IPv6 na última milha com PPPoE

Minitutorial

Eduardo Barasal Morales
emorales@nic.br
ipv6@nic.br

Agenda

- Motivação
- PPPoE
- SLAAC
- DHCPv6-PD
- Cenário completo
- Laboratório

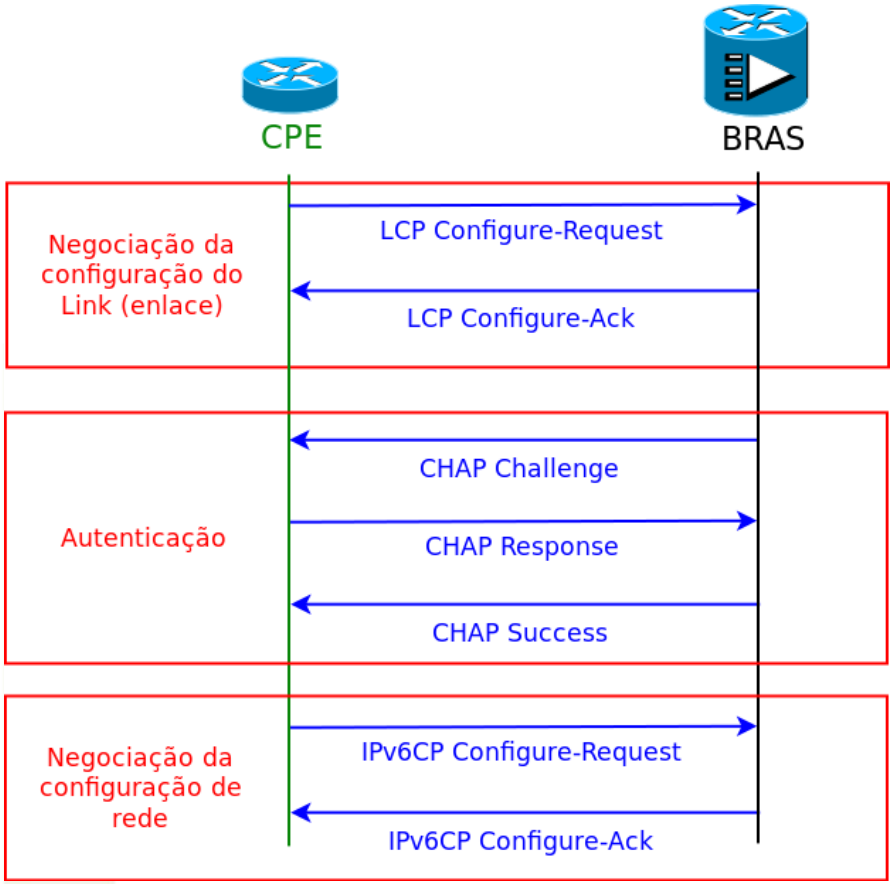
Motivação

- Esgotamento dos endereços IPv4
- Necessidade de implantação do IPv6
- Alunos do curso queriam saber mais sobre o assunto
- Ter uma noção do estado da implementação do IPv6 nos roteadores e nas aplicações

PPPoE

- *Point-to-Point Protocol over Ethernet*
- Fases para o estabelecimento da sessão
  - Estabelecimento do link
    - *Link Control Protocol* (LCP)
  - Autenticação
    - *Challenge Authentication Protocol* (CHAP)
    - *Password Authentication Protocol* (PAP)
  - Negociação da configuração do protocolo da camada de rede
    - *Network Control Protocol* (NCP) - ex: IPCP e o IPv6CP

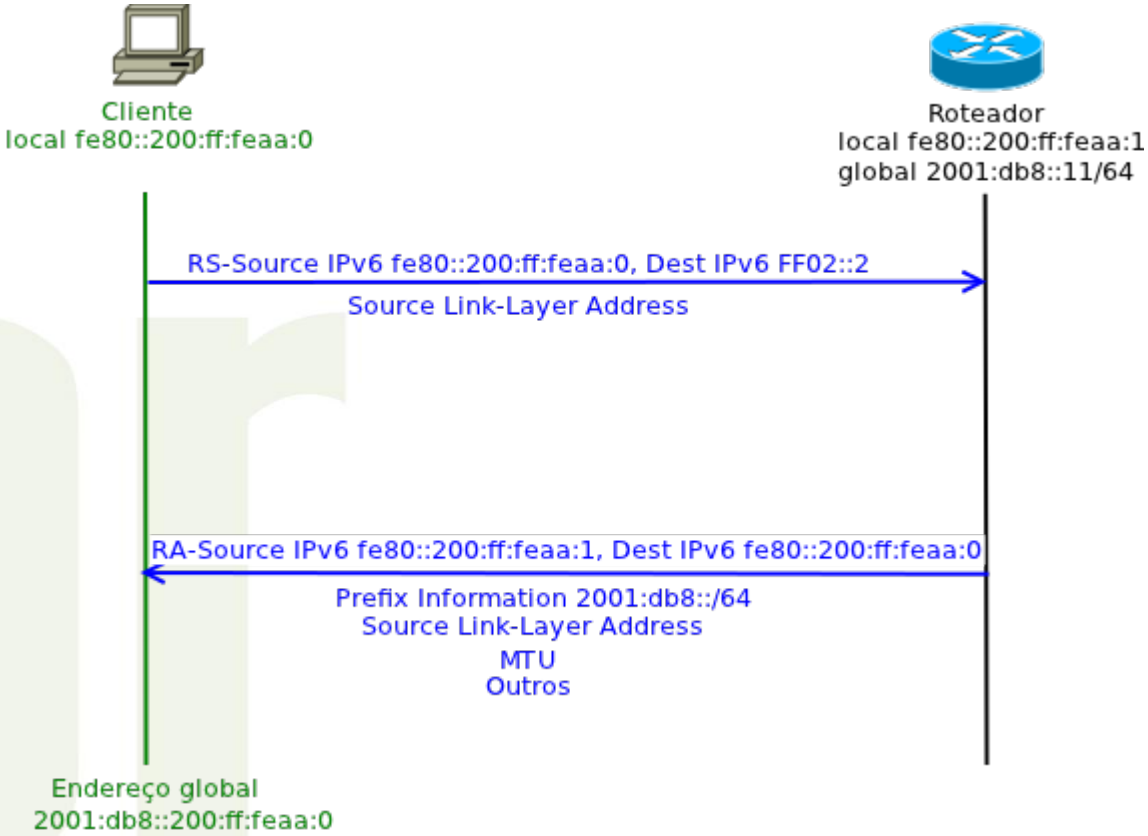
PPPoE


CPE
BRAS
Negociação da configuração do Link (enlace)
LCP Configure-Request
LCP Configure-Ack
Autenticação
CHAP Challenge
CHAP Response
CHAP Success
Negociação da configuração de rede
IPv6CP Configure-Request
IPv6CP Configure-Ack

SLAAC

- *Stateless address autoconfiguration*
- Utiliza mensagens ICMPv6
- Neighbor Discovery Protocol (NDP)
  - Router Solicitation (RS)
  - Router Advertisement (RA)
    - Flags
    - Prefix Information

