

INTRODUCTION TO MPLS USING ROUTEROS



**MIKROTIK USER MEETING
JAKARTA
2016**



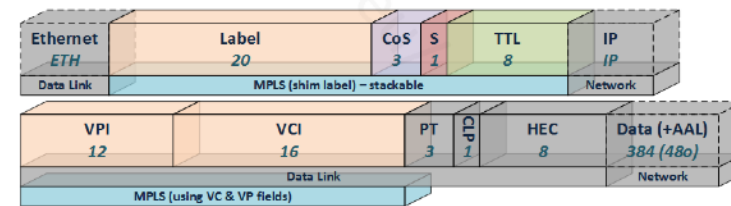
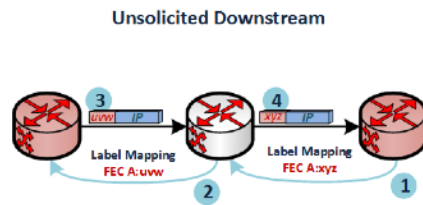
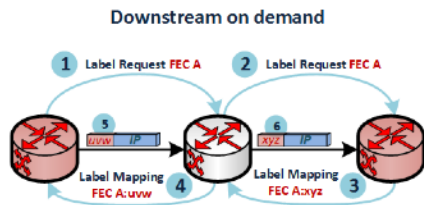
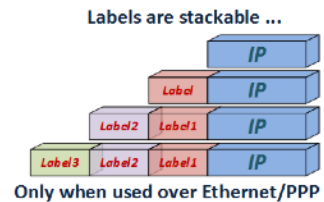
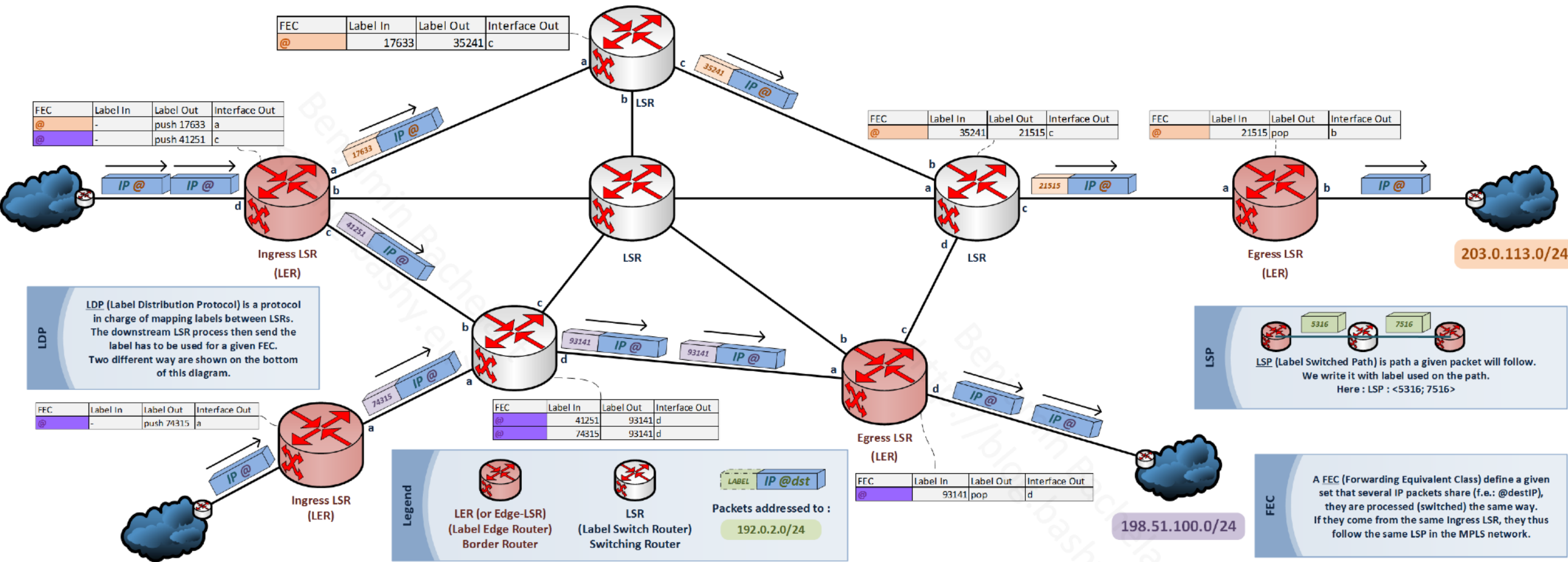
INTRODUCTION

- Irvan Adrian Kristiono
- CV Central Network
- Sytem Integrator & Trainer
- Grahamedia.Net
- Internet Service Provider
- At Salatiga, Jawa Tengah, Indonesia
- MTCNA(2010),MTCRE(2011),
MTCINE(2014)

MPLS



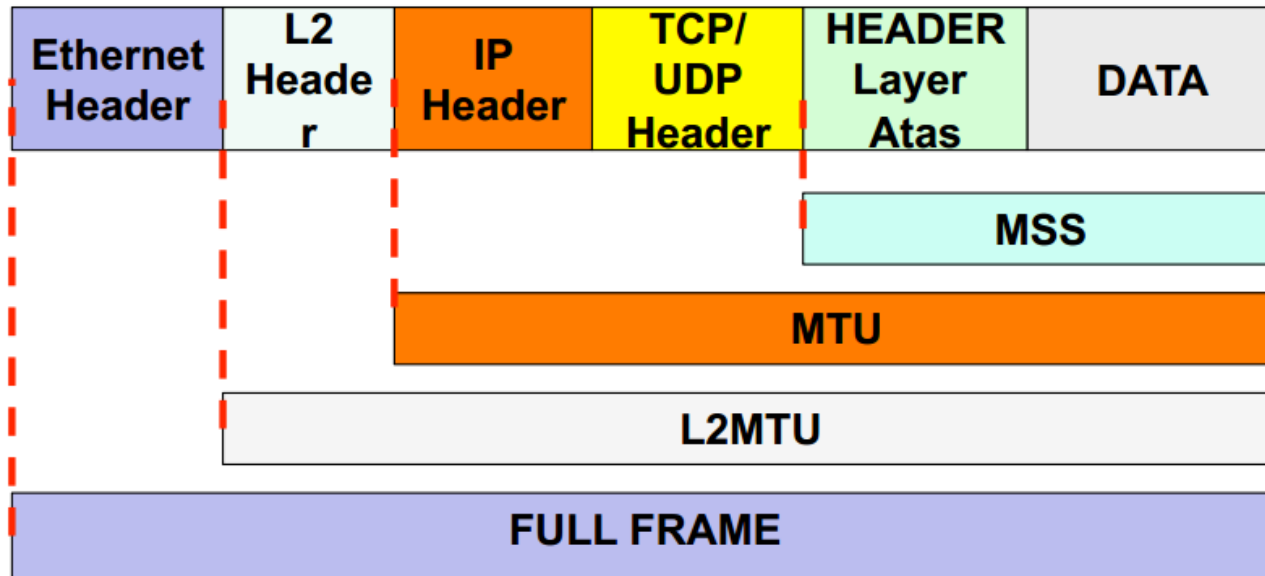
MPLS



LAYER 2.5 ?

