

# IPv6

**CARACTERÍSTICAS DO PROTOCOLO E PLANO DE AÇÃO  
PARA IMPLEMENTAÇÃO.**



**MOGA**  
Telecom



**solintel**



**VLISM**

---

**#juntosomosmais**

## Luis Silva

- Graduando em Engenharia Elétrica com ênfase em Telecomunicações;
- Analista de Telecomunicações – Solintel;
- Conhecimento regulatório para provedores;
- Conhecimento em roteamento utilizando mikrotik;
- Serviços de numeração ASN.

# Objetivos

- Características e benefícios no uso do IPv6;
- Dimensionar a implantação e utilização do protocolo, levando em consideração as dificuldades no cenário real;
- Apresentar cases de utilização do IPv6 na última milha utilizando equipamentos Mikrotik;
- Apresentar autenticação PPPoE de CPE's e seu funcionamento.



## Características do protocolo

- IPv6 - Definido pela RFC 2460 em 1998;
- Grande espaço de endereçamento e escalabilidade (128 bits);
- Formato de cabeçalho simplificado para otimização de entrega de pacote;
- Suporte aos atuais protocolos de roteamento;
- Possui serviços de autoconfiguração;
- Crescimento do número de endereços multicast;
- Não utiliza processos de broadcast.



**IPv6** Ready

## Diferenças básicas entre IPv4 e IPv6

	<b>IPv4</b>	<b>IPv6</b>
Espaço endereçamento	32 bits	128 bits
Endereços Possíveis	$2^{32}$	$2^{128}$
Formato do endereço	10.1.1.1	2001:0db8:a:b:1:2:3:f
Tamanho do cabeçalho	20 bytes	40 bytes
Campos do cabeçalho	14	8
IPSec	opcional	recomendado

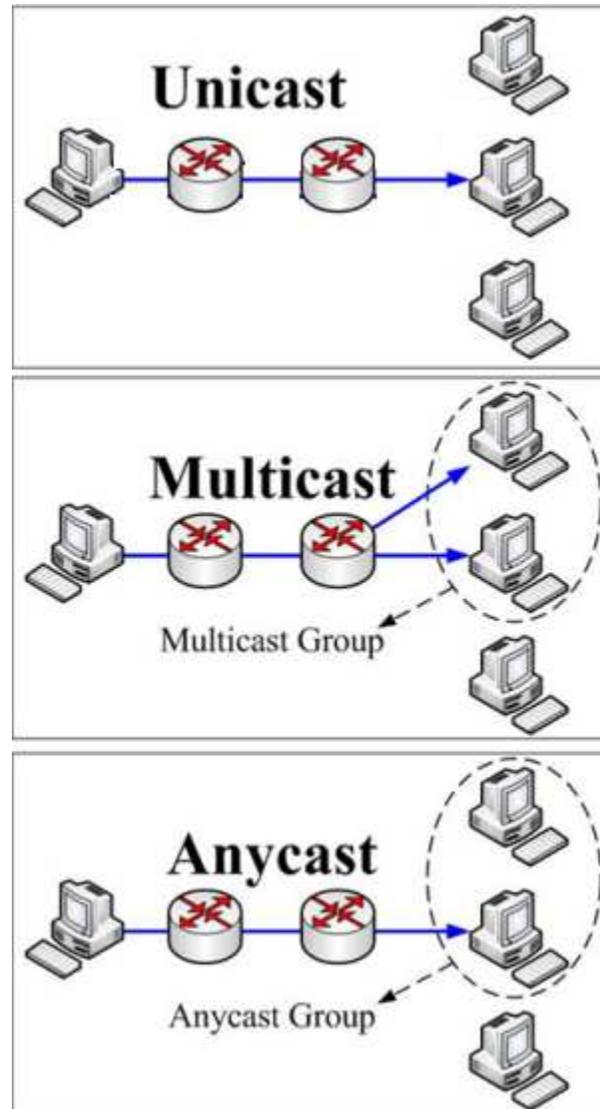
Nº de endereços IPv4:  $2^{32} = 4.294.967.296$

Nº de endereços IPv6:  $2^{128} = 340.282.366.920.938.463.463.374.607.431.768.211.456$

## Tipos de endereços IPv6 (RFC 4291)

- **Unicast** – cada endereço corresponde a uma única interface;
- **Anycast** – Quando o mesmo endereço é utilizado em mais um host, porém é entregue a interface mais próxima da origem;
- **Multicast** – identifica um conjunto de interfaces, entretanto, um pacote enviado a um endereço multicast é entregue a todas as interfaces associadas a esse endereço. Um endereço multicast é utilizado em comunicações de um-para-muitos.

# Funcionamento dos endereços



# Endereçamento

- Representação dos endereços IPv6:

**2001:0DB8:AD1F:25E2:CADE:CAFE:F0Ca:84C1**

**Na representação de um endereço IPv6 é permitido:**

- Utilizar caracteres maiúsculos ou minúsculos;
  - Omitir os zeros à esquerda;
- Representar os zeros contínuos por "::".