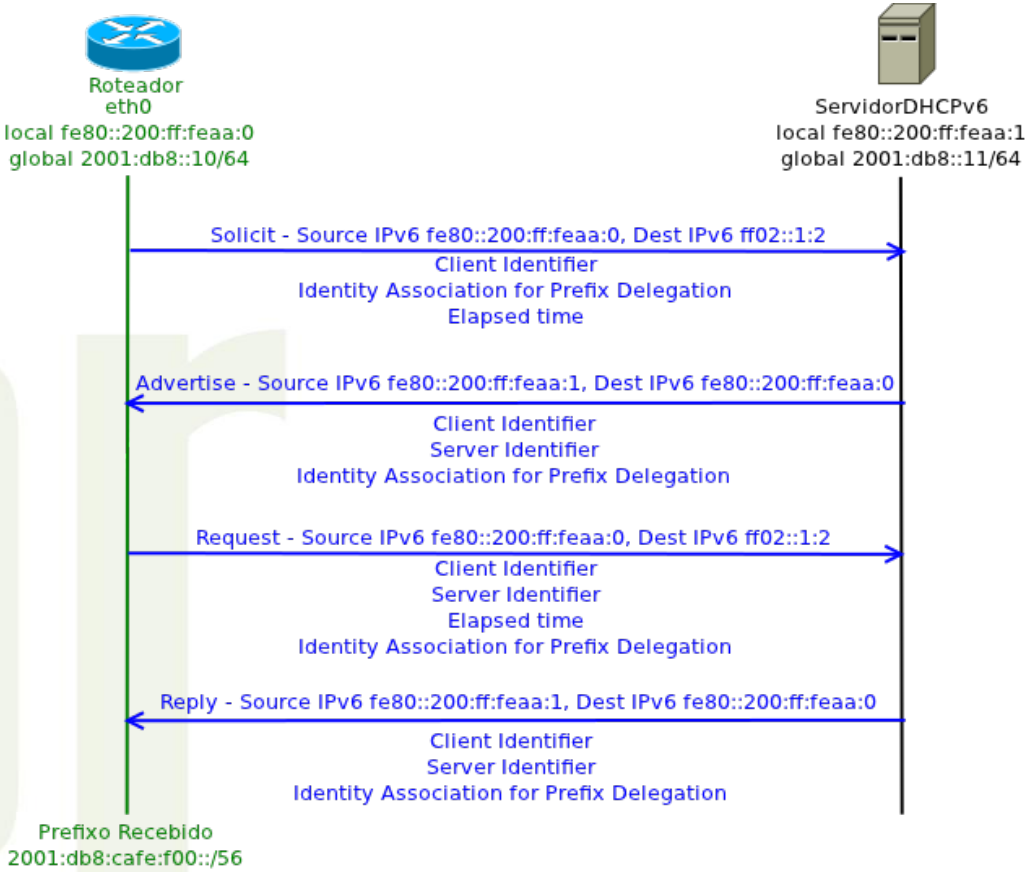
SLAAC


Cliente
local fe80::200:ff:feaa:0
Roteador
local fe80::200:ff:feaa:1
global 2001:db8::11/64
RS-Source IPv6 fe80::200:ff:feaa:0, Dest IPv6 FF02::2
Source Link-Layer Address
RA-Source IPv6 fe80::200:ff:feaa:1, Dest IPv6 fe80::200:ff:feaa:0
Prefix Information 2001:db8::/64
Source Link-Layer Address
MTU
Outros
Endereço global
2001:db8::200:ff:feaa:0

DHCPv6-PD

- *Dynamic Host Configuration Protocol - prefix delegation*
- Delega prefixos de maneira Statefull
- Mesma mensagens DHCPv6
  - 4 mensagens básicas
    - Solicit
    - Advertise
    - Request
    - Reply
  - Adição do Identity Association for Prefix Delegation

DHCPv6-PD

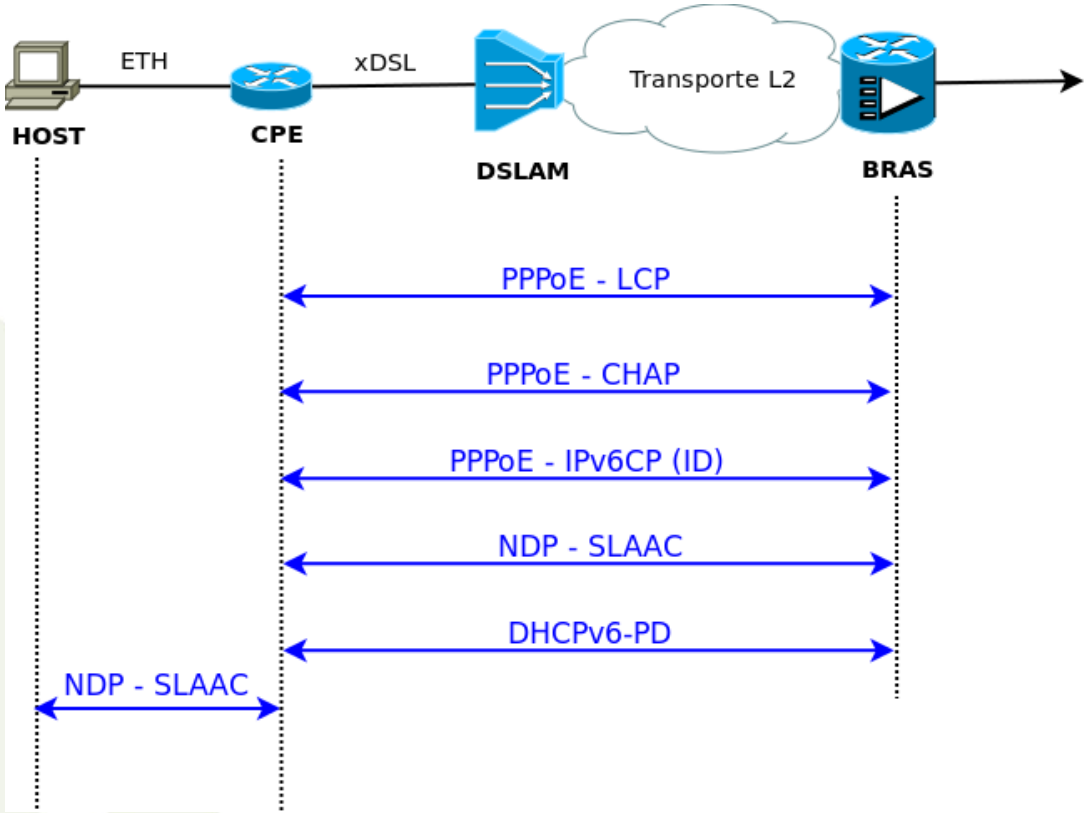

Roteador
eth0
local fe80::200:ff:feaa:0
global 2001:db8::10/64
ServidorDHCPv6
local fe80::200:ff:feaa:1
global 2001:db8::11/64
Solicit - Source IPv6 fe80::200:ff:feaa:0, Dest IPv6 ff02::1:2
Client Identifier
Identity Association for Prefix Delegation
Elapsed time
Advertise - Source IPv6 fe80::200:ff:feaa:1, Dest IPv6 fe80::200:ff:feaa:0
Client Identifier
Server Identifier
Identity Association for Prefix Delegation
Request - Source IPv6 fe80::200:ff:feaa:0, Dest IPv6 ff02::1:2
Client Identifier
Server Identifier
Elapsed time
Identity Association for Prefix Delegation
Reply - Source IPv6 fe80::200:ff:feaa:1, Dest IPv6 fe80::200:ff:feaa:0
Client Identifier
Server Identifier
Identity Association for Prefix Delegation
Prefixo Recebido
2001:db8:cafe:f00::/56

Cenário completo

- Modos de implementação
  - SLAAC (**WAN**) + DHCPv6-PD (**LAN**) - atual
  - DHCPv6 Statefull (**WAN**) + DHCPv6-PD (**LAN**) - tendencia

- Recomendações
  - Trabalhar com endereços globais
  - Sessão PPPoE: /64 para cada usuário (WAN CPE)
  - DHCPv6-PD: /56 para cada usuário (LAN CPE)

Cenário 1

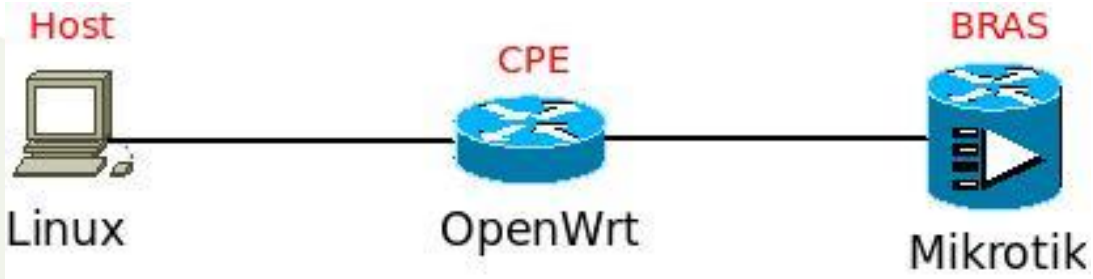

ETH
xDSL
Transporte L2
HOST
CPE
DSLAM
BRAS
PPPoE - LCP
PPPoE - CHAP
PPPoE - IPv6CP (ID)
NDP - SLAAC
DHCPv6-PD
NDP - SLAAC

