

# MPLS vs OSPF



SLAVIK SAMBURSKI

MikroTik User Meeting

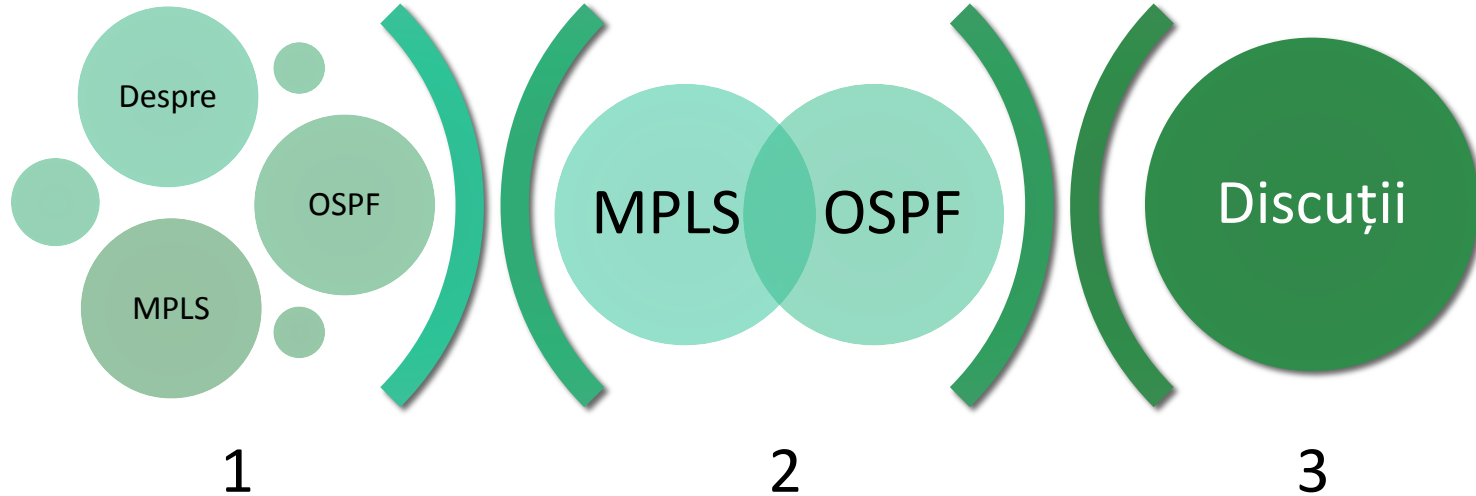
București 2014

vsamburski@gmail.com +37379931981, +40748511932

# MIKROTIK MUM

## Octombrie 2014, București

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# Despre mine....

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- Veaceslav Samburschii – inginer IT din 2003
- Certificare Mikrotik (MTCNA, MTCRE, MTCWE, MTCTCE)
- Trainer Mikrotik
- Certificare CCNA
- Profesor universitar
- Inginer IT – Aitec CA SRL, Chişinău, partener oficial Mikrotik m. Chişinău
- Email: [vsamburski@gmail.com](mailto:vsamburski@gmail.com)

# La început a fost idea...

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SI IDEA A PORNIT DE LA CLIENT

# Ce vor clienții?

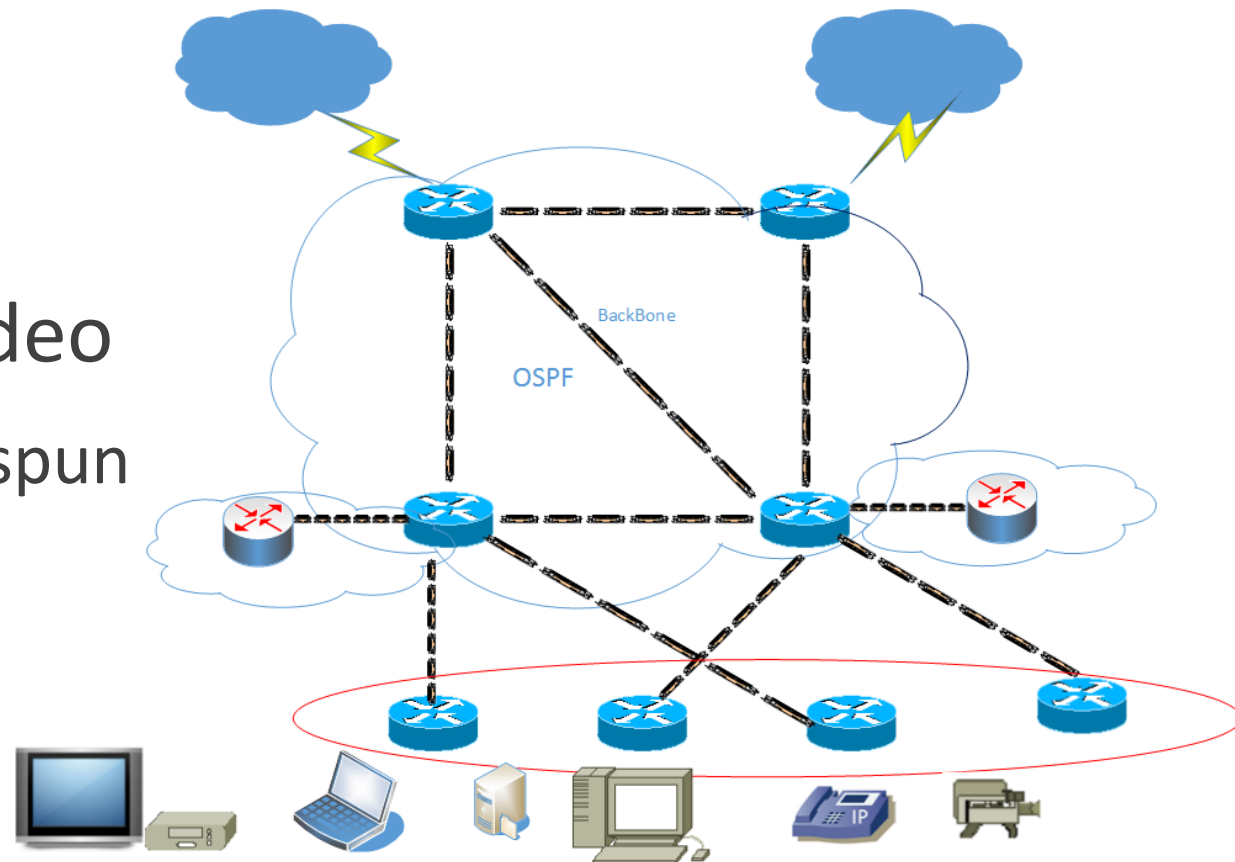
Access Internet

IP TV

IP Telefonie

Supraveghere video

Și altele care nu se spun  
în public...



# CE AU PROVIDERII?

REȚELE DE TRANSPORT DATE....