**Exemplo:**

**2001:0DB8:0000:0000:12F1:0000:0000:140B**

**2001:db8:0:0:12F1::140b**

# Quem é o responsável pelas alocações IPv6?



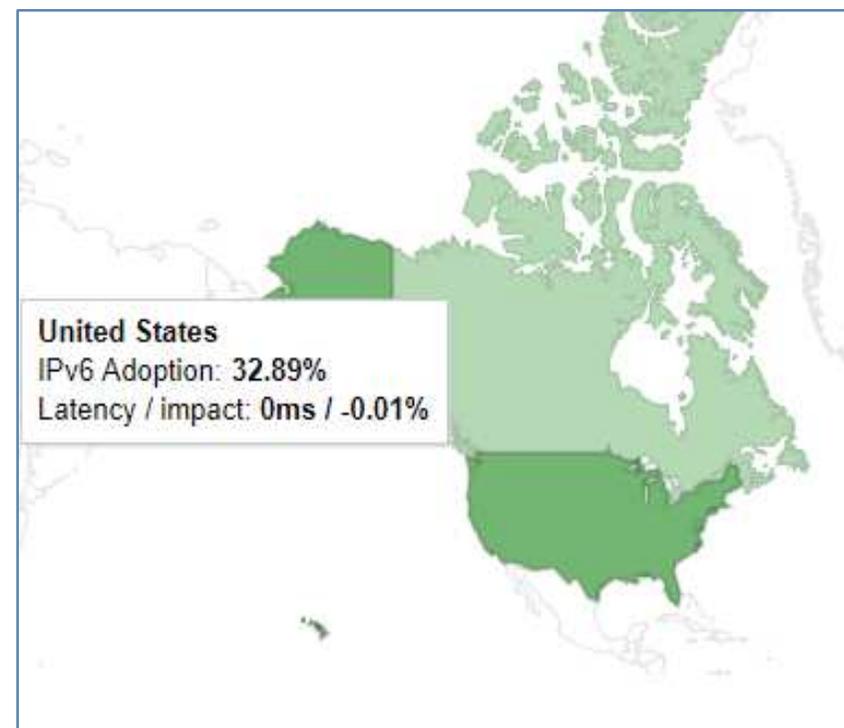
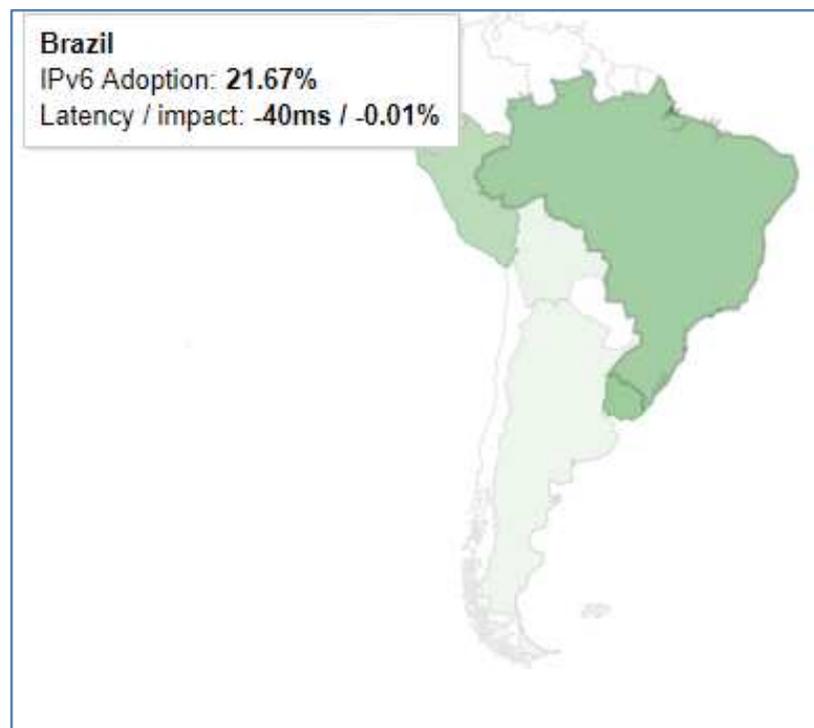
# Quem é o responsável pelas alocações IPv6?



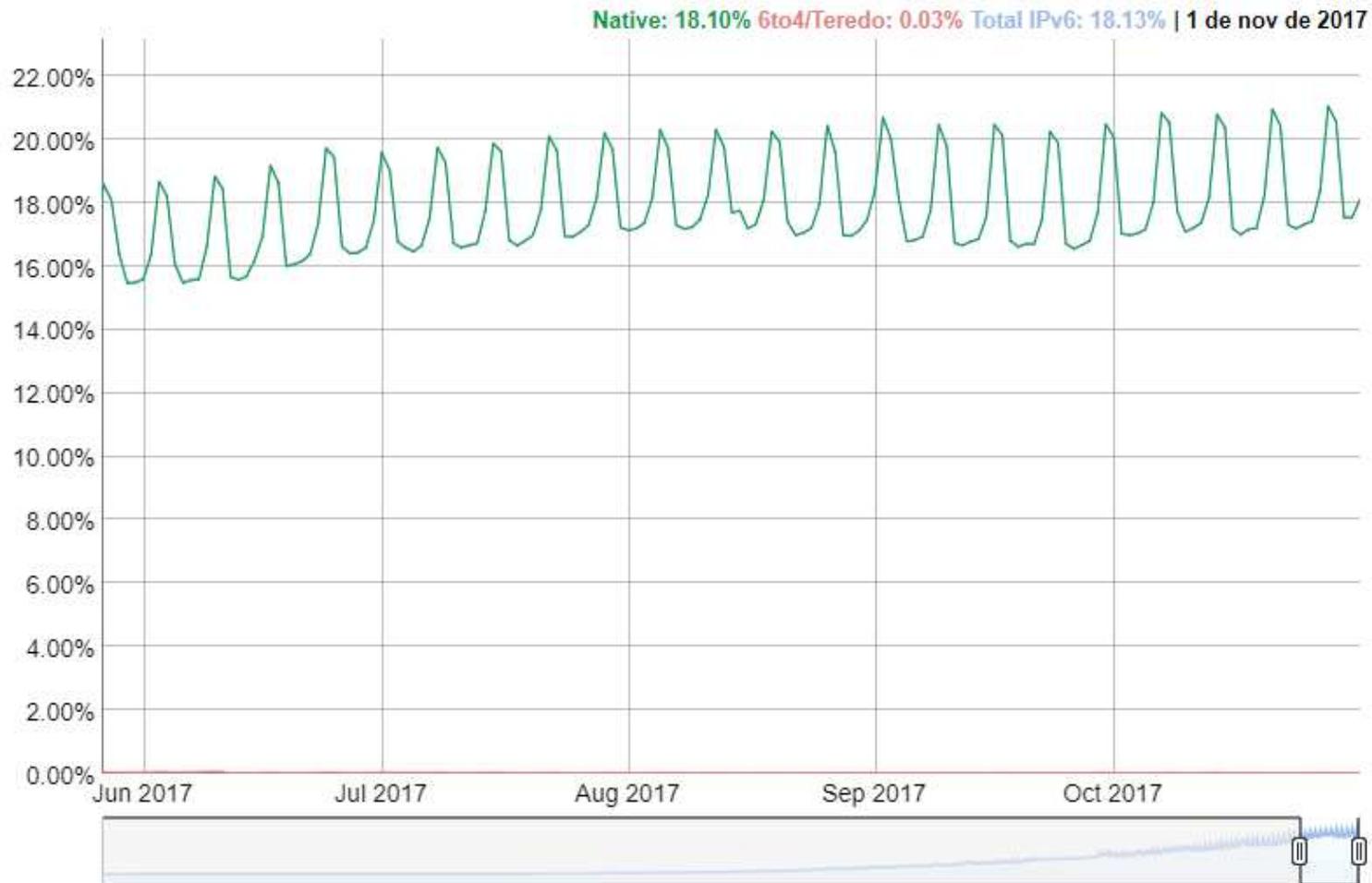
## Como está o uso do IPv6?



