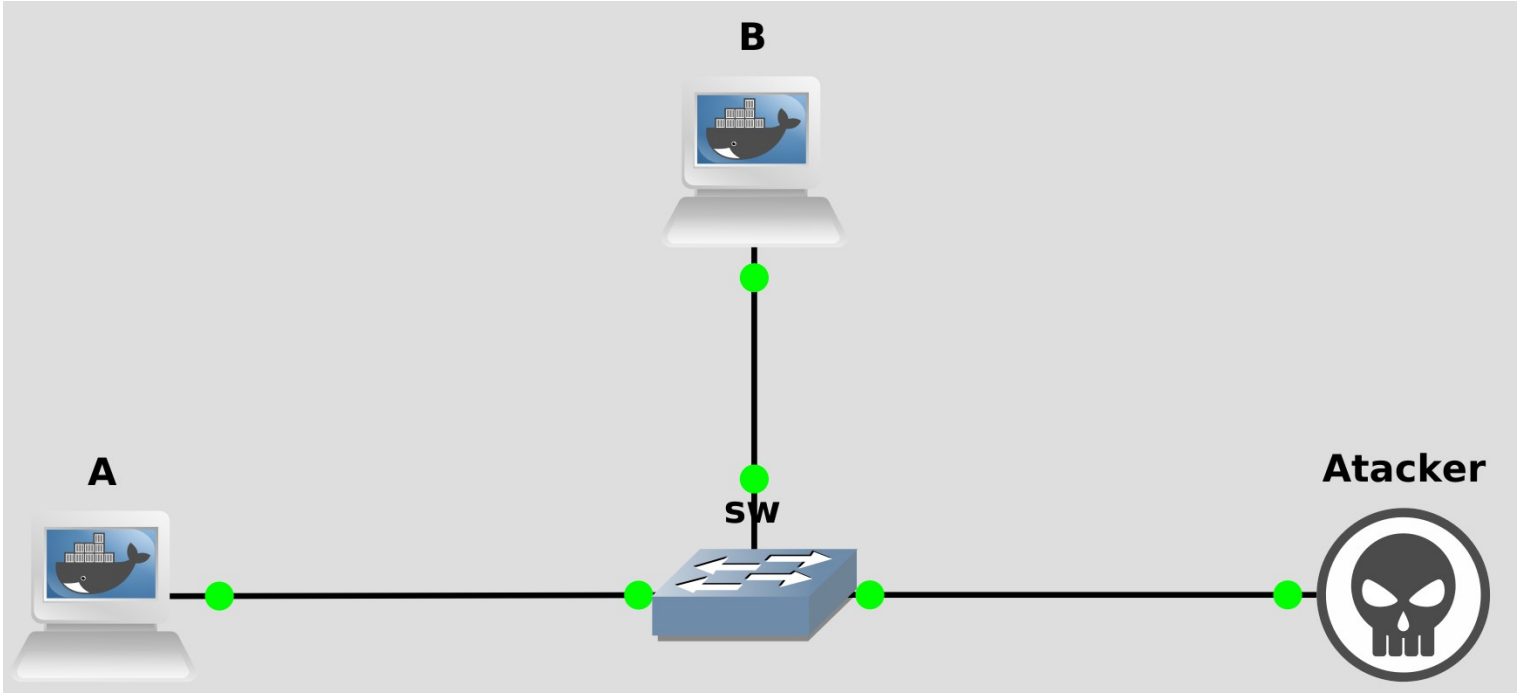




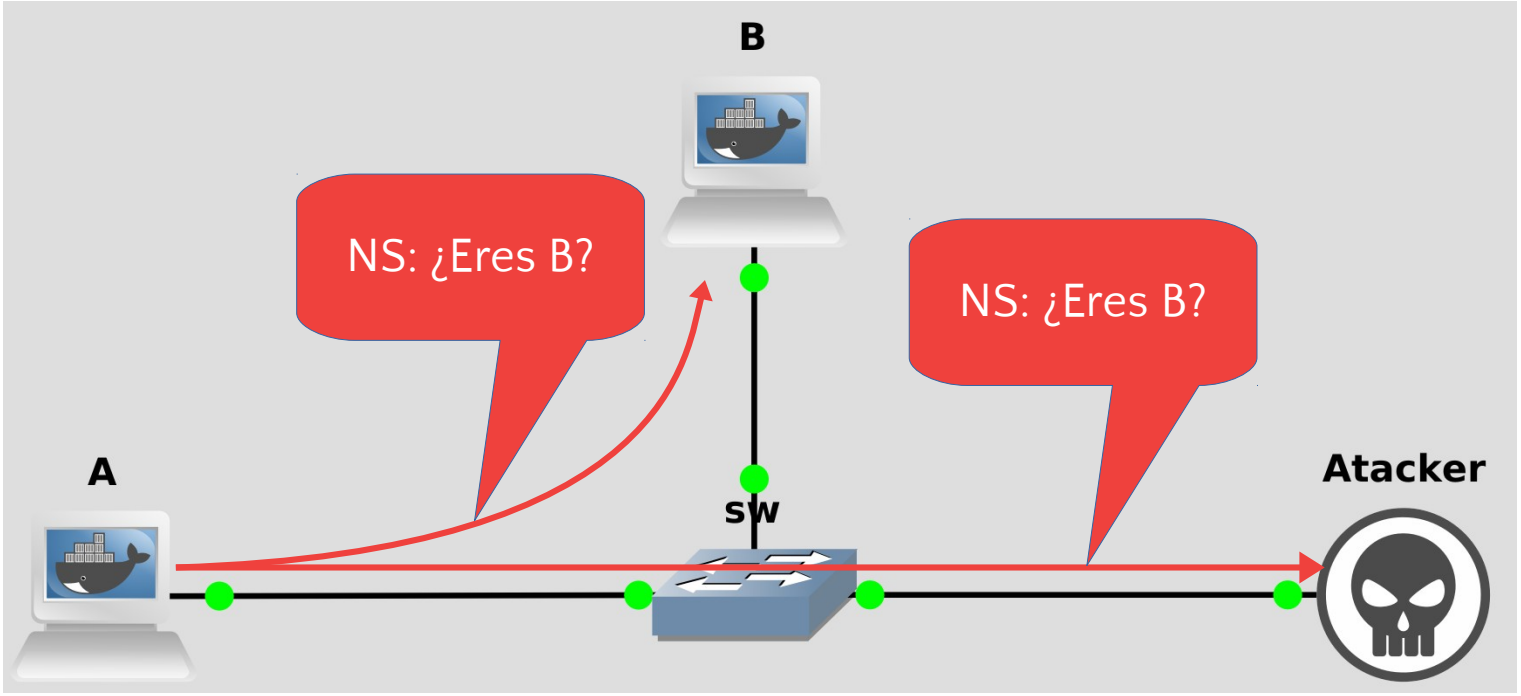
Ataque MitM

Falsificación de ICMPv6 NA

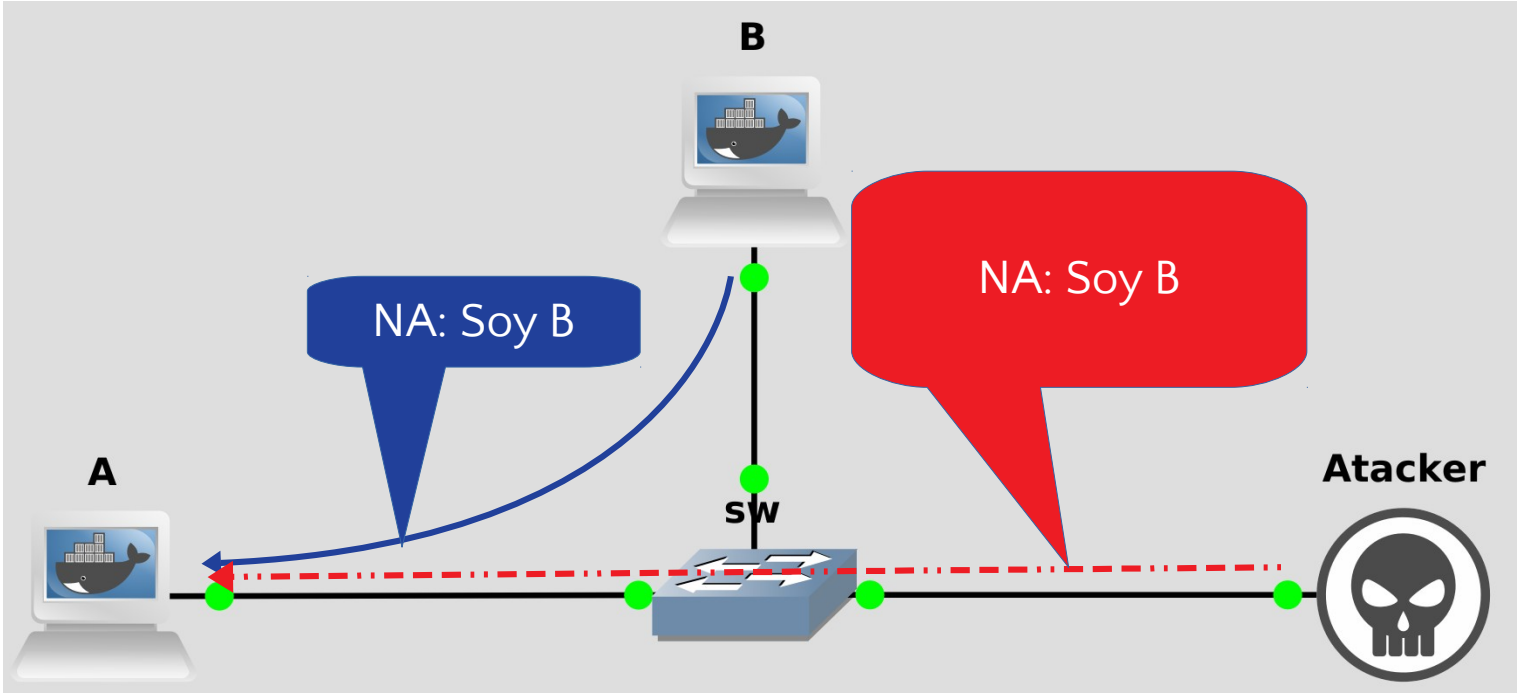
MitM falsificando ICMPv6 NA



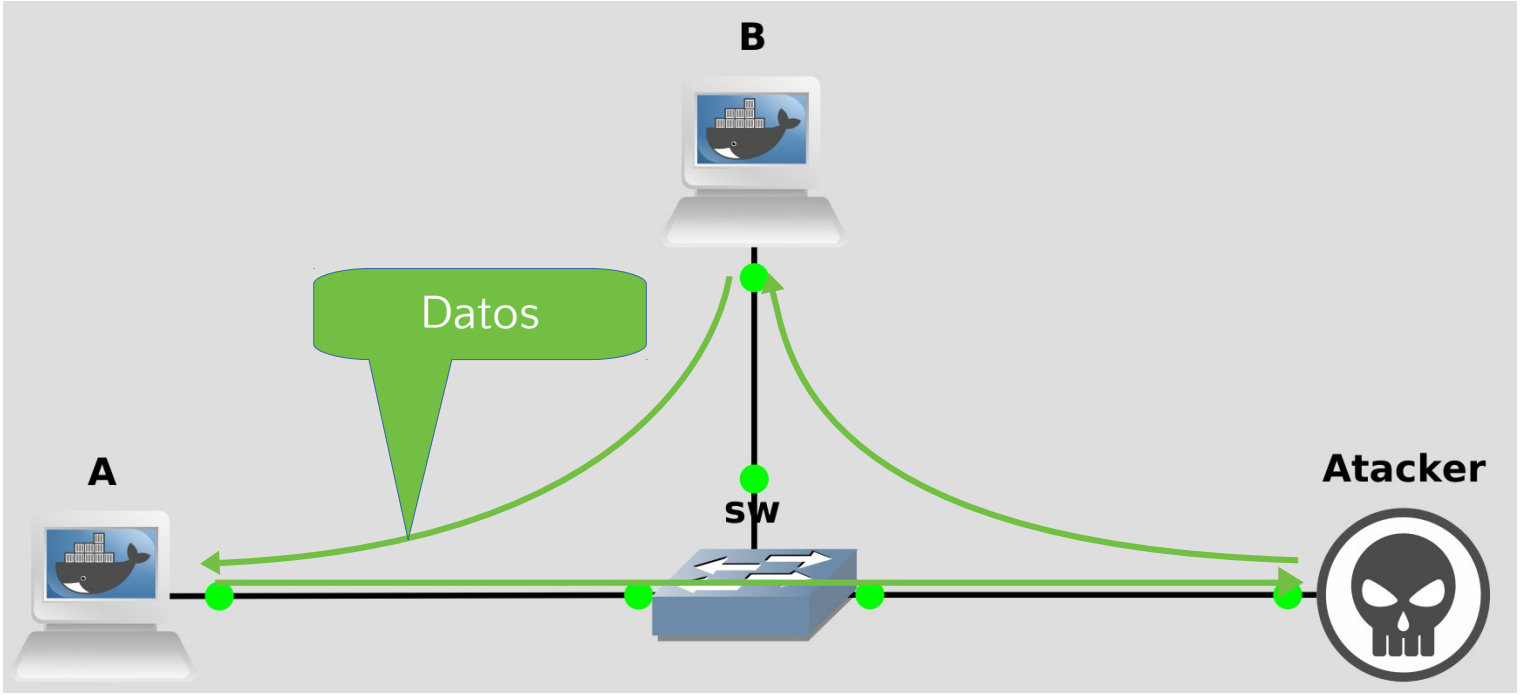
MiTM falsificando ICMPv6 NA



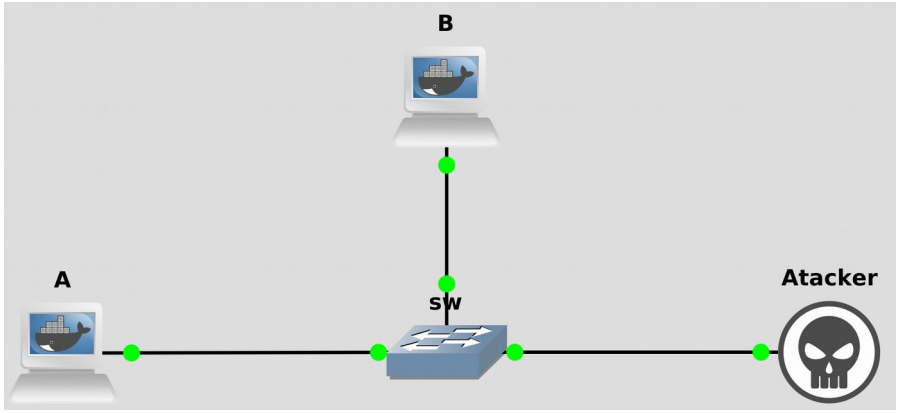
MiTM falsificando ICMPv6 NA



MiTM falsificando ICMPv6 NA



MiTM falsificando NA




```
root@Atacker:/thc-ipv6# parasite6 eth0 -l
Remember to enable routing, you will denial service otherwise:
 =>  echo 1 > /proc/sys/net/ipv6/conf/all/forwarding
Remember to prevent sending out ICMPv6 Redirect packets:
 =>  ip6tables -I OUTPUT -p icmpv6 --icmpv6-type redirect -j DROP
Started ICMP6 Neighbor Solitication Interceptor (Press Control-C to end) ...
Spoofed packet to fe80::7835:58ff:fe86:b2ff as fe80::58b1:b4ff:fe09:d25b
Spoofed packet to fe80::a43e:c5ff:fe0b:1e6b as fe80::58b1:b4ff:fe09:d25b
Spoofed packet to fe80::58b1:b4ff:fe09:d25b as fe80::a43e:c5ff:fe0b:1e6b
Spoofed packet to fe80::a43e:c5ff:fe0b:1e6b as fe80::58b1:b4ff:fe09:d25b
```