# OSPF

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DESCRIERE, AVANTAJE ȘI DEZAVANTAJE

# Audiența țintă...

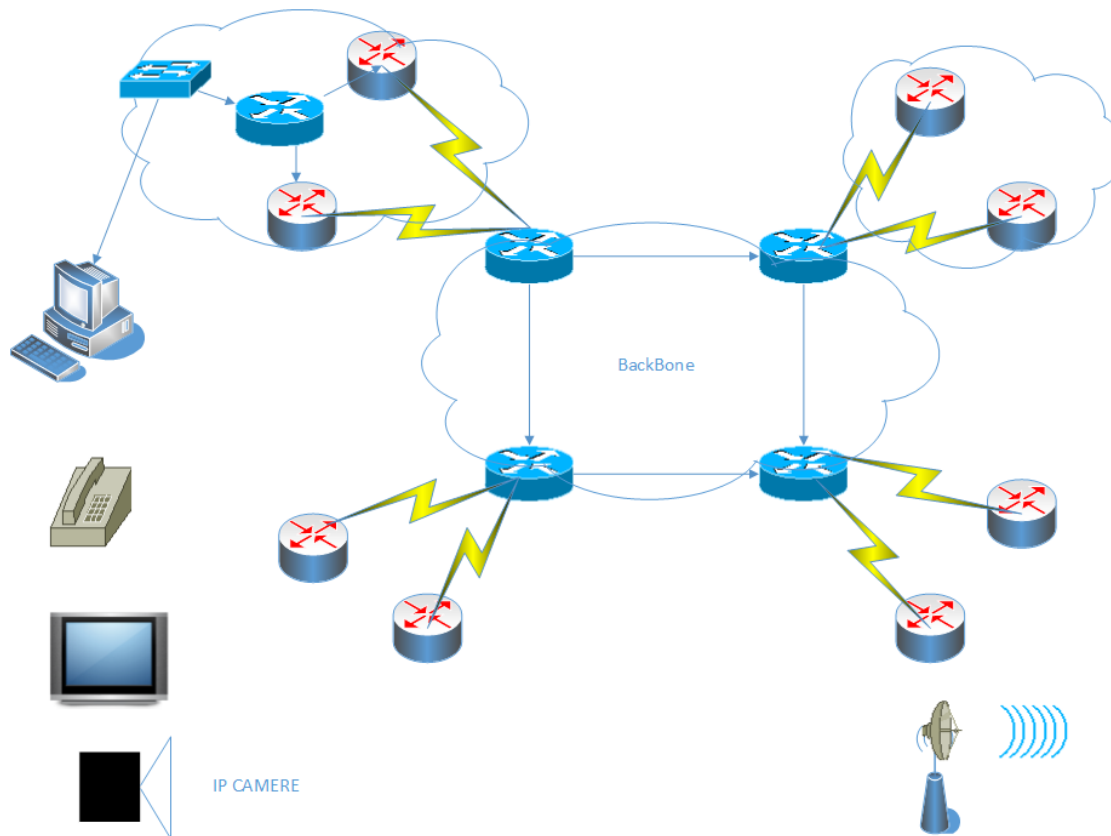
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# OSPF

*Open Shortest Path First – găsește mai întâi calea cea mai scurtă.*



# De ce OSPF?

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1. Este protocol Open Source.
2. Este un protocol ierarhic și anunță starea canalelor de conexiune (Link –state)
3. În calitate de protocol de transport folosește protocolul IP /89.
4. Este proiectat pentru rețele interne AS (Autonomous System).
5. Schimbul de informație despre rute în AS se face în baza LSA (Link-state Advertisement)

# Principiul de funcționare

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Algoritmul de bază pentru OSPF este algoritmul Dijkstra.

La conectarea unui router în rețea, va verifica capacitatea de funcționare a interfețelor, iar mai apoi se va folosi protocolul *Hello* pentru a găsi vecinii, primind pachete la fel.

Fiecare router periodic trimite mesaje de verificare a stărilor linkurilor – LSA messages.

După formarea arborelui de rute în interior se va verifica și rutele externe ce au legătură cu AS dat.

Din aceste mesaje se formează tabelul de rutare.

# Configurarea OSPF pe Mikrotik RouterOS

---

1. Setăm adresele IP
2. Adăugăm **area name**
3. Adăugăm area ID: **Ex.area-id=0.0.0.3**
4. Adăugăm rețelele în AS
5. Verificăm neighbors OSPF

# OSPF Configurare

New OSPF Area

Area Name:

Instance:

Area ID:

Type:

Translator Role:

Inject Summary LSAs

Default Cost:

Interfaces:

Active Interfaces:

Neighbors:

Adjacent Neighbors:

enabled

OK  
Cancel  
Apply  
Disable  
Comment  
Copy  
Remove

OSPF

Networks Areas Area Ranges Virtual Links Neighbors NBMA Neighbors Sham Links LSA Routes ...

Find

Area Name	Instance	Area ID	Type	Default C...	Interfac...	Active I...	Neighb...
area1	default	0.0.0.3	default		1	1	0
* backbone	default	0.0.0.0	default		2	2	2

2 items

# OSPF Configurare

The image shows two windows from the Mikrotik WinBox interface. The 'New OSPF Network' window is in the foreground, showing the 'Network' field set to '0.0.0.0/0' and the 'Area' dropdown set to 'backbone'. Below these fields, the 'enabled' checkbox is checked. The 'OSPF' window is in the background, displaying a table of configured networks. The table has two columns: 'Network' and 'Area'. The first row shows '192.168.1.0/24' assigned to 'backbone'. The second row shows '192.168.13.0/24' assigned to 'area1'. The table also includes a 'Find' search box and various action icons.

Network	Area
192.168.1.0/24	backbone
192.168.13.0/24	area1

# OSPF Configurare

OSPF

Interfaces Instances Networks Areas Area Ranges Virtual Links Neighbors NBMA Neighbors ...

Find

Interface	Cost	Priority	Authentic...	Authenticatio...	Network Type	Instance	Area
D ether2	10	1	none	*****	broadcast	default	backbone
D ether3	10	1	none	*****	broadcast	default	backbone
D ether5	10	1	none	*****	broadcast	default	area1

OSPF

Virtual Links Neighbors NBMA Neighbors Sham Links LSA Routes AS Bo

Find

Instance	Router ID	Address	Interface	State Changes
default	192.168.1.193	192.168.1.190	ether2	6
default	192.168.1.65	192.168.1.65	ether3	5

OSPF

Neighbors NBMA Neighbors Sham Links LSA Routes AS Border Routers Area Border Routers ...

Find all

Instance	Area	Router ID	Gateway	Interface	Cost	State
▶ default	area1	192.168.1.126			0	intra area
▶ default	backbone	192.168.1.126			0	intra area
▶ default	backbone	192.168.1.193	192.168.1.190	ether2	10	intra area

3 items out of 0

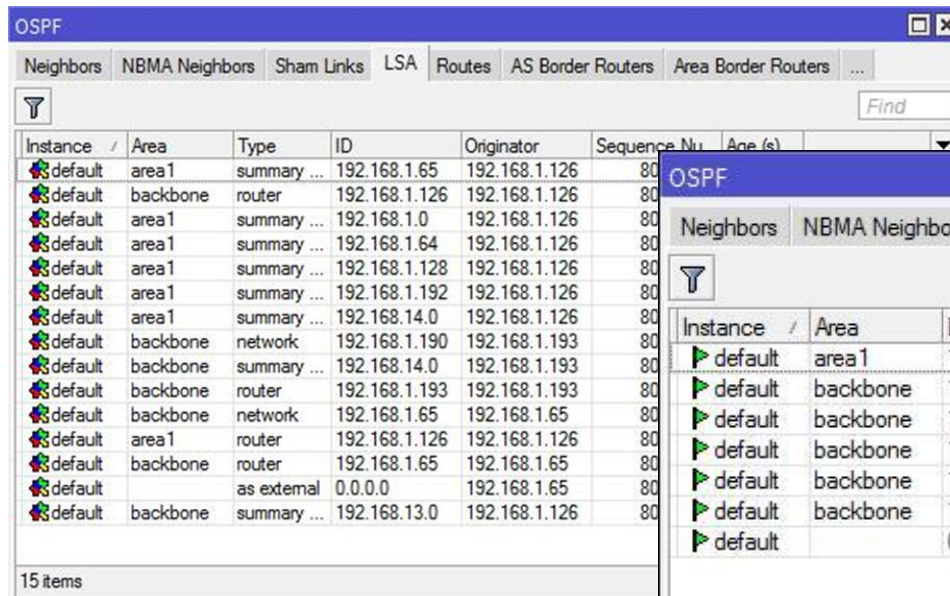
OSPF

Neighbors NBMA Neighbors Sham Links LSA Routes AS Border Routers Area Border Routers ...