## Taxa de acesso do Google via IPv6

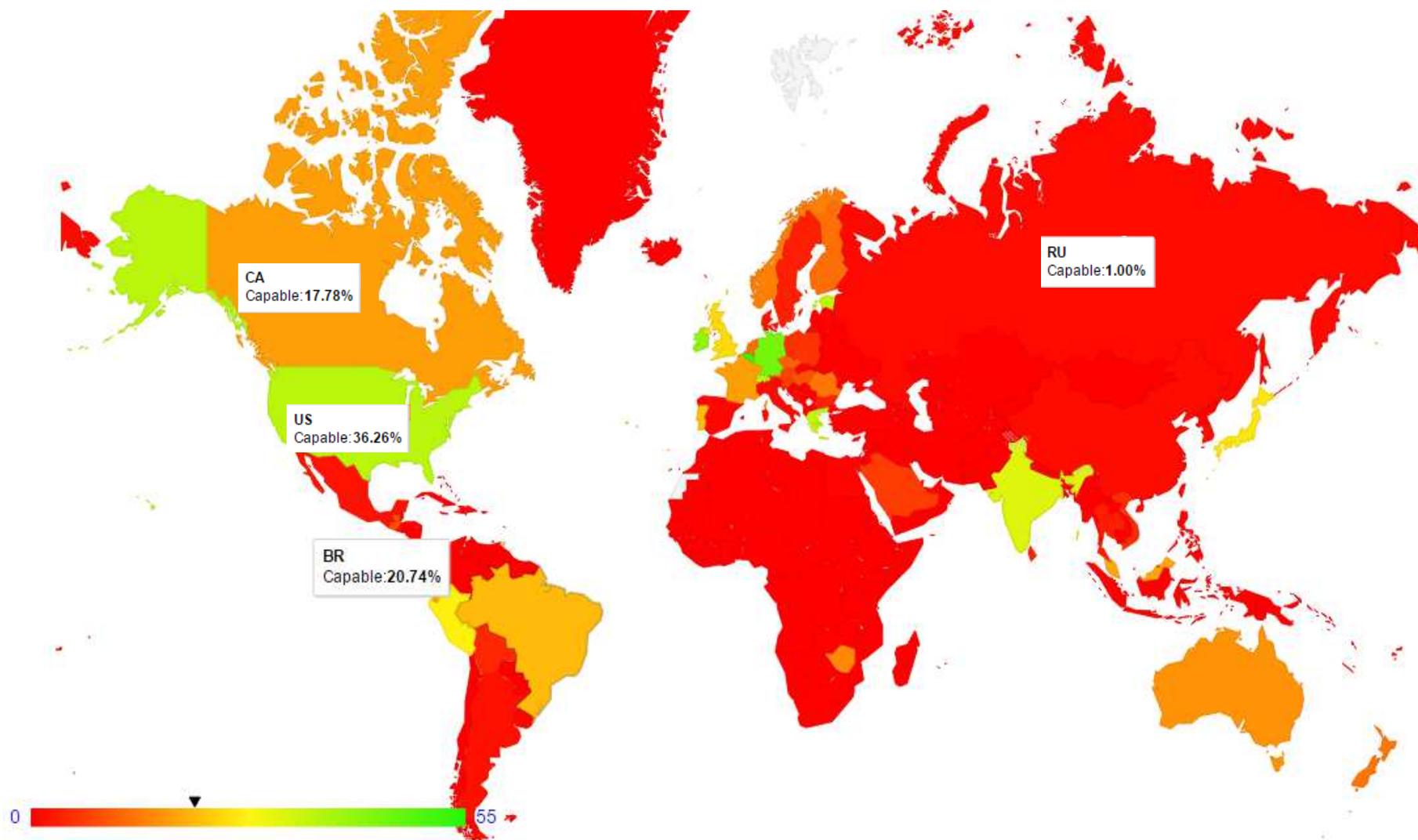


# Taxa de acesso do Google via IPv6



fonte: <https://www.google.com/intl/pt-BR/ipv6/statistics.html#tab=per-country-ipv6-adoption&tab=per-country-ipv6-adoption> (Acessos no mundo)

# Taxa de uso dos endereços

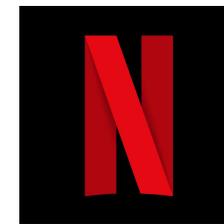


## Quais sites permitem conexões via IPV6?



## Sites que permitem acesso via IPv6

Google



## Mais algumas estatísticas...

	Country/Region	Q1 2017 IPv6 %	QoQ Change
1	Belgium	38%	-19%
2	Greece	25%	-16%
3	United States	22%	-15%
4	Switzerland	21%	-22%
5	Trinidad and Tobago	21%	-4.8%
6	Germany	20%	-20%
7	India	17%	21%
8	Estonia	16%	-10%
9	Brazil	13%	29%
10	United Kingdom	13%	-4.8%

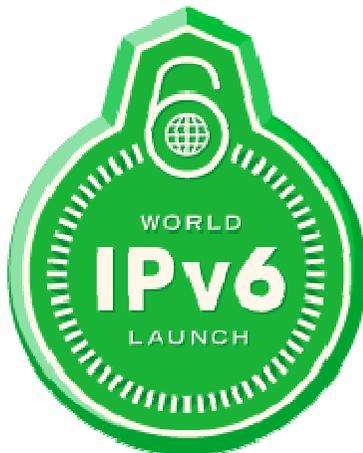
Fonte: Akamai's [state of the internet] - Q1 2017 report

