Introduction to MPLS Using RouterOS

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Mikrotik User Meeting – Indonesia 2016

About Presenter

- Irvan Adrian Kristiono
- MTCNA (2010), MTCRE (2011), MTCINE (2014)
- Central Network (2011)
  - IT Solution & Training Center
  - http://www.centralnetwork.net
- Grahamedia Informasi (2006)
  - Internet Service Provider
  - http://www.grahamedia.net.id
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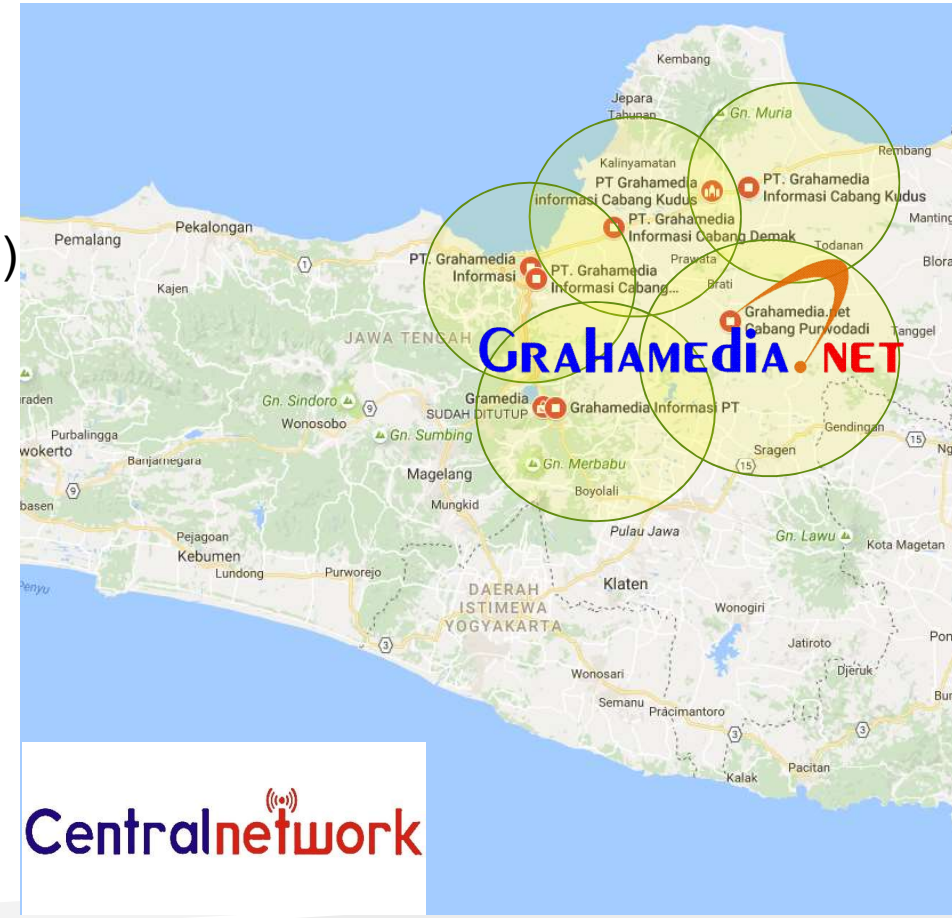
Salatiga – Semarang – Demak – Kudus - Purwodadi



Belum tahu tentang MPLS ?

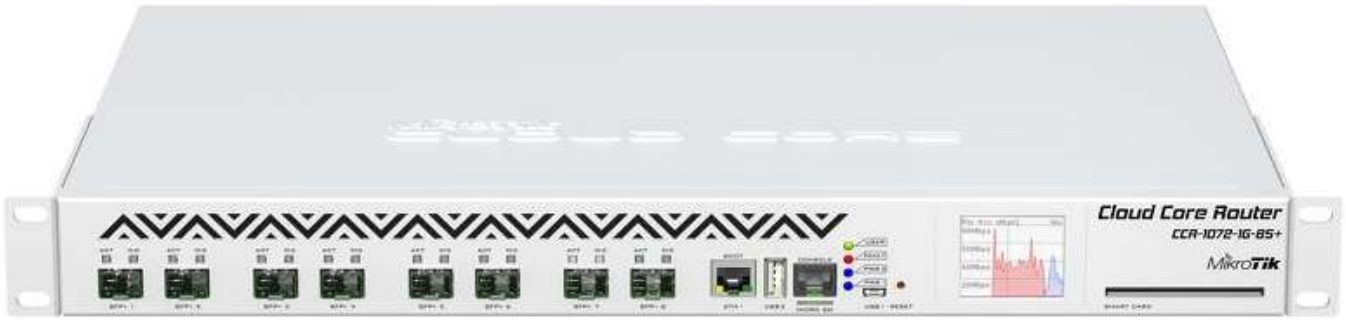
- Mungkin karena harga peralatannya yang tinggi
- Peralatan yang support MPLS masih terbatas
- Hanya Perusahaan kelas Operator Telekomunikasi yang mampu menggunakan MPLS
- Konsep MPLS masih asing di dunia IT Networking
- SDM yang menguasai terbatas



$$

MPLS Available in Mikrotik ROS !!

- Saat ini Fitur MPLS sudah tersedia di Mikrotik RouterOS
- Mulai dari Router RB hAP lite $22 / Rp. 300.000,-
  sampai dengan Multicore Router
- Sekarang waktunya Implementasi MPLS

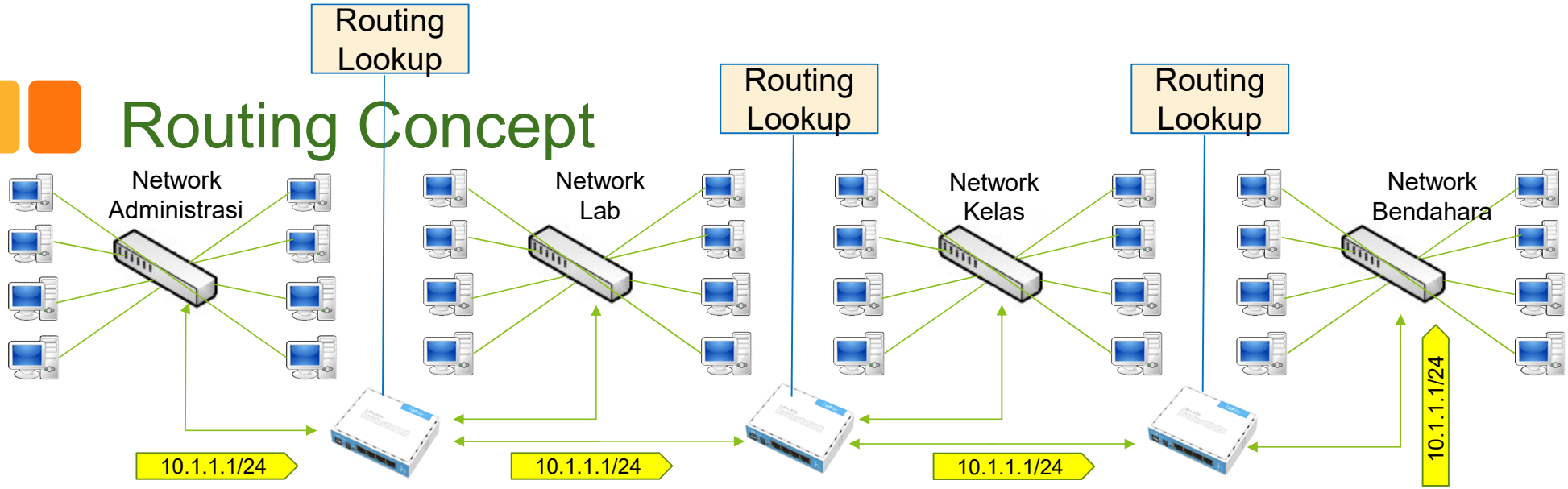


HOW TO NETWORKING

3 metode untuk melakukan koneksi Jaringan :