*Mikro***Tik**

L2MTU

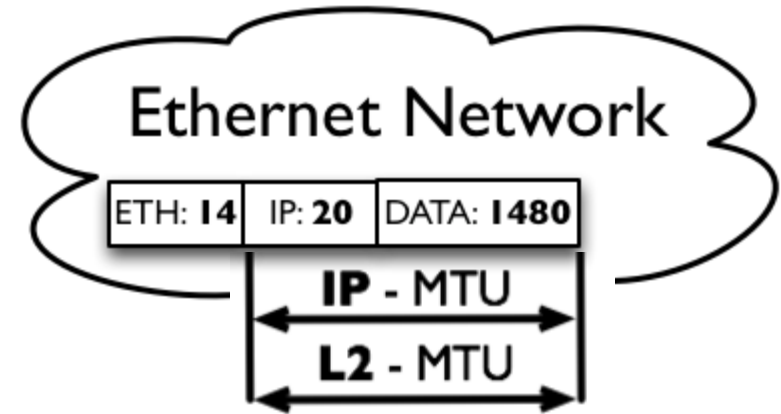


- **MTU** (Maximum Transmit Unit) is maximum amount packet data can be transmit over interface after header layer 3
- **L2MTU** (Layer 2 MTU) is maximum amount frame can be transmit over interface after header layer 2
- **Full Frame** is amount of all frame with Ethernet Header

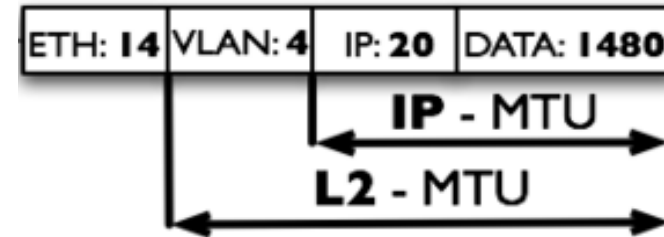
L2MTU

Layer 2 Maximum Transmission Unit

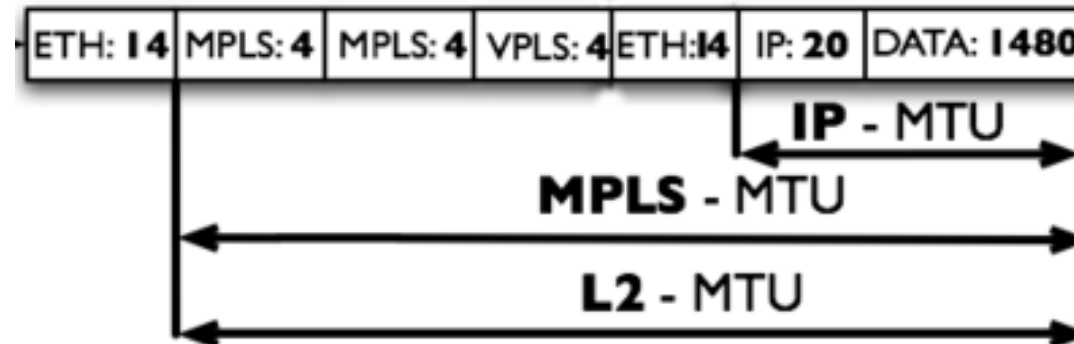
Ethernet
L2MTU: **1500**



L2MTU: **1504**



VPLS - MPLS
L2MTU: **1526**



L2MTU

Interface <ether1>

General | Ethernet | Overall Stats | Rx Stats | Tx Stats | Status | Traffic

Name: ether1

Type: Ethernet

MTU: 1500

L2 MTU: 1598

Max L2 MTU: 2028

MAC Address: E4:8D:8C:E7:7C:8A

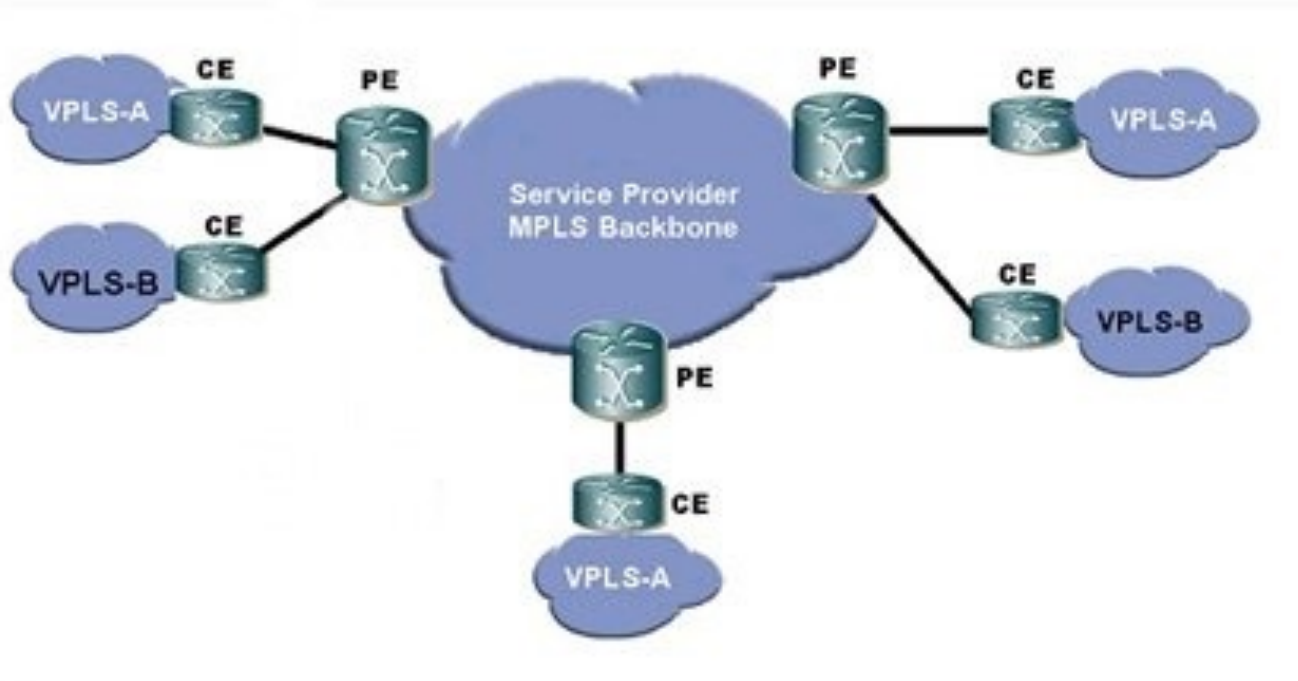
ARP: enabled

OK
Cancel
Apply
Disable
Comment
Torch
Cable Test

WHAT IS VPLS ?