## Como podemos auxiliar na transição?

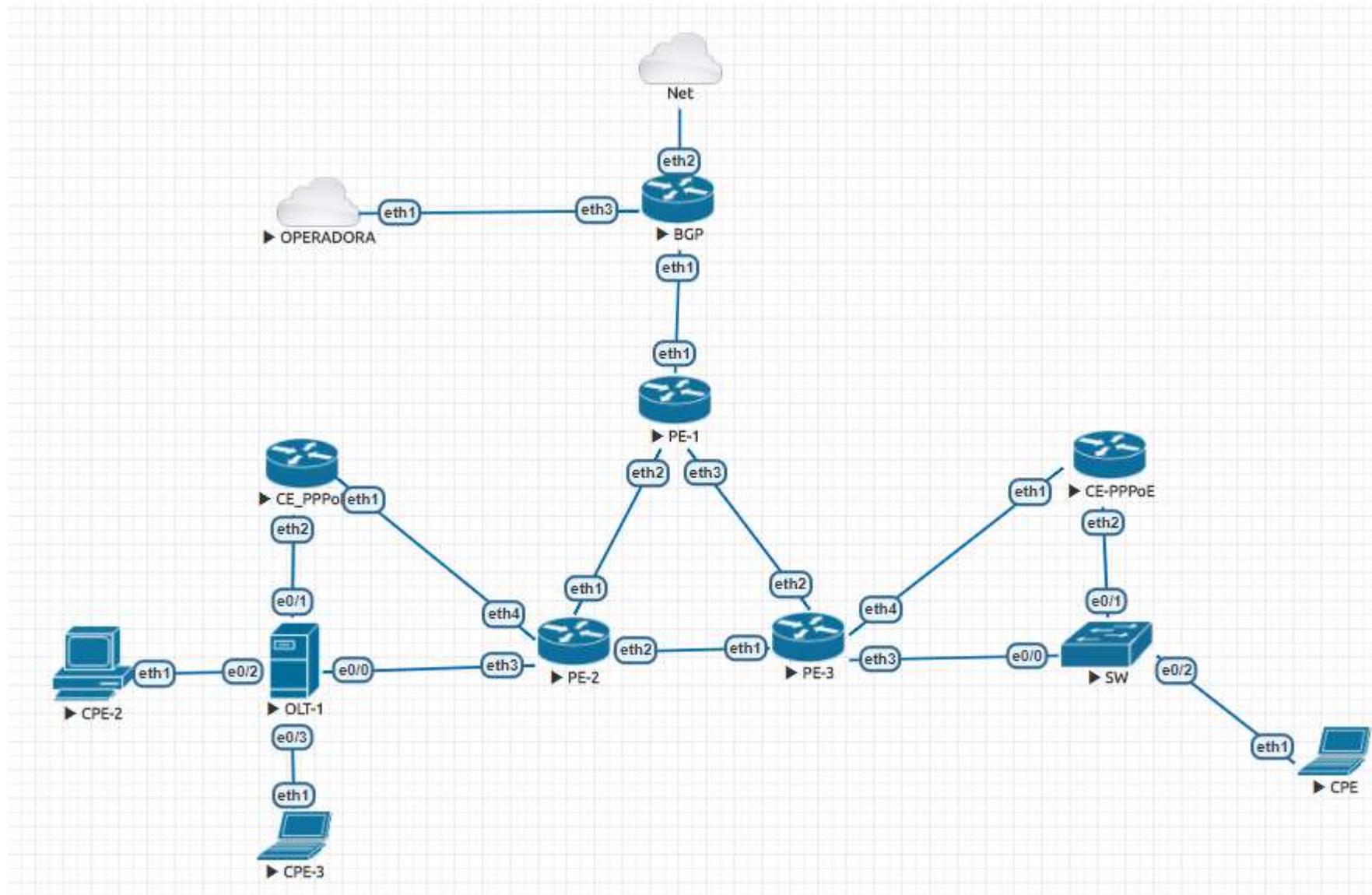


## Passos para a transição

- Analise a rede e sua conectividade;
- Crie uma estratégia;
- Segregue as áreas de implementação;
- Utilize a tecnologia a seu favor;
- Crie um cronograma.

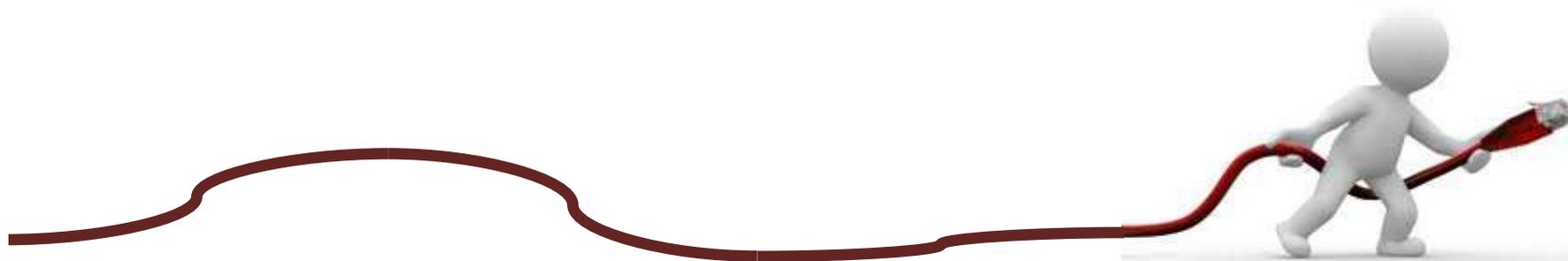


# Rede com IPv6



## Backbone - soluções mais usuais

- Dual stack utilizando OSPFv3 - **RFC 6333**;
- Tunelamento 6to4 - **RFC 2784**;
- 6PE e 6VPE - **RFCs 4798 e 4659** utilizável em backbones MPLS.