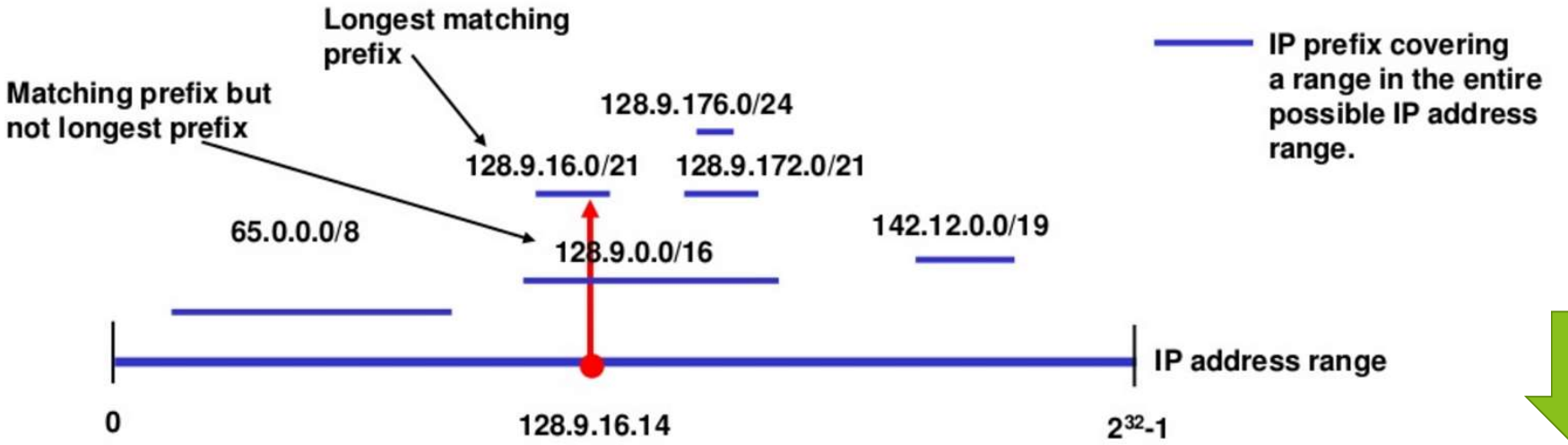
- Bridging
  - STP, RSTP, Mesh
- Routing
  - RIP, OSPF, BGP
- Switching
  - **MPLS**, ATM, Frame Relay

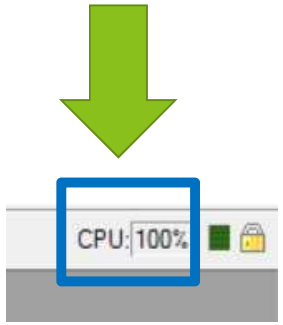
Routing Concept



- Dimulai Jaringan kecil LAN dalam 1 Network, kita tidak memerlukan Routing, semua bisa dilakukan menggunakan bridging
- Semakin besar network, karena kebutuhan managent policy, looping, broadcast storm maka dibuat segmentasi network.
- Routing Protocol diperlukan untuk distribusi Informasi Jaringan
- Routing Lookup dilakukan di tiap Hop menggunakan Tabel Routing

Drawbacks Routing Lookup





- Menggunakan CIDR (Classless Inter-Domain Routing) pencarian berdasarkan longest matching prefix", memakan resource dan proses CPU Router yg cukup besar.
- Router dengan CPU dan Resouce terbatasini akan jadi permasalahan
- Kebutuhan dan teknologi traffic media semakin besar, tantangannya pada limitasi Proses PPS (Packet per Second) dari CPU.

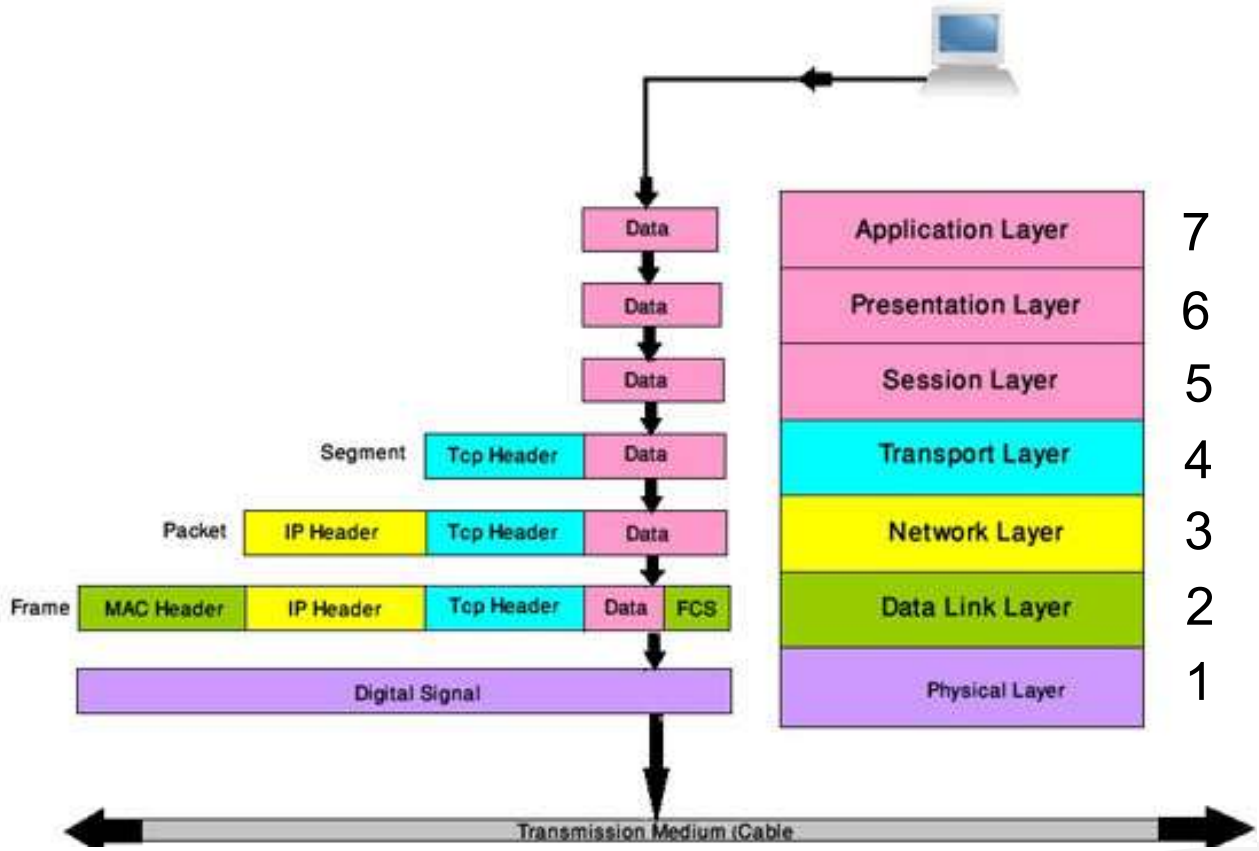
Source : Overview of the MPLS backbone transmission technology - Peter R. Egli