Laboratório

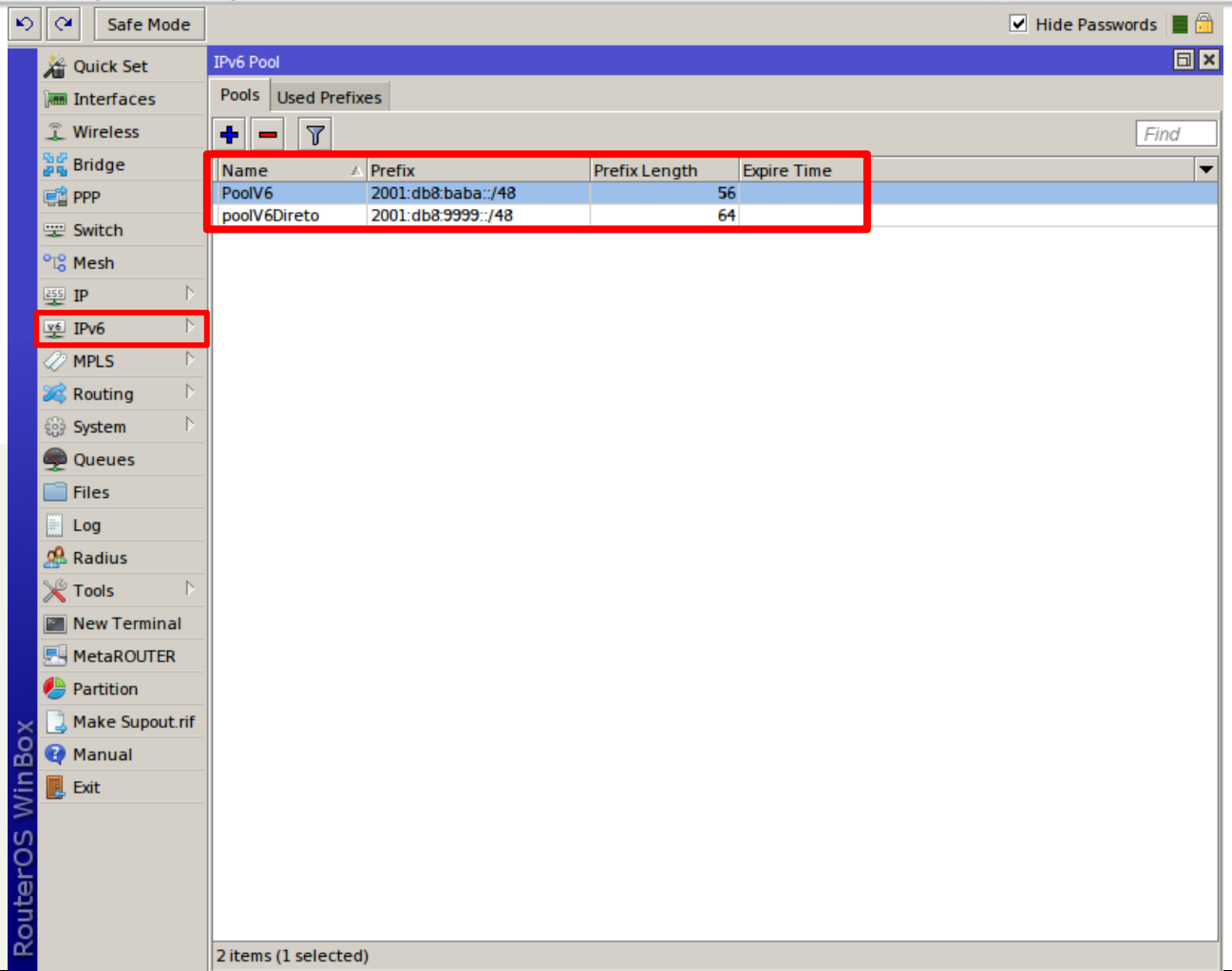
- Materiais
  - BRAS - Mikrotik RB433 - v6.18
  - CPE - TP-Link TL-WR1043ND - Barrier Breaker 14.07
  - Host - Notebook Linux - Ubuntu 14.04

Laboratório

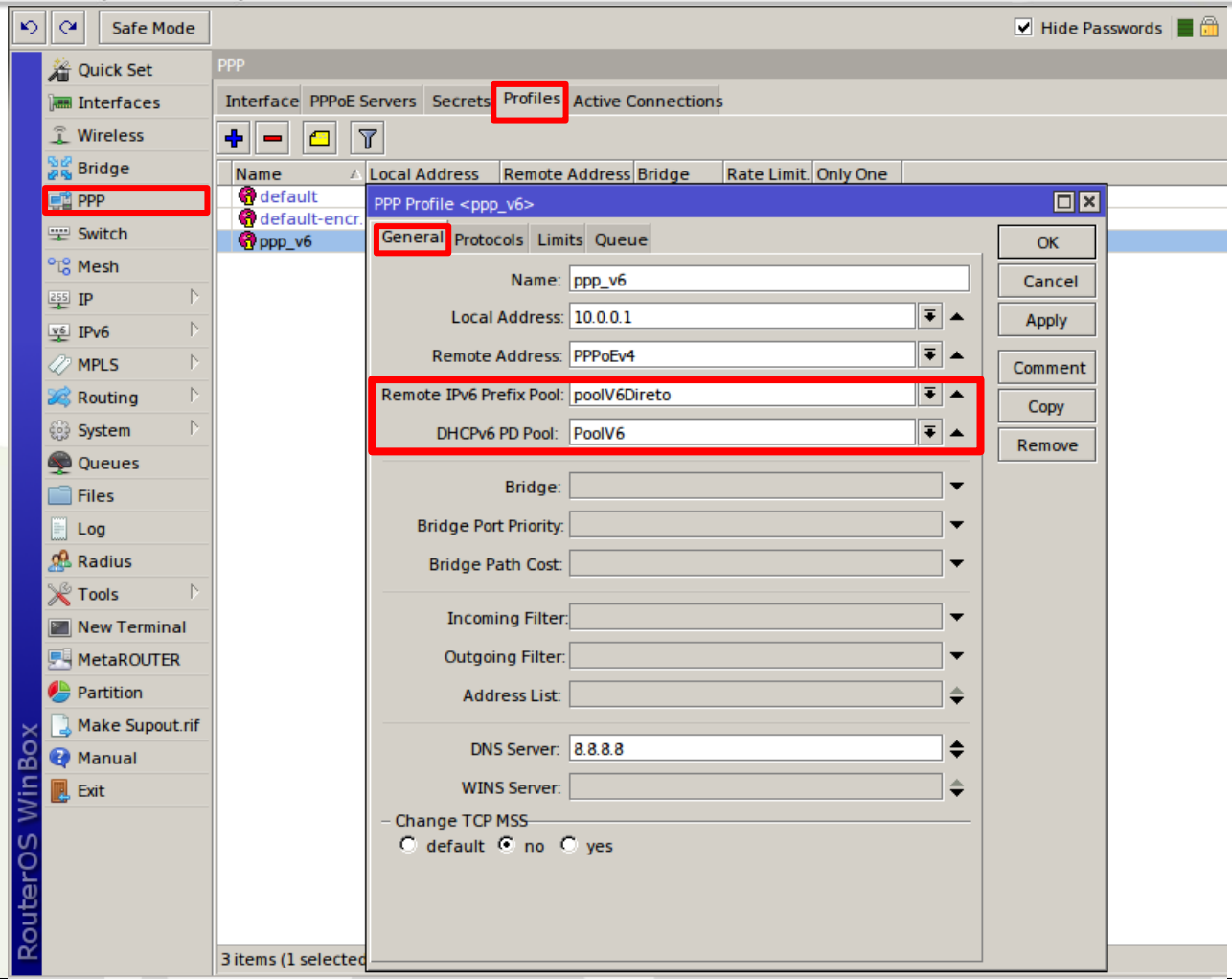
- Cenário 1



BRAS


Safe Mode
Hide Passwords
Quick Set
Interfaces
Wireless
Bridge
PPP
Switch
Mesh
IP
IPv6
MPLS
Routing
System
Queues
Files
Log
Radius
Tools
New Terminal
MetaROUTER
Partition
Make Supout.rif
Manual
Exit
RouterOS WinBox
IPv6 Pool
Pools
Used Prefixes
Find
Name
Prefix
Prefix Length
Expire Time
PoolV6
2001:db8:baba::/48
56
poolV6Direto
2001:db8:9999::/48
64
2 items (1 selected)