ICMPv6

RS: Router Solicitation

ICMPv6 tipo 133

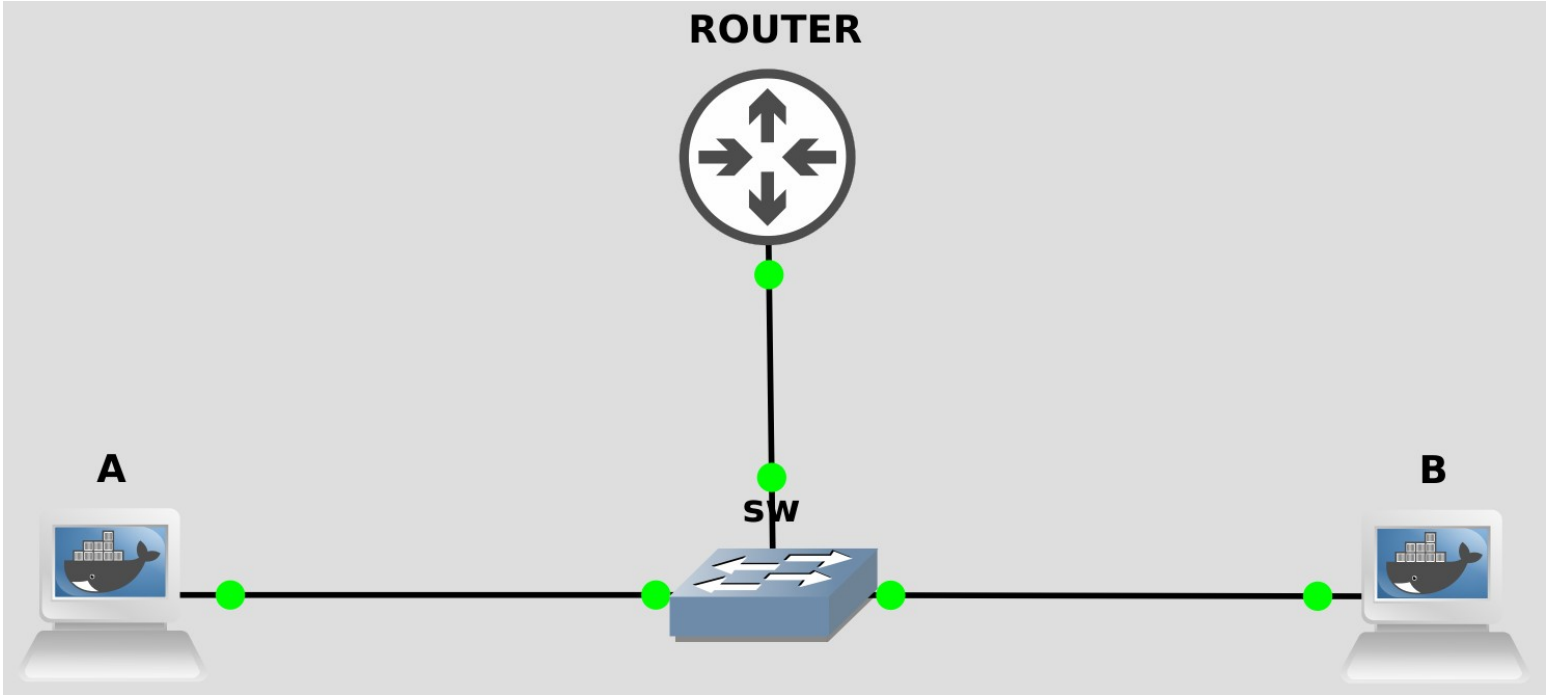
Sirve para solicitar un router en la red