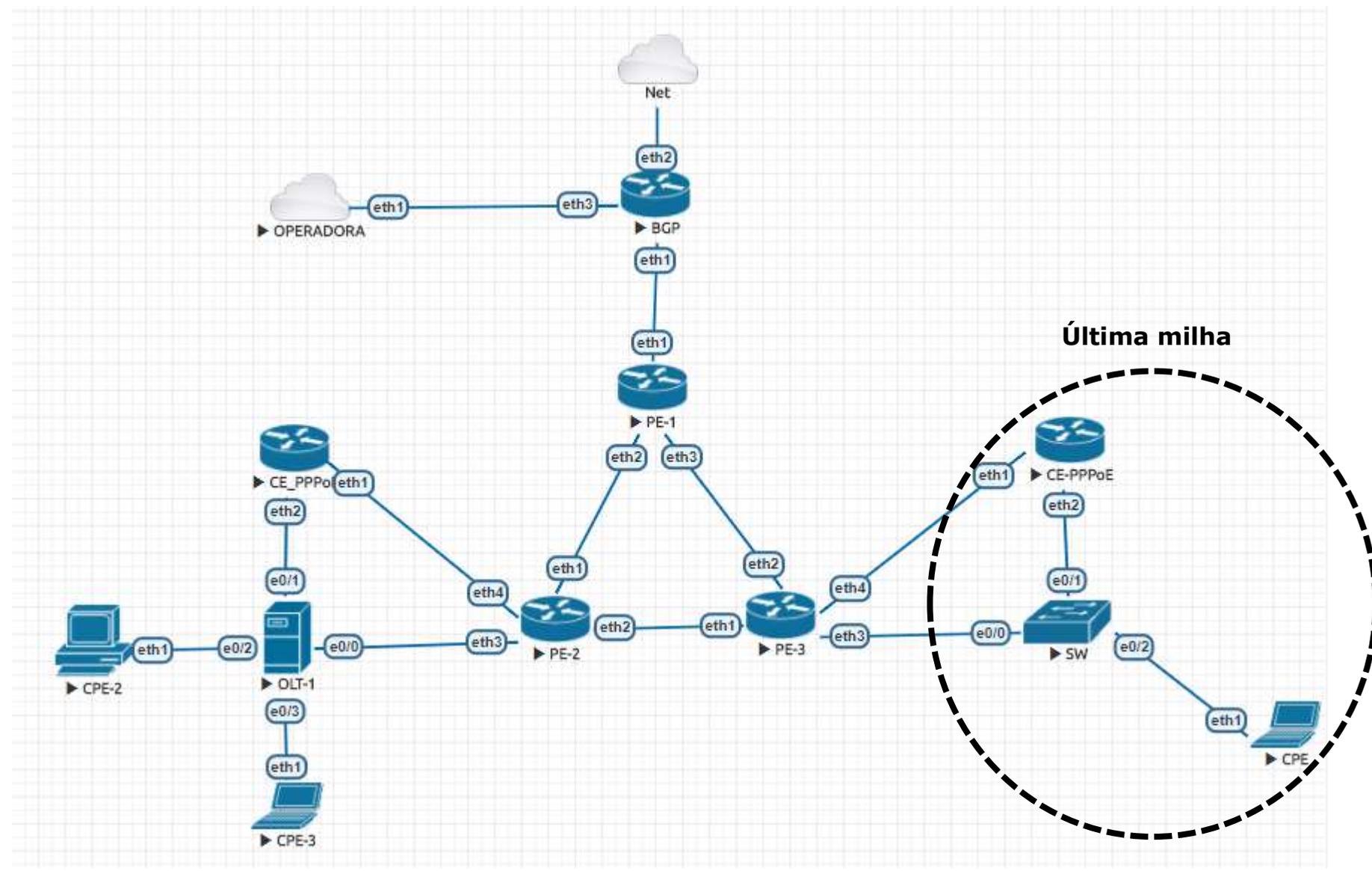
# Como tratamos os equipamentos da última milha?



## **Rede IPv6 - Última milha (PPPoE Server)**

- Radius - Sistema de gerenciamento;
- Configuração manual de clientes PPPoE.

# Rede com IPv6



# Rede IPv6 - Última milha (PPPoE Server)

The screenshot displays the Mikrotik WinBox interface. On the left sidebar, the 'IPv6' menu item is highlighted with a red box, and its sub-menu 'Pool' is also highlighted with a red box. The main window shows the 'IPv6 Pool' configuration window, which has two tabs: 'Pools' (selected and highlighted with a red box) and 'Used Prefixes'. The 'Pools' tab contains a table with the following data:

Name	Prefix	Prefix Length	Expire Time
pool_PD	2000:5400::/56	64	
pool_remoto	2000:5300::/52	56	

At the bottom of the window, it indicates '2 items'.

RouterOS WinBox

Safe Mode Session: Uptime: 0

Quick Set  
Interfaces  
Bridge  
**PPP**  
Mesh  
IP  
IPv6  
MPLS  
Routing  
System  
Queues  
Files  
Log  
Radius  
Tools  
New Terminal  
Make Supout.tif  
Manual  
New WinBox  
Exit

PPP

Interface PPPoE Servers Secrets **Profiles** Active Connections L2TP Secrets

Name	Local Address	Remote Address	Bridge	Rate Limit...	Only One
default	10.99.99.4	DHCP_v4			default
default-encr...					default

2 items (1 selected)

PPP Profile <default>

**General** Protocols Limits Queue Scripts

Name: default

Local Address: 10.99.99.4

Remote Address: DHCP\_v4

Remote IPv6 Prefix Pool: pool\_remoto

DHCPv6 PD Pool: pool\_PD

Bridge:

Bridge Port Priority:

Bridge Path Cost:

Incoming Filter:

Outgoing Filter:

Address List:

DNS Server:

WINS Server:

- Change TCP MSS  
 no  yes  default

- Use UPnP  
 no  yes  default

OK  
Cancel  
Apply  
Comment  
Copy  
Remove

default

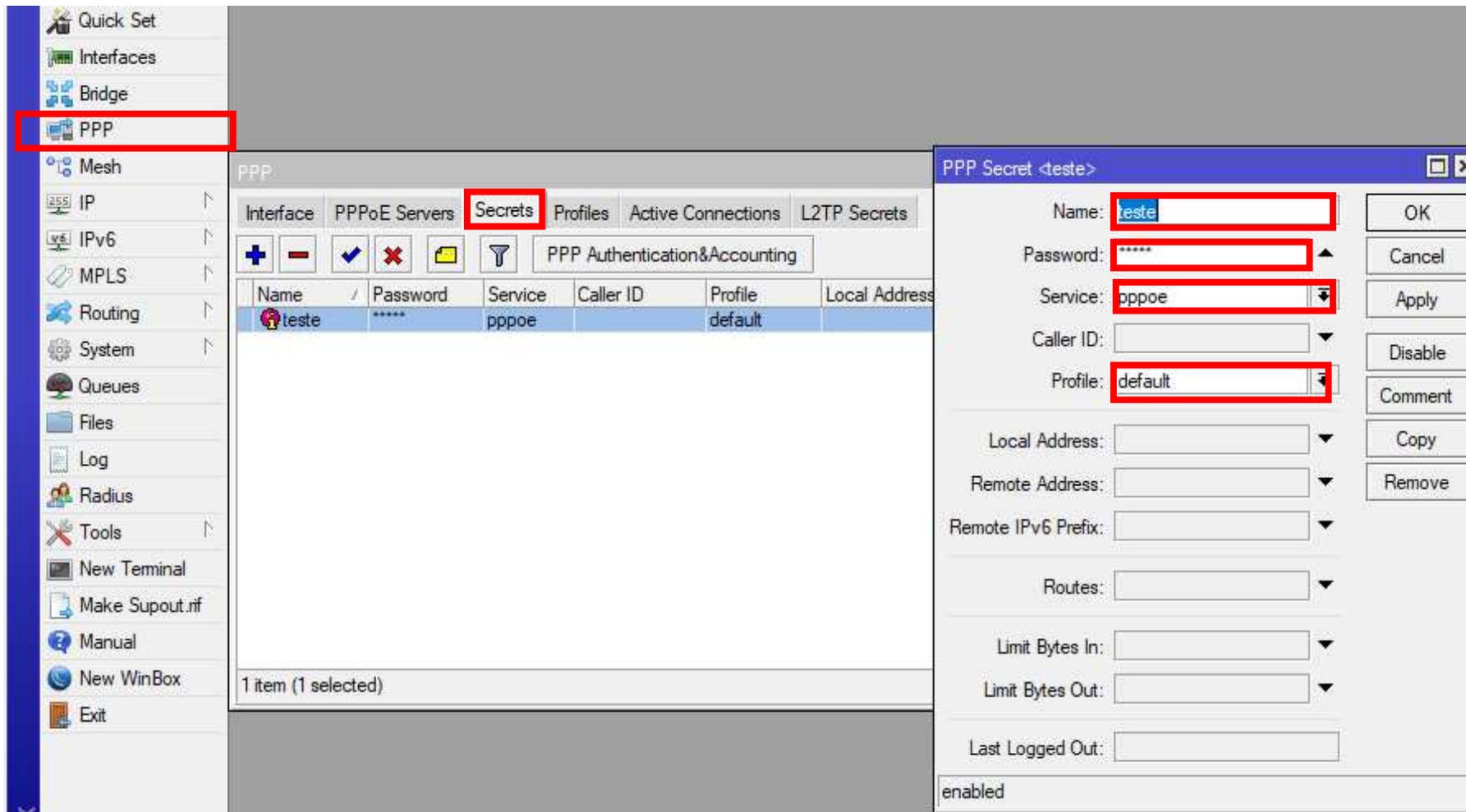
The screenshot shows a network configuration application with a sidebar on the left and a main workspace. The sidebar includes options like Quick Set, Interfaces, Bridge, PPP (highlighted with a red box), Mesh, IP, IPv6, MPLS, Routing, System, Queues, Files, Log, Radius, Tools, New Terminal, Make Supout.tif, Manual, New WinBox, and Exit. The main workspace has tabs for Interface, PPPoE Servers, Secrets, Profiles (highlighted with a red box), Active Connections, and L2TP Secrets. Below the tabs is a table of PPP profiles:

Name	Local Address	Remote Address	Bridge	Rate Limit...	Only One
default	10.99.99.4				default
default-encr...					default

Below the table, it says "2 items (1 selected)". A dialog box titled "PPP Profile <default>" is open on the right, with the "Protocols" tab selected (highlighted with a red box). The dialog has several sections with radio button options:

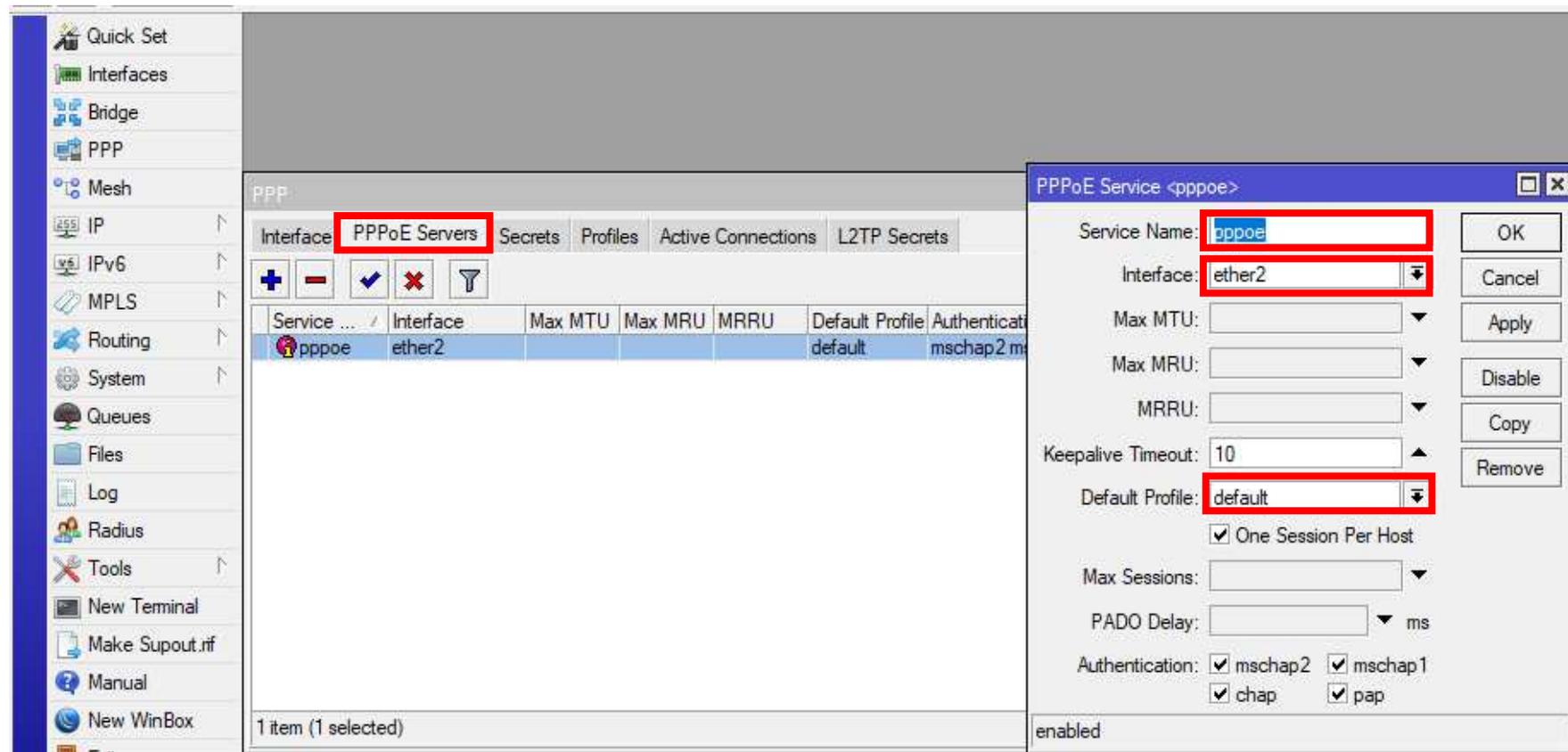
- Use IPv6:  no,  yes,  required,  default
- Use MPLS:  no,  yes,  required,  default
- Use Compression:  no,  yes,  default
- Use Encryption:  no,  yes,  required,  default