VPLS



- Virtual Private LAN Service
- VPN Service of MPLS Protocol
- Support VPN Tunnel :
 - Point to Point
 - Multipoint

VPLS VS CURRENT VPN



SMALLER OVERHEAD = MORE BANDWIDTH

CURRENT VPN

- o Bigger Overhead
EoIP tunnel add 42 bytes overhead
(8 bytes GRE+14 bytes Ethernet +20
bytes IP) source
from : (<http://wiki.mikrotik.com/wiki/Manual:Interface/EoIP>)

Around 30 % space

Ethernet Frame



VPLS

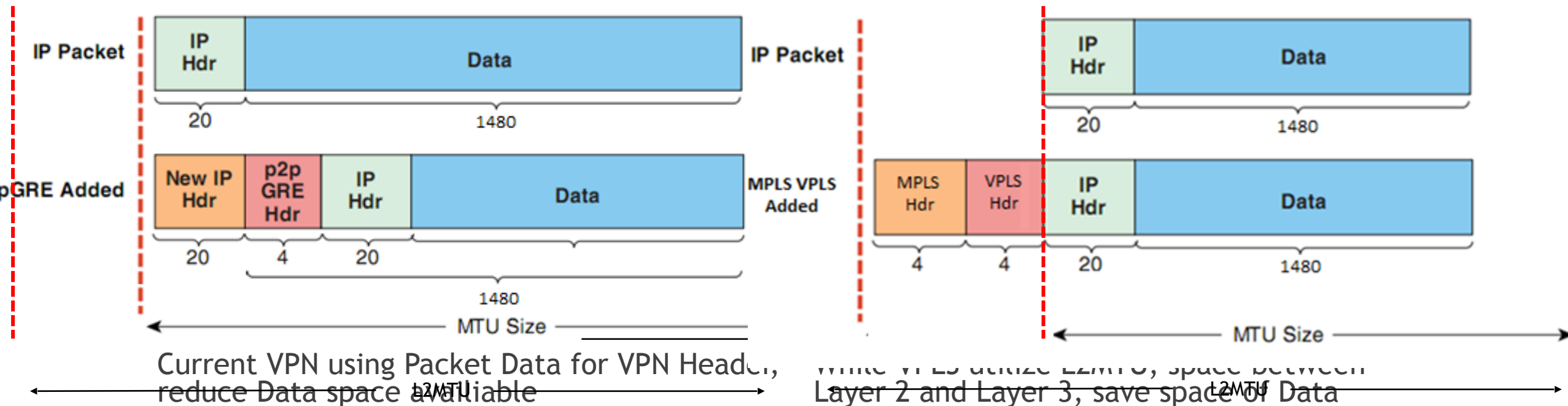
- o VPLS tunnel add 22 bytes overhead
(2 x Labels @4 Bytes + 14 Bytes
Ethernet)
- o Around 15 % space Ethernet Frame



L2VPN WITHOUT REDUCE DATA SPACE NO NEED TO SHRINK OR FRAGMENT DATA

CURRENT VPN

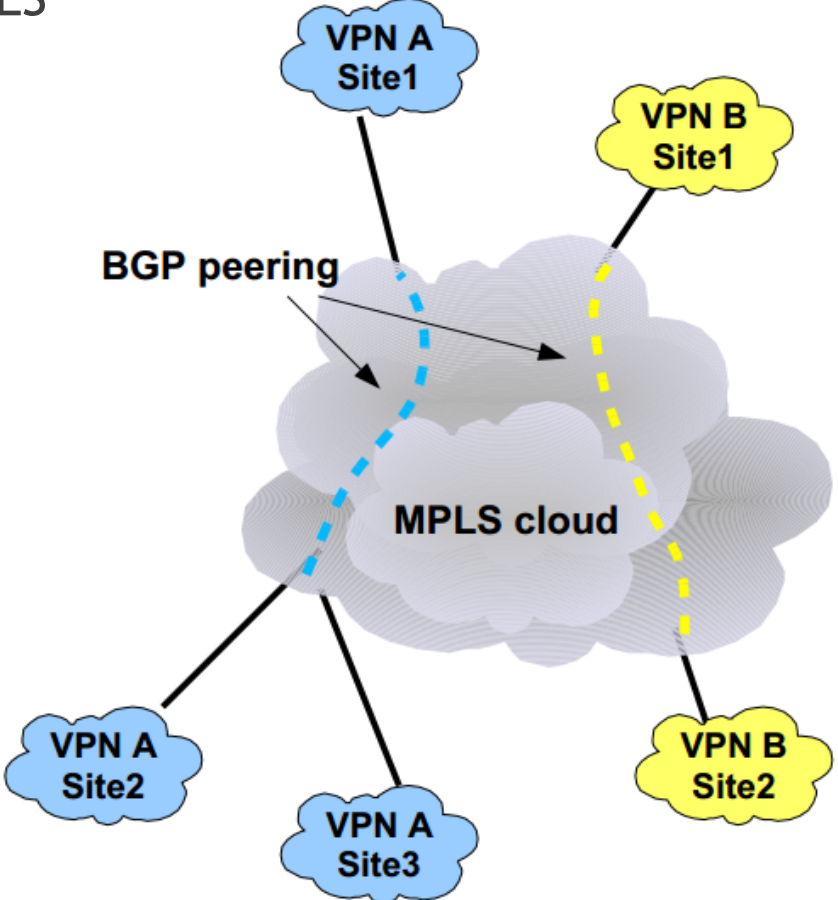
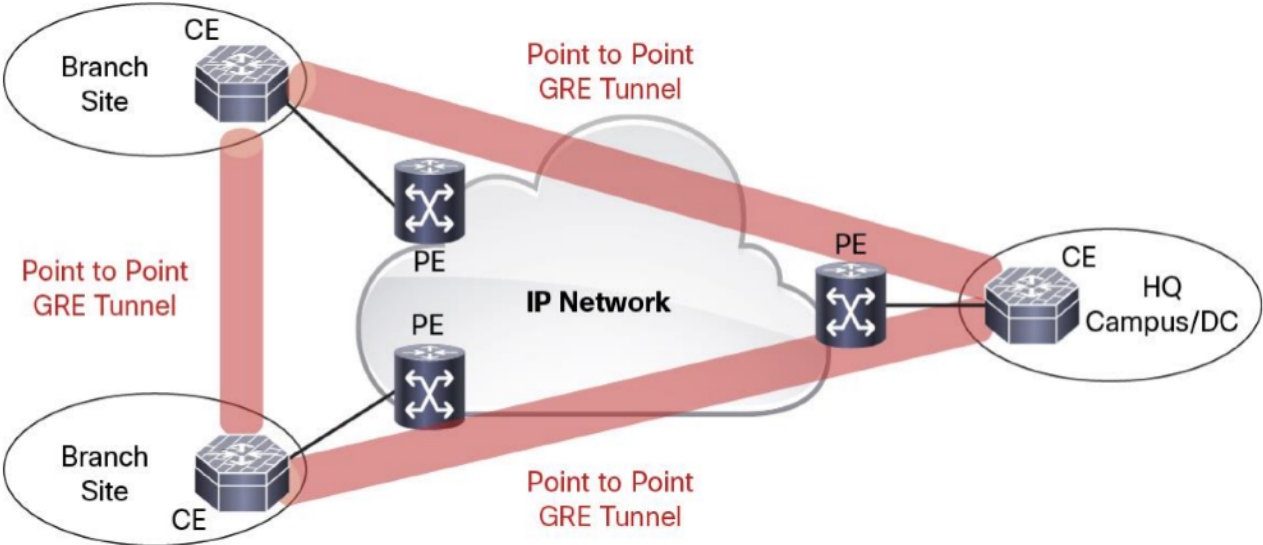
VPLS