What is MPLS

- MPLS = Multi Protocol Label Switching
- MPLS adalah metode pengiriman data yang menggunakan Label yang dilekatkan pada paket
- Dalam network MPLS, forwarding dengan switching label, tanpa memakai IP layer 3 Header
- Routing Lookup yang berat digantikan Label Lookup dengan beban lookup minimal, membuat efesiensi proses dan meningkatkan performa jaringan

LAYER 2.5

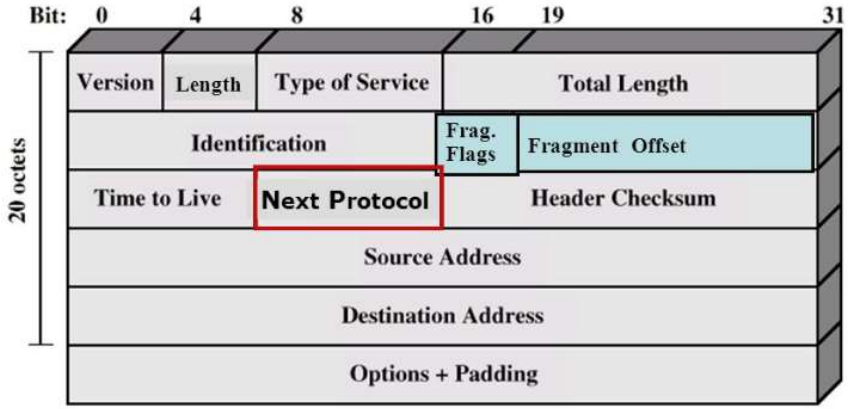
MPLS berada di antara ini



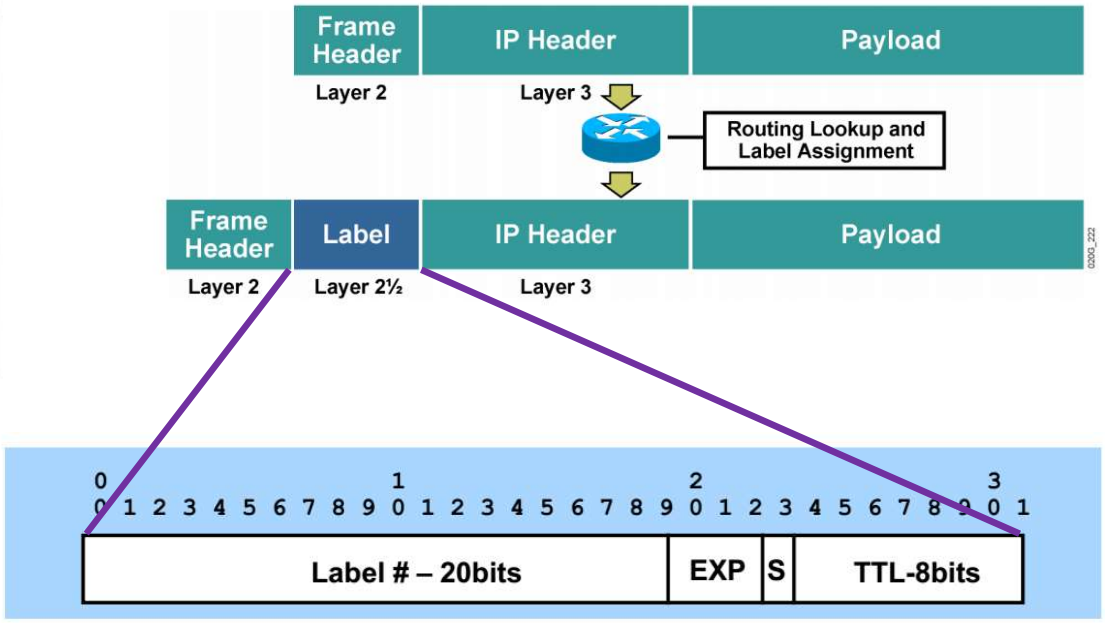
Source : http://rumyittips.com/wp-content/uploads/2013/08/Most-Common-Interview-Questions-on-OSI-model1.jpg

MPLS LABELS DAN LABEL ENCAPSULATION

IP Header (20 Bytes)



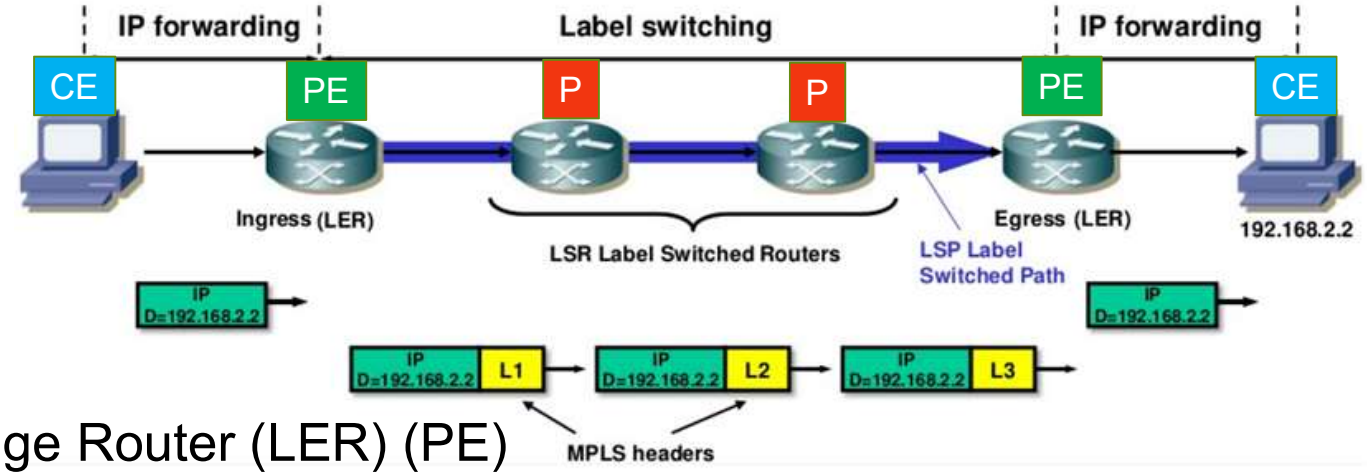
MPLS Header (4 Bytes)



COS/EXP = Class of Service: 3 Bits; S = Bottom of Stack; TTL = Time to Live

Source : Introducing Basic MPLS Concepts – Cisco.com

How MPLS Work ?