RA: Router Advertisement

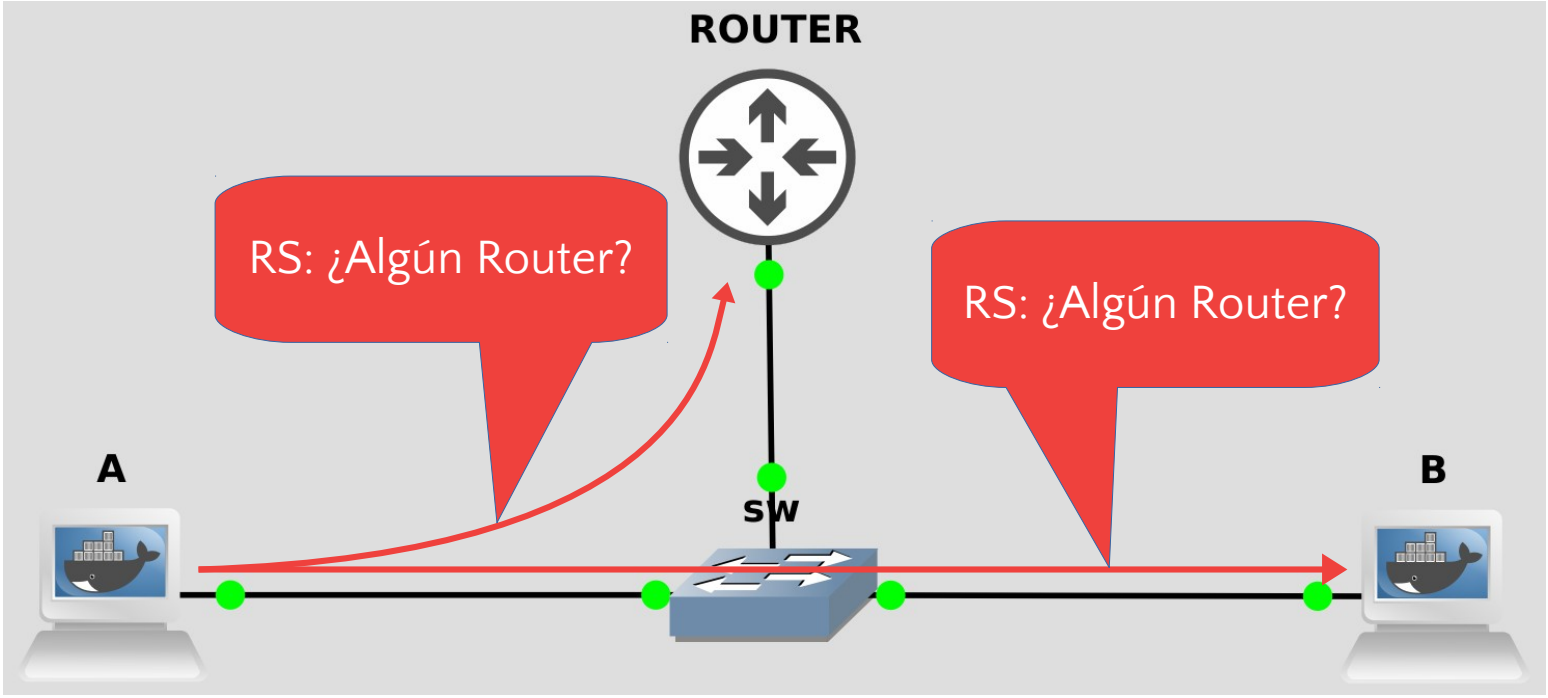
ICMPv6 tipo 134

Sirve para que un router publique opciones de autoconfiguración IPv6

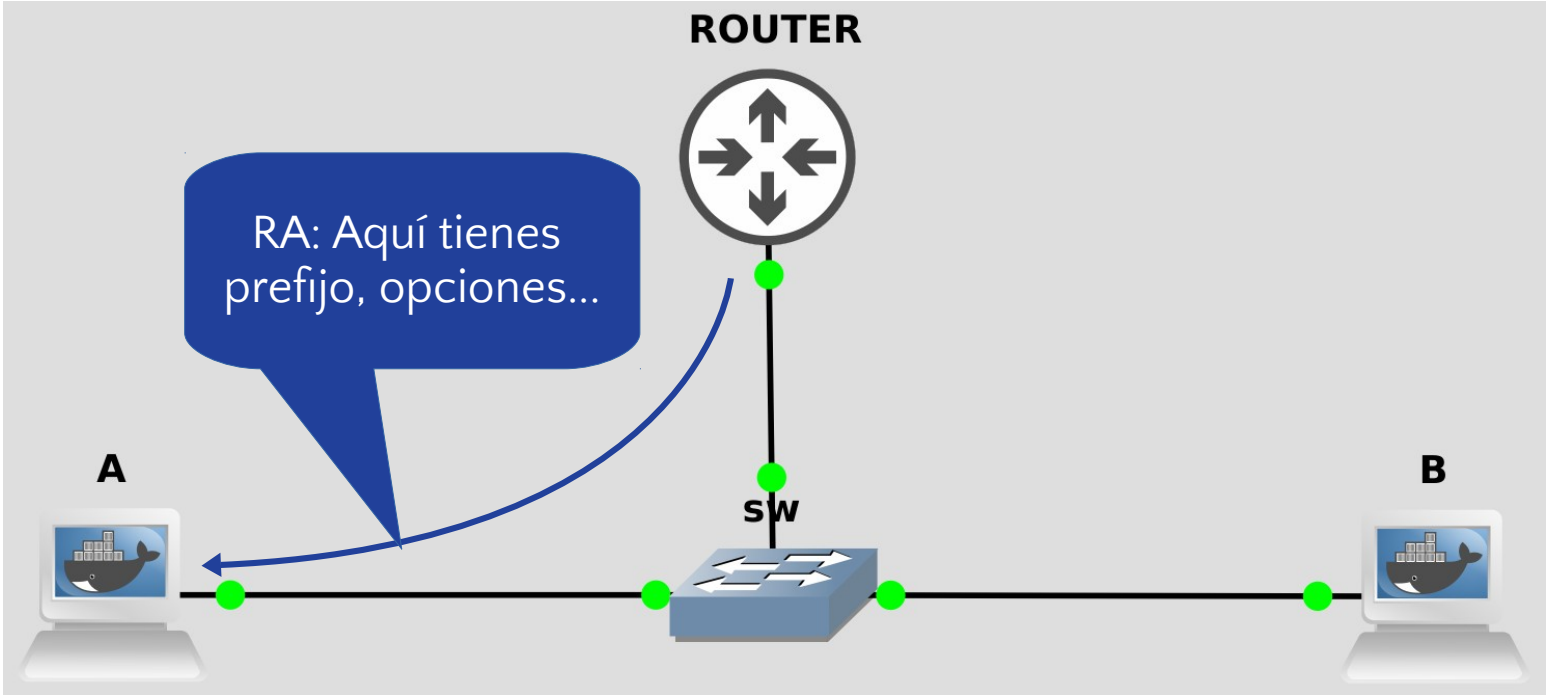
ICMPv6 RS y RA



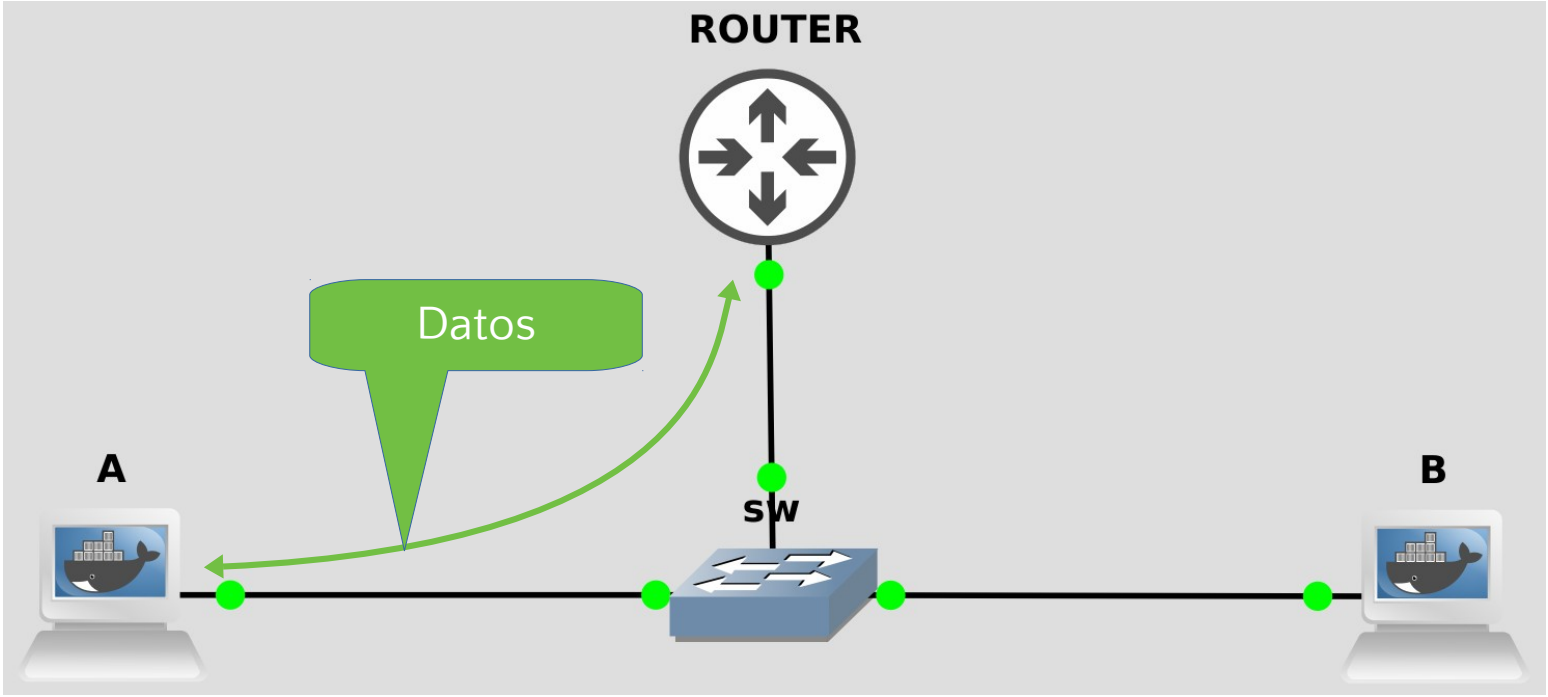
ICMPv6 RS y RA

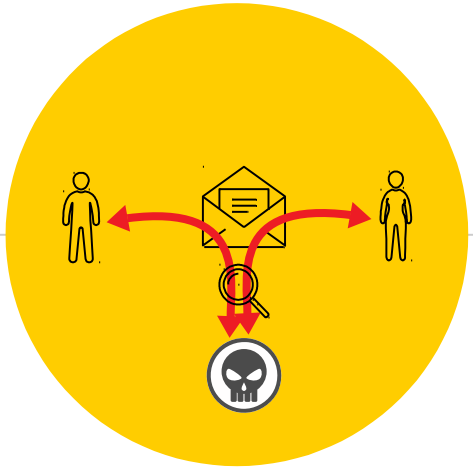


ICMPv6 RS y RA



ICMPv6 RS y RA

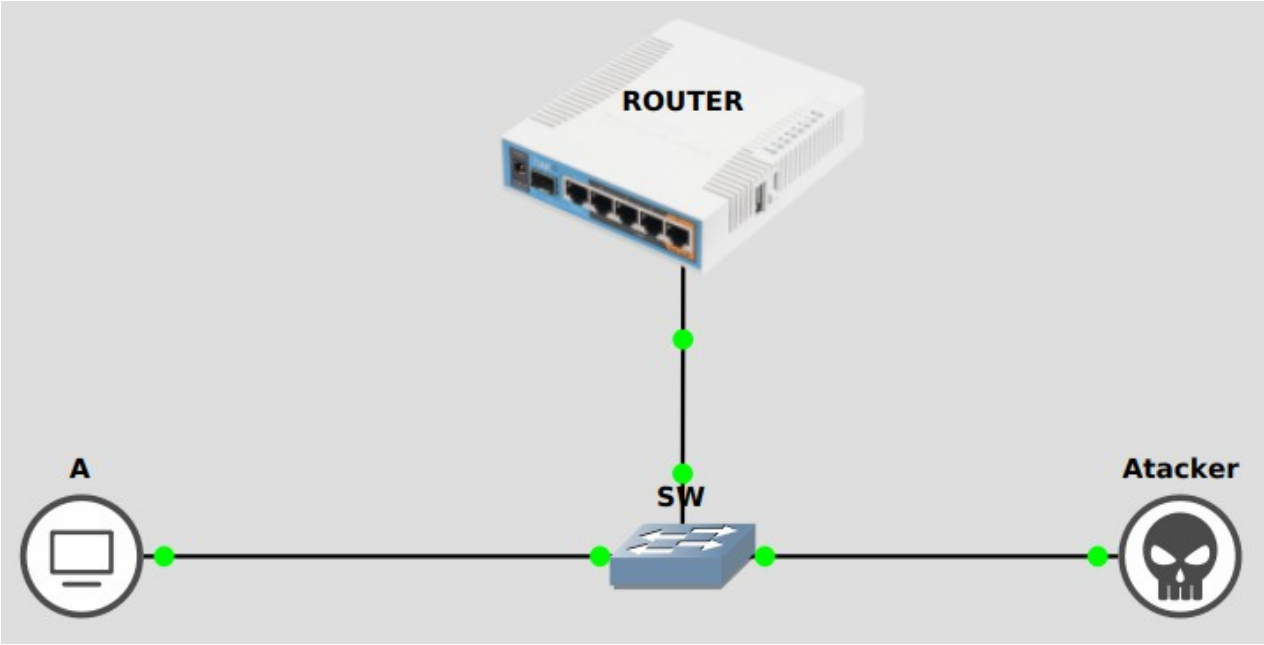




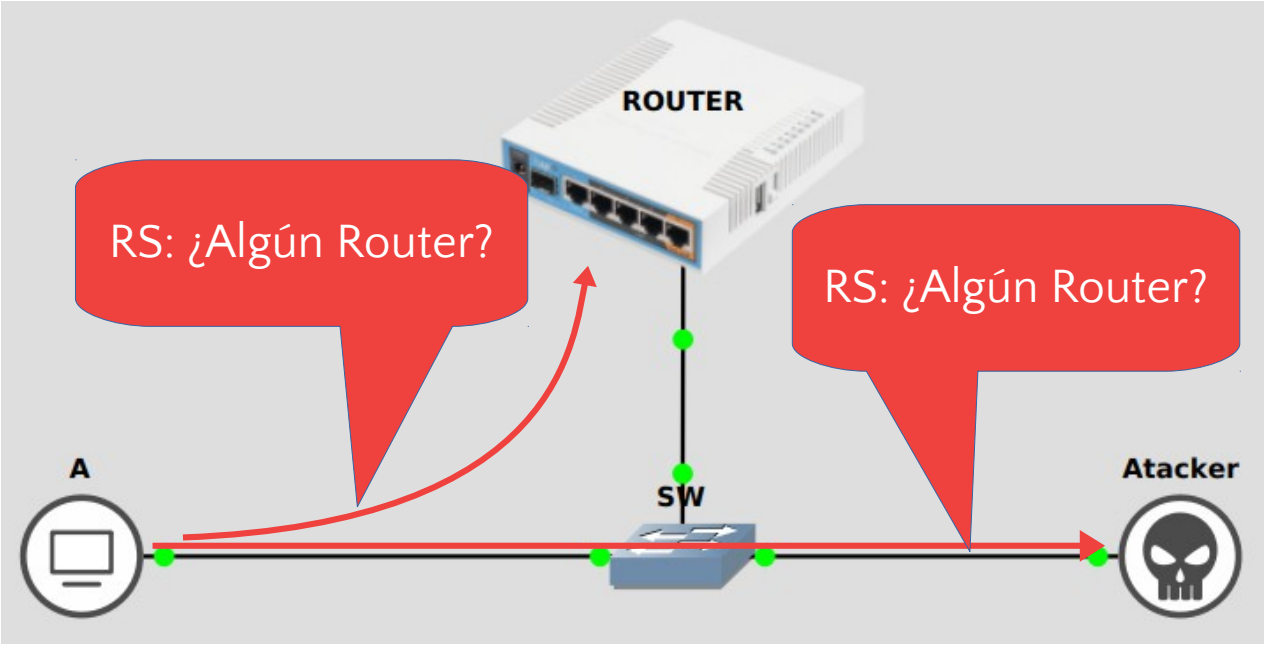
Ataque MitM

Falsificación de ICMPv6 RA

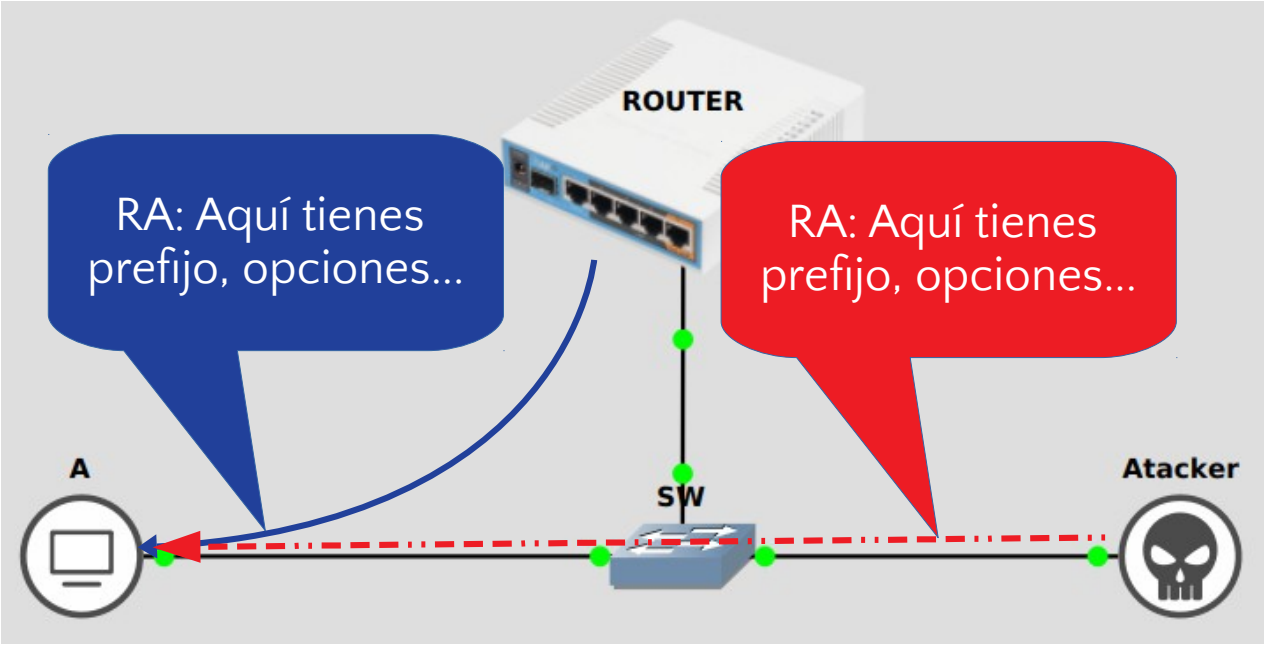
MiTM falsificando ICMPv6 RA



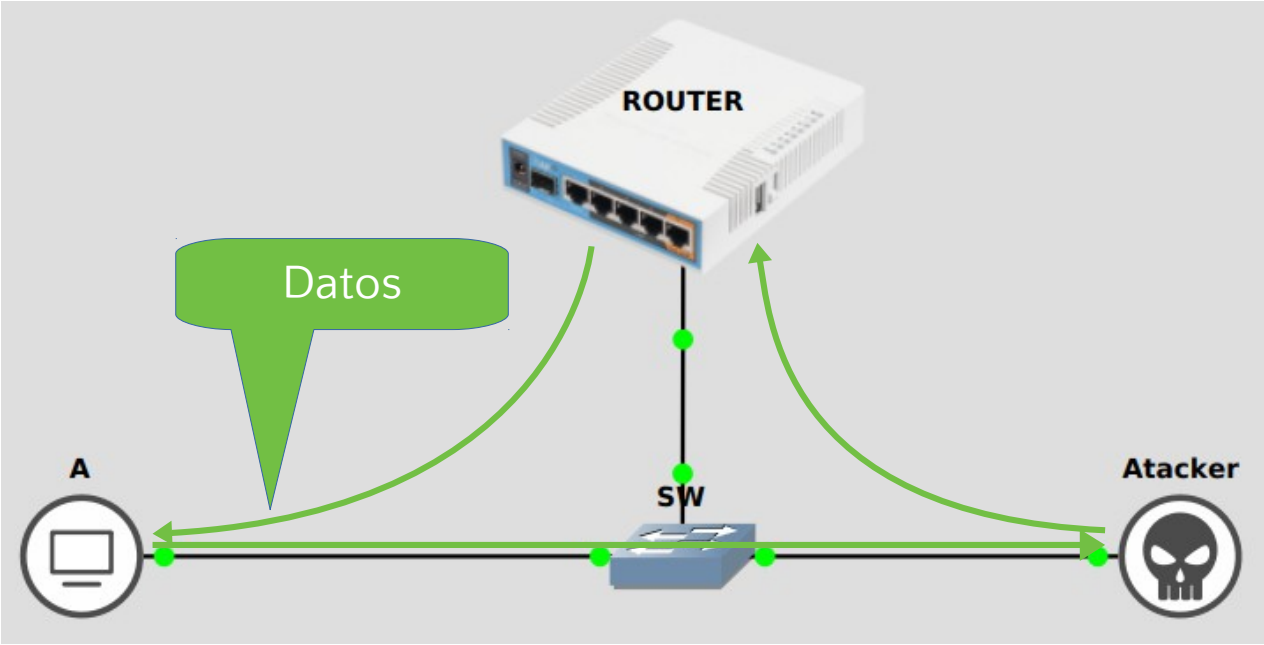
MiTM falsificando ICMPv6 RA



MiTM falsificando ICMPv6 RA

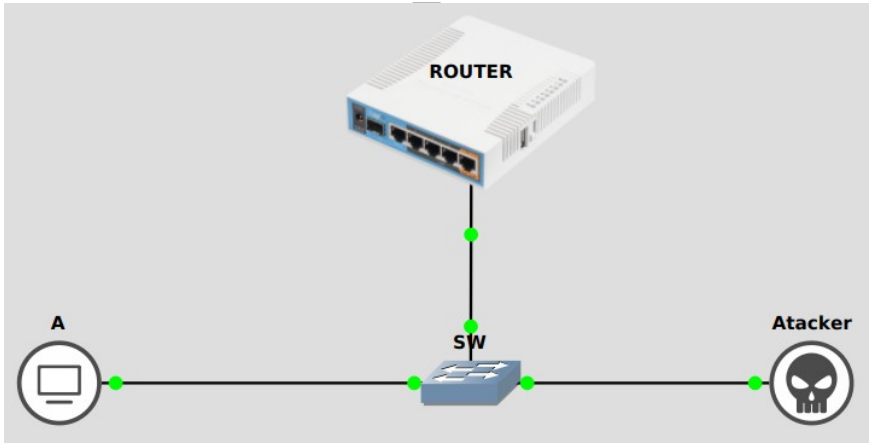


MiTM falsificando ICMPv6 RA



MiTM falsificando RA

Usando fake_router6




```
Atacker console is now available... Press RETURN to get started.
root@Atacker:/thc-ipv6# fake_router6 eth0 2001:bad::bad/64
Starting to advertise router 2001:bad::bad (Press Control-C to end) ...
```

```
root@A:/# ip -6 r
2001:bad::/64 dev eth0 proto kernel metric 256 expires 21474836sec pref mediu
m
2001:db8::/64 dev eth0 proto kernel metric 256 expires 2591964sec pref medium
fe80::/64 dev eth0 proto kernel metric 256 pref medium
default via fe80::e15:77ff:fecb:900 dev eth0 proto ra metric 1024 expires 176
4sec pref medium
default via fe80::5882:cfff:fed3:b2d6 dev eth0 proto ra metric 1024 expires 4
365sec hoplimit 255 pref high
```

¿Qué pasa con...

*Entre los **objetivos** de diseño principales **de IPv6** se encuentran la **seguridad** y la auto-configuración*

“

Requisitos Nodo IPv6

Año 2006
RFC4294
IPv6 DEBE soportar IPSec

IPSec*

- Control de acceso
- Integridad
- Autenticación del origen de los datos
- Detección y eliminación de repeticiones
- Confidencialidad

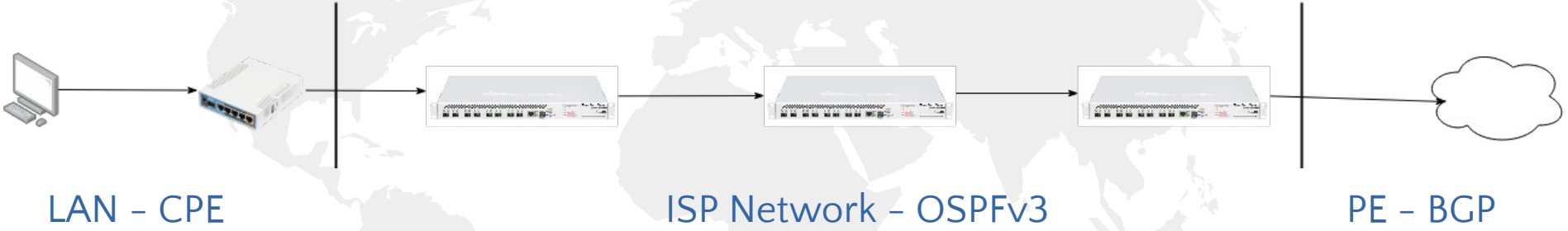
*RFC 4301–Security Architecture for the Internet Protocol

Requisitos Nodo IPv6

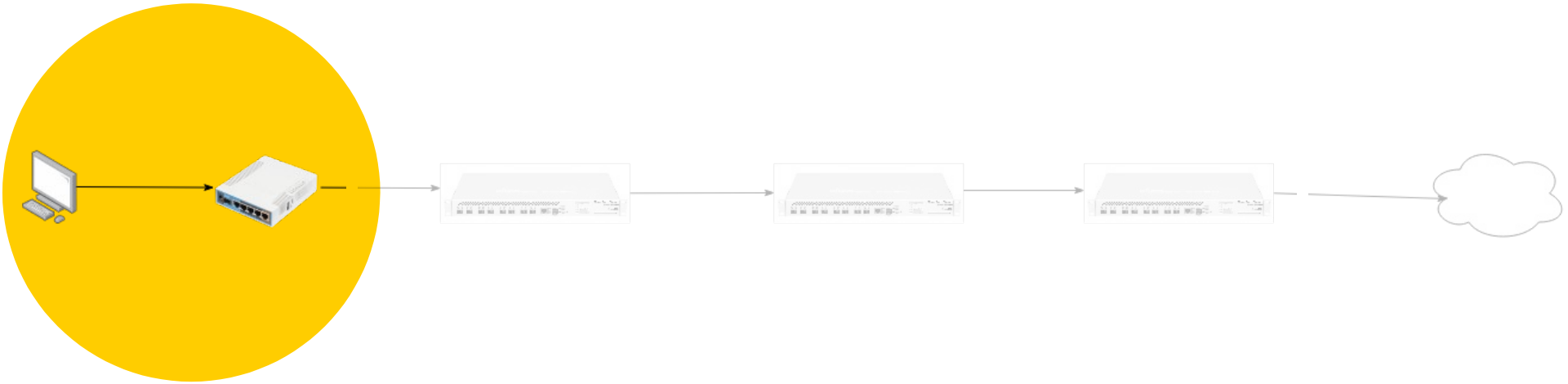
4

Seguridad en la red

Cómo proteger las distintas capas de la red



Topología de la Red de un ISP



Seguridad en el CPE

¿Echaremos de menos NAT?