BRAS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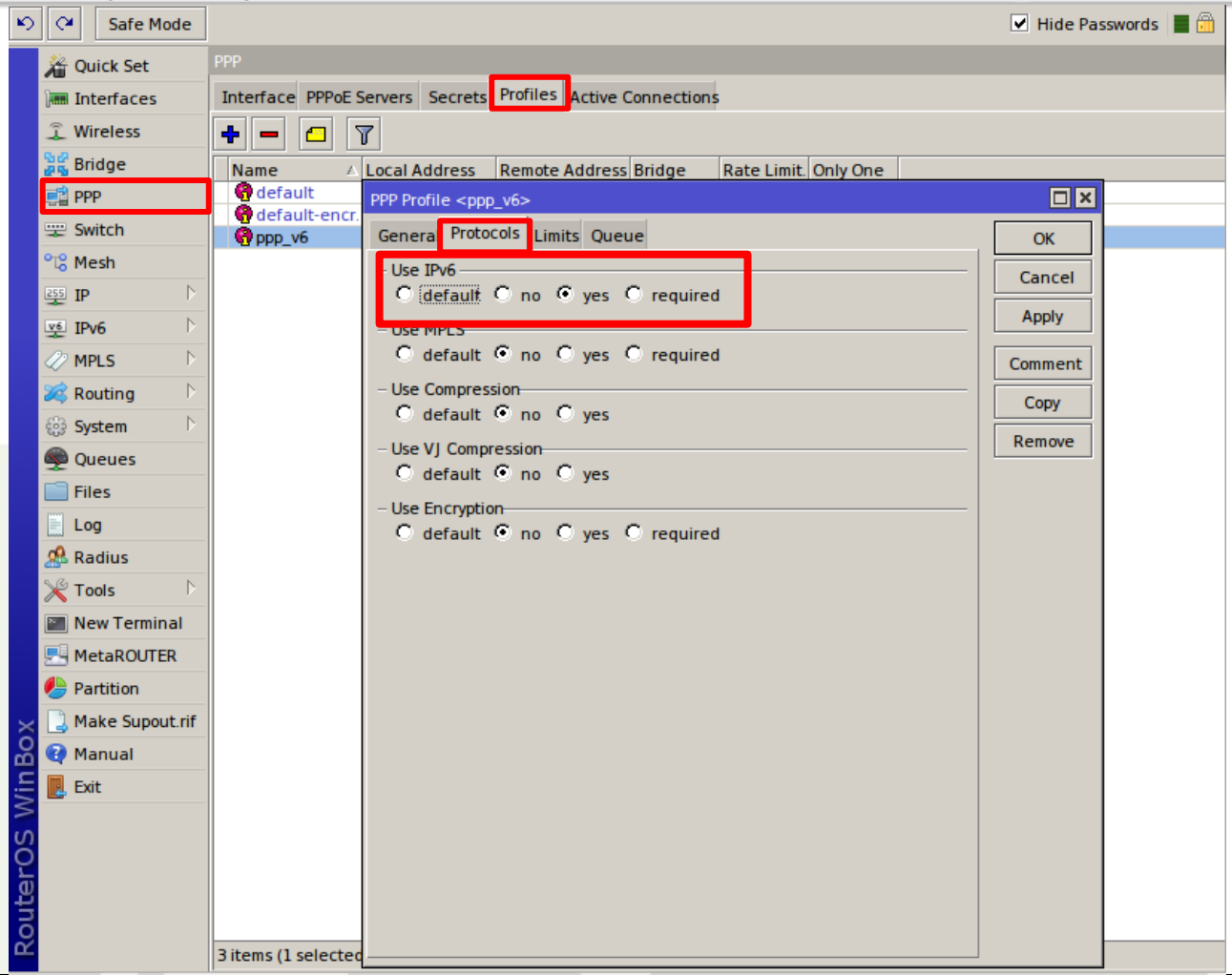
Files
Log
Radius
Tools
New Terminal
MetaROUTER
Partition
Make Supout.rif
Manual
Exit
PPP
Interface
PPPoE Servers
Secrets
Profiles
Active Connections
Name
Local Address
Remote Address
Bridge
Rate Limit
Only One
default
default-encr.
ppp_v6
3 items (1 selected
PPP Profile <ppp_v6>
General
Protocols
Limits
Queue
OK
Cancel
Apply
Comment
Copy
Remove
Name: ppp_v6
Local Address: 10.0.0.1
Remote Address: PPPoEv4
Remote IPv6 Prefix Pool: poolV6Direto
DHCPv6 PD Pool: PoolV6
Bridge:
Bridge Port Priority:
Bridge Path Cost:
Incoming Filter:
Outgoing Filter:
Address List:
DNS Server: 8.8.8.8
WINS Server:
Change TCP MSS
default
no
yes

BRAS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Bridge
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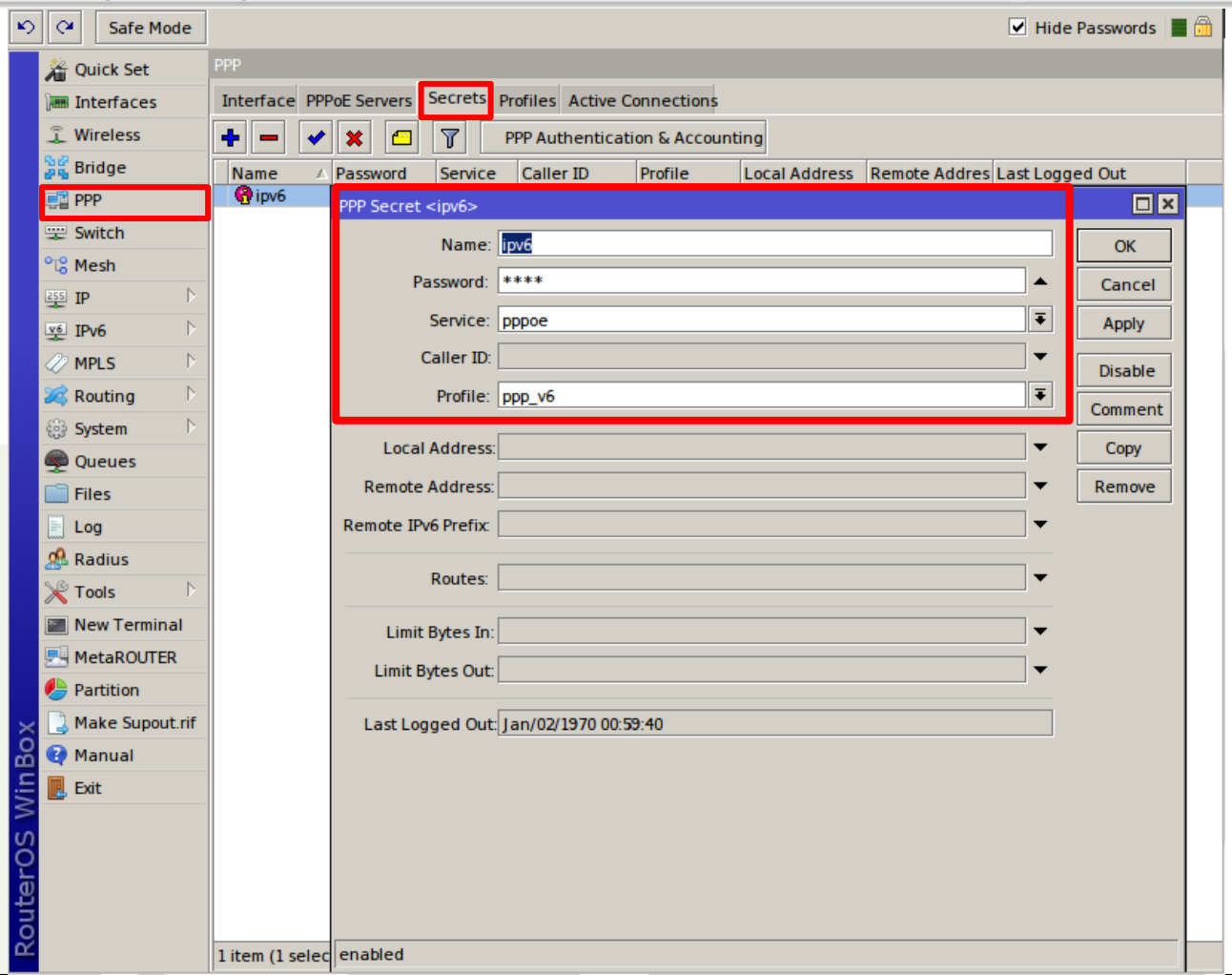
ppp_v6
3 items (1 selected
PPP Profile <ppp_v6>
Genera
Protocols
Limits
Queue
OK
Cancel
Apply
Comment
Copy
Remove
Use IPv6
default
no
yes
required
Use MPLS
default
no
yes
required
Use Compression
default
no
yes
Use VJ Compression
default
no
yes
Use Encryption
default
no
yes
required