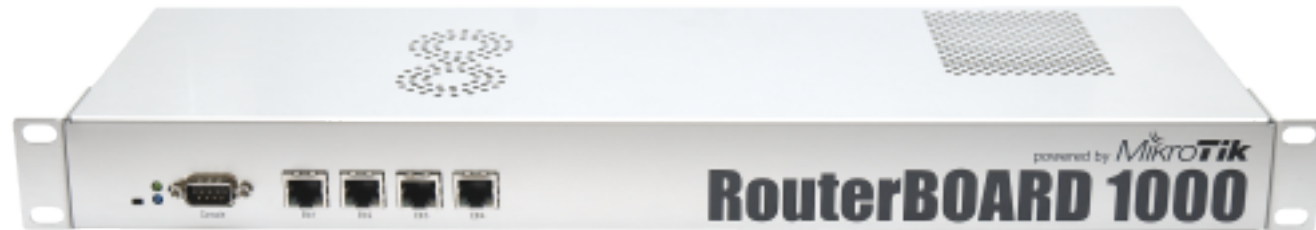
MORE SCALABLE WITH MULTIPOINT VPN

CURRENT VPN

VPLS



PERFORMANCE TESTING ON ROUTERBOARD



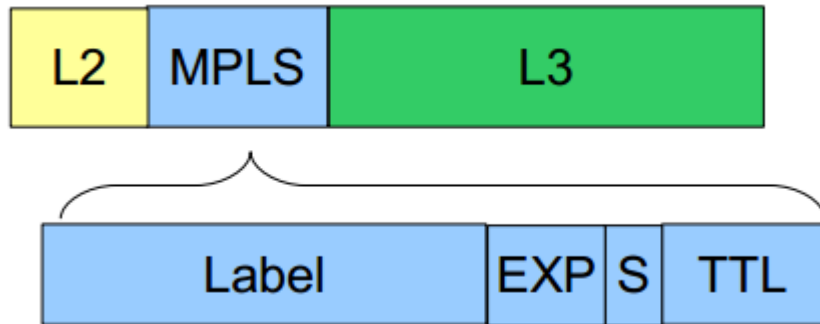
	64 byte pps	512 byte pps
Bridge	414.000	359.000
MPLS	410.000	358.000
Routing	236.000	229.700

	64 byte pps	512 byte pps
EoIP	190.000	183.900
VPLS	332.500	301.000

HOW TO MAKE MPLS ?



MPLS LABEL



- MPLS still need L3 Routing Protocol for propagate information routing for every members MPLS Network to propagate label information
- Routing Protocol which can be use are :
 - OSPF, IGRP, EIGRP, IS-IS, RIP
- Label Exchange Protocol which can be use are :
 - LDP, TDP, BGP(VPN), RSVP(MPLS-TE), CR-LDP

MPLS LDP

- MPLS Labels are assigned and distributed by the Label Distribution Protocol (LDP)
- LDP requirements :
 - IP connectivity - properly configured IP routing (static, OSPF, RIP) between all Router
 - “loopback” IP address that isn’t attached to any real network interface
 - Homogeneous MPLS cloud - all router inside MPLS Cloud must MPLS enable