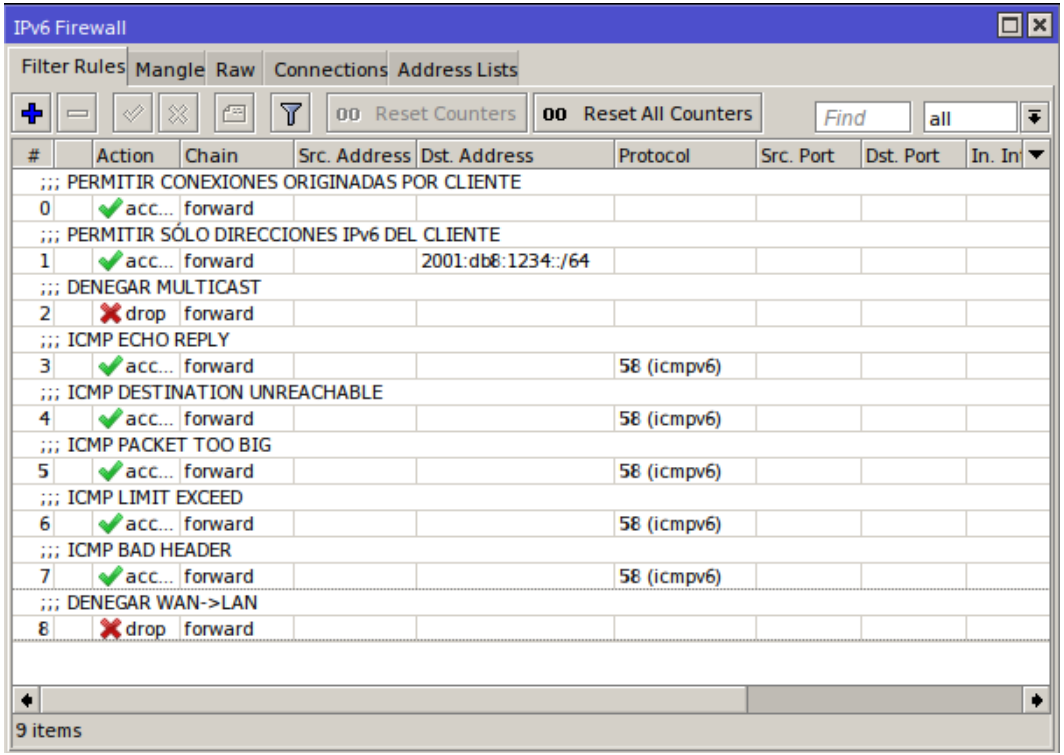
- NAT se inventó para prolongar la vida de IPv4
- “Falsa sensación de seguridad”
- NAT requiere “connection-tracking”

Filtrado para CPE (sustituir NAT)

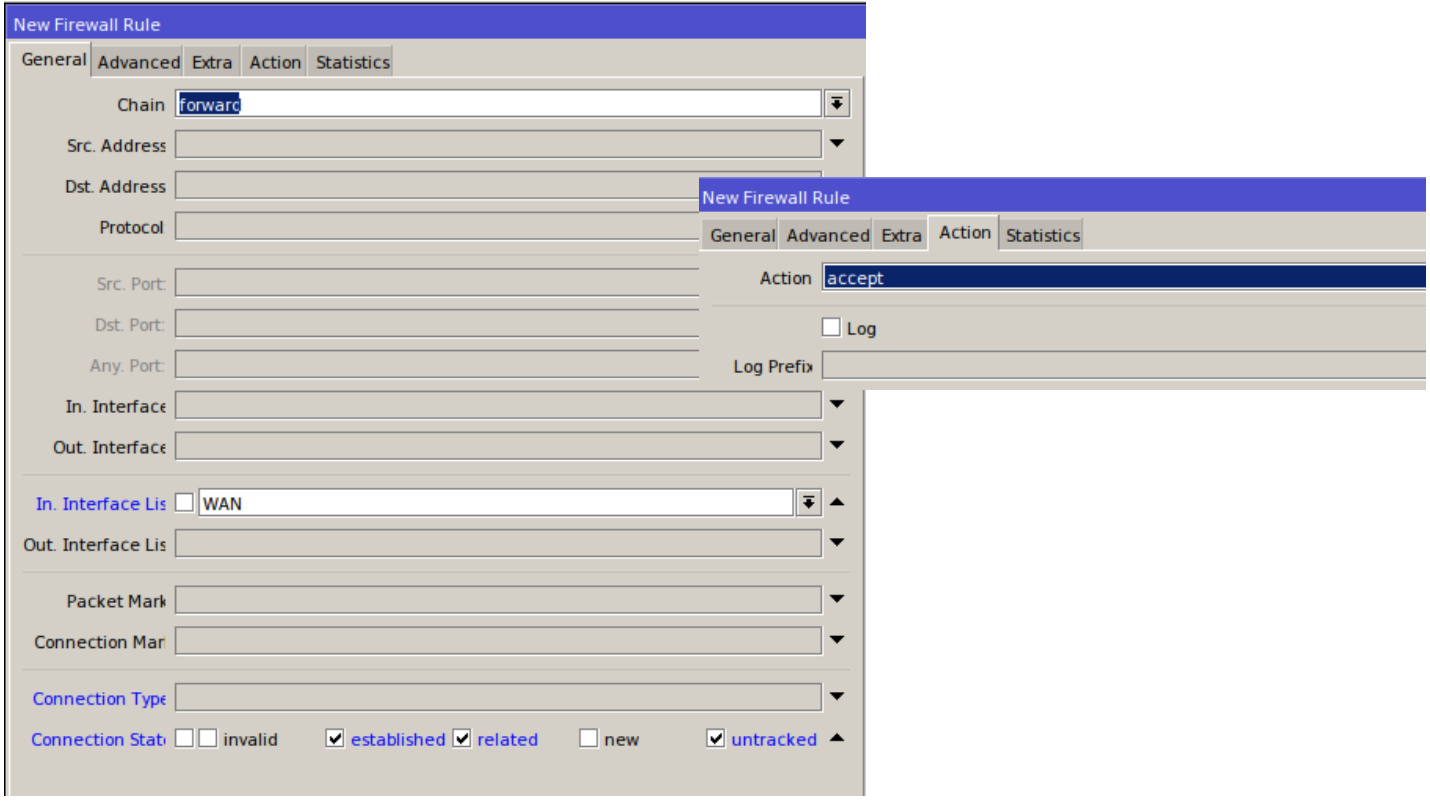
- Permitir sólo conexiones originadas por cliente
- Permitir sólo direcciones IPv6 del cliente
- Denegar todo el tráfico multicast in/out
- Filtrar ICMPv6 (selectivamente)

- RFC 6092, Recommended Simple Security in CPE for Residential IPv6

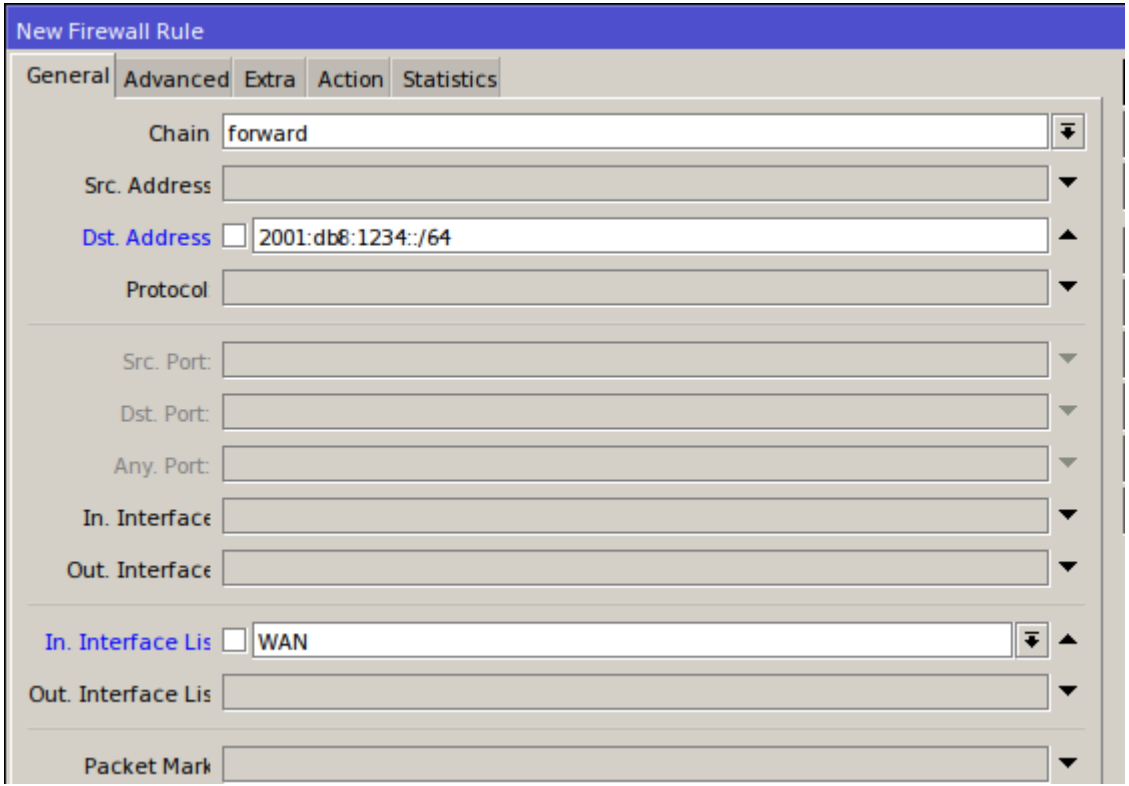
Filtrado para CPE



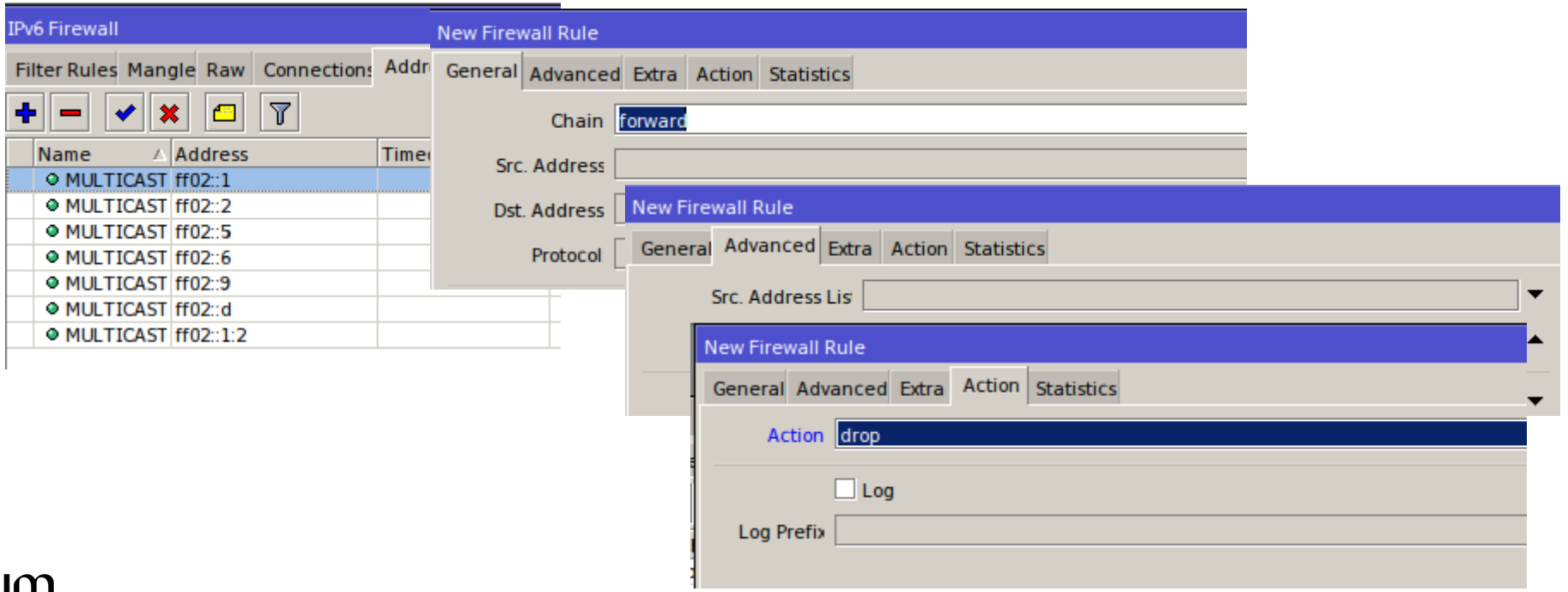
Filtrado CPE: Conexiones Originadas por el Cliente



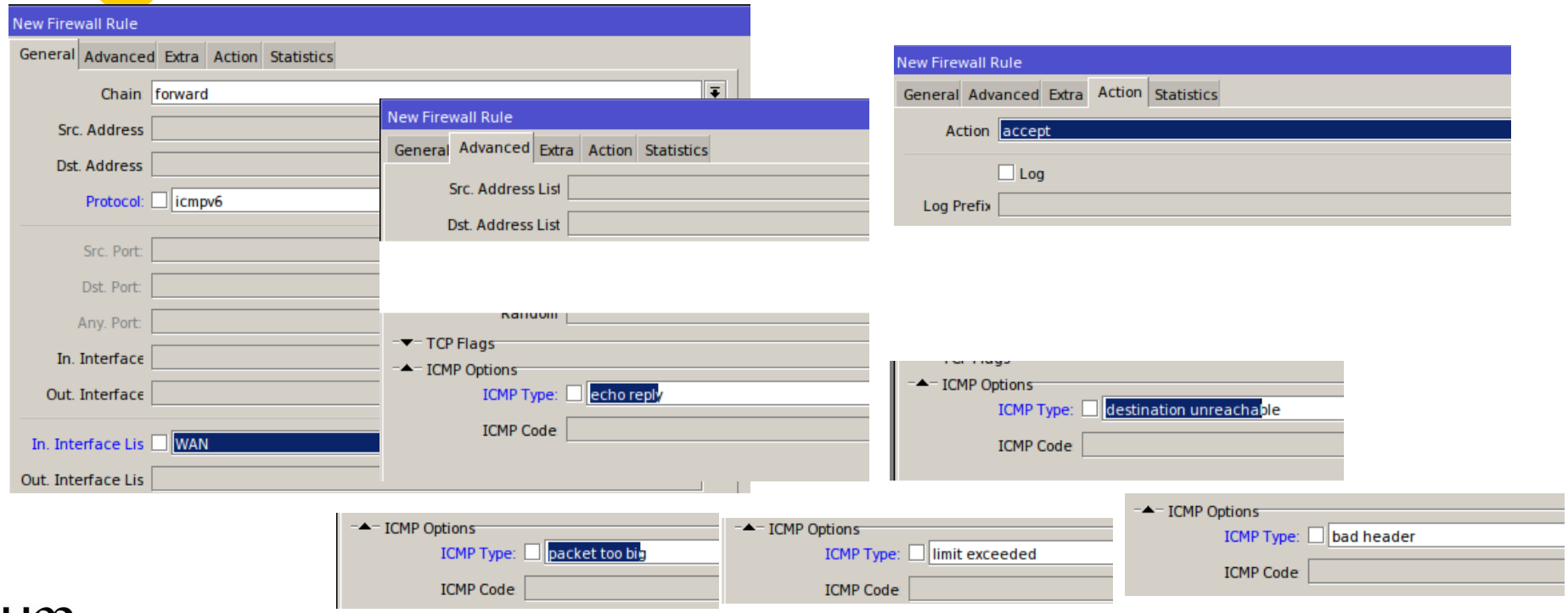
Filtrado CPE: Sólo Direcciones del Cliente