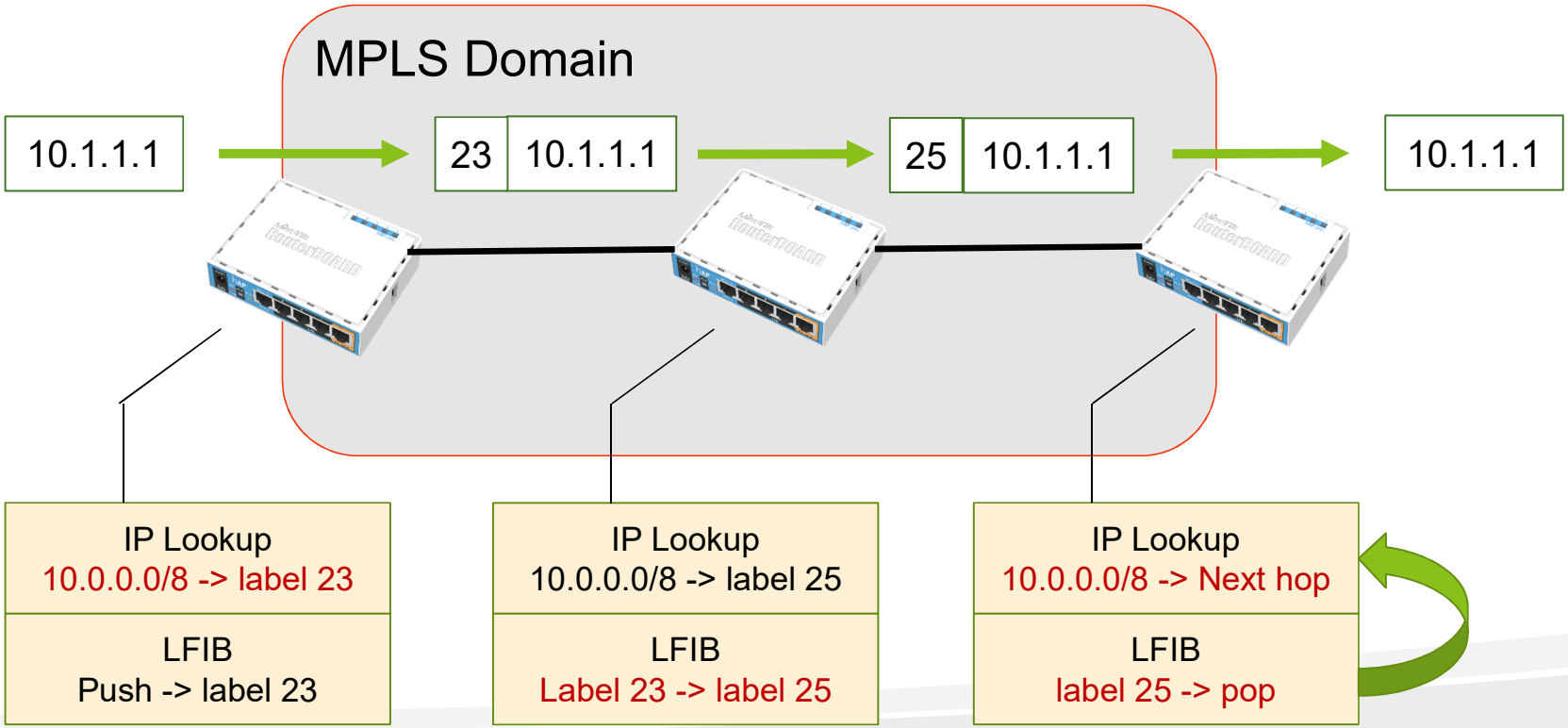


CE : Customer Edge
PE : Provider Edge
P : Provider

- Label Edge Router (LER) (PE)
  - Perlu adanya **Header Label** pada Paket Data, supaya bisa masuk MPLS Network
  - Label ditambahkan (Push) / dihilangkan (PoP) oleh **Label edge Router (LER)**
- Label Switching Router (LSR) (P)
  - Core Router hanya melakukan switching berdasarkan “Exact Matching” Label Lookup sederhana untuk menukar label untuk hop selanjutnya

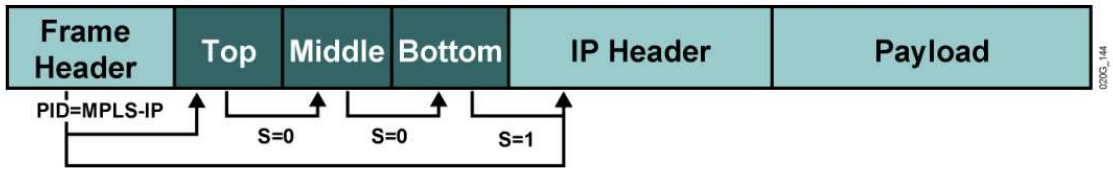
Source : Overview of the MPLS backbone transmission technology - Peter R. Egli

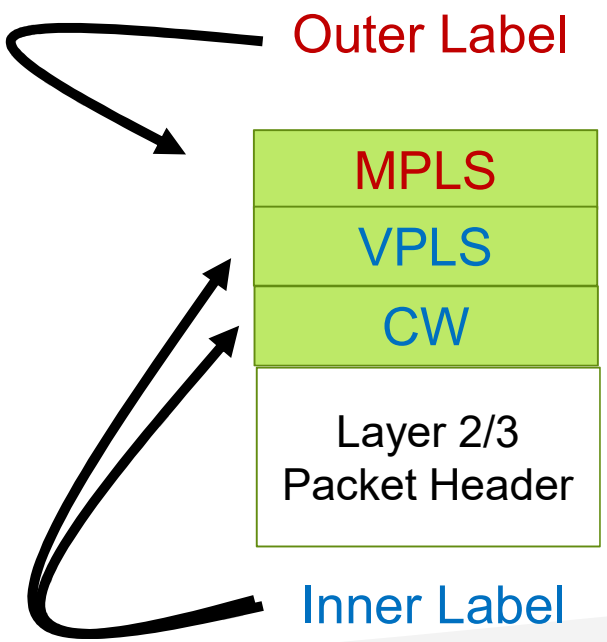
MPLS Forwarding Example



MPLS LABELS STACK (FITUR TAMBAHAN MPLS)