SIMULATION



NETWORK DIAGRAM

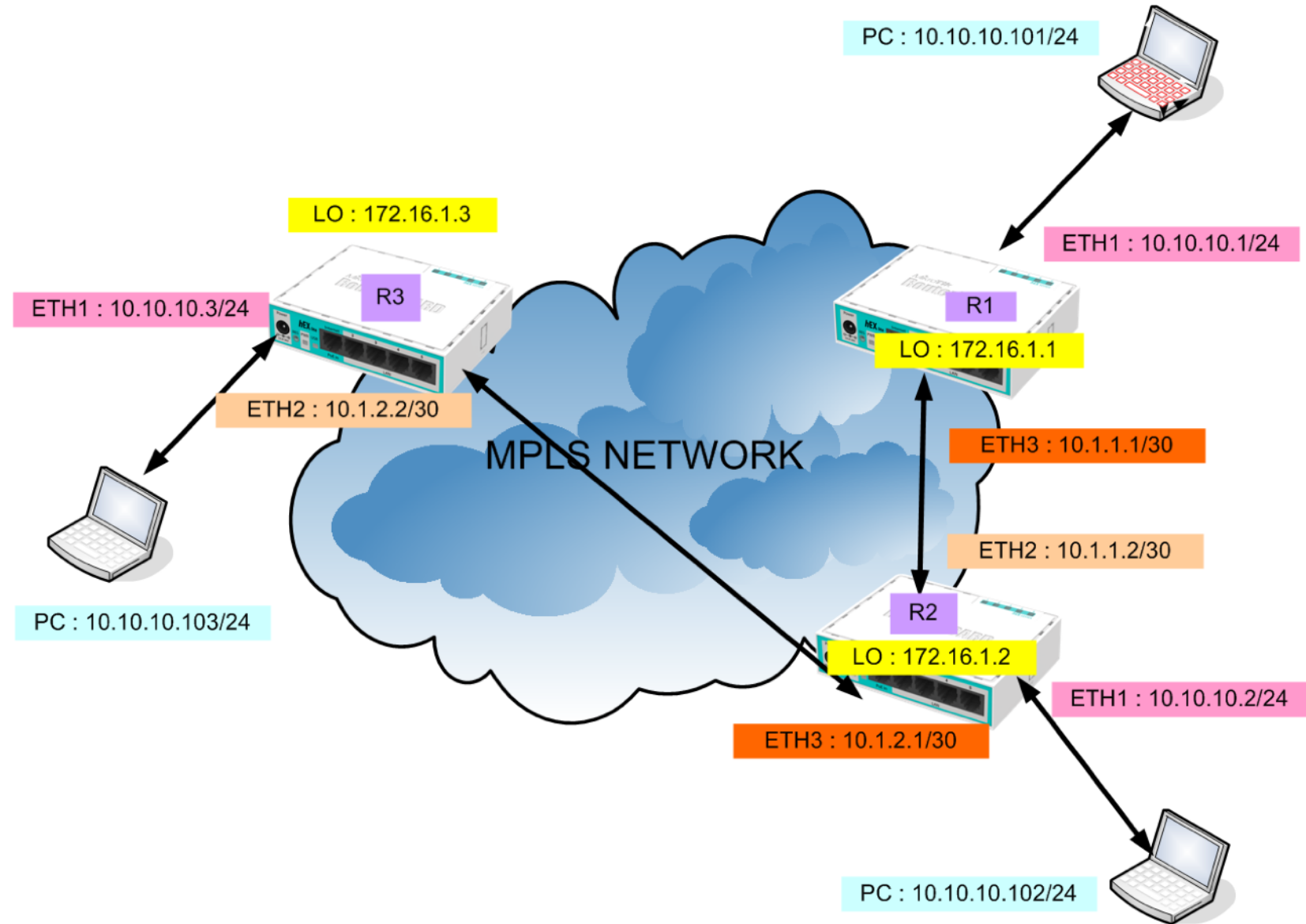


TABLE IP ADDRESS INTERFACE

	ROUTER 1
LO	172.168.1.1
ETH1	10.10.10.1/24
ETH2	
ETH3	10.1.1.1/30
PC	10.10.10.101/24

	ROUTER 2
LO	172.168.1.2
ETH1	10.10.10.2/24
ETH2	10.1.1.2/30
ETH3	10.1.2.1/30
PC	10.10.10.102/24

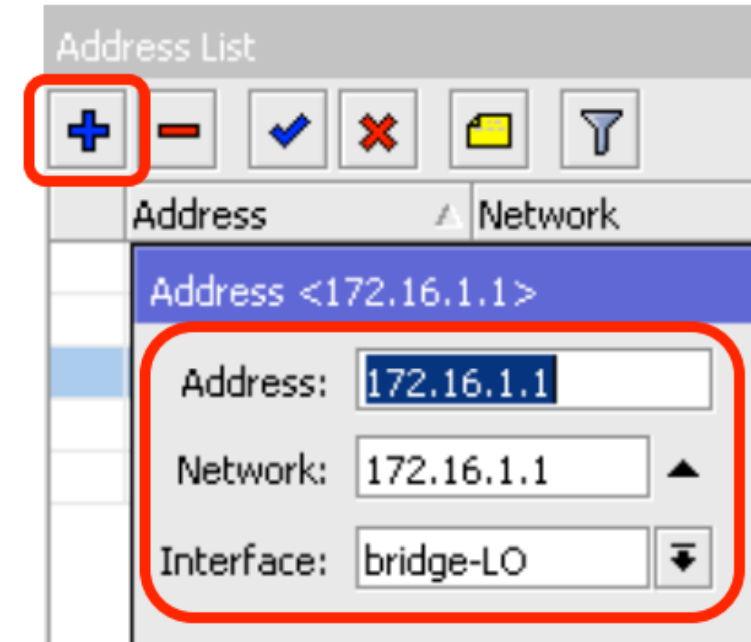
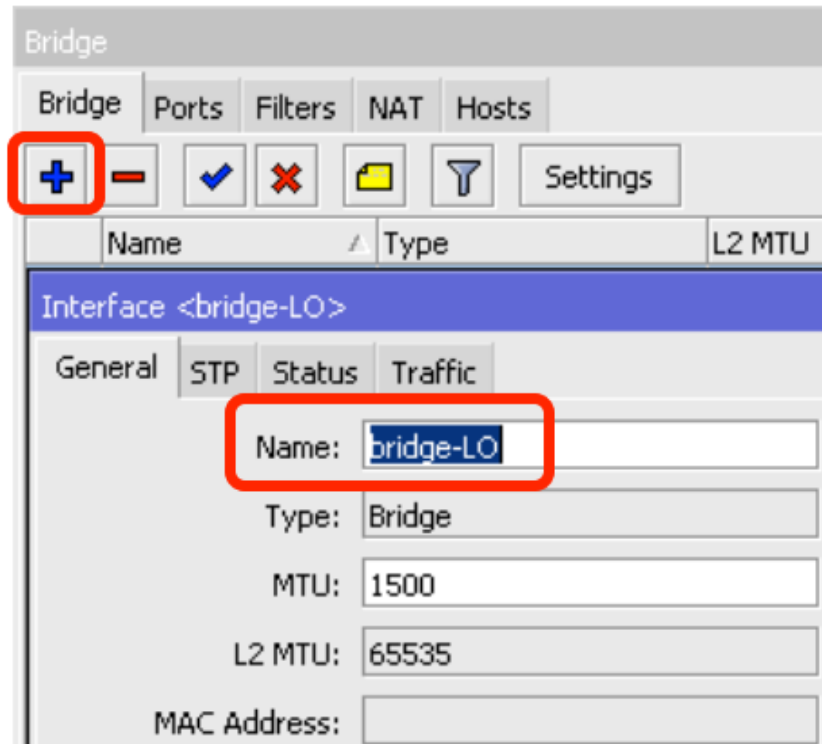
	ROUTER 3
LO	172.168.1.3
ETH1	10.10.10.3/24
ETH2	10.1.2.2/30
ETH3	
PC	10.10.10.103/24