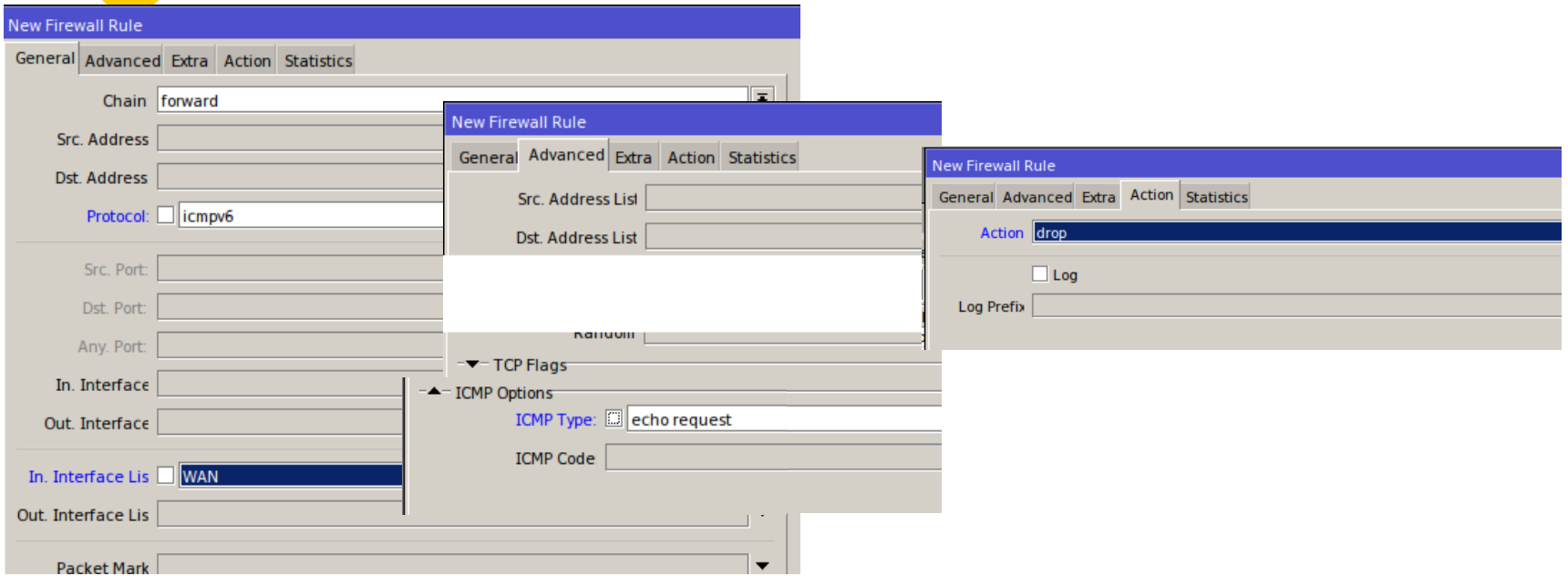
Filtrado CPE: Denegar Tráfico Multicast

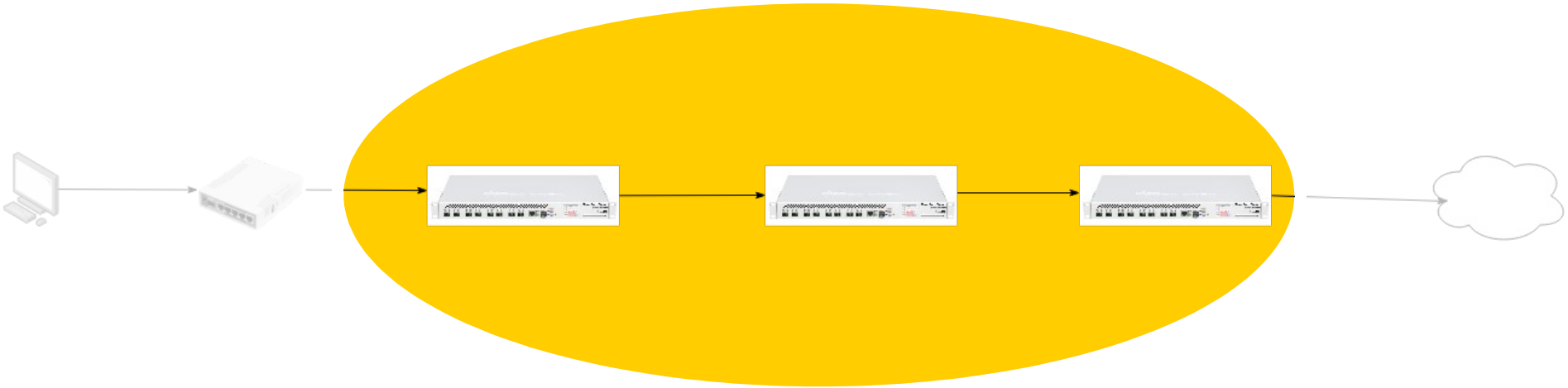


Filtrado CPE: Filtrado selectivo de ICMPv6



Filtrado CPE: Filtrado selectivo de ICMPv6





Seguridad en la red ISP - OSPFv3

Ataques sobre OSPFv3

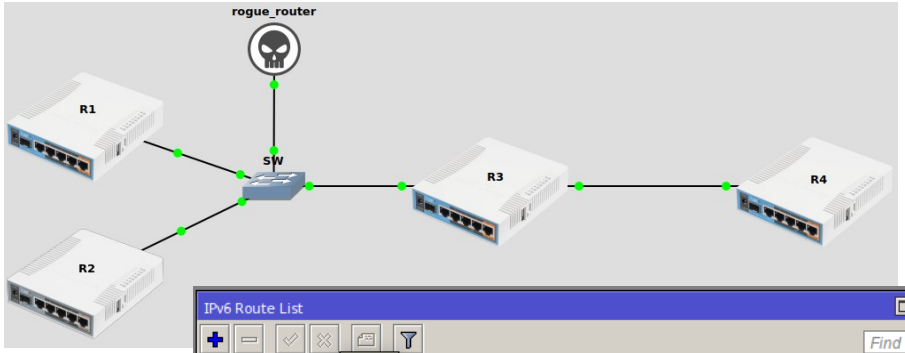
Rogue Router

Un atacante con acceso a la red conecta un dispositivo y modifica la topología OSPFv3

Router comprometido

Se altera la configuración de un Router legítimo que ha sido comprometido, alterando la información de enrutamiento

Rogue OSPF-v3

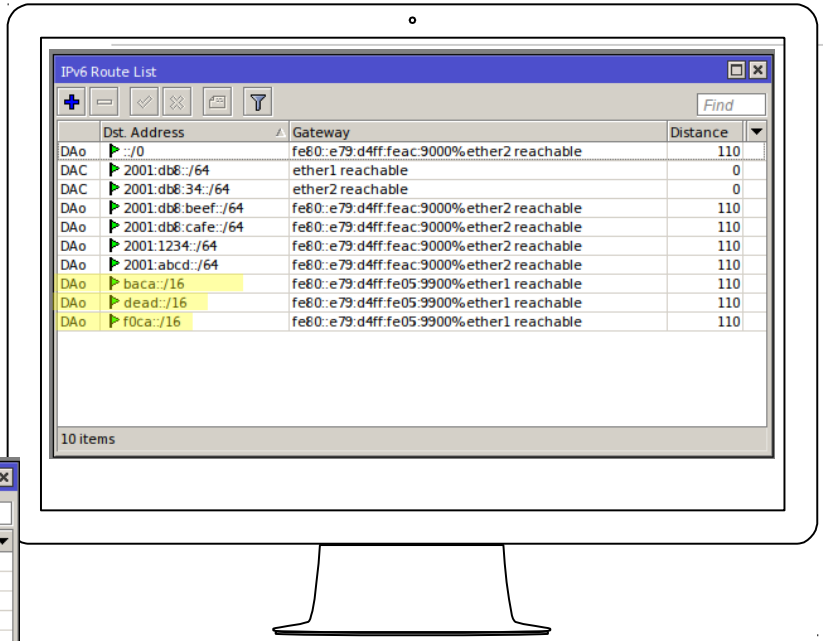


IPv6 Route List

Find

	Dst. Address	Gateway	Distance
DAo	::/0	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAC	2001:db8::/64	ether1 reachable	0
DAC	2001:db8:34::/64	ether2 reachable	0
DAo	2001:db8:beef::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAo	2001:db8:cafe::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAo	2001:1234::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAo	2001:abcd::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110

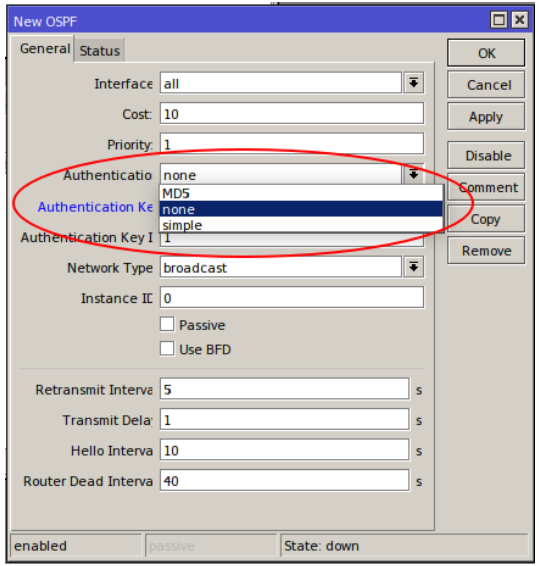
7 items



Autenticación en OSPF v2 y v3

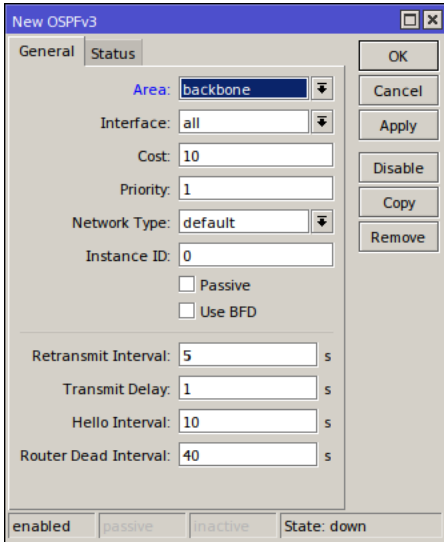
OSPFv2

- Autenticación

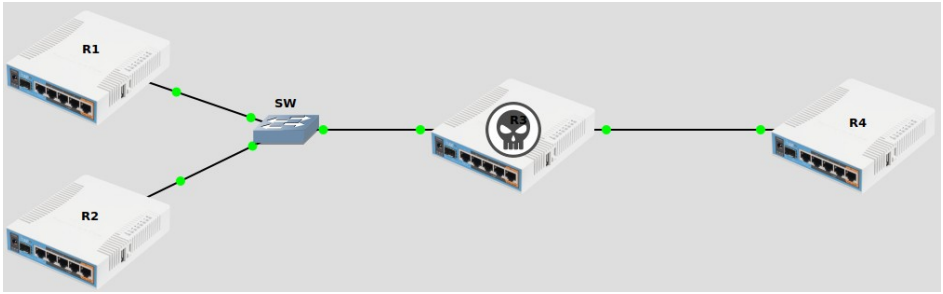


OSPFv3

- ¡Sin autenticación!



Router Comprometido



IPv6 Route List

Find

	Dst. Address	Gateway	Distance
DAo	::/0	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAC	2001:db8::/64	ether1 reachable	0
DAC	2001:db8:34::/64	ether2 reachable	0
DAo	2001:db8:beef::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAo	2001:db8:cafe::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAo	2001:1234::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAo	2001:abcd::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAo	baca::/16	fe80::e79:d4ff:fe05:9900%ether1 reachable	110
DAo	dead::/16	fe80::e79:d4ff:fe05:9900%ether1 reachable	110
DAo	f0ca::/16	fe80::e79:d4ff:fe05:9900%ether1 reachable	110

10 items

IPv6 Route List

Disable

Find

	Dst. Address	Gateway	Distance
DAo	::/0	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAC	2001:db8::/64	ether1 reachable	0
DAC	2001:db8:34::/64	ether2 reachable	0
DAo	2001:db8:beef::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAo	2001:db8:cafe::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAo	2001:1234::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110
DAo	2001:abcd::/64	fe80::e79:d4ff:feac:9000%ether2 reachable	110

7 items

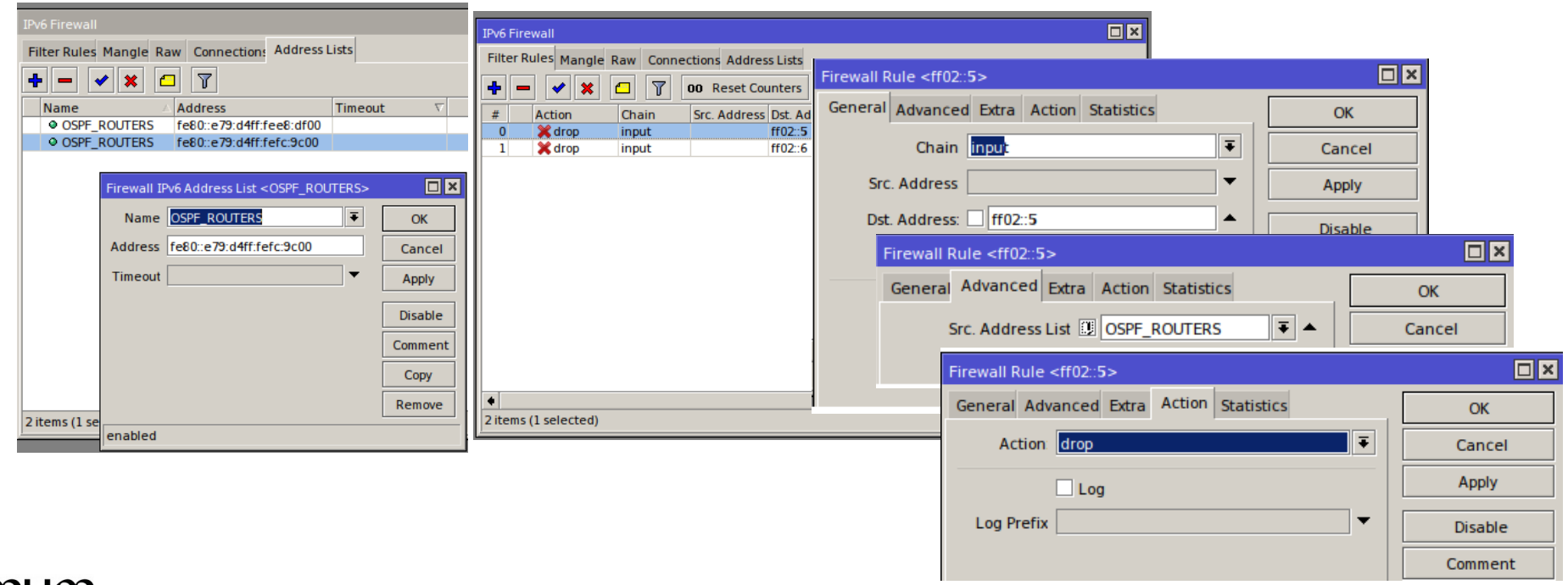
Seguridad OSPF-v3

- Desactivar la instancia si no se utiliza
- Todos los interfaces **passive**
- Sólo interfaces necesarios **active**