Find

Instance	Router ID	Gateway	Interface	Cost	State
▶ default	192.168.1.65	192.168.1.65	ether3	10	intra area

# Rezultatul /LSA / Routes



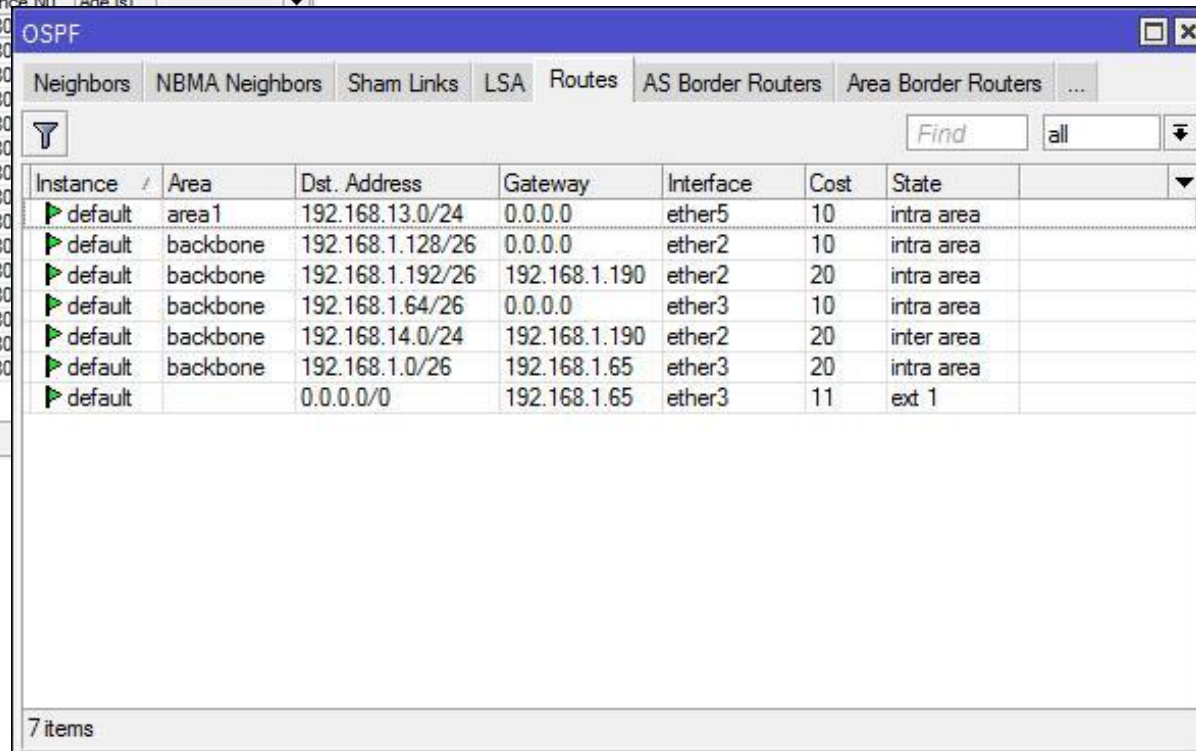
OSPF

Neighbors NBMA Neighbors Sham Links LSA Routes AS Border Routers Area Border Routers ...

Find

Instance /	Area	Type	ID	Originator	Sequence Nu.	Age (s)	
default	area 1	summary ...	192.168.1.65	192.168.1.126	80		
default	backbone	router	192.168.1.126	192.168.1.126	80		
default	area 1	summary ...	192.168.1.0	192.168.1.126	80		
default	area 1	summary ...	192.168.1.64	192.168.1.126	80		
default	area 1	summary ...	192.168.1.128	192.168.1.126	80		
default	area 1	summary ...	192.168.1.192	192.168.1.126	80		
default	area 1	summary ...	192.168.14.0	192.168.1.126	80		
default	backbone	network	192.168.1.190	192.168.1.193	80		
default	backbone	summary ...	192.168.14.0	192.168.1.193	80		
default	backbone	router	192.168.1.193	192.168.1.193	80		
default	backbone	network	192.168.1.65	192.168.1.65	80		
default	area 1	router	192.168.1.126	192.168.1.126	80		
default	backbone	router	192.168.1.65	192.168.1.65	80		
default		as external	0.0.0.0	192.168.1.65	80		
default	backbone	summary ...	192.168.13.0	192.168.1.126	80		

15 items



OSPF

Neighbors NBMA Neighbors Sham Links LSA Routes AS Border Routers Area Border Routers ...

Find all

Instance /	Area	Dst. Address	Gateway	Interface	Cost	State	
default	area 1	192.168.13.0/24	0.0.0.0	ether5	10	intra area	
default	backbone	192.168.1.128/26	0.0.0.0	ether2	10	intra area	
default	backbone	192.168.1.192/26	192.168.1.190	ether2	20	intra area	
default	backbone	192.168.1.64/26	0.0.0.0	ether3	10	intra area	
default	backbone	192.168.14.0/24	192.168.1.190	ether2	20	inter area	
default	backbone	192.168.1.0/26	192.168.1.65	ether3	20	intra area	
default		0.0.0.0/0	192.168.1.65	ether3	11	ext 1	

7 items



# Avantaje

---

Chiar și în rețele mari, nu încarcă rețeaua cu trafic propriu.

Rutele generate de protocolul OSPF nu pot fi ciclice.

Schimbul de informație despre tabela de rutare are loc doar la reconfigurarea topologiei.

Informația despre reconfigurarea topologiei se răspândește prin toată rețeaua.

Reconfigurarea este rapidă.

Poate fi aplicat multicasting pentru a micșora încărcarea canalelor neimplicate.

# Dezavantaje

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Algoritm complicat de configurat

**Consumă resurse ale procesorului.**

**Necesită mai multă memorie.**

Orice schimbare în rețea necesită retransmiterea LSA.

# MPLS

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DESCRIERE, AVANTAJE ȘI DEZAVANTAJE

EU....  
MPLS?.....



# Conceptul la majoritatea este...

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- Doar rețele bazate pe adrese IP ( Layer 3)
- MPLS miroase a ATM, iar ATM a fost proiectat la beție la partea de implementare pe rețele IP
- Multe aspecte ale MPLS ar putea fi numit prea complicate, sau cel puțin au fost prezentate într-un mod extrem de complicat în trecut.

**!!! Dar MPLS poate fi un instrument puternic pentru orice rețea.**

# Descriere MPLS

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La baza funcționării MPLS stă principiul schimbului de etichete (Labels). Orice pachet transmis este asociat cu o anumită clasă a nivelului rețea. (FEC)

Valoarea etichetei este unică doar pentru sectorul dintre ruterele MPLS, care se numesc LSR (Label Switching Router).