SETUP

IP LOOPBACK ADDRESS AND OSPF

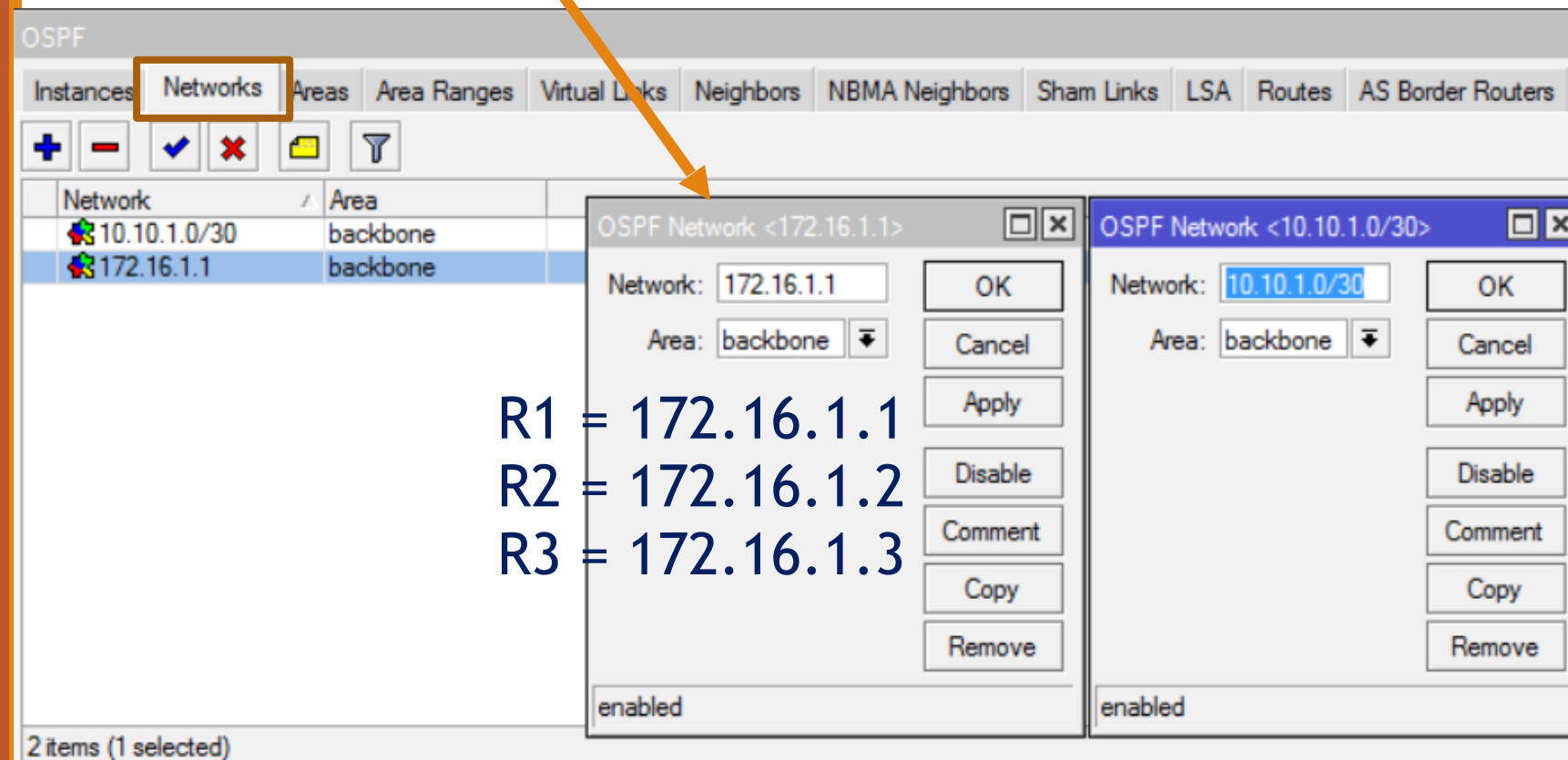
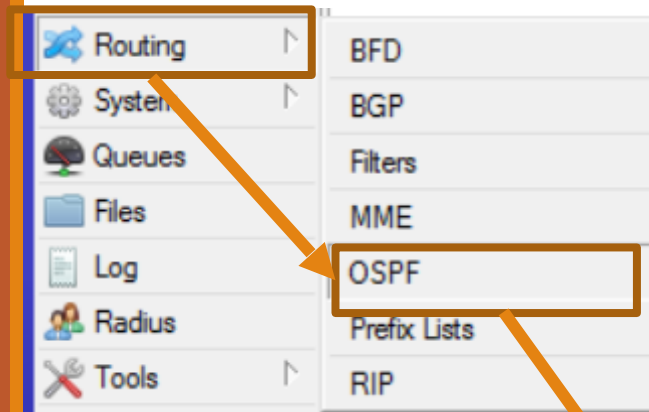
- Add Interface Bridge as a Loopback Interface.
 - Give IP Loopback at Bridge Loopback
- Enable OSPF :
 - Area : Backbone
 - Advertise local network
 - Advertise network point-to-point
 - Advertise IP loopback

Create Bridge Loopback



R1 = 172.16.1.1
R2 = 172.16.1.2
R3 = 172.16.1.3

Configure OSPF



CHECK OSPF RUNNING ?

OSPF

Interfaces Instances Networks Areas Area Ranges Virtual Links Neighbors NBMA Neighbors Sham Links LSAs Routes

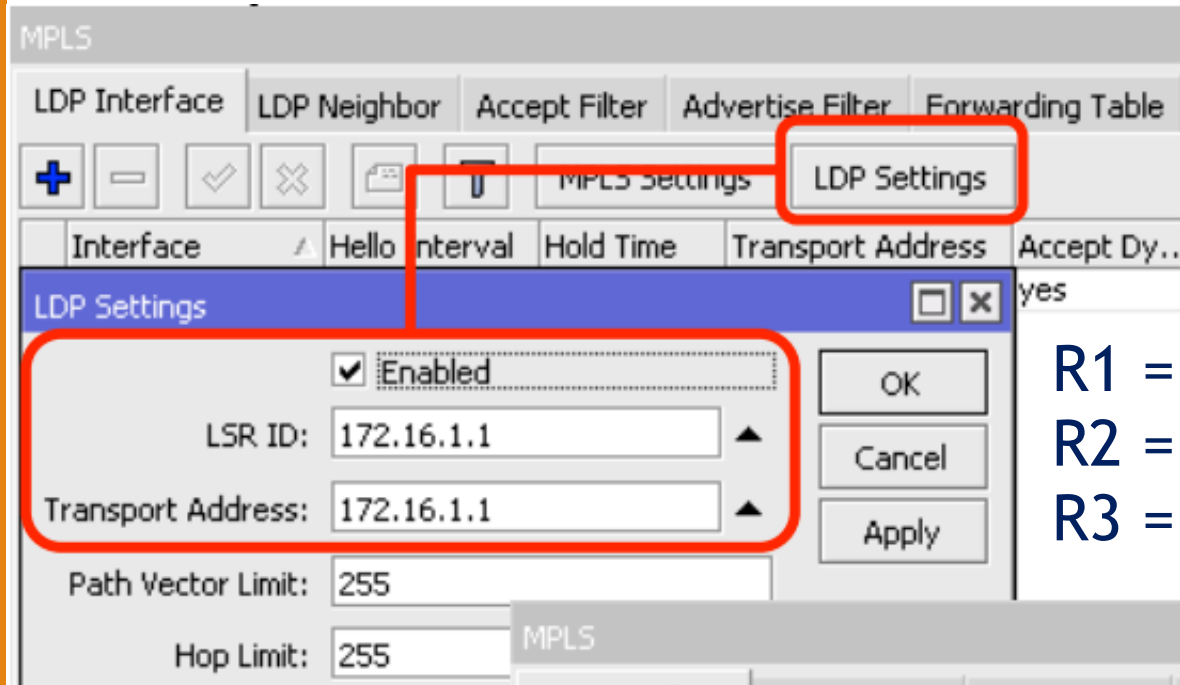


Instance	Area	Dst. Address	Gateway	Interface	Cost	State	
▶ default	backbone	10.10.1.0/30	0.0.0.0	ether3	10	intra area	
▶ default	backbone	10.10.2.0/30	10.10.1.2	ether3	20	intra area	
▶ default	backbone	172.16.1.1	0.0.0.0	bridge-LO	10	intra area	
▶ default	backbone	172.16.1.2	10.10.1.2	ether3	20	intra area	
▶ default	backbone	172.16.1.3	10.10.1.2	ether3	30	intra area	
▶ default	backbone	192.168.12.0/24	10.10.1.2	ether3	20	intra area	
▶ default	backbone	192.168.13.0/24	10.10.1.2	ether3	30	intra area	

SETUP MPLS LABEL EXCHANGE PROTOCOL (LDP)