Protección de OSPF-v3

- Proteger la capa 2
- Aceptar multicast a FF02:5 y FF02:6 sólo desde IP conocidas
- Utilizar IPSec

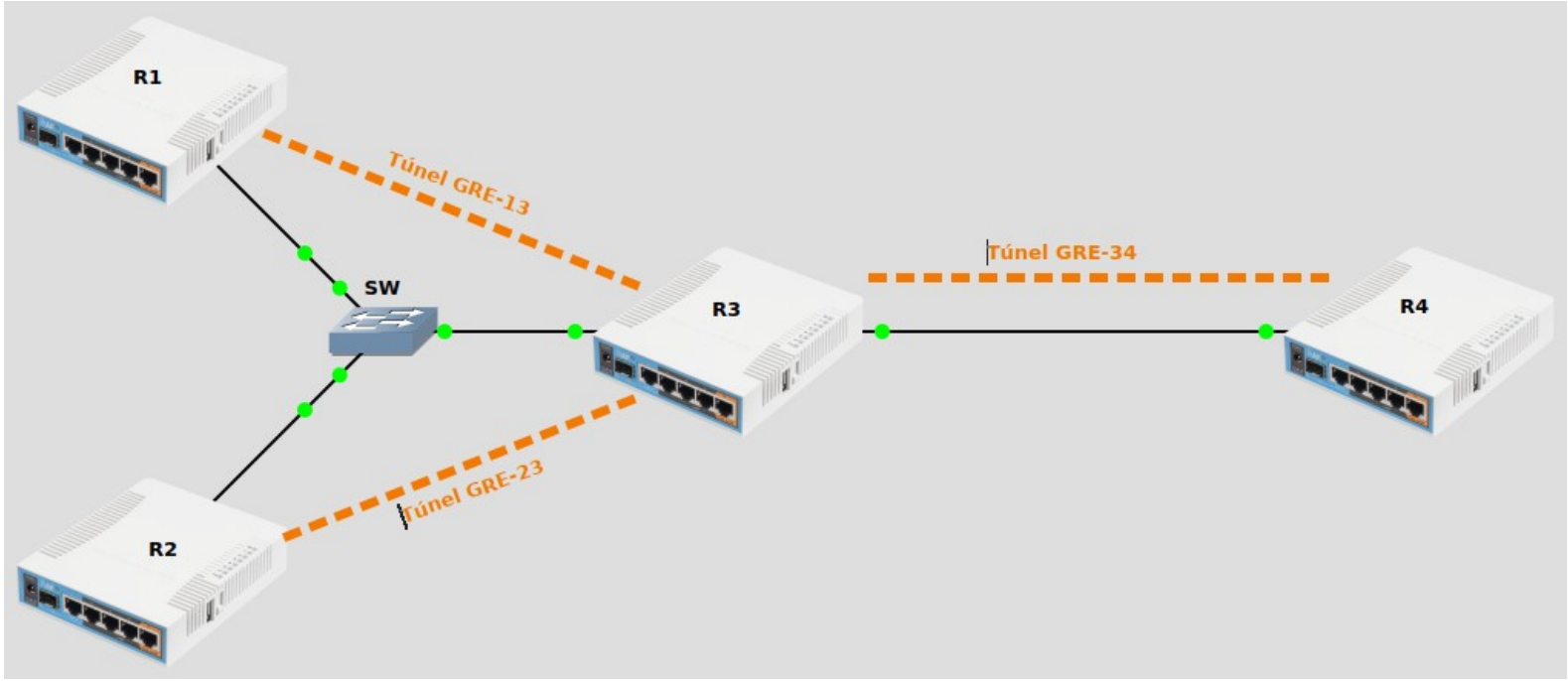
Filtrado Multicast OSPF-v3



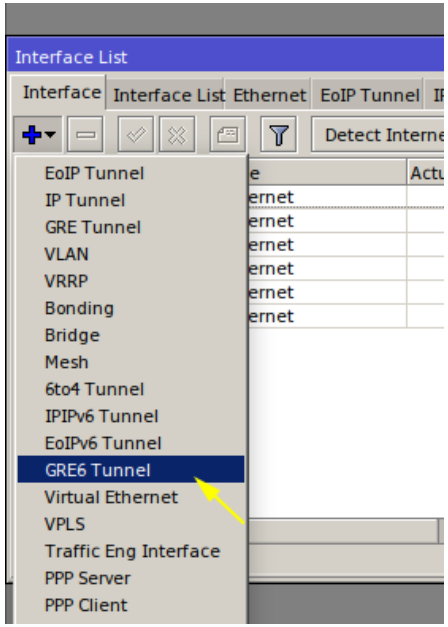
IPSec en OSPF-v3

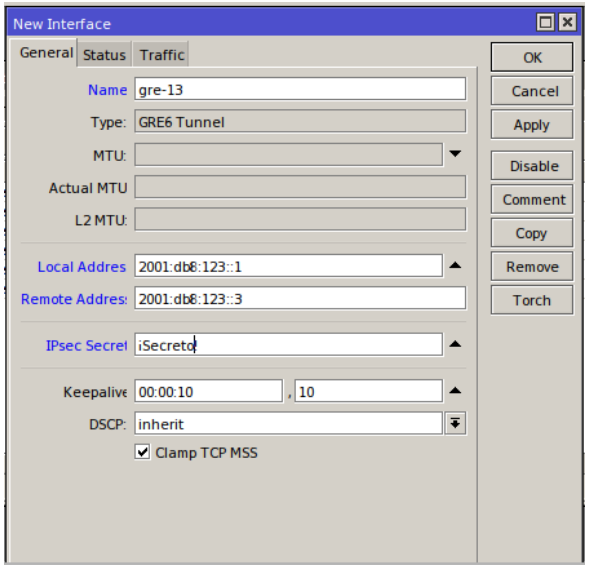
- IPSec no puede transmitir tráfico multicast
- OSPF-v3 no puede utilizarse directamente sobre IPSec
- Pueden usarse túneles GRE6

IPSec en OSPF-v3: How To

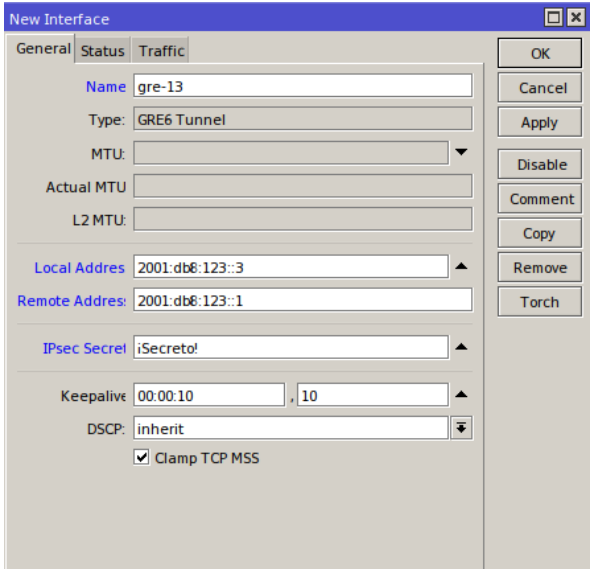


IPSec en OSPF-v3: Túnel GRE



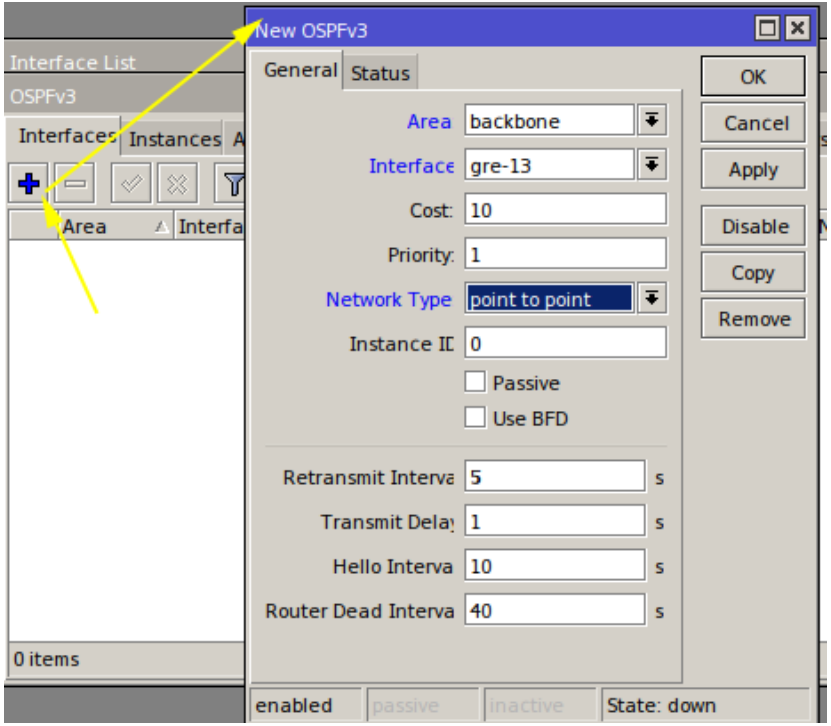


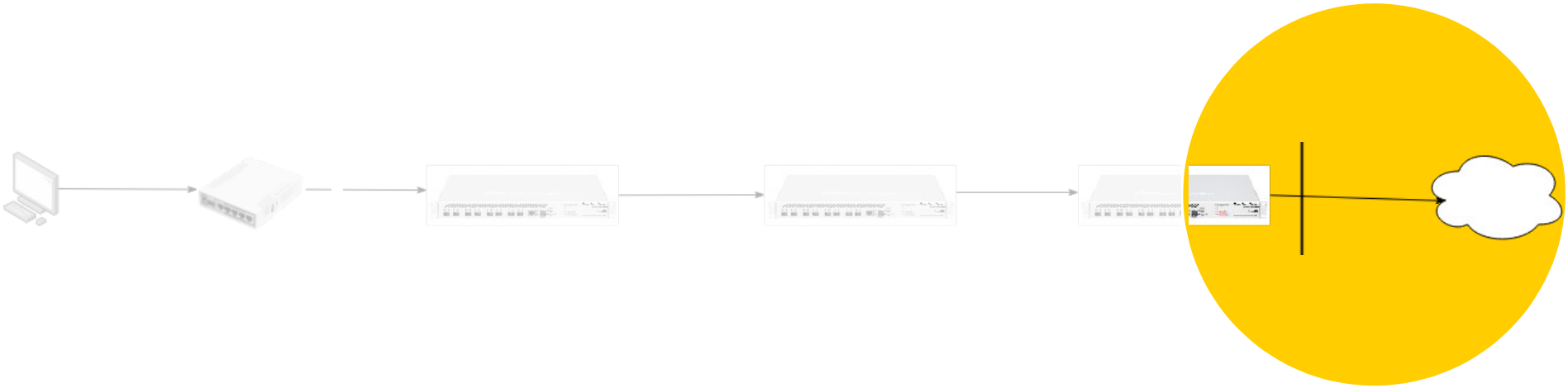
Router R1



Router R3

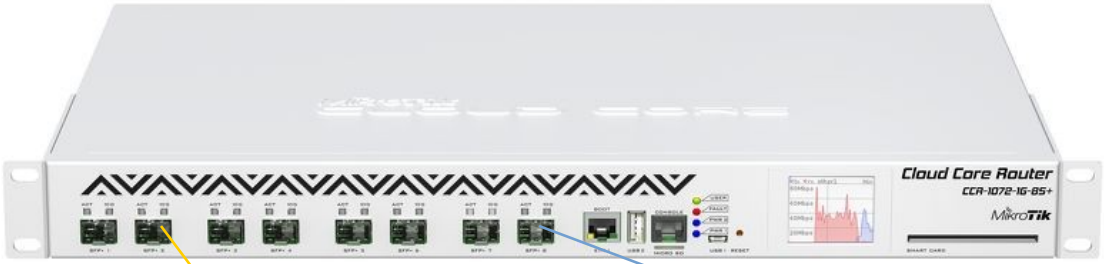
IPSec en OSPF-v3: Interfaces

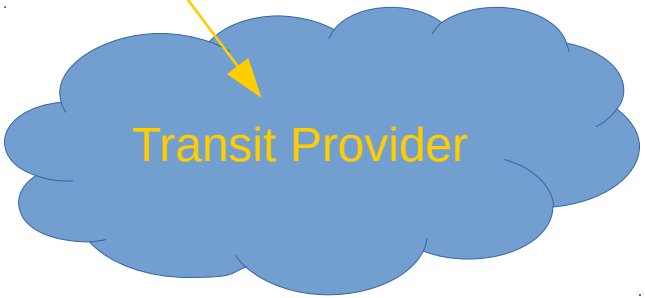


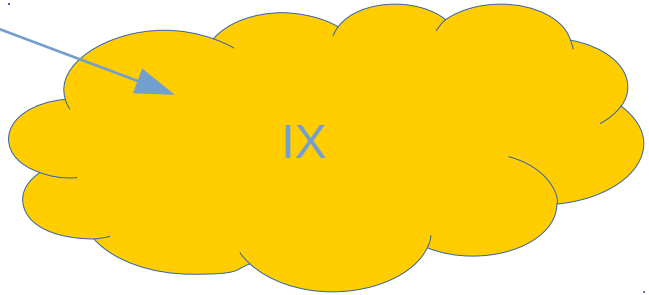


Seguridad en el PE

Amenazas


Cloud Core Router
CCR-1072-1G-8S+
MikroTik


Transit Provider


IX

Amenazas

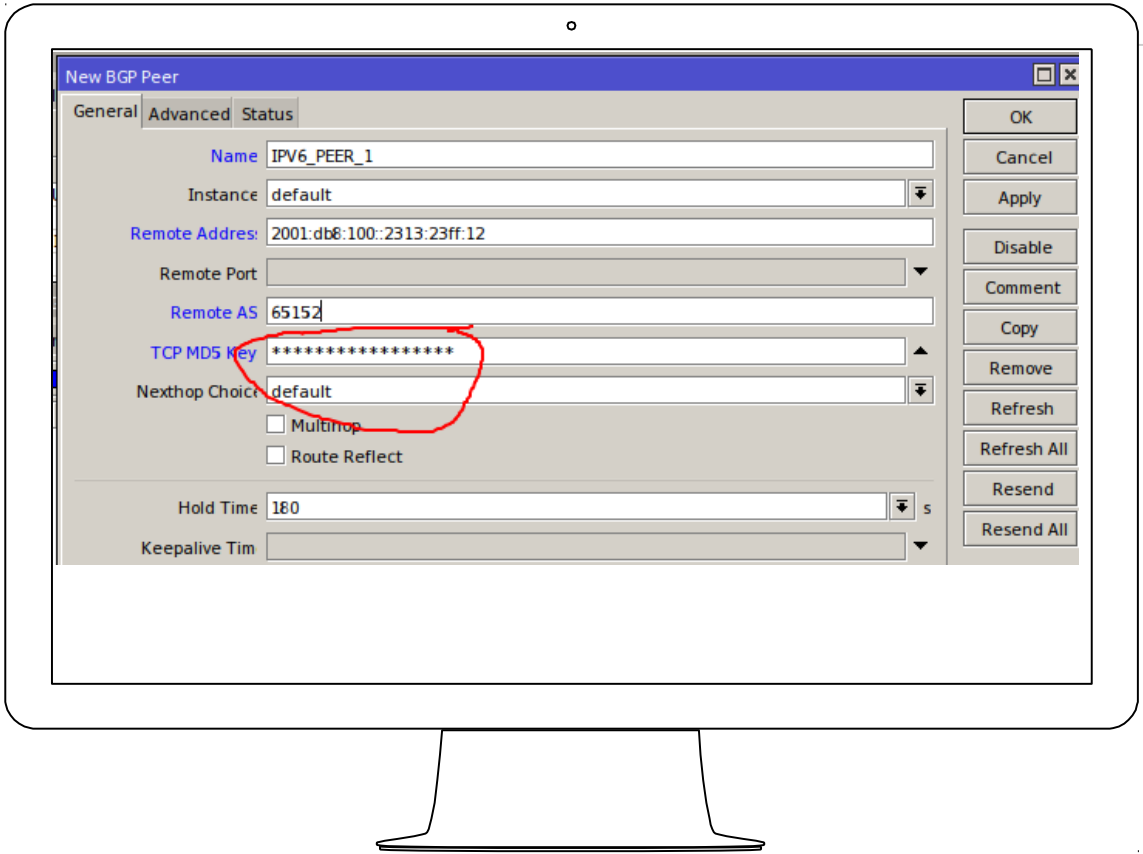
- BGP no protegido
- Tráfico entrante/saliente bogons/martians
- Tráfico no deseado RFC 4890