Schimbul de etichete are loc în baza protocolului LDP (Label Distribution Protocol)

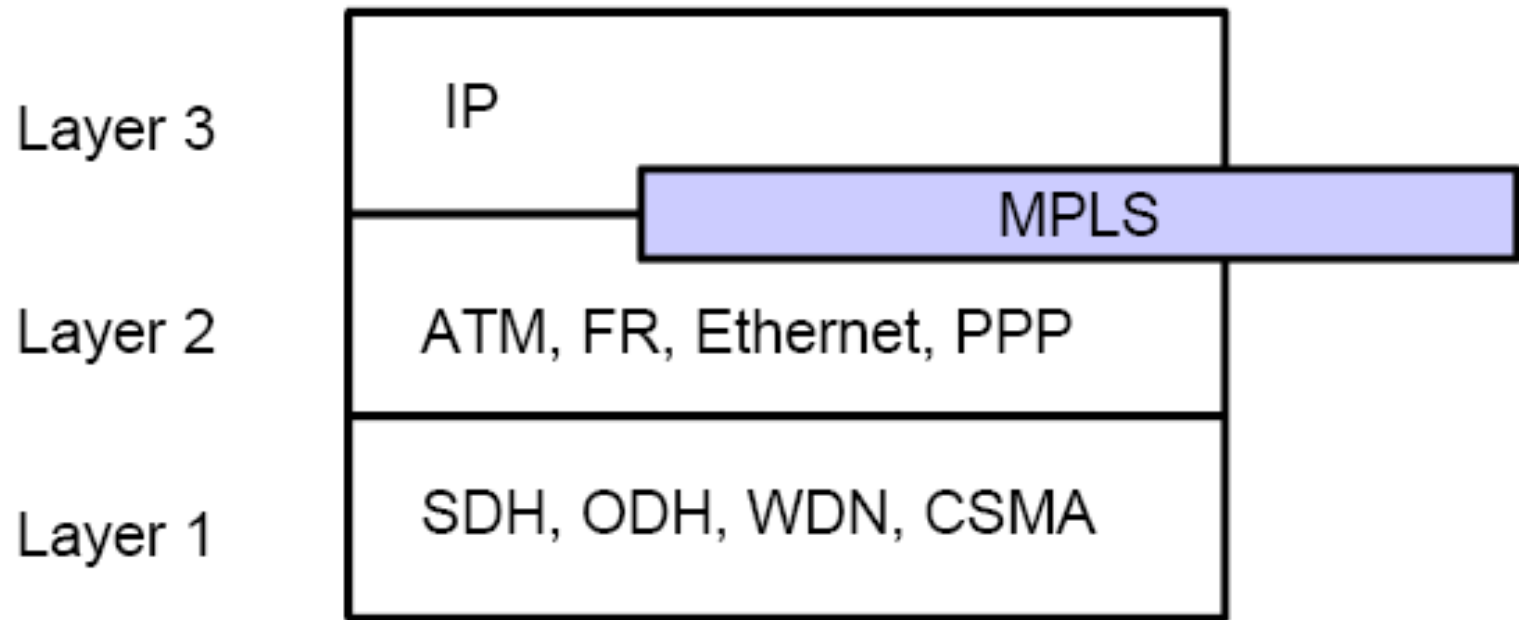
Împărțirea etichetelor între LSR, permite setarea în interiorul domeniului MPLS a canalelor cu comutare de etichete LSP (Label Switchng Path).

Fiecare router LSR conține următoarea informație:

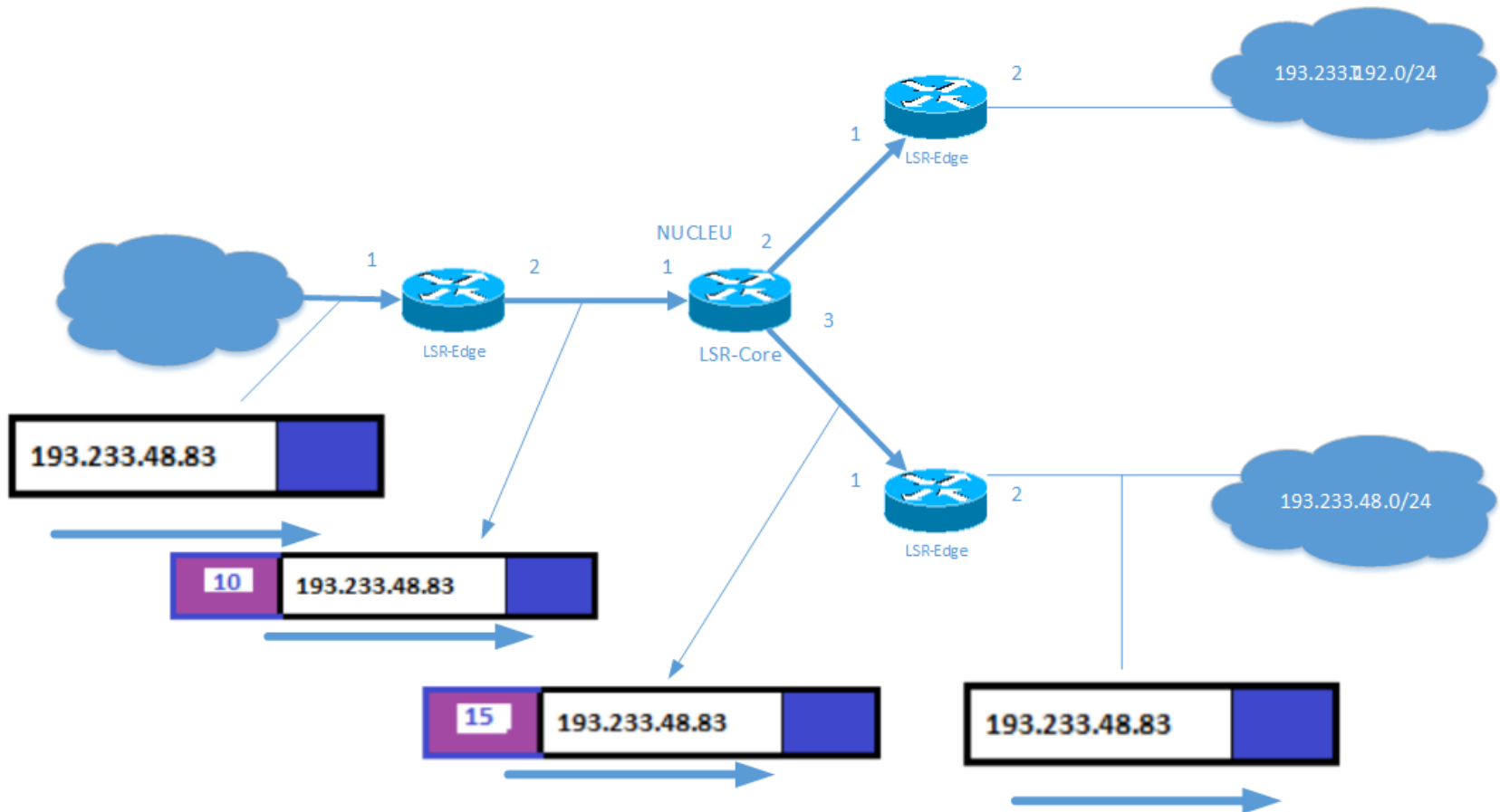
- IN-Interface , In-Label
- Prefix DST-address, Out-Interface, Out – Label.