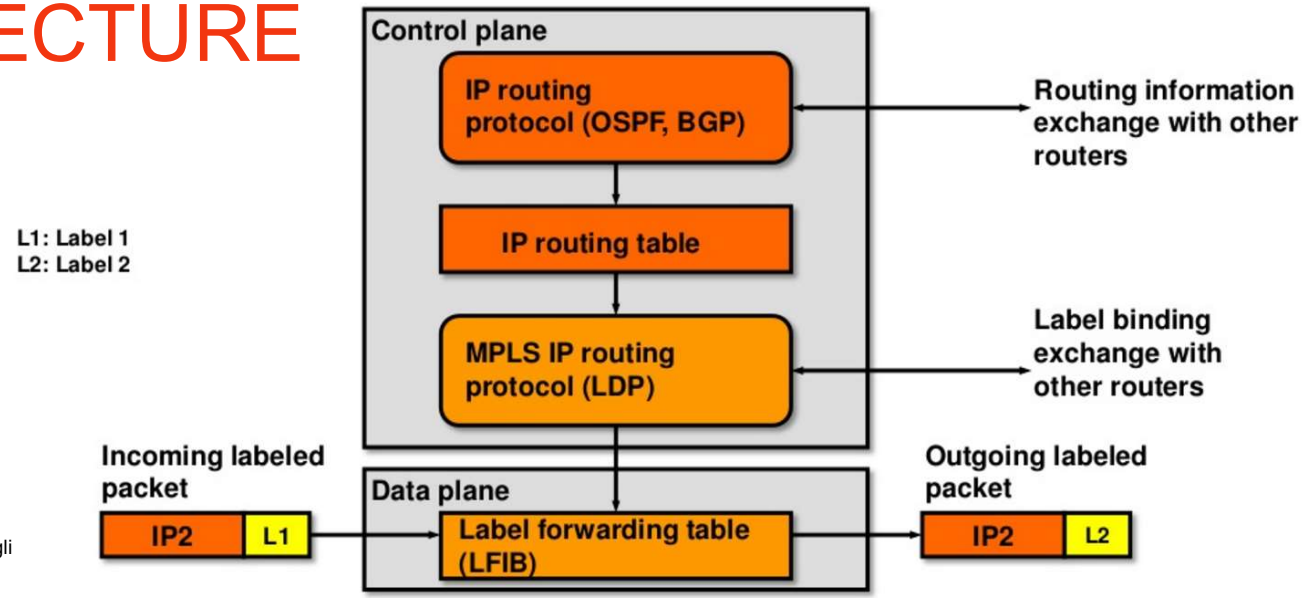
- Dalam satu paket dapat dipasang lebih dari 1 label
- Tiap label memiliki fungsi yang berbeda tujuannya
- Label terluar (Outer Label) selalu digunakan untuk Label pengontrol paket sampai ke LER tujuan
- Sedangkan lainnya untuk Service MPLS lainnya, misalnya VPN dan Traffic Enginnering





Source : Introducing Basic MPLS Concepts – Cisco.com

MPLS ARCHITECTURE



Source : Overview of the MPLS backbone transmission technology - Peter R. Egli

- **Control Plane** : Masih membutuhkan Layer 3 routing protocol untuk menyebarkan informasi routing antara tiap router Network MPLS

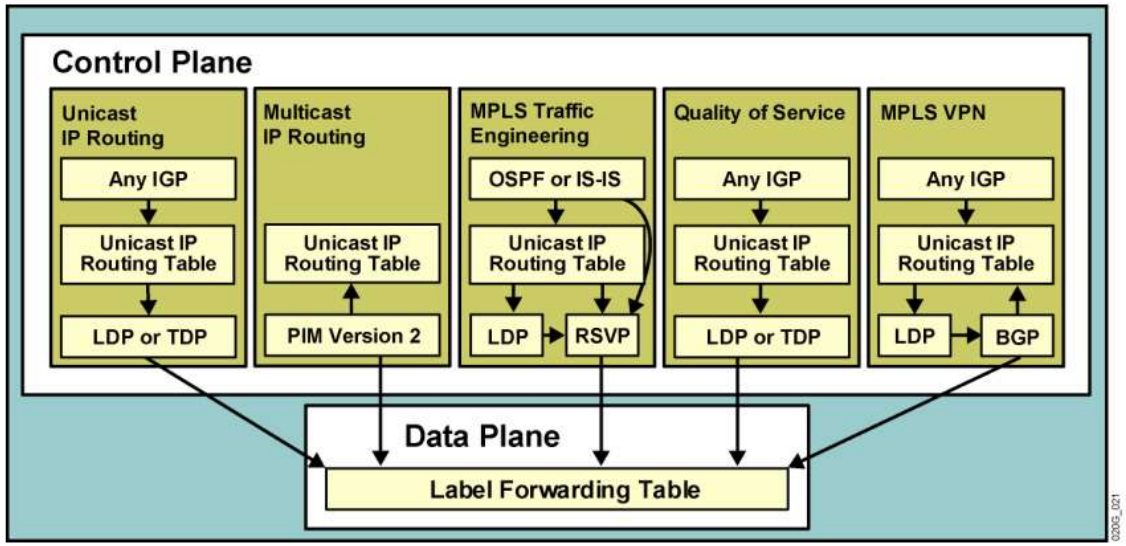
  dan menyebarkan Informasi label pada seluruh router di Network MPLS

  Routing Protocol yang bisa digunakan : OSPF, IGRP, EIGRP, IS-IS, RIP

  Label Exchange Protocol yang digunakan : LDP, BGP(VPN), RSVP(MPLS-TE)
- **Data Plane** : Proses forwarding sederhana dengan pertukaran Label,

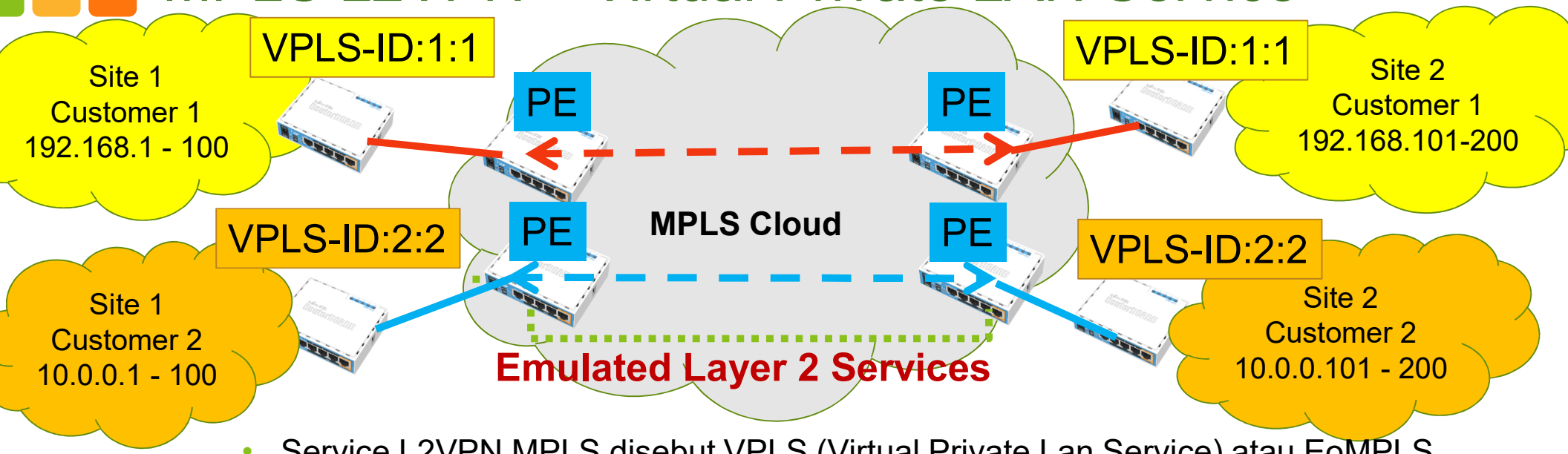
  Lookup berdasarkan LFIB (Label Forwarding Information Base)