Proteger el PE

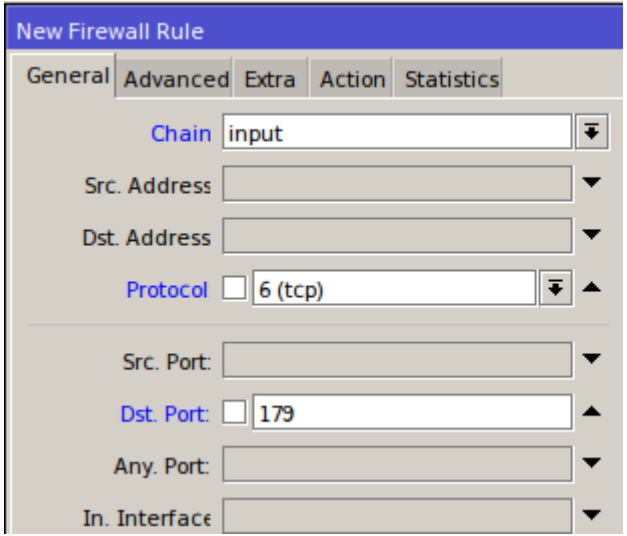
Fortificar BGP

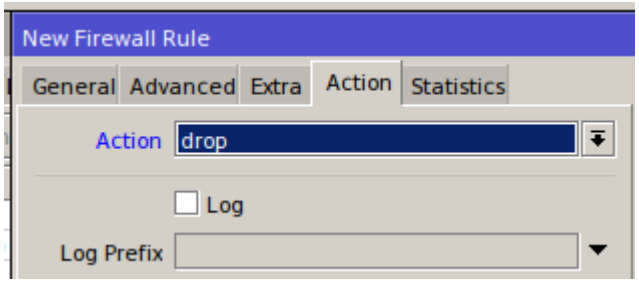
- Desactivar la instancia si no se utiliza
- Utilizar clave MD5
- Filtros en Firewall para PEERS

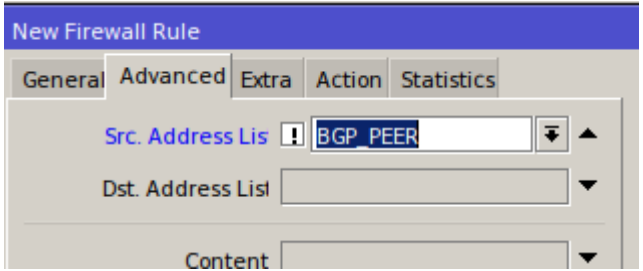
BGP: MD5

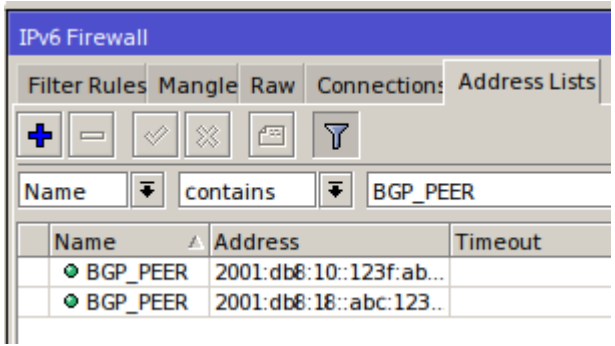

New BGP Peer
General
Advanced
Status
Name
IPV6_PEER_1
Instance
default
Remote Addres
2001:db8:100::2313:23ff:12
Remote Port
Remote AS
65152
TCP MD5 Key
Nexthop Choic
default
Multihop
Route Reflect
Hold Time
180
s
Keepalive Tim
OK
Cancel
Apply
Disable
Comment
Copy
Remove
Refresh
Refresh All
Resend
Resend All

Filtrado Peers









Proteger el PE

BGP

Bogons & Martians

Tráfico no deseado

Prefijos a filtrar

- Martians: prefijos no válidos para su uso en Internet
- Bogons: prefijos válidos sin asignar por IANA a RIR
- Full-bogons: prefijos asignados a RIR pero no a ISP

¡Se usan como dirección origen de ataques!

Martians & Bogons

Direcciones a bloquear	Descripción
::	Dirección no especificada
::1	Dirección de Loopback
::/96	Direcciones IPv4-compatibles
::ffff:0.0.0.0/96	Direcciones IPv4-mapeadas (obsoletas)
::0.0.0.0/96	Direcciones de túneles (obsoletas)

Martians & Bogons (2)

Direcciones a bloquear	Descripción
Fe80::/10	Direcciones de enlace local
Fec0::/10	Direcciones site-local (obsoletas)
Fc00::/7	Direcciones unique-local
Ff00::/8	Direcciones multicast (sólo como origen)
2001:db8::/32	Dirección de documentación

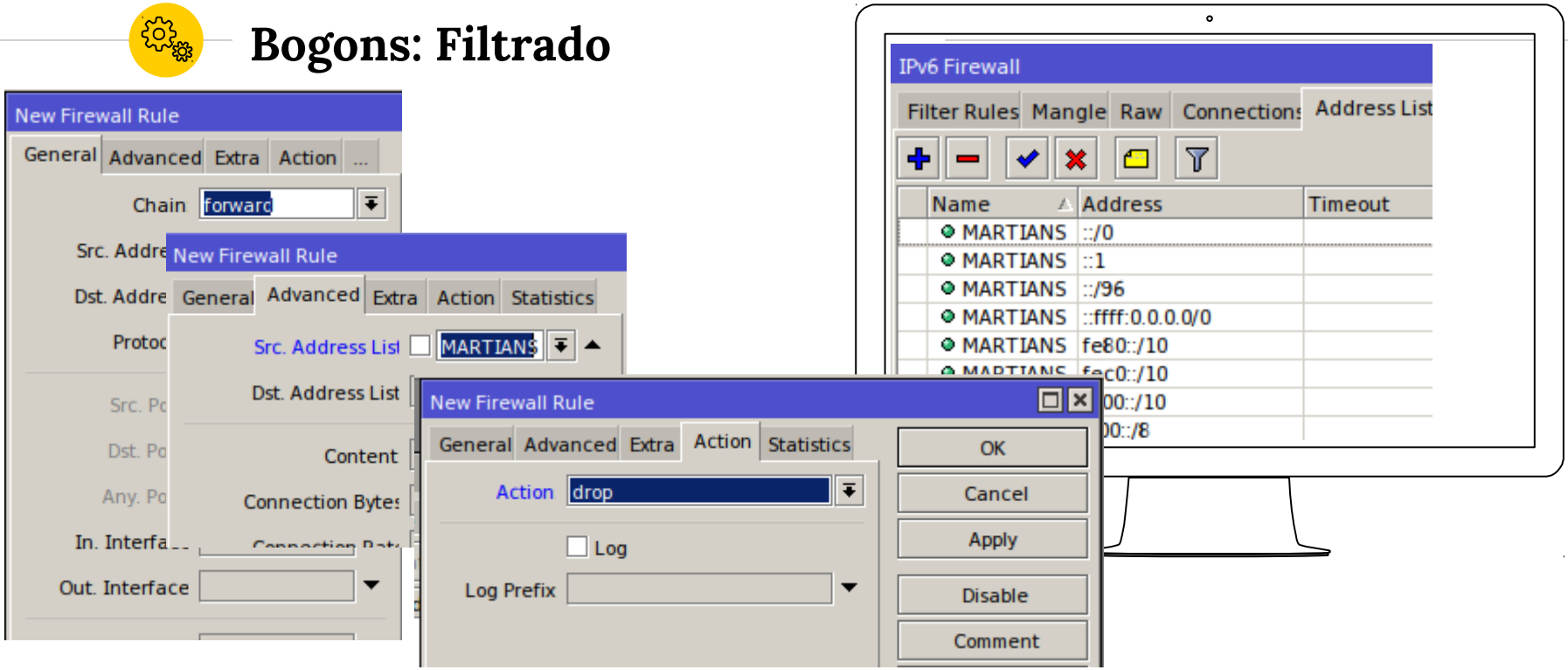
Martians & Bogons (3)

Direcciones a bloquear		Descripción
::224.0.0.0/100 ::127.0.0.0/104	::0.0.0.0/104 ::255.0.0.0/104	Otras direcciones compatibles
2002:e000::/20 2002:7f00::/24 2002:0a00::/24 2002:ac10::/28	2002::/24 2002:ff00::/24 2002:c0a8::/32	Direcciones falsas 6to4

Lista Completa: Bogons

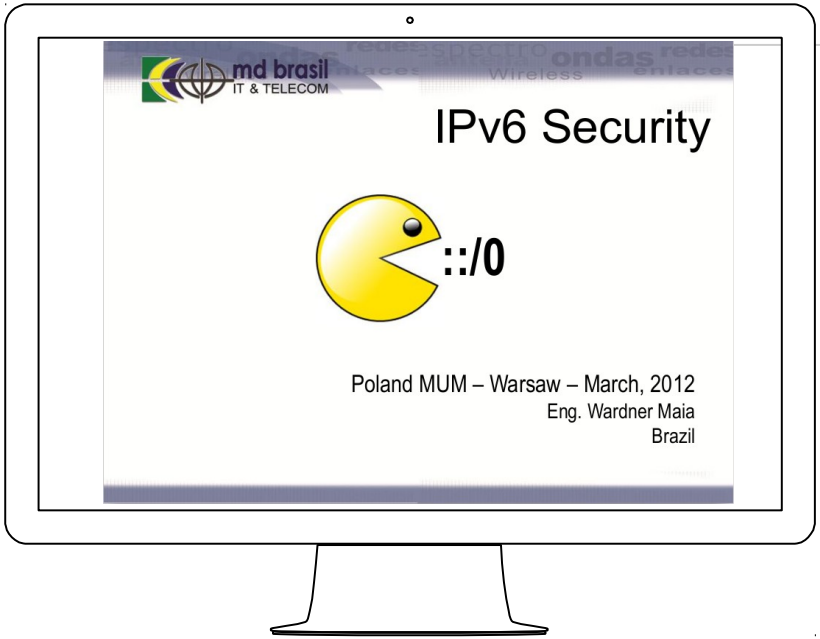
https://www.team-cymru.org/Services/Bogons/fullbogons-ipv6.txt

Bogons: Filtrado



Bogons: Filtrado

- BGP Peering con Cymru
  - Filtrado automático de B&M
- Script Address List de B&M Cymru
  - Filtrado FW entrante



Proteger el PE

RFC 4890: Recomendaciones filtros ICMPv6 en FW

- Reglas para:
  - FW de tránsito (**chain=forward**)
  - Interfaces del FW (**chain=input**)

RFC 4890: Recomendaciones filtros ICMPv6 en FW

- Categorías de Reglas para los mensajes:
  - No deben ser bloqueados
  - No deberían ser bloqueados
  - Deben ser bloqueados
  - Los administradores deben decidir si bloquear
  - Los administradores deben considerar bloquear

RFC 4890: ICMPv6 que no debe eliminarse

Mensajes de error esenciales:

- Destination Unreachable (Tipo 1) – todos los códigos
- Packet Too Big (Tipo 2)
- Time Exceeded (Tipo 3) sólo código 0
- Parameter Problem (Tipo 4) sólo códigos 1 y 2

RFC 4890: ICMPv6 que no debe eliminarse (2)

Mensajes de comprobación de conectividad:

- Echo Request (Tipo 128)
- Echo Response (Tipo 129)

RFC 4890: ICMPv6 normalmente no debe eliminarse

Otros mensajes de error

- Time Exceeded (Tipo 3) código 1
- Parameter Problem(Tipo 4) código 0

RFC 4890: ICMPv6 normalmente no debe eliminarse (2)

Mensajes para asistencia en movilidad:

- Home Agent Address Discovery Request (Tipo 144)
- Home Agent Address Discovery Reply (Tipo 145)
- Mobile Prefix Solicitation (Tipo 146)
- Mobile Prefix Advertisement (Tipo 147)

RFC 4890: ICMPv6 normalmente se elimina

Mensajes Address Conf. Y Router Sel. (deben recibirse con hop limit = 255)

- Router Solicitation (Tipo 133)
- Router Advertisement (Tipo 134)
- Neighbor Solicitation (Tipo 135)
- Neighbor Advertisement (Tipo 136)

RFC 4890: ICMPv6 normalmente se elimina (2)

- Redirect (Tipo 137)
- Inverse Neighbor Discovery Solicitation (Tipo 141)
- Inverse Neighbor Discovery Advert. (Tipo 142)

RFC 4890: ICMPv6 normalmente se elimina (3)

Link-local multicast receiver notification messages
(deben recibirse con dirección de origen link-local)

- Listener Query (Tipo 130)
- Listener Report (Tipo 131)
- Listener Done (Tipo 132)
- Listener Report v2 (Tipo 143)

RFC 4890: ICMPv6 normalmente se elimina (4)

Mensajes de notificación SEND Certificate Path (deben recibirse con hop limit = 255)