# MPLS pe ISO/OSI

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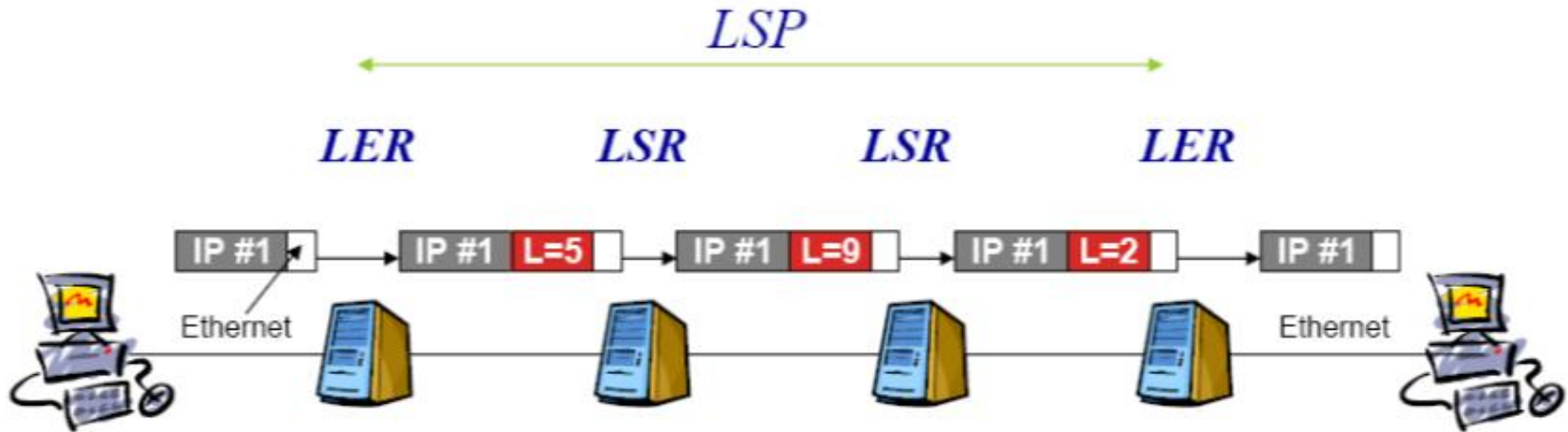


# Structură





# Structură



IP Addr	Out Label	In Label	Out Label	In Label	Out Label	In Label	Next Hop
192.4/16	5	5	9	9	2	2	192.4/16
Layer 2 Transport	Assign init label	Label Swapping		Label Swapping		Remove Label	Layer 2 Transport

“ROUTE AT EDGE, SWITCH IN CORE”

# Descriere

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In Label	Port IN	Prefix	Port out	Aut Label
-	-	193.233.48	2	10
-	-	193.233.192	2	8

In Label	Port IN	Prefix	Port out	Aut Label
11	1	193.233.192	2	-
8	1	193.233.192	2	-

In Label	Port IN	Prefix	Port out	Aut Label
10	1	193.233.192	2	11
8	1	193.233.48	3	15
7	4	193.233.192	2	8

In Label	Port IN	Prefix	Port out	Aut Label
15	1	193.233.48	2	

# Aplicare pe Mikrotik

The screenshot displays the Mikrotik WinBox interface for configuring MPLS. The 'MPLS Settings' window is open, showing the 'LDP Settings' tab. The 'LDP Settings' window is highlighted with a red box. The 'Enabled' checkbox is checked and highlighted with a red box. The 'Distribute For Default Route' checkbox is also checked and highlighted with a red box. The 'LSR ID' and 'Transport Address' fields are both set to 10.1.1.254. The 'Path Vector Limit' and 'Hop Limit' are both set to 255. The 'Loop Detect' and 'Use Explicit Null' checkboxes are unchecked. The 'OK', 'Cancel', and 'Apply' buttons are visible on the right side of the 'LDP Settings' window. The background window shows a table with one item for interface wlan1.

Interface	Hello Interval	Hold Time	Transport Address	Accept Dy...
wlan1	00:00:05	00:00:15	10.1.1.254	yes

1 item

# New MPLS interface

The screenshot shows the Mikrotik WinBox interface for configuring MPLS. The main window is titled 'MPLS' and has several tabs: 'LDP Interface', 'LDP Neighbor', 'Accept Filter', 'Advertise Filter', 'Forwarding Table', 'MPLS Interface', and 'Local Bindings'. The 'MPLS Interface' tab is active. Below the tabs are several icons and buttons, including 'MPLS Settings' and 'LDP Settings'. A table lists the current MPLS interfaces:

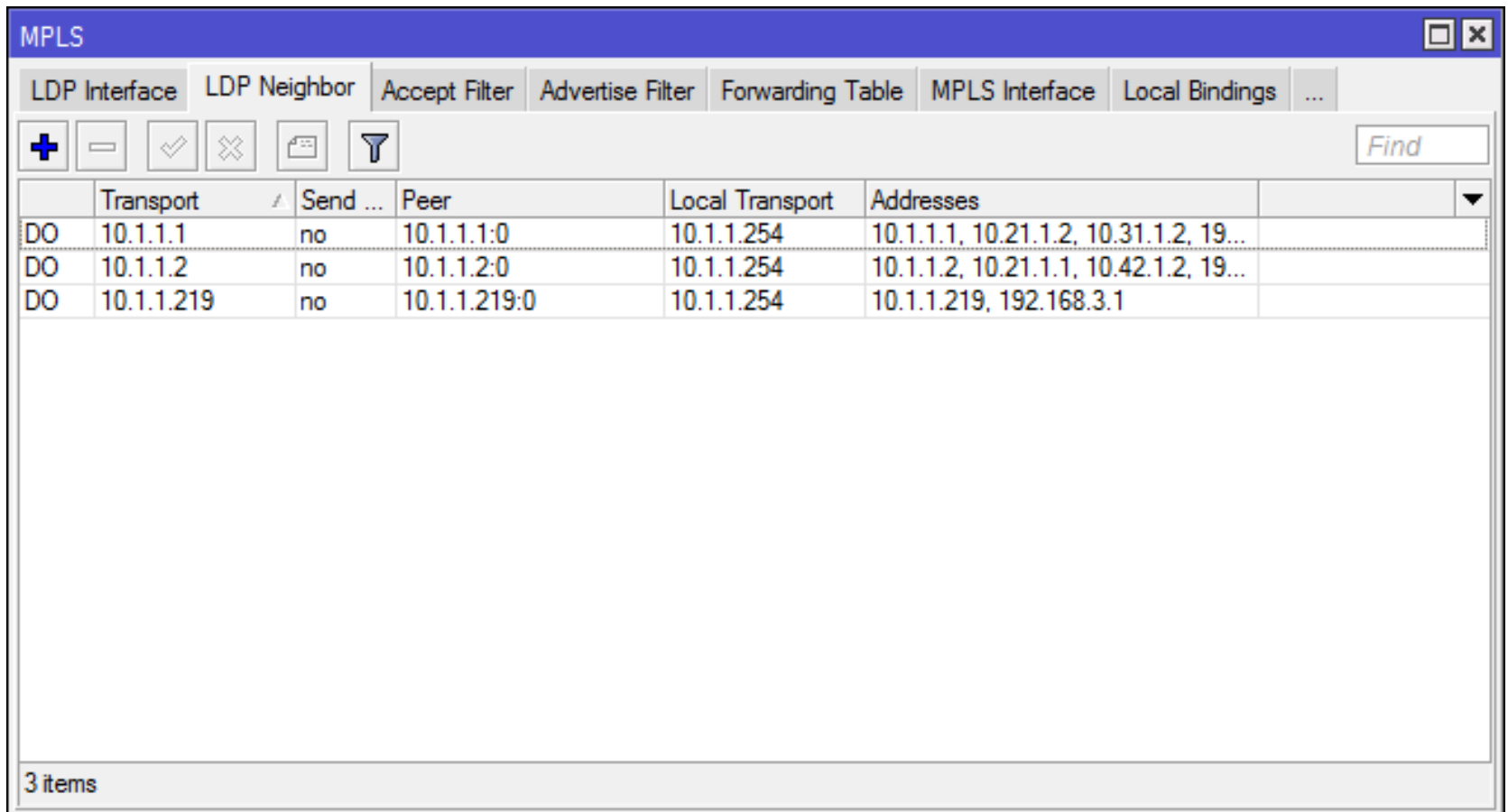
Interface	Hello Interval	Hold Time	Transport Address	Accept Dy...
wlan1	00:00:05	00:00:15	10.1.1.254	yes

A 'New MPLS Interface' dialog box is open, allowing configuration for a new interface. The fields are as follows:

- Interface: wlan1
- Hello Interval: 00:00:05
- Hold Time: 00:00:15
- Transport Address: (empty)
- Accept Dynamic Neighbors

Buttons on the right side of the dialog include: OK, Cancel, Apply, Disable, Comment, Copy, and Remove. At the bottom of the main window, it shows '1 item' and 'enabled'.