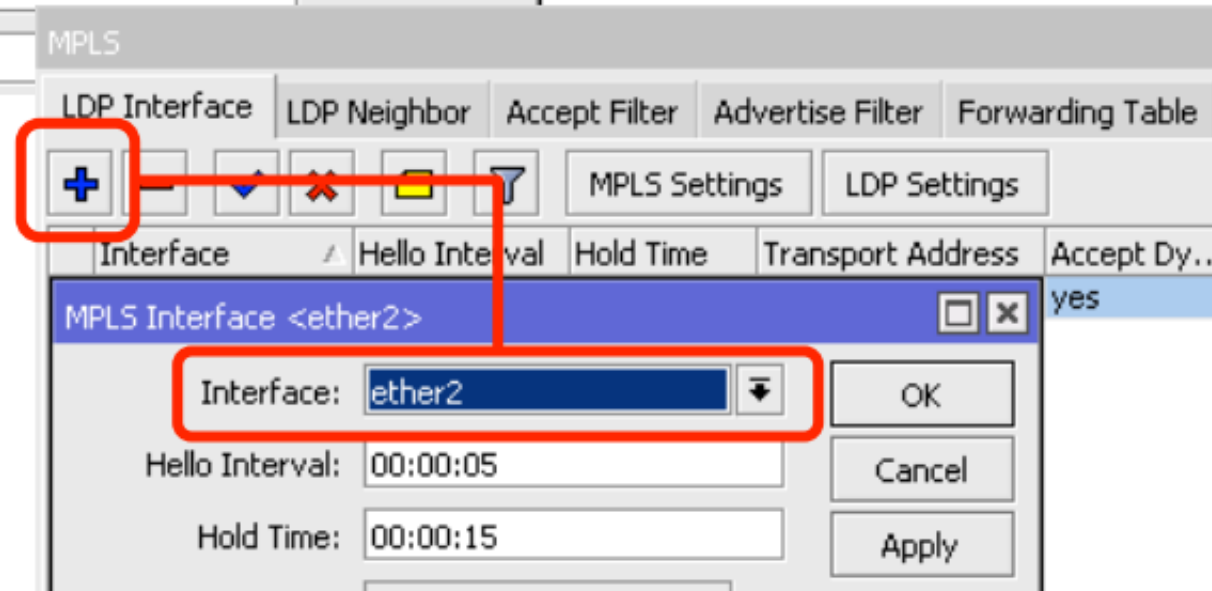
- Enable LDP
- Setup LSR-ID and Transport-Address with ip loopback.
- Add to list of LDP-Interface, All Interfaces connected to other router

LDP SETTING



**LDP Setting
Router-R1**


R1 = 172.16.1.1
R2 = 172.16.1.2
R3 = 172.16.1.3



CHECK MPLS RUNNING ?

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	
32		ether3	10.10.1.2	10.10.1.0/30	0	0	
33		ether3	10.10.1.2	172.16.1.2	0	0	
35	34	ether3	10.10.1.2	172.16.1.3	0	0	
34		ether3	10.10.1.2	192.168.12.0/24	0	0	
36	35	ether3	10.10.1.2	192.168.13.0/24	0	0	
39				vpls4	988700	12749	
40				vpls5	1485606	19074	

TRACEROUTE TEST MPLS

Traceroute (Running)

Traceroute To: 172.16.1.3

Packet Size: 56

Timeout: 1000 ms

Protocol: icmp

Port: 33434

Use DNS

Count:

Max Hops:

Src. Address: 172.16.1.1

Interface:

DSCP:



Routing Table:

Start

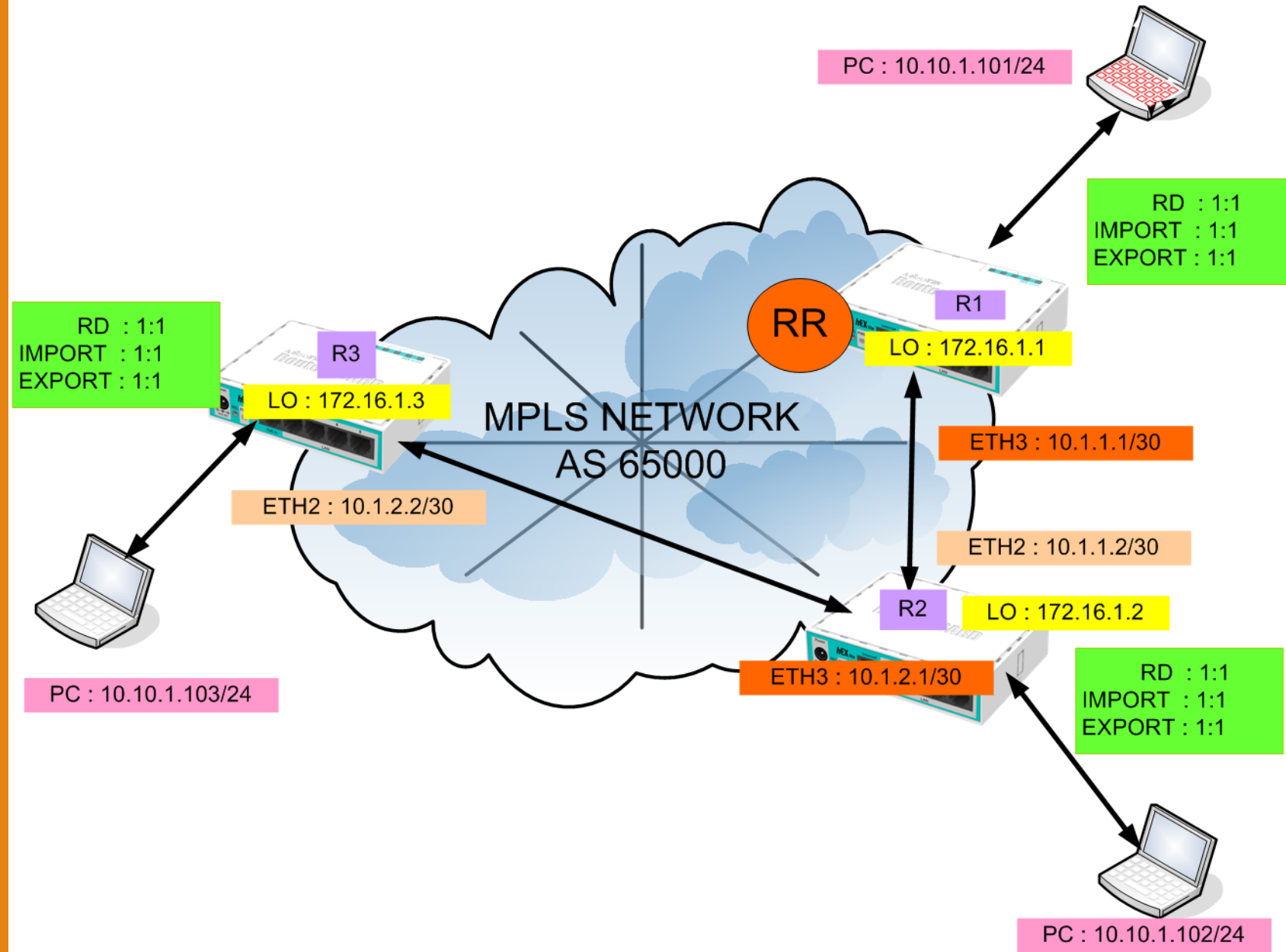
Stop

Close

New Window

Hop	/	Host	Loss	Sent	Last	Avg.	Best	Worst	Std. Dev.	History	Status
1		10.10.1.2	0.0%	6	0.3ms	0.4	0.3	0.7	0.1		<MPLS:L=34,E=0>
2		172.16.1.3	0.0%	6	0.2ms	0.3	0.2	0.4	0.1		