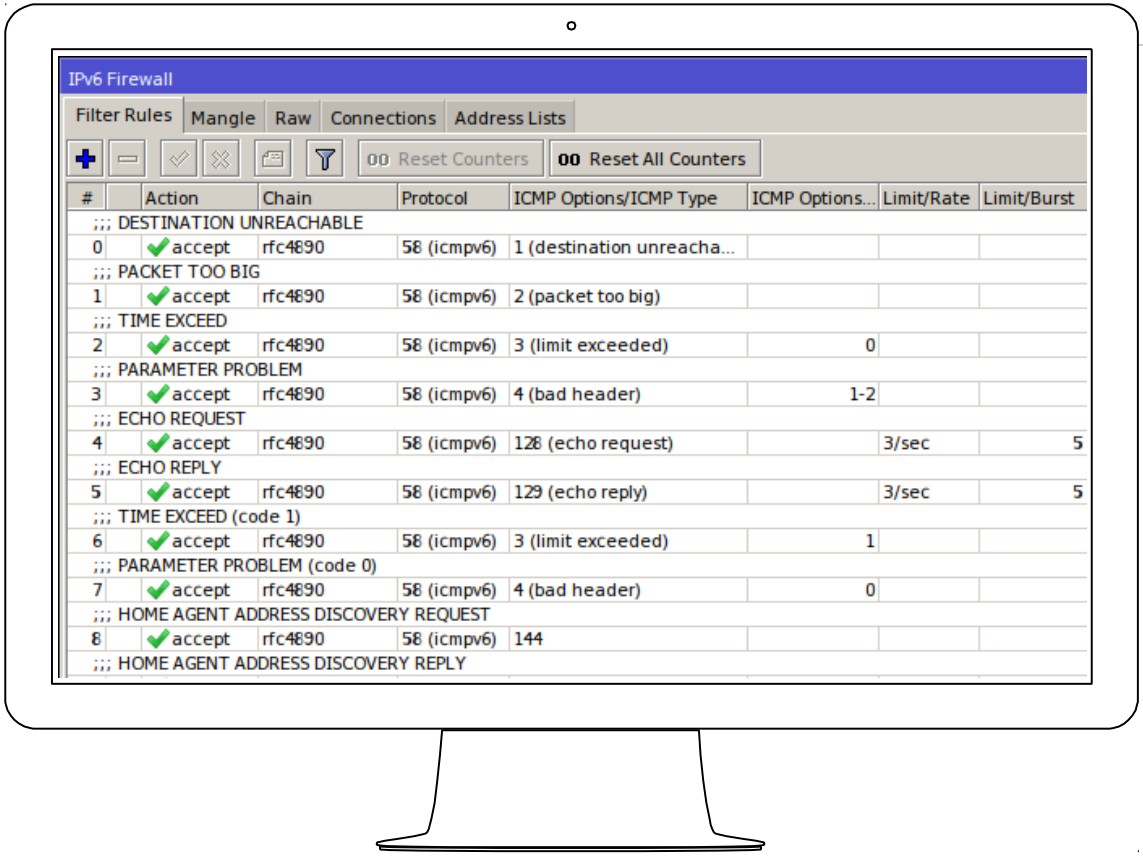
- Certificate Path Solicitation (Tipo 148)
- Certificate Path Advertisement (Tipo 149)

RFC 4890: ICMPv6 normalmente se elimina (5)

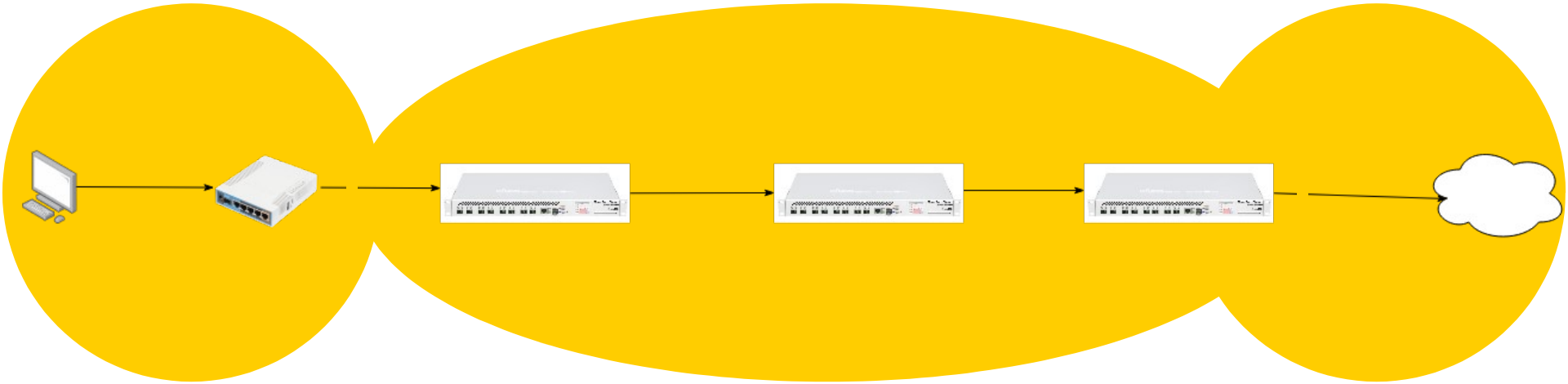
Mensajes Multicast Router Discovery (deben recibirse con hop limit = 1 y dirección de origen link-local)

- Multicast Router Advertisement (Tipo 151)
- Multicast Router Solicitation (Tipo 152)
- Multicast Router Termination (Tipo 153)

RFC 4890



#		Action	Chain	Protocol	ICMP Options/ICMP Type	ICMP Options...	Limit/Rate	Limit/Burst
;;; DESTINATION UNREACHABLE								
0		accept	rfc4890	58 (icmpv6)	1 (destination unreacha...			
;;; PACKET TOO BIG								
1		accept	rfc4890	58 (icmpv6)	2 (packet too big)			
;;; TIME EXCEED								
2		accept	rfc4890	58 (icmpv6)	3 (limit exceeded)	0		
;;; PARAMETER PROBLEM								
3		accept	rfc4890	58 (icmpv6)	4 (bad header)	1-2		
;;; ECHO REQUEST								
4		accept	rfc4890	58 (icmpv6)	128 (echo request)		3/sec	5
;;; ECHO REPLY								
5		accept	rfc4890	58 (icmpv6)	129 (echo reply)		3/sec	5
;;; TIME EXCEED (code 1)								
6		accept	rfc4890	58 (icmpv6)	3 (limit exceeded)	1		
;;; PARAMETER PROBLEM (code 0)								
7		accept	rfc4890	58 (icmpv6)	4 (bad header)	0		
;;; HOME AGENT ADDRESS DISCOVERY REQUEST								
8		accept	rfc4890	58 (icmpv6)	144			
;;; HOME AGENT ADDRESS DISCOVERY REPLY								



Seguridad en la Red

Entonces...

...¿se acabaron los problemas de seguridad?

La Seguridad...

- No es un producto, sino un proceso
- Debe ser, principalmente, proactiva...
  ... y no reactiva
- No tiene por qué ser complicada

Si van a implantar IPv6

- Asesórense
- Fórmense
- Tengan en cuenta las RFC

- Traten de hacerlo seguro desde el inicio

Recuerden...

¡Gracias!

¿Preguntas?

Puedes contactar conmigo en

- @jprietove
- info@jprietove.com

Bibliografía y Referencias

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- RFC 4301 Security Architecture for the Internet Protocol, http://bit.ly/IPv6RFC4301
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- RFC 6092 Recommended Simple Sec. Cap. in CPE for Residential IPv6, http://bit.ly/IPv6RFC6092
- RFC 7217 A method for generating semantically opaque IID with IPv6 SLAAC, http://bit.ly/IPv6RFC7217
- RFC 7707 Network Reconnaissance in IPv6 Networks, http://bit.ly/IPv6RFC7707
- RFC 8200 Internet Protocol, Version 6 (IPv6) Specification, http://bit.ly/IPv6RFC8200

5 Anexos

Reglas Filtrado Evitar Ping Pág. 18

- /ipv6 firewall filter

  add action=drop chain=input icmp-options=128:0-255 protocol=icmpv6

Reglas Filtrado Ping Multicast Pág. 25

- /ipv6 firewall address-list
- add address=ff02::1/128 list=MULTICAST
- add address=ff02::2/128 list=MULTICAST
- add address=ff02::5/128 list=MULTICAST
- add address=ff02::6/128 list=MULTICAST
- add address=ff02::9/128 list=MULTICAST
- add address=ff02::d/128 list=MULTICAST
- add address=ff02::1:2/128 list=MULTICAST
- /ipv6 firewall filter
- add action=drop chain=input dst-address-list=MULTICAST icmp-options=128:0-255 \
- protocol=icmpv6

Reglas Filtrado CPE Pág. 63. (1 de 2)

```
/ipv6 firewall filter
add action=accept chain=forward comment=\
    "PERMITIR CONEXIONES ORIGINADAS POR CLIENTE" connection-state=\
    established,related,untracked in-interface-list=WAN
add action=accept chain=forward comment=\
    "PERMITIR S\D3LO DIRECCIONES IPv6 DEL CLIENTE" dst-address=\
    2001:db8:1234::/64 in-interface-list=WAN
add action=drop chain=forward comment="DENEGAR MULTICAST" dst-address-list=\
    MULTICAST
add action=accept chain=forward comment="ICMP ECHO REPLY" icmp-options=\
    129:0-255 in-interface-list=WAN protocol=icmpv6
```

Reglas Filtrado CPE Pág. 63. (2 de 2)

```
add action=accept chain=forward comment="ICMP DESTINATION UNREACHABLE" \
    icmp-options=1:0-255 in-interface-list=WAN protocol=icmpv6
add action=accept chain=forward comment="ICMP PACKET TOO BIG" icmp-options=\
    2:0-255 in-interface-list=WAN protocol=icmpv6
add action=accept chain=forward comment="ICMP LIMIT EXCEED" icmp-options=\
    3:0-255 in-interface-list=WAN protocol=icmpv6
add action=accept chain=forward comment="ICMP BAD HEADER" icmp-options=\
    4:0-255 in-interface-list=WAN protocol=icmpv6
add action=drop chain=forward comment="DENEGAR WAN->LAN" in-interface-list=\
    WAN
```

Reglas Filtrado OSPF-v3
Pág. 76.

- /ipv6 firewall filter
- add chain=input dst-address=ff02::5 src-address-list=!OSPF_ROUTERS action=drop
- add chain=input dst-address=ff02::6 src-address-list=!OSPF_ROUTERS action=drop

IPSec en OSPF-v3. Túnel Gre. Pág. 79

- ## Router 1
- /interface gre6
- add ipsec-secret="\A1Secreto!" local-address=2001:db8:123::1 name=gre-13 \
- remote-address=2001:db8:123::3
- /routing ospf-v3 interface
- add area=backbone interface=gre-13 network-type=point-to-point
-
- ## Router 3
- /interface gre6
- add ipsec-secret="\A1Secreto!" local-address=2001:db8:123::3 name=gre-13 \
- remote-address=2001:db8:123::1
- /routing ospf-v3 interface
- add area=backbone interface=gre-13 network-type=point-to-point

Regla de Filtrado BGP Peer. Pág. 87

- /ipv6 firewall filter add chain=input protocol=tcp dst-port=179 src-address-list=!BGP_PEER action=drop

Regla de Filtrado Bogons. (1 de 2). Pág. 94

- /ipv6 firewall address-list
- add list=MARTIANS
- add address=::1/128 list=MARTIANS
- add address=::/96 list=MARTIANS
- add address=::ffff:0.0.0.0/96 list=MARTIANS
- add address=fe80::/10 list=MARTIANS
- add address=fec0::/10 list=MARTIANS
- add address=fc00::/10 list=MARTIANS
- add address=ff00::/8 list=MARTIANS
- add address=2001:db8::/32 list=MARTIANS
- add address=::224.0.0.0/100 list=MARTIANS
- add address=::127.0.0.0/104 list=MARTIANS
- add address=::/104 list=MARTIANS

Regla de Filtrado Bogons. (2 de 2). Pág. 94

- /ipv6 firewall address-list
- add address=::255.0.0.0/104 list=MARTIANS
- add address=2002:e000::/20 list=MARTIANS
- add address=2002:7f00::/24 list=MARTIANS
- add address=2002:a00::/24 list=MARTIANS
- add address=2002:ac10::/28 list=MARTIANS
- add address=2002::/24 list=MARTIANS
- add address=2002:ff00::/24 list=MARTIANS
- add address=2002:c0a8::/32 list=MARTIANS

RFC 4890. (1 de 7). Pág. 108

```
/ipv6 firewall filter
add action=accept chain=rfc4890 comment="DESTINATION UNREACHABLE" \
    icmp-options=1:0-255 protocol=icmpv6
add action=accept chain=rfc4890 comment="PACKET TOO BIG" icmp-options=2:0-255 \
    protocol=icmpv6
add action=accept chain=rfc4890 comment="TIME EXCEED" icmp-options=3:0 \
    protocol=icmpv6
add action=accept chain=rfc4890 comment="PARAMETER PROBLEM" icmp-options=\
    4:1-2 protocol=icmpv6
```

RFC 4890. (2 de 7). Pág. 108

```
/ipv6 firewall filter
add action=accept chain=rfc4890 comment="ECHO REQUEST" icmp-options=128:0-255 \
    limit=3,5:packet protocol=icmpv6
add action=accept chain=rfc4890 comment="ECHO REPLY" icmp-options=129:0-255 \
    limit=3,5:packet protocol=icmpv6
```

RFC 4890. (4 de 7). Pág. 108

- /ipv6 firewall filter
- add action=accept chain=rfc4890 comment=\
- "HOME AGENT ADDRESS DISCOVERY REQUEST" icmp-options=144:0-255 protocol=\
- icmpv6
- add action=accept chain=rfc4890 comment="HOME AGENT ADDRESS DISCOVERY REPLY" \
- icmp-options=145:0-255 protocol=icmpv6
- add action=accept chain=rfc4890 comment="MOBILE PREFIX SOLICITATION" \
- icmp-options=146:0-255 protocol=icmpv6
- add action=accept chain=rfc4890 comment="MOBILE PREFIX ADVERTISEMENT" \
- icmp-options=147:0-255 protocol=icmpv6

RFC 4890. (5 de 7). Pág. 108

- /ipv6 firewall filter
- add action=drop chain=rfc4890 comment="ROUTER SOLICITATION" icmp-options=\
- 133:0-255 protocol=icmpv6
- add action=drop chain=rfc4890 comment="ROUTER ADVERTISEMENT" icmp-options=\
- 134:0-255 protocol=icmpv6
- add action=drop chain=rfc4890 comment="NEIGHBOR SOLICITATION" icmp-options=\
- 135:0-255 protocol=icmpv6
- add action=drop chain=rfc4890 comment="NEIGHBOR ADVERTISEMENT" icmp-options=\
- 136:0-255 protocol=icmpv6

RFC 4890. (6 de 7). Pág. 108

- /ipv6 firewall filter
- add action=drop chain=rfc4890 comment=REDIRECT icmp-options=137:0-255 \
- protocol=icmpv6
- add action=drop chain=rfc4890 comment=\
- "INVERSE NEIGHBOR DISCOVERY SOLICITATION" icmp-options=141:0-255 \
- protocol=icmpv6
- add action=drop chain=rfc4890 comment=\
- "INVERSE NEIGHBOR DISCOVERY ADVERTISEMENT" icmp-options=142:0-255 \
- protocol=icmpv6

RFC 4890. (7 de 7). Pág. 108

- /ipv6 firewall filter
- add action=drop chain=rfc4890 comment="LISTENER QUERY" icmp-options=130:0-255 \
- protocol=icmpv6
- add action=drop chain=rfc4890 comment="LISTENER REPORT" icmp-options=\
- 131:0-255 protocol=icmpv6
- add action=drop chain=rfc4890 comment="LISTENER DONE" icmp-options=132:0-255 \
- protocol=icmpv6
- add action=drop chain=rfc4890 comment="LISTENER REPORT V2" icmp-options=\
- 143:0-255 protocol=icmpv6
- /ipv6 firewall filter
- add action=drop chain=rfc4890 comment="DROP THE REST OF ICMPv6" protocol=\
- icmpv6