# LDP Neighbors



The screenshot shows the Mikrotik WinBox interface for the MPLS LDP Neighbors configuration. The window title is 'MPLS'. The 'LDP Neighbor' tab is selected. The table below displays the current LDP neighbor configuration.

	Transport	Send ...	Peer	Local Transport	Addresses
DO	10.1.1.1	no	10.1.1.1:0	10.1.1.254	10.1.1.1, 10.21.1.2, 10.31.1.2, 19...
DO	10.1.1.2	no	10.1.1.2:0	10.1.1.254	10.1.1.2, 10.21.1.1, 10.42.1.2, 19...
DO	10.1.1.219	no	10.1.1.219:0	10.1.1.254	10.1.1.219, 192.168.3.1

3 items

# Se adaugă interfețe...

## LDP Interface

MPLS

LDP Interface | LDP Neighbor | Accept Filter | Advertise Filter | Forwarding Table | MPLS Interface | Local Bindings | Remote Bindings

+ - ✓ ✗ [ ] [ ] MPLS Settings LDP Settings

Interface	Hello Interval	Hold Time	Transport Address	Accept Dy...
ether2	00:00:05	00:00:15	172.20.1.1	yes
wlan1	00:00:05	00:00:15	10.1.1.5	yes

LDP Settings

Enabled

LSR ID: 10.1.1.5 ▲

Transport Address: 10.1.1.5 ▲

Path Vector Limit: 255

Hop Limit: 255

Loop Detect

Use Explicit Null

Distribute For Default Route

OK

Cancel

Apply

# Forwarding / Labels

MPLS

LDP Interface LDP Neighbor Accept Filter Advertise Filter Forwarding Table MPLS Interface Local Bindings Remote Bindings

+ - ✓ ✗ ☰ ⏏

	Transport	Send ...	Peer	Local Transport	Addresses
DOT	10.1.1.1	yes	10.1.1.1:0	10.1.1.5	10.1.1.1, 10.21.1.2, 10.31.1.2, 192.168.1.1
DO	10.1.1.2	no	10.1.1.2:0	10.1.1.5	10.1.1.2, 10.21.1.1, 10.42.1.2, 172.20.1.2, 192.168.2.1
DO	10.1.1.219	no	10.1.1.219:0	10.1.1.5	10.1.1.219, 10.31.1.1, 192.168.3.1
DO	10.1.1.254	no	10.1.1.254:0	10.1.1.5	10.1.1.254, 172.16.1.1, 192.168.4.107

MPLS

LDP Interface LDP Neighbor Accept Filter Advertise Filter Forwarding Table MPLS Interface Local Bindings Remote Bindings

⏏

In Label	Out Labels	Interface	Nexthop	Destination	Bytes	Packets
expl-null					0	0
17		wlan1	10.1.1.3	192.169.3.0/24	0	0
20				vpls 1-Felix	1356	12

# Local Bindings

MPLS

LDP Interface LDP Neighbor Accept Filter Advertise Filter Forwarding Table MPLS Interface Local Bindings Remote Bindings