Buttons on the right of the dialog include OK, Cancel, Apply, Comment, Copy, and Remove. The text "default" is visible at the bottom of the dialog box.



The screenshot displays a network configuration application. On the left is a sidebar menu with options like Quick Set, Interfaces, Bridge, PPP (highlighted with a red box), Mesh, IP, IPv6, MPLS, Routing, System, Queues, Files, Log, Radius, Tools, New Terminal, Make Supout.tif, Manual, New WinBox, and Exit. The main window shows the 'PPP' configuration page with tabs for Interface, PPPoE Servers, Secrets (highlighted with a red box), Profiles, Active Connections, and L2TP Secrets. Below the tabs is a table with columns: Name, Password, Service, Caller ID, Profile, and Local Address. One entry is visible: Name 'teste', Password '\*\*\*\*\*', Service 'pppoe', Profile 'default'. A 'PPP Secret <teste>' dialog box is open on the right, with fields for Name (teste), Password (\*\*\*\*\*), Service (pppoe), and Profile (default), all highlighted with red boxes. The dialog also includes fields for Local Address, Remote Address, Remote IPv6 Prefix, Routes, Limit Bytes In, Limit Bytes Out, and Last Logged Out, along with buttons for OK, Cancel, Apply, Disable, Comment, Copy, and Remove. The status 'enabled' is shown at the bottom of the dialog.

# Rede IPv6 - Última milha (PPPoE Server)



The screenshot displays the Mikrotik WinBox interface for configuring a PPPoE Server. The left sidebar shows the navigation menu with 'PPP' selected. The main window shows the 'PPP' configuration page with the 'PPPoE Servers' tab active. A table lists the configured servers:

Service Name	Interface	Max MTU	Max MRU	MRRU	Default Profile	Authentication
pppoe	ether2				default	mschap2 m

The configuration dialog for the 'pppoe' service is open, showing the following settings:

- Service Name: pppoe
- Interface: ether2
- Max MTU: (empty)
- Max MRU: (empty)
- MRRU: (empty)
- Keepalive Timeout: 10
- Default Profile: default
- One Session Per Host
- Max Sessions: (empty)
- PADO Delay: (empty) ms
- Authentication:  mschap2,  mschap1,  chap,  pap
- Status: enabled

**E o CPE...?**



# Rede IPv6 - Última milha (CPE - Mikrotik)

RouterOS WinBox

Quick Set  
Interfaces  
Bridge  
PPP  
Mesh  
IP  
IPv6  
MPLS  
Routing  
System  
Queues  
Files  
Log  
Radius  
Tools  
New Terminal  
Make Supout.rf  
Manual  
New WinBox  
Exit

PPP

Interface PPPoE Servers Secrets Profiles Active Connections L2TP Secrets

PPP Scanner PPTP Server SSTP Server L2TP Server OVPN Server PPPoE Scan Find

Name	Type	Actual MTU	L2 MTU	Tx	Rx	Tx Packet (p/s)	Rx Pack
R <>pppoe-out 1	PPPoE Client	1480		0 bps	0 bps	0	

Interface <pppoe-out 1>

General Dial Out Status Traffic

Name: pppoe-out 1

Type: PPPoE Client

Actual MTU: 1480

Max MTU: [ ]

Max MRU: [ ]

MRRU: [ ]

Interfaces: ether1

Interface <pppoe-out 1>

General Dial Out Status Traffic

Service: pppoe

AC Name: [ ]

User: teste

Password: [ ]

Profile: default

Keepalive Timeout: 60

Dial On Demand

Use Peer DNS

Add Default Route

Default Route Distance: 0

Allow:  mschap2  mschap1  
 chap  pap

OK  
Cancel  
Apply  
Disable  
Comment  
Copy  
Remove  
Torch  
PPPoE Scan

enabled running slave Status

enabled running slave Status: connected

The screenshot displays the RouterOS WinBox interface for configuring a DHCPv6 Client. The left sidebar shows the navigation menu with 'IPv6' expanded and 'DHCP Client' selected. The main window shows a table of DHCPv6 clients and a configuration dialog for the selected client.

**Table: DHCPv6 Client**

Interface	Request	Pool Name	Pool Pr...	Prefix	Prefix Expir...	Status
pppoe-out1	prefix	pool_PD	64	2001:db8::/64	2d 23:51:15	bound