BRAS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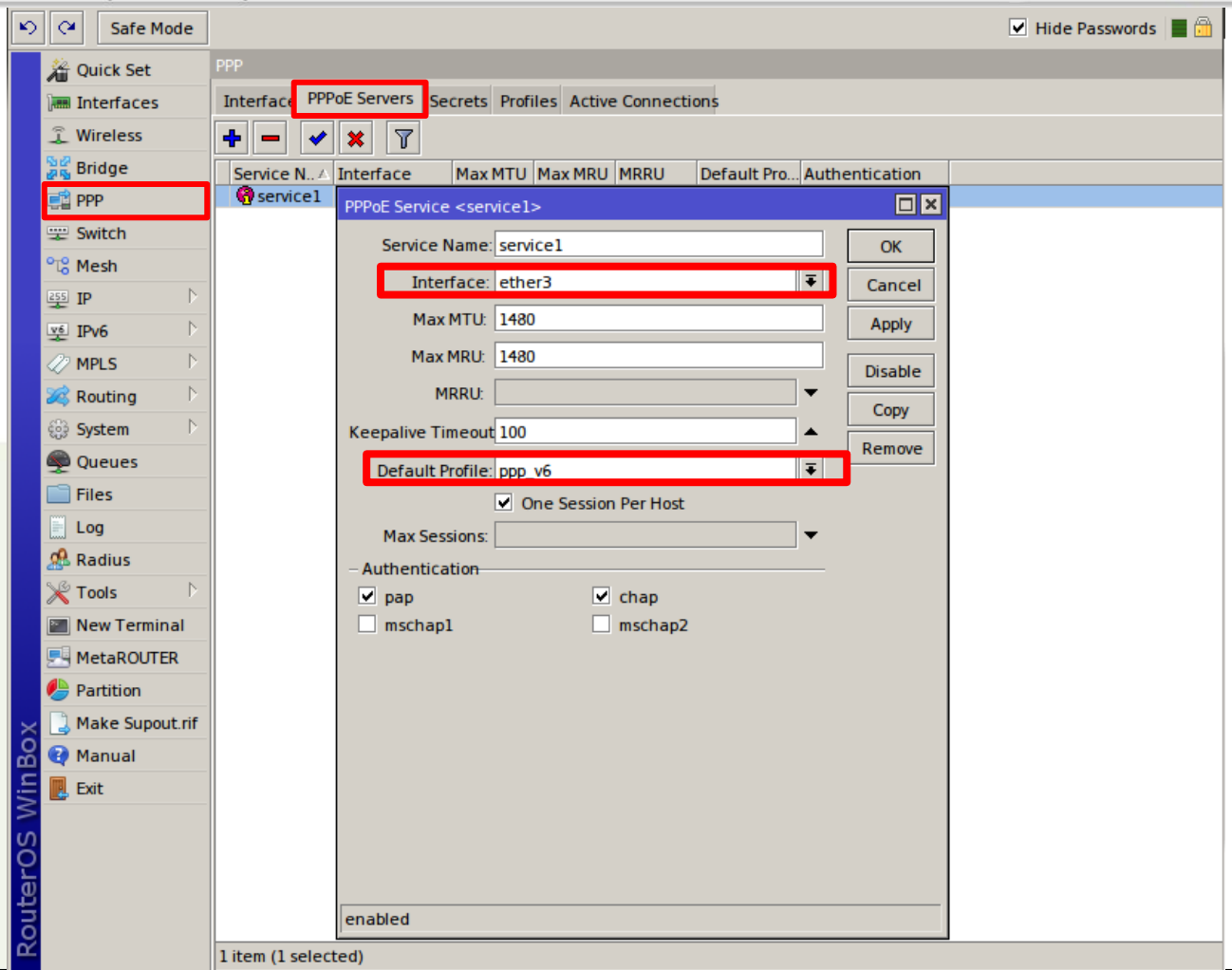
Make Supout.rif
Manual
Exit
RouterOS WinBox
PPP
Interface
PPPoE Servers
Secrets
Profiles
Active Connections
PPP Authentication & Accounting
Name
Password
Service
Caller ID
Profile
Local Address
Remote Addres
Last Logged Out
ipv6
PPP Secret <ipv6>
Name: ipv6
Password: ****
Service: pppoe
Caller ID:
Profile: ppp_v6
Local Address:
Remote Address:
Remote IPv6 Prefix:
Routes:
Limit Bytes In:
Limit Bytes Out:
Last Logged Out: Jan/02/1970 00:59:40
OK
Cancel
Apply
Disable
Comment
Copy
Remove
1 item (1 selec
enabled

BRAS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Manual
Exit
PPP
Interface
PPPoE Servers
Secrets
Profiles
Active Connections
Service N...
Interface
Max MTU
Max MRU
MRRU
Default Pro...
Authentication
service1
PPPoE Service <service1>
Service Name: service1
Interface: ether3
Max MTU: 1480
Max MRU: 1480
MRRU:
Keepalive Timeout: 100
Default Profile: ppp_v6
One Session Per Host
Max Sessions:
Authentication
pap
chap
mschap1
mschap2
OK
Cancel
Apply
Disable
Copy
Remove
enabled
1 item (1 selected)

Common Configuration

General Setup | Advanced Settings | Physical Settings | Firewall Settings

Status

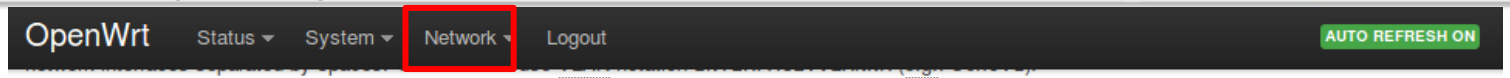
pppoe-wan

Uptime: 2h 51m 51s
RX: 191.29 KB (1999 Pkts.)
TX: 134.43 KB (1977 Pkts.)
IPv4: 192.168.99.255/32
IPv6: 2001:DB8:9999:0:ED81:7009:BD54:8E2D/64

CPE

Protocol	PPPoE
PAP/CHAP username	ipv6
PAP/CHAP password	••••
Access Concentrator	auto
	Leave empty to autodetect
Service Name	auto
	Leave empty to autodetect

Save & Apply | Save | Reset



Common Configuration

General Setup | Advanced Settings | Physical Settings | Firewall Settings

Bring up on boot ☑

Use builtin IPv6-management ☑

Enable IPv6 negotiation on the PPP link ☑

Use default gateway ☑ If unchecked, no default route is configured

Use gateway metric 0

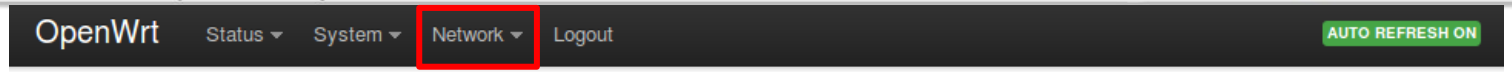
Use DNS servers advertised by peer ☑ If unchecked, the advertised DNS server addresses are ignored

LCP echo failure threshold 0
Presume peer to be dead after given amount of LCP echo failures, use 0 to ignore failures

LCP echo interval 5
Send LCP echo requests at the given interval in seconds, only effective in conjunction with failure threshold

Inactivity timeout 0
Close inactive connection after the given amount of seconds, use 0 to persist connection

CPE



CPE

DHCP Server

General Setup | Advanced Settings | IPv6 Settings

Router Advertisement-Service	server mode
DHCPv6-Service	server mode
NDP-Proxy	disabled
DHCPv6-Mode	stateless + stateful

Always announce default router: Announce as default router even if no public prefix is available.

Announced DNS servers

Announced DNS domains

Save & Apply | Save | Reset

CPE

OpenWrt Status System Network Logout AUTO REFRESH ON

Interfaces

Interface Overview

Network	Status	Actions
LAN br-lan	**Uptime:** 0h 8m 27s **MAC-Address:** F8:D1:11:90:E1:1A **RX:** 47.49 KB (467 Pkts.) **TX:** 81.13 KB (396 Pkts.) **IPv4:** 192.168.1.1/24 **IPv6:** 2001:DB8:BABA:0:0:0:0:1/64	Connect Stop Edit Delete
WAN pppoe-wan	**Uptime:** 0h 7m 31s **RX:** 9.27 KB (101 Pkts.) **TX:** 6.93 KB (102 Pkts.) **IPv4:** 192.168.99.255/32 **IPv6:** 2001:DB8:9999:0:B85B:2EA6:9C07:C506/64	Connect Stop Edit Delete
WAN6 @wan	**Uptime:** 0h 7m 28s **MAC-Address:** 00:00:00:00:00:00 **RX:** 9.27 KB (101 Pkts.) **TX:** 6.93 KB (102 Pkts.)	Connect Stop Edit Delete

Add new interface...