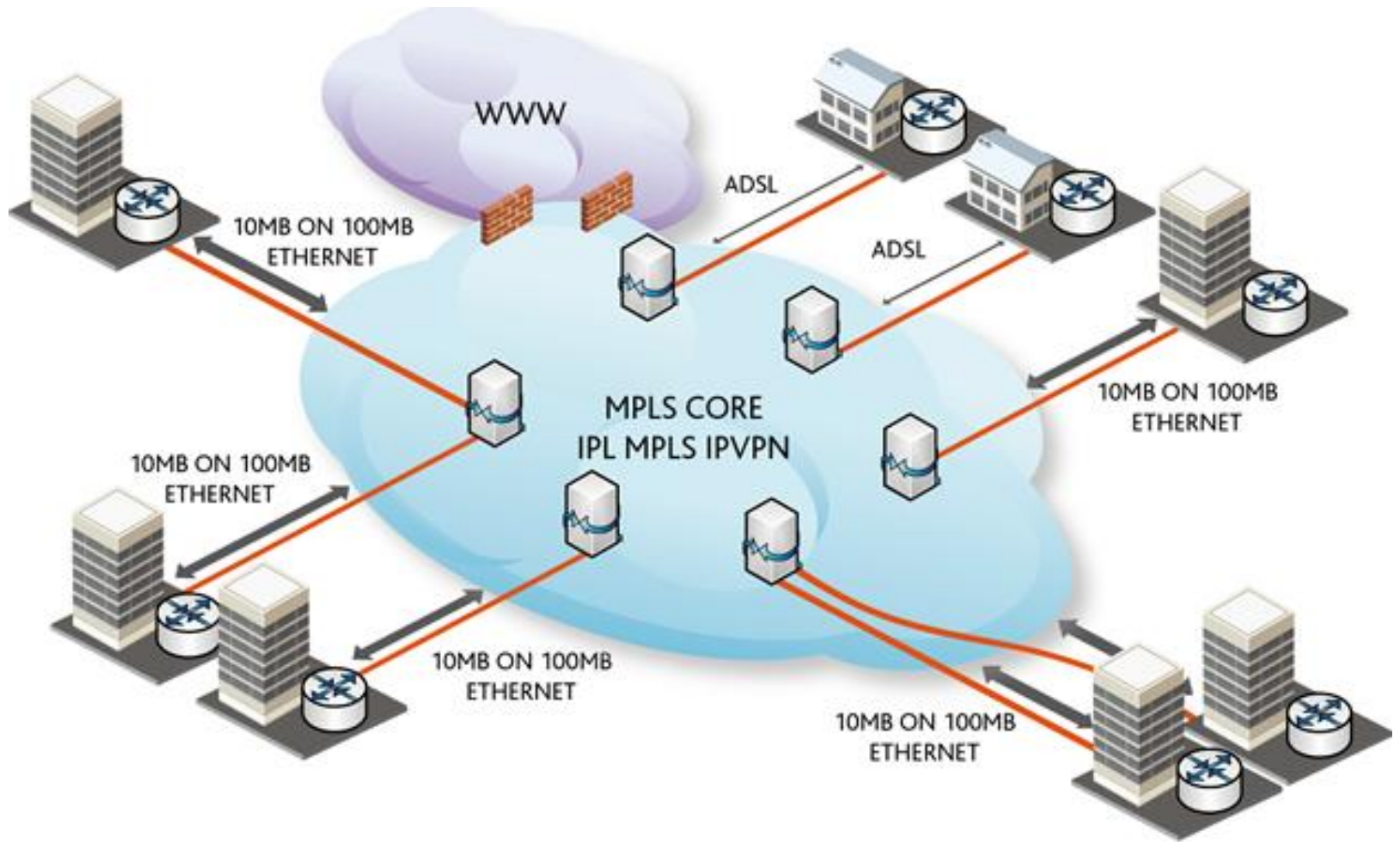
+ - ✓ ✗ 📄 🏠

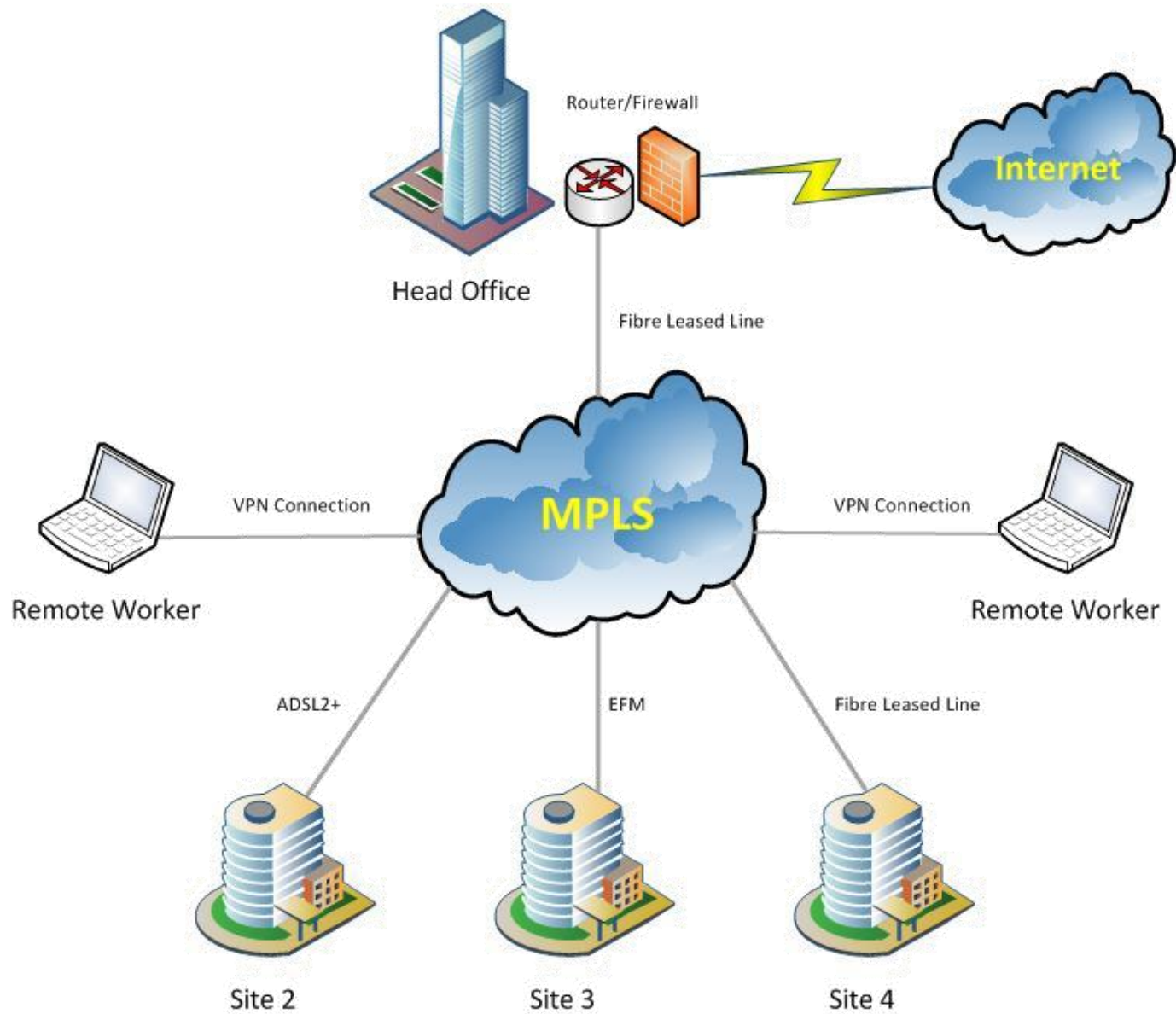
	Dst. Address	Label	Advertised Path	Peers
DAeL	10.1.1.0/24	impl-null	empty	10.1.1.2:0, 10.1.1.254:0, 10.1.1.1:0, 10.1.1.219:0
DAeL	172.20.1.0/30	impl-null	empty	10.1.1.2:0, 10.1.1.254:0, 10.1.1.1:0, 10.1.1.219:0
DAeL	192.168.5.0/24	impl-null	empty	10.1.1.2:0, 10.1.1.254:0, 10.1.1.1:0, 10.1.1.219:0
DAG	192.169.3.0/24	17	empty	10.1.1.2:0, 10.1.1.254:0, 10.1.1.1:0, 10.1.1.219:0



# Remote Bindings

MPLS							
LDP Interface	LDP Neighbor	Accept Filter	Advertise Filter	Forwarding Table	MPLS Interface	Local Bindings	Remote Bindings
+	-	✓	✗	✉	⌵		
	Dst. Address	Label	NextHop	Peer	Path		
D	0.0.0.0/0	impl-null	0.0.0.0	10.1.1.2:0	empty		
D	0.0.0.0/0	21	0.0.0.0	10.1.1.254:0	empty		
D	0.0.0.0/0	impl-null	0.0.0.0	10.1.1.1:0	empty		
D	10.1.1.0/24	impl-null	0.0.0.0	10.1.1.2:0	empty		
D	10.1.1.0/24	impl-null	0.0.0.0	10.1.1.254:0	empty		
D	10.1.1.0/24	impl-null	0.0.0.0	10.1.1.1:0	empty		
D	10.1.1.0/24	impl-null	0.0.0.0	10.1.1.219:0	empty		
D	10.21.1.0/30	impl-null	0.0.0.0	10.1.1.2:0	empty		
D	10.21.1.0/30	impl-null	0.0.0.0	10.1.1.1:0	empty		
D	10.31.1.0/30	impl-null	0.0.0.0	10.1.1.1:0	empty		
D	10.31.1.0/31	impl-null	0.0.0.0	10.1.1.219:0	empty		
D	172.16.1.0/30	impl-null	0.0.0.0	10.1.1.254:0	empty		
D	172.20.1.0/30	impl-null	0.0.0.0	10.1.1.2:0	empty		
D	192.168.1.0/24	18	0.0.0.0	10.1.1.2:0	empty		
D	192.168.1.0/24	impl-null	0.0.0.0	10.1.1.1:0	empty		
D	192.168.2.0/24	impl-null	0.0.0.0	10.1.1.2:0	empty		
D	192.168.2.0/24	21	0.0.0.0	10.1.1.1:0	empty		
D	192.168.3.0/24	19	0.0.0.0	10.1.1.2:0	empty		
D	192.168.3.0/24	16	0.0.0.0	10.1.1.1:0	empty		
D	192.168.3.0/24	impl-null	0.0.0.0	10.1.1.219:0	empty		
D	192.168.4.0/24	impl-null	0.0.0.0	10.1.1.254:0	empty		
D	192.168.4.0/24	17	0.0.0.0	10.1.1.1:0	empty		





# Avantaje

---

- Caracteristica principală MPLS este despărțirea procesului de comutare de analiza adreselor IP în antetul pachetului.
- Nucleul este format din dispozitive cu cerințe minime față de resurse (Unica cerință – funcționarea MPLS)
- Nucleul are doar funcția de comutare, funcțiile de clasificare a pachetelor, filtrarea și rutarea, dirijarea traficului și optimizarea sarcinii o au ruterele LSR.
- Comutarea este rapidă, minimizează timpul de căutare în tabele.
- Este implementată un sistem de QoS foarte flexibil, permite implementarea diferitor servicii integrate și a VPN
- Utilizarea eficientă a rutelor.