VPLS L2VPN MULTIPOINT



iBGP VPLS CONFIG

- Choose R1 as Router Reflector
- Configure every router running BGP instance and configure all router peer to Route Reflector.
- Configure at Peer to use L2VPN dan Loopback
- Configure RD, RT (Import & Export) according as diagram

R1 ROUTER CONFIG iBGP ROUTING

BGP Instance <default>

Name: default

AS: 65000

Router ID:

Redistribute Connected
 Redistribute Static
 Redistribute RIP
 Redistribute OSPF
 Redistribute Other BGP

OK
Cancel
Apply
Disable
Comment
Copy
Remove

BGP Peer <R1-R2>

General Advanced Status

Name: R1-R2

Instance: default

Remote Address: 172.16.1.2

Remote Port:

Remote AS: 65000

TCP MD5 Key:

Nexthop Choice: default

Multihop
 Route Reflect

Hold Time: 180

Keepalive Time:

TTL: default

Max Prefix Limit:

Max Prefix Restart Time:

BGP Peer <R1-R3>

General Advanced Status

Name: R1-R3

Instance: default

Remote Address: 172.16.1.3

Remote Port:

Remote AS: 65000

TCP MD5 Key:

Nexthop Choice: default

Multihop
 Route Reflect

Hold Time: 180

Keepalive Time:

TTL: default

Max Prefix Limit:

Max Prefix Restart Time:

BGP Peer <R1-R4>

General Advanced Status

Address Families: ip ipv6 I2vpn

Update Source: bridge-LO

Cisco VPLS NLRI Length Format: auto bits

enabled

BGP SETUP ROUTER R2 R3

BGP Instance <default>

Name: default

AS: 65000

Router ID:

Redistribute Connected

Redistribute Static

Redistribute RIP

Redistribute OSPF

Redistribute Other BGP

Out Filter:

Confederation:

Confederation Peers:

Cluster ID:

Routing Table:

Client To Client Reflection

OK

Cancel

Apply

Disable

Comment

Copy

Remove

BGP Peer <R2-R1>

General Advanced Status

Name: R2-R1

Instance: default

Remote Address: 172.16.1.1

Remote Port:

Remote AS: 65000

TCP MD5 Key:

Nexthop Choice: default

Multihop

Route Reflect

BGP Peer <R3-R1>

General Advanced Status

Name: R3-R1

Instance: default

Remote Address: 172.16.1.1

Remote Port:

Remote AS: 65000

TCP MD5 Key:

Nexthop Choice: default

Multihop

Route Reflect

BGP Peer <R2-R1>

General Advanced Status

Address Families: ip ipv6 I2vpn

Update Source: bridge-LO

Cisco VPLS NLRI Length Format: auto bits

CHECK BGP PEER RUNNING ?

The screenshot shows the Mikrotik WinBox interface for BGP configuration. The left sidebar contains navigation options like Quick Set, CAPsMAN, Interfaces, Wireless, Bridge, PPP, Switch, Mesh, IP, MPLS, and Routing. The main window is titled 'BGP' and has tabs for Instances, VRFs, Peers, Networks, Aggregates, VPN4 Routes, and Advertisements. Below the tabs are control buttons: +, -, checkmark, X, filter, Refresh, Refresh All, Resend, and Resend All. A table displays the BGP peer configuration:

Name	Instance	Remote Address	Remote AS	M...	R...	TTL	Remote ID	Uptime	Prefix Co...	State
R1-R2	default	172.16.1.2	65000	no	yes	d...	10.10.1.2	02:18:13		established
R1-R3	default	172.16.1.3	65000	no	yes	d...	10.10.2.2	02:17:26		established

SETUP BRIDGE ETHER1 @BRIDGE-VPLS

The image shows a sequence of three configuration windows in a network management application:

- Bridge Table:** A table listing existing bridges. The first entry is 'bridge-LO' of type 'Bridge' with L2 MTU 65535. A '+' icon is highlighted with an orange box and an arrow pointing to the 'Interface <bridge-vpls>' window.
- Interface <bridge-vpls> - General:** The 'Name' field is set to 'bridge-vpls' (highlighted with an orange box). Other fields include Type: Bridge, MTU: (empty), Actual MTU: 1500, L2 MTU: 1500, MAC Address: 02:74:18:AD:7F:A2, and ARP: enabled.
- Interface <bridge-vpls> - STP:** The 'Protocol Mode' is set to 'none' (highlighted with an orange box). The Priority is 8000 (hex) and Max Message Age is 00:00:20.
- Bridge Ports Table:** A table showing the configuration of bridge ports. The first entry is 'ether1' connected to 'bridge-vpls' with a Priority of 80 and Path Cost of 10. A 'Ports' tab is highlighted with an orange box and an arrow pointing to the 'Bridge Port <ether1>' window.
- Bridge Port <ether1> - General:** The 'Interface' is set to 'ether1' and the 'Bridge' is set to 'bridge-vpls' (both highlighted with orange boxes).

BGP VPLS SETUP R1

Quick Set
CAPsMAN
Interfaces
Wireless
Bridge
PPP
Switch
Mesh
IP
MPLS
Routing
System
Queues
Files
Log
Radius
Tools
New Terminal
Make Supout.nif
Manual

VPLS
VPLS BGP VPLS Cisco BGP VPLS

Route Disting...	Import Route ...	Export Route ...	Site ID	Bridge
1:1	1:1	1:1	1	bridge-vpls

BGP VPLS <VPLS-R1>

Name: VPLS-R1

Route Distinguisher: 1:1

Import Route Targets: 1:1

Export Route Targets: 1:1

Site ID: 1

Bridge: bridge-vpls

Bridge Cost: 0

Bridge Horizon: 1

Use Control Word

PW MTU: 1500

enabled inactive

OK
Cancel
Apply
Disable
Copy
Remove

R2 = 2
R3 = 3

DYNAMIC VPLS INTERFACE

VPLS

VPLS BGP VPLS Cisco BGP VPLS

+ - ✓ ✗ 📄 🔍

	Name	Type	MTU	L2 MTU	Tx	Rx	Tx Packet (p/s)	Rx Packet (p/s)	Remote Peer
DRSB	↔ vpls4	VPLS	1500	1500	0 bps	0 bps	0	0	172.16.1.2
DRSB	↔ vpls5	VPLS	1500	1500	0 bps	0 bps	0	0	172.16.1.3

Bridge

Bridge Ports Filters NAT Hosts

+ - ✓ ✗ 📄 🔍

	Interface	Bridge	Priority (h...)	Path Cost	Horizon	Role
	↕ ether1	bridge-vpls	80	10		designated port
D	↕ vpls6	bridge-vpls	80	10	1	designated port
D	↕ vpls7	bridge-vpls	80	10	1	designated port

TEST PING :
PC1 – PC2 – PC3

VPLS L2VPN MULTIPPOINT
SUCCESS !!

ANY QUESTION ?

FINISH
THANK YOU

MikroTik

IRVAN ADRIAN KRISTIONO

Centralnetwork