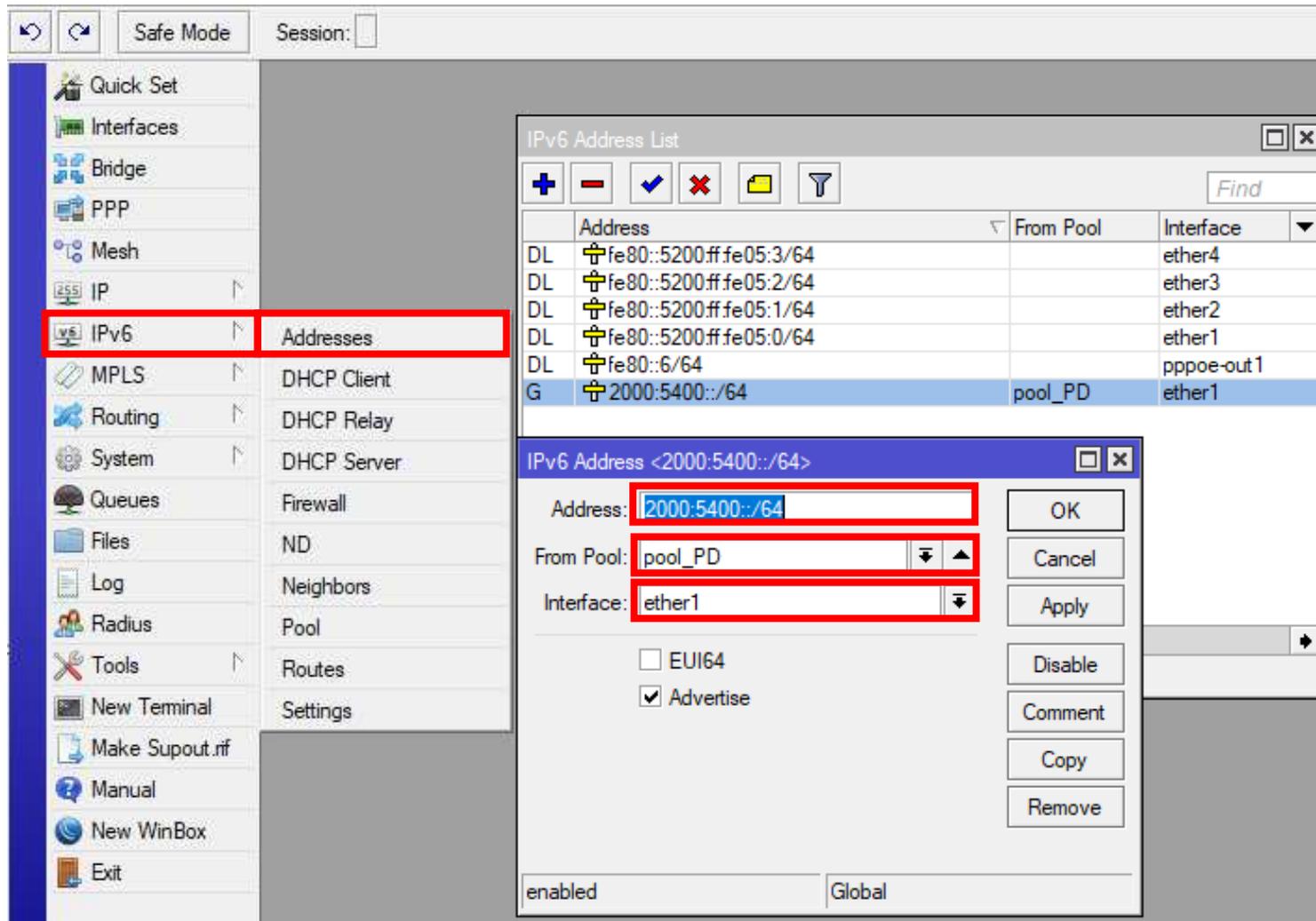
**DHCPv6 Client <pppoe-out1> Configuration Dialog:**

- Interface: pppoe-out1
- Request:  address  prefix
- Pool Name: pool\_PD
- Pool Prefix Length: 64
- Prefix Hint: [Dropdown]
- Use Peer DNS
- Add Default Route

Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove, Release, Renew.

Summary: 1 item, enabled, Status: bound

# Rede IPv6 - Última milha (CPE - Mikrotik)



Safe Mode Session: [ ]

- Quick Set
- Interfaces
- Bridge
- PPP
- Mesh
- IP
  - IPv6**
    - Addresses**
  - MPLS
    - DHCP Client
  - Routing
    - DHCP Relay
    - DHCP Server
  - System
    - Firewall
    - ND
    - Neighbors
    - Pool
    - Routes
    - Settings
  - Queues
  - Files
  - Log
  - Radius
  - Tools
    - New Terminal
    - Make Supout.rif
    - Manual
    - New WinBox
    - Exit

**IPv6 Address List**

	Address	From Pool	Interface
DL	fe80::5200:ff:fe05:3/64		ether4
DL	fe80::5200:ff:fe05:2/64		ether3
DL	fe80::5200:ff:fe05:1/64		ether2
DL	fe80::5200:ff:fe05:0/64		ether1
DL	fe80::6/64		pppoe-out1
G	2000:5400::/64	pool_PD	ether1

**IPv6 Address <2000:5400::/64>**

Address: 2000:5400::/64

From Pool: pool\_PD

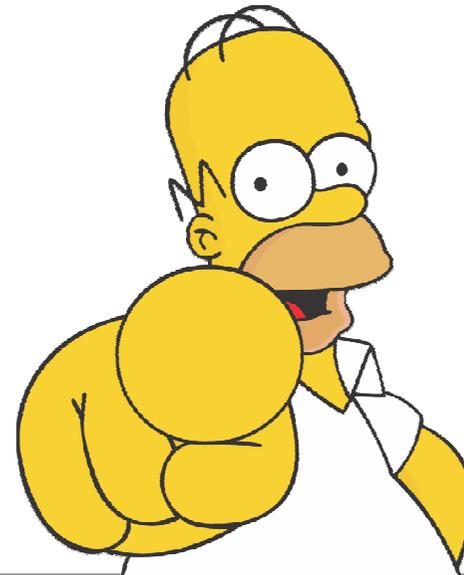
Interface: ether1

EUI64  
 Advertise

enabled Global

## Conclusão

- ✓ O IPv4 coexistirá com o IPv6 durante um bom tempo;
- ✓ Um IPv4 bem implementado auxilia na implementação de IPv6;
- ✓ O conteúdo ainda é restrito em v6 porém não é empecílio para sua implementação;
- ✓ Vamos focar na solução?!



# Perguntas ?

# Obrigado.

Luis Silva

 [luis.silva@solintel.com.br](mailto:luis.silva@solintel.com.br)

 solintel.engenharia6

 +55 (043) 98817-7781

 <https://www.linkedin.com/in/luis-silva128>

 <https://facebook.com/luis.silva128>



**MOGA**  
Telecom



**solintel**



**VLSM**

---

#juntosomosmais