# Dezavantaje

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- Un nivel adițional este adăugat
- Ruterul trebuie să înțeleagă MPLS

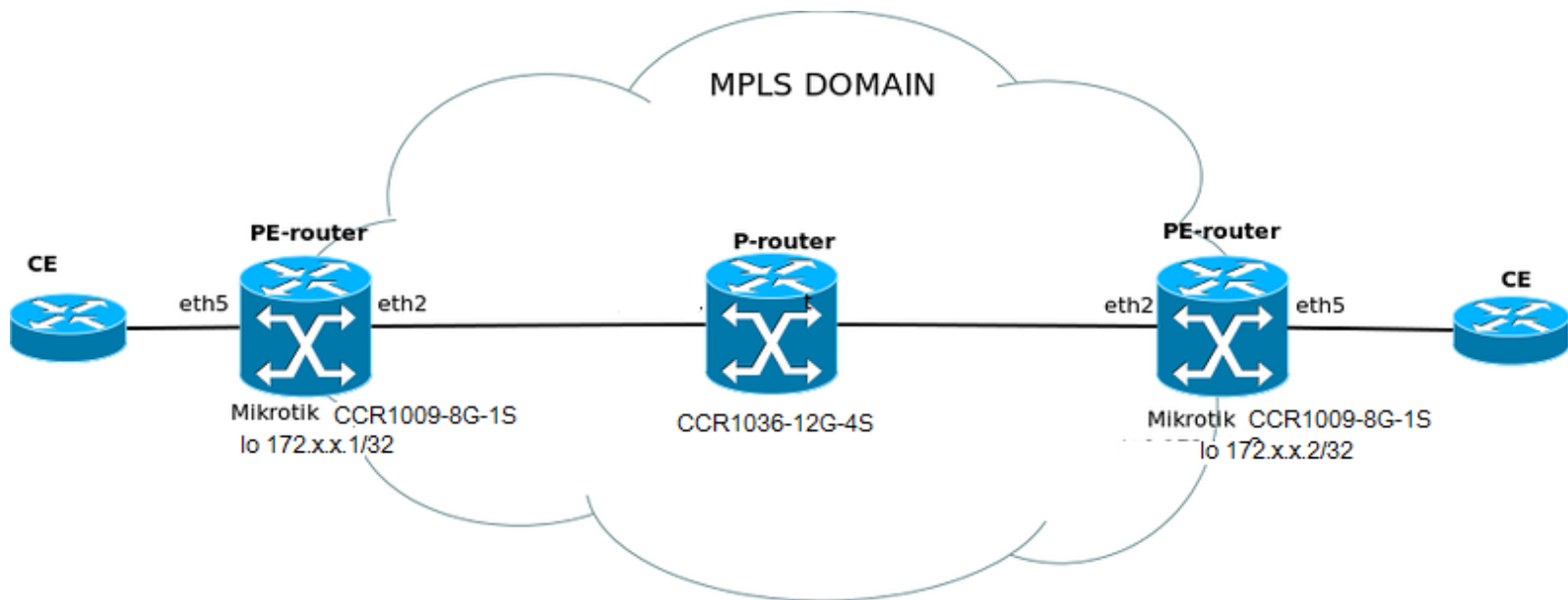
# Soluția?

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The Mikrotik logo features the word "Mikrotik" in a stylized, bold, sans-serif font. The "i" in "Mikro" has a unique design with two curved lines above it, resembling a stylized 'i' or a signal. The "T" in "Tik" is also stylized with a thick, blocky appearance. The overall font is modern and professional.

## MPLS & OSPF

# OSPF & MPLS



# Ridicăm adresele IP pe interfeță

---

```
/interface bridge
```

```
add name=loopback
```

```
add l2mtu=1526 name=vpn
```

```
/ip address
```

```
add address=10.0.11.24/24 interface=eth2
```

```
add address=172.x.x.1/32 interface=loopback  
network=172.x.x.1
```



# Am ajustat OSPF, am anunțat rețele prin care ne-am văzut vecinii + loopback:

---

```
/routing ospf instance
```

```
set [ find default=yes ] router-id=172.x.x.2
```

```
/routing ospf interface
```

```
add interface=eth2
```

```
/routing ospf network
```

```
add area=backbone network=10.0.11.0/24
```

```
add area=backbone network=172.x.x.2/32
```

# Am ajustat LDP, nu uităm de MPLS-MTU (pentru trecerea cu succes CCR1036 de pachete și QinQ)

---

```
/mpls interface
```

```
set [ find default=yes ] mpls-mtu=1526
```

```
/mpls ldp
```

```
set enabled=yes lsr-id=172.19.238.33 transport-  
address=172.19.238.33
```

```
/mpls ldp interface
```

```
add interface=eth2
```

În cele din urmă, am ridicat L2VPN și ne-am întors acolo eth5 unde vor trăi clientii nostri

---

```
/interface vpls
```

```
add advertised-l2mtu=1526 cisco-style=yes cisco-style-id=5 disabled=no l2mtu=1526 name=l2circuit remote-peer=172.x.x.2
```

```
/interface bridge port
```

```
add bridge=vpn interface=eth5
```

```
add bridge=vpn interface=l2circuit
```

# Pe ruterul 2 repetăm procedura

```
/interface bridge
add name=loopback
add l2mtu=1526 name=vpn
/ip address add address=172.x.x.2/32
interface=loopback network=172.x.x.2
add address=192.168.168.2/24
interface=eth2 network=192.168.168.0
/routing ospf instance set [find default=yes]
router-id=172.x.x.2
/routing ospf interface add interface=eth2
/routing ospf network add area=backbone
network=192.168.168.0/24
add area=backbone network=172.x.x.2/32
/mpls interface set [find default=yes] mpls-
mtu=1526
/mpls ldp set enabled=yes lsr-id=172.x.x.2
transport-address=172.x.x.2
/mpls ldp interface add interface=eth2
/interface vpls add advertised-l2mtu=1526
cisco-style=yes cisco-style-id=5 disabled=no
l2mtu=1526 name=junos-l2circuit remote-
peer=172.x.x.1
/interface bridge port add bridge=vpn
interface=eth5
add bridge=vpn interface=l2circuit
```

# Configurăm Ruterul P pe Mikrotik

---

```
/interface bridge add name=loopback
```

```
/ip address add address=10.0.11.24/24 interface=eth3
```

```
add address=172. x.x.1/32 interface=loopback network=x.x.1 add  
address=192.168.168.1/24 interface=eth2
```

```
/routing ospf instance set [ find default=yes ] router-id=172. x.x.1
```

```
/routing ospf interface add interface=eth2
```

```
add interface=eth3
```

```
/routing ospf network
```

```
add area=backbone network=10.0.11.0/24
```

```
add area=backbone network=172. x.x.1/32
```

```
add area=backbone network=192.168.168.0/24
```

# continuare

---

```
/mpls interface
```

```
set [ find default=yes ] mpls-mtu=1526
```

```
/mpls ldp
```

```
set enabled=yes lsr-id=172.x.x.1 transport-address=172.x.x.1
```

```
/mpls ldp interface
```

```
add interface=eth2
```

```
add interface=eth3
```

# Concluzii

---

- Pe Mikrotik aveți soluții eficiente din punct de vedere al costurilor raportate la beneficii.
- Aveți o multitudine de protocoale implementate și pot fi utilizate utilizând licențe deja bătute pe router începând cu nivel 4.
- Aveți suport și training-uri comparativ ieftine. (Cisco, Juniper ș.a.)
- Implementare soluții combinate OSPF, MPLS/VPLS, VLAN, IP Sec etc.

# Vă mulțumesc!



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[WWW.MIKROTIK.COM](http://WWW.MIKROTIK.COM)

[WWW.AITEC.MD](http://WWW.AITEC.MD)

MIKROTIK-TRAINING-CENTER.WEEBLY.COM

VSAMBURSKI@GMAIL.COM