FITUR TAMBAHAN MPLS



- VPN Layer 2
  - Layer 2 VPN – Tunnel EoMPLS (VPLS)
  - Layer 2 VPN – Multi Site (VPLS)
- VPN Layer 3
  - Layer 3 VPN Multi Site Multi Service (VPNV4)
- Traffic Enginnering
  - Bandwidth Optimation (RSVP)
  - Redundant dan Fail Over (RSVP)
- Quality of Service

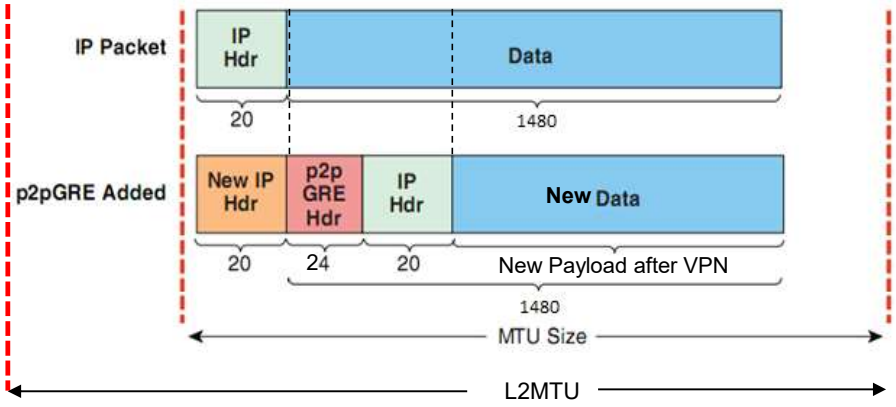
MPLS L2VPN – Virtual Private LAN Service



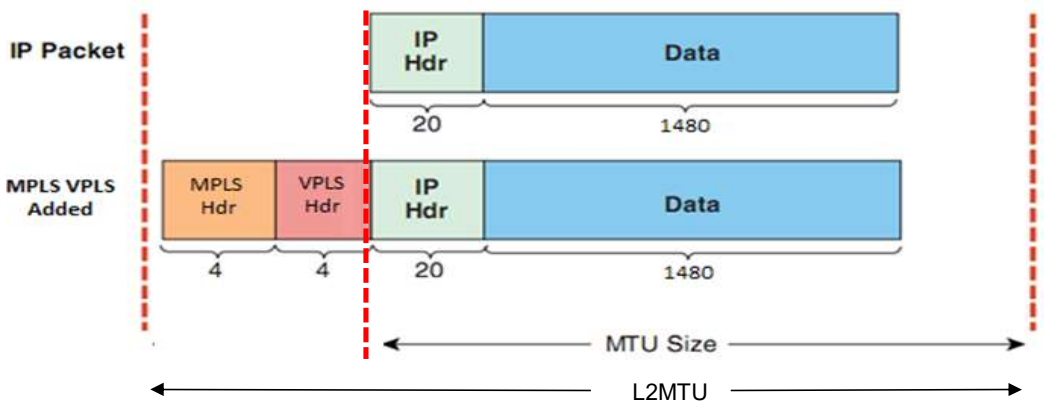
- Service L2VPN MPLS disebut VPLS (Virtual Private Lan Service) atau EoMPLS
- Bertujuan membuat Private Tunnel menghubungkan Layer 2 antara 2 site
- VPLS memiliki kemampuan :
  - MAC Learning
  - Flooding
  - Forwarding

MPLS L2VPN : WITHOUT DRAWBACKS L2 PAYLOAD

VPN SAAT INI



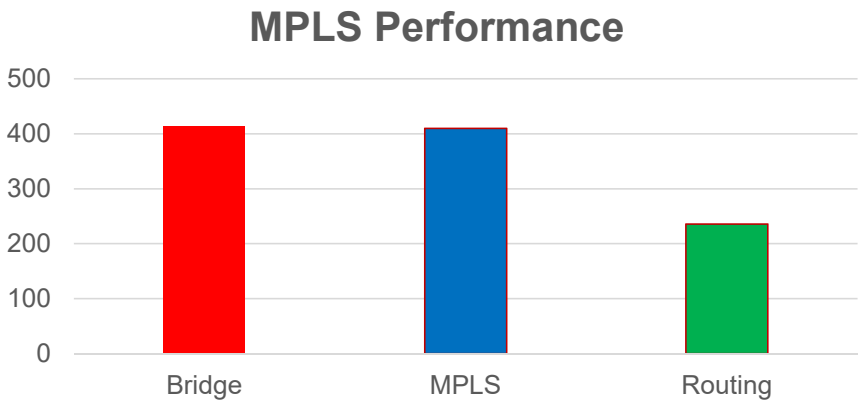
VPN VPLS

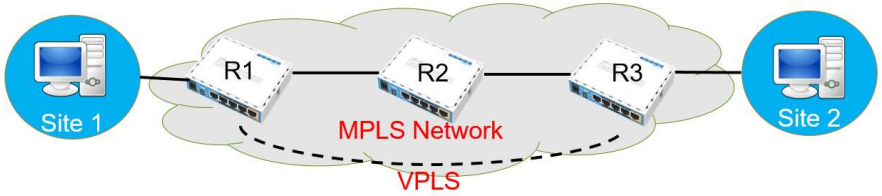


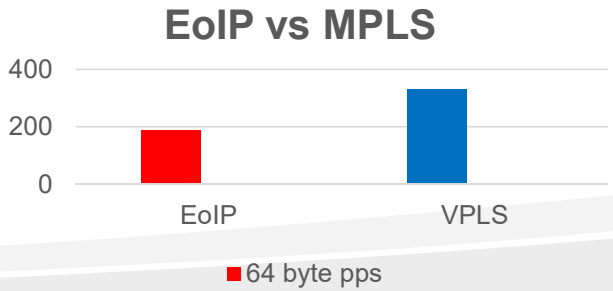
- Big Overhead EoIP (Ethernet + GRE + IP) ~ 40 Bytes
- VPN saat ini menggunakan header yang termasuk dalam L2 Data, dengan tambahan header VPN saat ini harus penyesuaian MTU Data agar dapat masuk tanpa terfragment
- VPLS VPN menggunakan space L2MTU untuk Header MPLS dan VPLS, header lebih kecil dan tidak mengurangi L2 Data
- Benefit : Effesiensi Low Overhead dan Resource

MPLS Performance

- Kecepatan Forwarding MPLS Switching Hampir 2 kali lebih cepat dari IP Routing,
  Hampir sama kecepatan Layer 2 Bridging
- Tunnel VPLS lebih cepat 60% dari Tunnel EoIP