Global network options

IPv6 ULA-Prefix

Linux

```
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP gr
oup default qlen 1000
    link/ether 5c:26:0a:80:4c:9f brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.1/24 brd 192.168.0.255 scope global eth0
       valid_lft forever preferred_lft forever
    inet 192.168.1.10/24 scope global eth0
       valid_lft forever preferred_lft forever
    inet6 2001:db8:baba:0:5806:563c:f9e1:87ac/64 scope global temporary dynamic
       valid_lft 7052sec preferred_lft 1652sec
    inet6 2001:db8:baba:0:5e26:aff:fe80:4c9f/64 scope global dynamic
       valid_lft 7052sec preferred_lft 1652sec
    inet6 fe80::5e26:aff:fe80:4c9f/64 scope link
       valid_lft forever preferred_lft forever
```

Laboratório

- Cenário 2 - Radius

Freeradius

```
  GNU nano 2.2.6               File: clients.conf

#       secret          = testing123
#       shortname       = localhost
#}

#client some.host.org {
#       secret          = testing123
#       shortname       = localhost
#}

#
#  You can now specify one secret for a network of clients.
#  When a client request comes in, the BEST match is chosen.
#  i.e. The entry from the smallest possible network.
#
#client 192.168.0.0/24 {
#       secret          = testing123-1
#       shortname       = private-network-1
#}
#

client 192.168.0.0/16 {
        secret          = root
        shortname       = Subnet
        nastype         = mikrotik
}
```

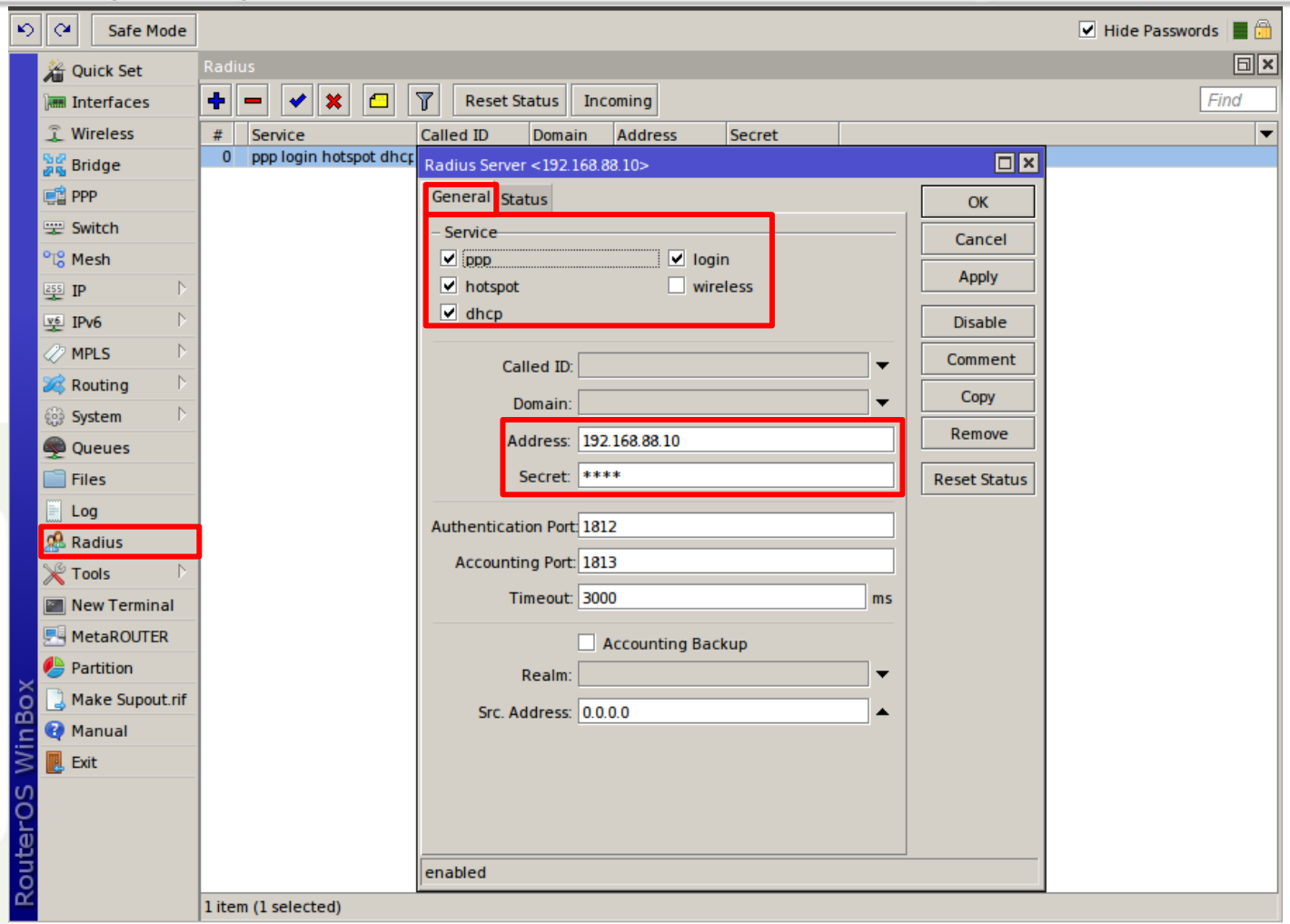
Freeradius

```
+------------------+
| Tables_in_radius |
+------------------+
| nas              |
| radacct          |
| radcheck         |
| radgroupcheck    |
| radgroupreply    |
| radippool        |
| radpostauth      |
| radreply         |
| radusergroup     |
+------------------+
9 rows in set (0.00 sec)

mysql> select * from radreply;
+----+----------+-------------------------------+----+-----------------------+
| id | username | attribute                     | op | value                 |
+----+----------+-------------------------------+----+-----------------------+
|  1 | test256  | Framed-IPv6-Prefix            | := | 2001:db8:256:256::/64 |
|  2 | test256  | Mikrotik-Delegated-IPv6-Pool  | := | 2001:db8:123::/56     |
+----+----------+-------------------------------+----+-----------------------+
2 rows in set (0.00 sec)

mysql> select * from radgroupreply;
+----+-----------+-----------------+----+-------------+
| id | groupname | attribute       | op | value       |
+----+-----------+-----------------+----+-------------+
|  1 | static256 | Framed-Protocol | := | PPP         |
|  2 | static256 | Service-Type    | := | Framed-User |
+----+-----------+-----------------+----+-------------+
2 rows in set (0.00 sec)
```

BRAS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New Terminal
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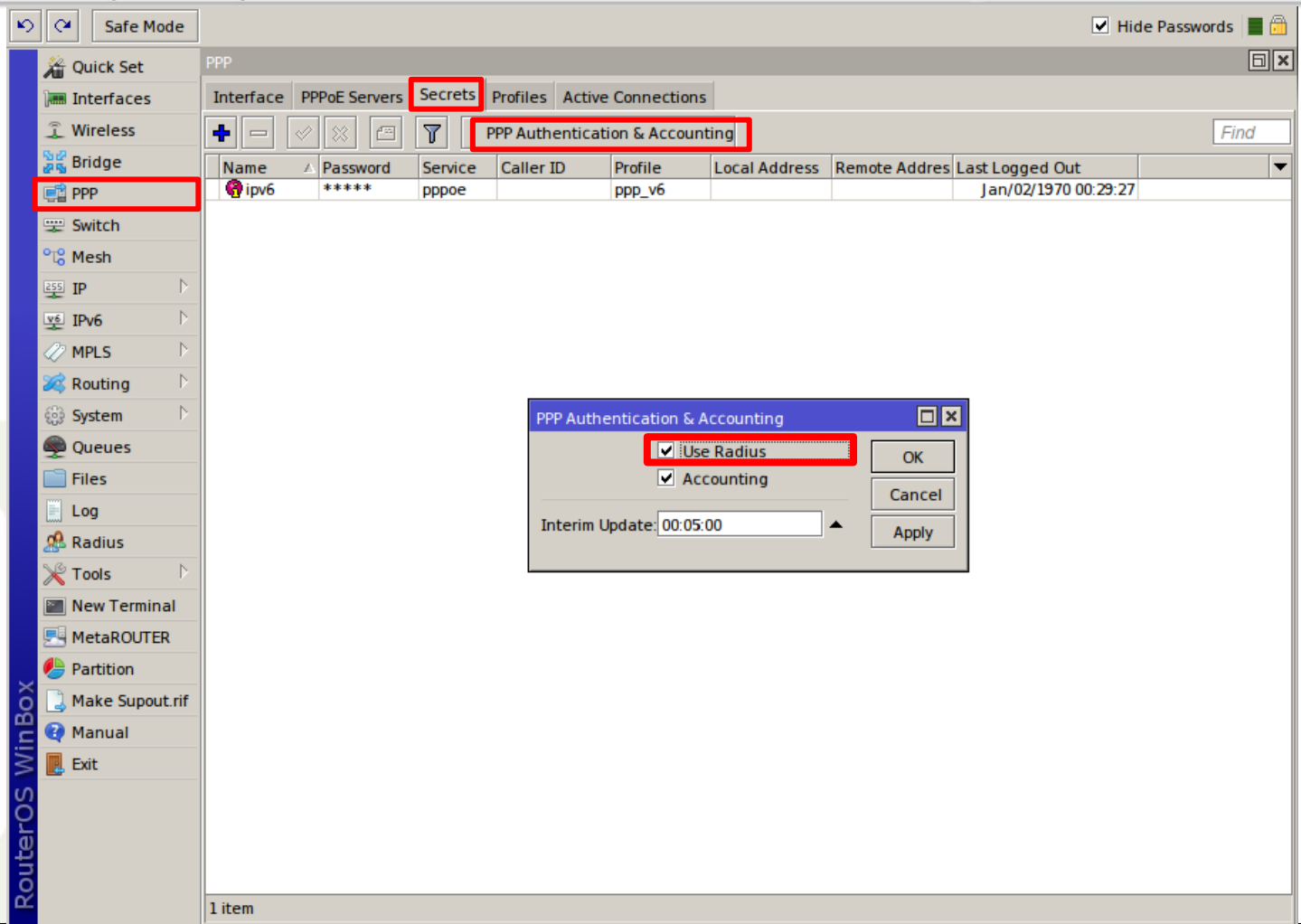
Make Supout.rif
Manual
Exit
RouterOS WinBox
Radius
Reset Status
Incoming
Find
Service Called ID Domain Address Secret
0 ppp login hotspot dhcp
Radius Server <192.168.88.10>
General
Status
Service
ppp
login
hotspot
wireless
dhcp
Called ID:
Domain:
Address: 192.168.88.10
Secret: ****
Authentication Port: 1812
Accounting Port: 1813
Timeout: 3000 ms
Accounting Backup
Realm:
Src. Address: 0.0.0.0
OK
Cancel
Apply
Disable
Comment
Copy
Remove
Reset Status
enabled
1 item (1 selected)