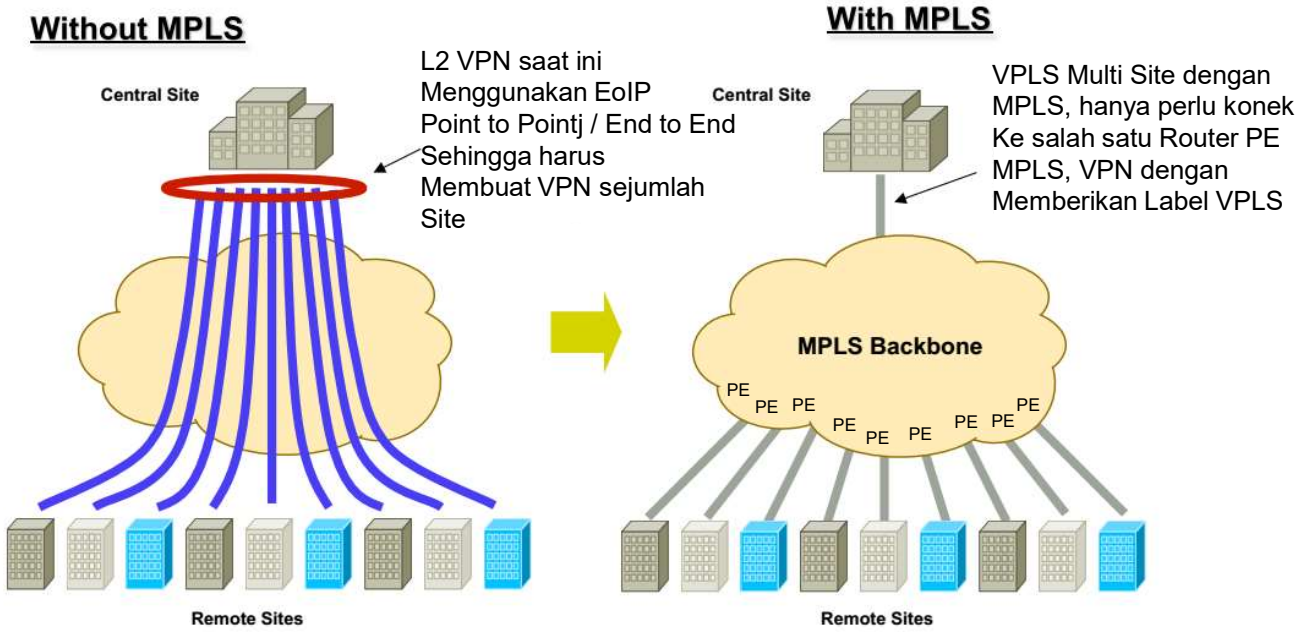






NB : Test on RB1000 pada MUM 2009 – Mikrotik Router OS - Introduction to MPLS

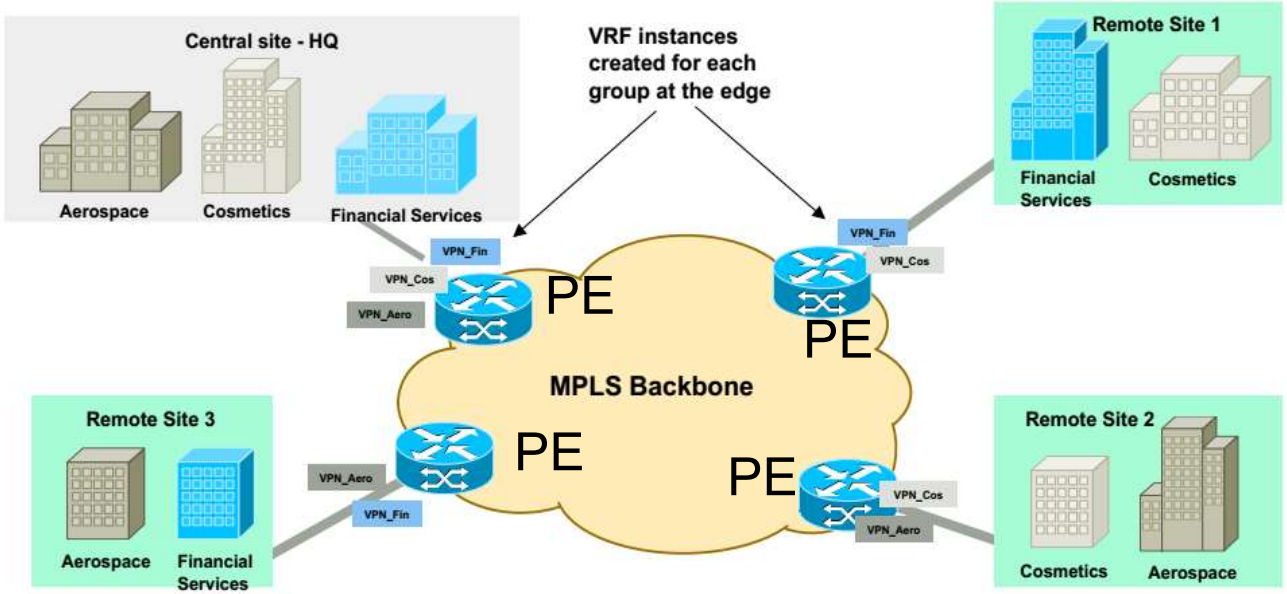
MPLS L2 VPN - MULTI SITE – MESH VPN



- Memungkinkan untuk membuat Mesh L2VPN / Layer 2 VPN Multi Site
- Skalabilitas lebih mudah diexpand, konek VPN tiap site ke PE terdekat
- Menggunakan iBGP VPLS untuk interkoneksi antar PE