BRAS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Secrets
Profiles
Active Connections
PPP Authentication & Accounting
Find
Name
Password
Service
Caller ID
Profile
Local Address
Remote Addres
Last Logged Out
ipv6
*****
pppoe
ppp_v6
Jan/02/1970 00:29:27
PPP Authentication & Accounting
Use Radius
Accounting
Interim Update:
00:05:00
OK
Cancel
Apply
1 item

CPE

OpenWrt Status System Network Logout AUTO REFRESH ON

Interfaces

Interface Overview

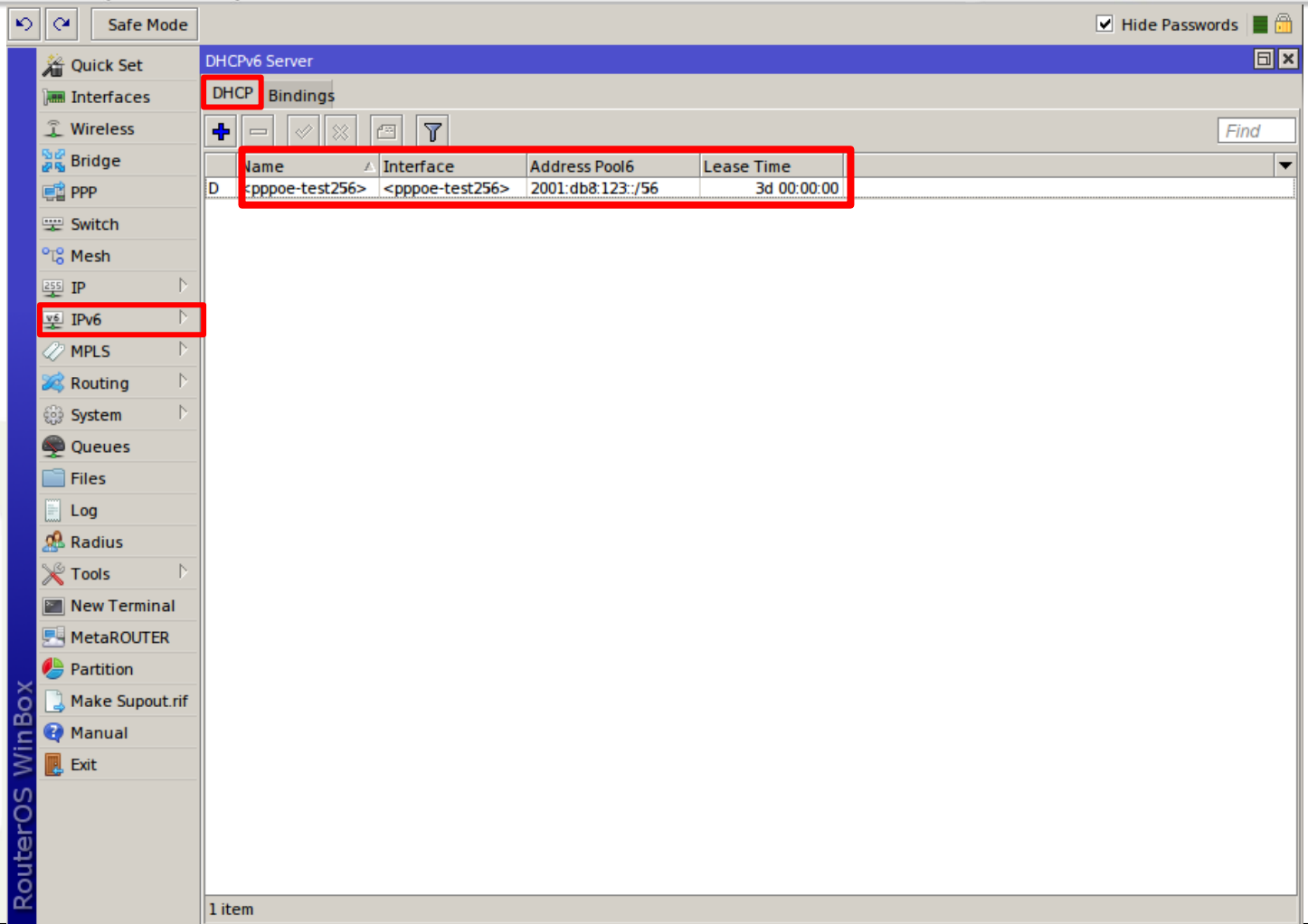
Network	Status	Actions
LAN br-lan	**Uptime:** 0h 1m 11s **MAC-Address:** F8:D1:11:90:E1:1A **RX:** 39.11 KB (417 Pkts.) **TX:** 79.35 KB (384 Pkts.) **IPv4:** 192.168.1.1/24	Connect Stop Edit Delete
WAN pppoe-wan	**Uptime:** 0h 1m 9s **RX:** 2.08 KB (27 Pkts.) **TX:** 2.62 KB (31 Pkts.) **IPv4:** 192.168.99.254/32 **IPv6:** 2001:DB8:256:256:FD92:5A16:AACB:E3B6/64	Connect Stop Edit Delete
WAN6 @wan	**Uptime:** 0h 1m 6s **MAC-Address:** 00:00:00:00:00:00 **RX:** 2.08 KB (27 Pkts.) **TX:** 2.62 KB (31 Pkts.)	Connect Stop Edit Delete

Add new interface...

Global network options

IPv6 ULA-Prefix

BRAS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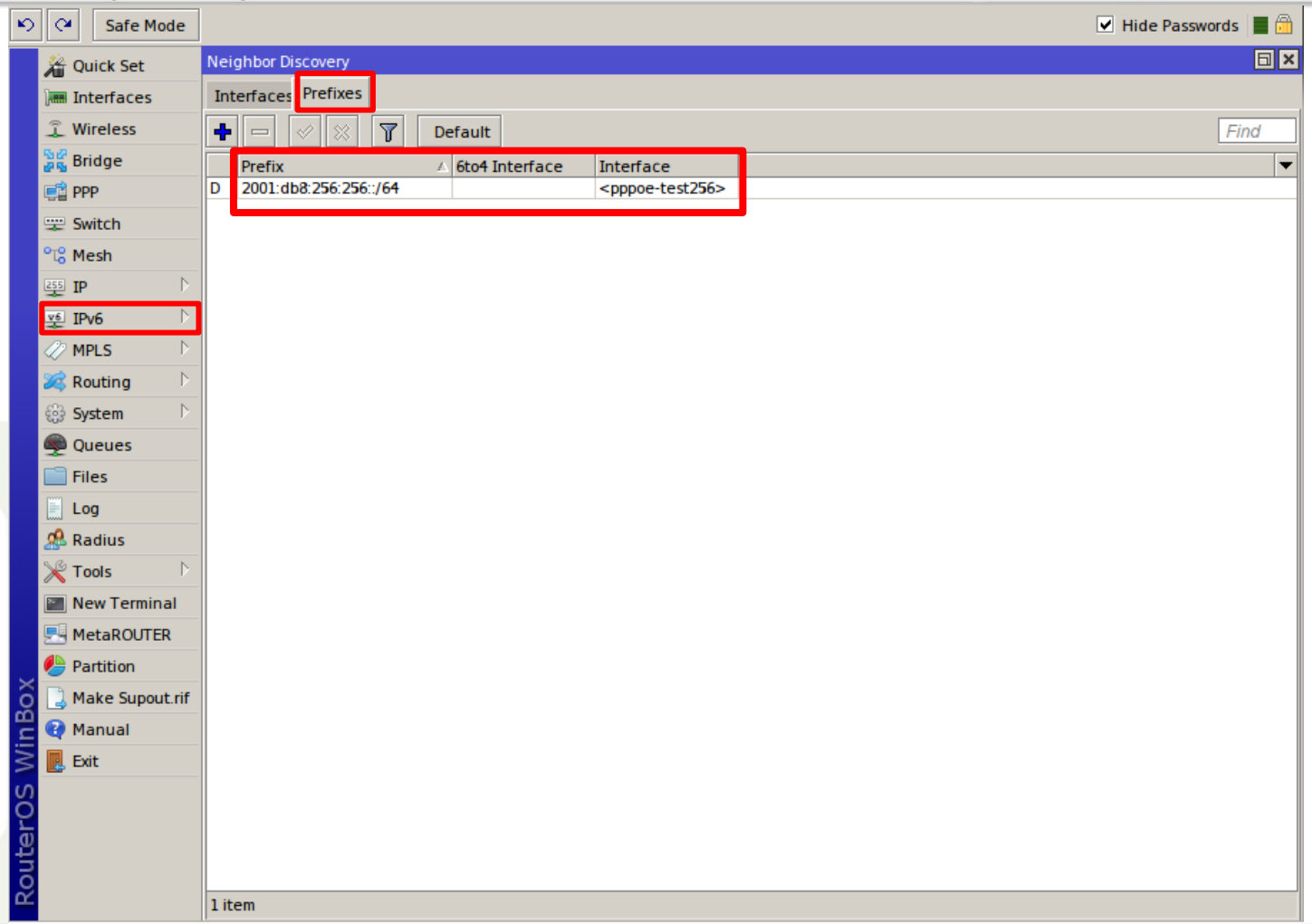
Manual
Exit
RouterOS WinBox
DHCPv6 Server
DHCP
Bindings
Find
Name
Interface
Address Pool6
Lease Time
D
<pppoe-test256>
<pppoe-test256>
2001:db8:123::/56
3d 00:00:00
1 item

BRAS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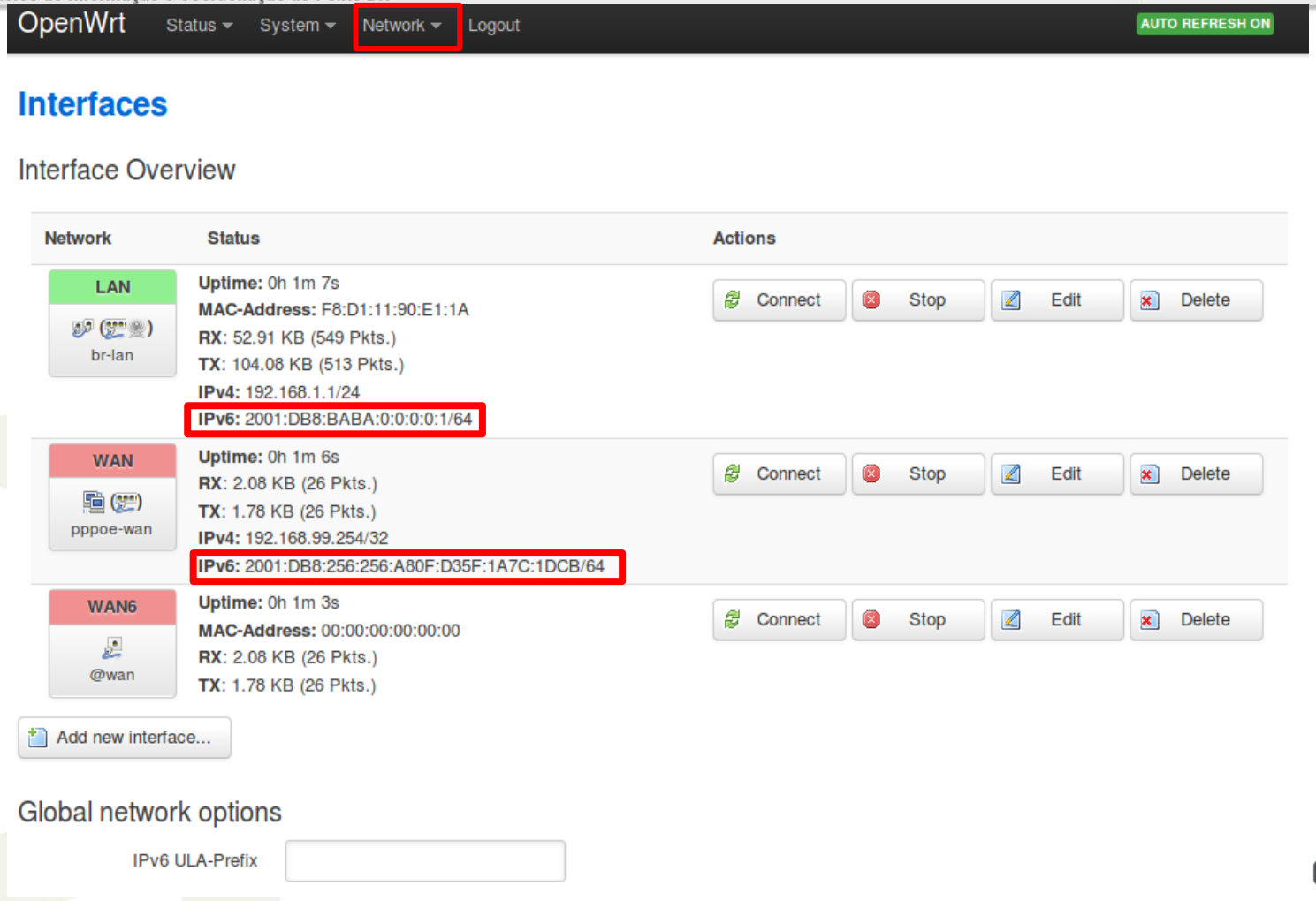
Make Supout.rif
Manual
Exit
RouterOS WinBox
Neighbor Discovery
Interfaces
Prefixes
Default
Find
Prefix
6to4 Interface
Interface
D
2001:db8:256:256::/64
<pppoe-test256>
1 item

Laboratório

- Problemas
  - O atributo mikrotik-delegated-ipv6-pool
  - Reportado no fórum http://forum.mikrotik.com/viewtopic.php?f=1&t=89443
  - Última mensagem pedindo Mon Nov 10, 2014


OpenWrt
Status
System
Network
Logout
AUTO REFRESH ON
Interfaces
Interface Overview
Network
Status
Actions
LAN
br-lan
Uptime: 0h 1m 7s
MAC-Address: F8:D1:11:90:E1:1A
RX: 52.91 KB (549 Pkts.)
TX: 104.08 KB (513 Pkts.)
IPv4: 192.168.1.1/24
IPv6: 2001:DB8:BABA:0:0:0:0:1/64
Connect
Stop
Edit
Delete
WAN
pppoe-wan
Uptime: 0h 1m 6s
RX: 2.08 KB (26 Pkts.)
TX: 1.78 KB (26 Pkts.)
IPv4: 192.168.99.254/32
IPv6: 2001:DB8:256:256:A80F:D35F:1A7C:1DCB/64
Connect
Stop
Edit
Delete
WAN6
@wan
Uptime: 0h 1m 3s
MAC-Address: 00:00:00:00:00:00
RX: 2.08 KB (26 Pkts.)
TX: 1.78 KB (26 Pkts.)
Connect
Stop
Edit
Delete
Add new interface...
Global network options
IPv6 ULA-Prefix

Bug?

Conclusão

- É possível implementar no PPPoE server no Mikrotik
- Com o Radius a integração pode ser feita em partes
- Deve-se pedir para o fabricante implementar o que falta - atributo, DNS e outros
- Ficar atento aos changelogs

Dúvidas

Obrigado!!!

Eduardo Barasal Morales

emorales@nic.br

ipv6@nic.br