Source : http://www.sanog.org/resources/sanog17/sanog17-mpls-intro-santanu.pdf

MPLS L3 VPN - MULTI SERVICE MULTI SITE

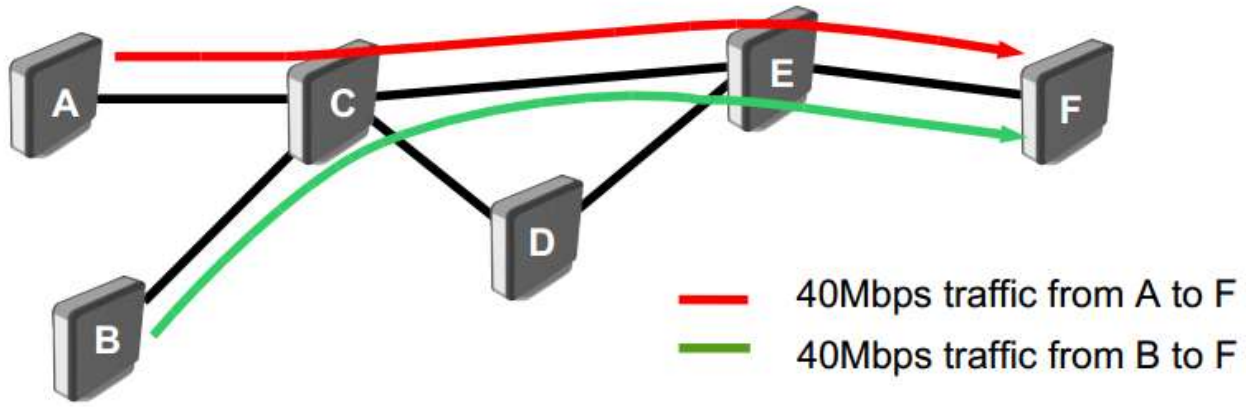


Source : http://www.sanog.org/resources/sanog17/sanog17-mpls-intro-santanu.pdf

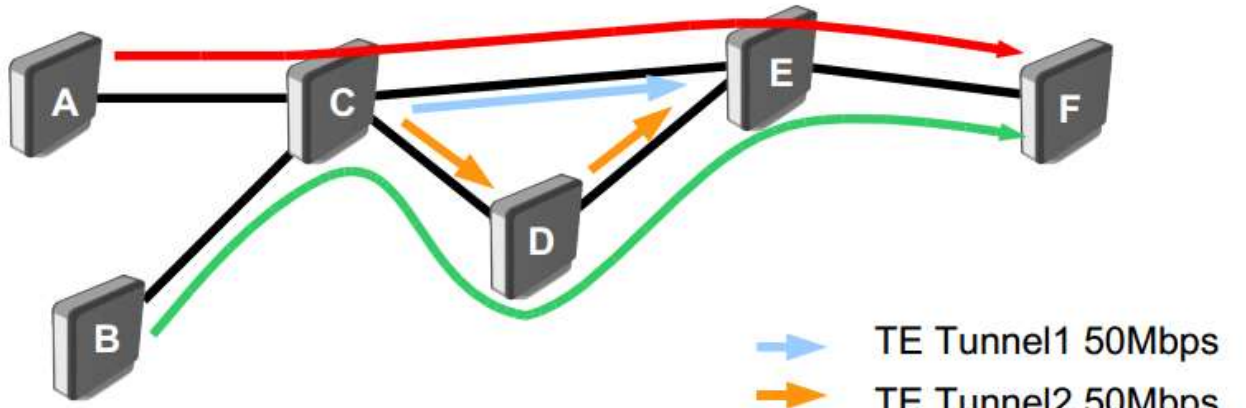
- iBGP VPNv4 route antar PE Router
- Menggunakan VRF (Virtual Routing Forwarding) untuk memisahkan routing dan forwarding tiap customer
- RD (Router Distinguisher) 8 Byte + VPN Prefix : VPNv4 Address

TRAFFIC ENGINNERING – BANDWIDTH OPTIMATION

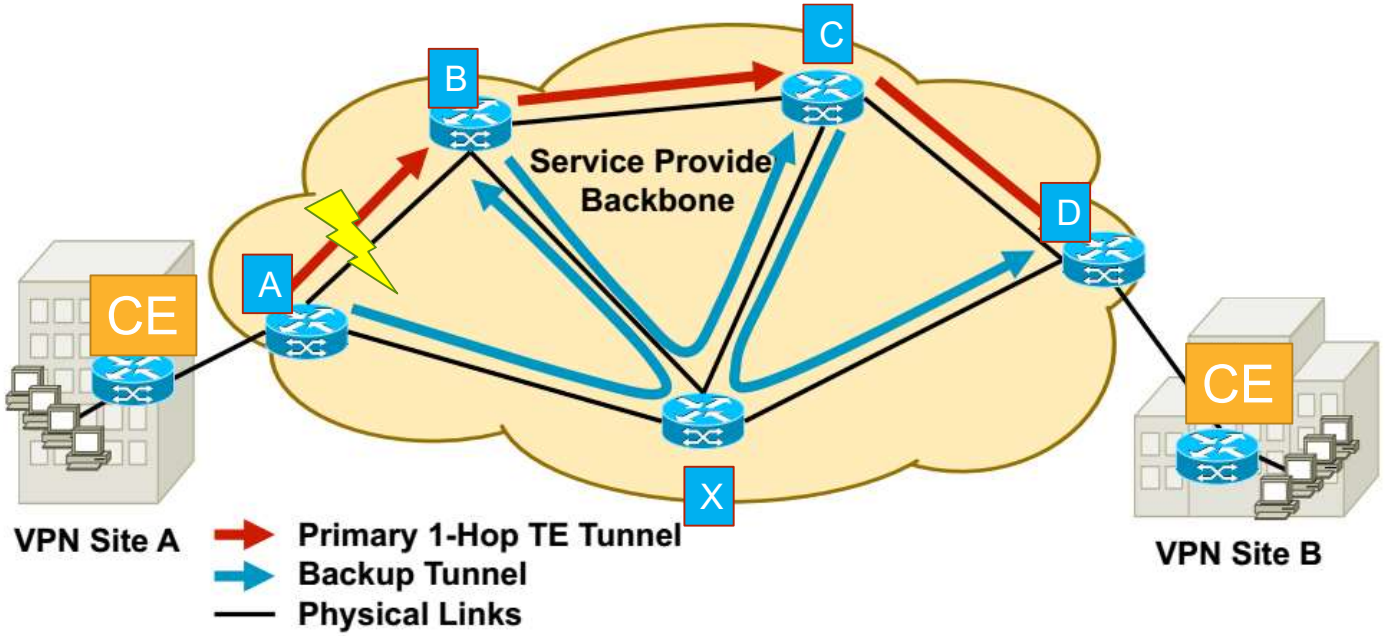
SEBELUM



SESUDAH

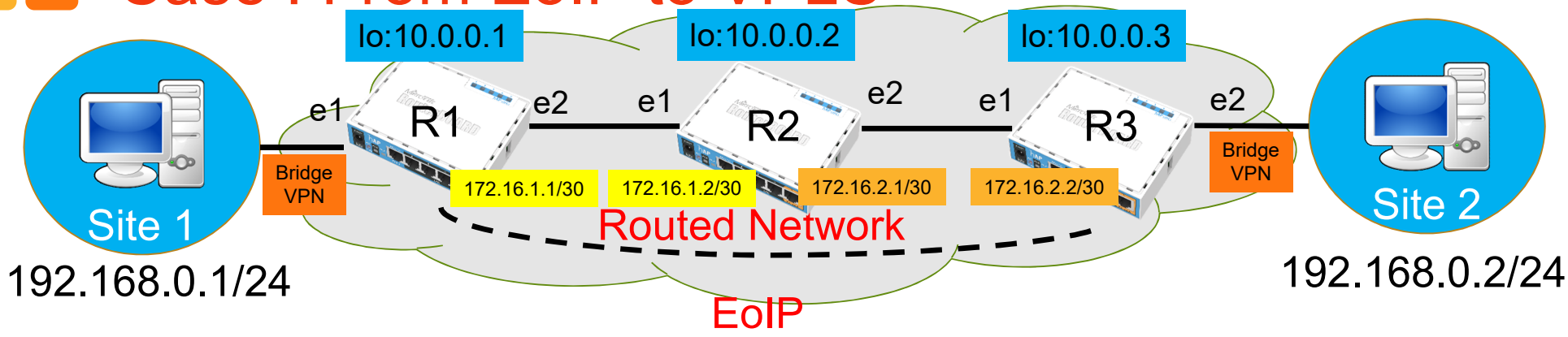


MPLS TE : Bandwidth Protection



- Primary Tunnel : A -> B -> C -> D
- Secondary Tunnel : A -> X -> B -> C -> D

Case : From EoIP to VPLS



- Kasus : Dari contoh jaringan diatas, sebuah jaringan routing untuk interkoneksi antar Router R1, R2 dan R3
- EoIP tunnel menjadi solusi untuk menghubungkan Site 1 dan Site 2 secara Layer 2 dengan EoIP Tunnel antar R1 dan R3
- Solusi : Akan kita migrasi menjadi MPLS Network, sehingga bias diterapkan L2 VPN dengan VPLS

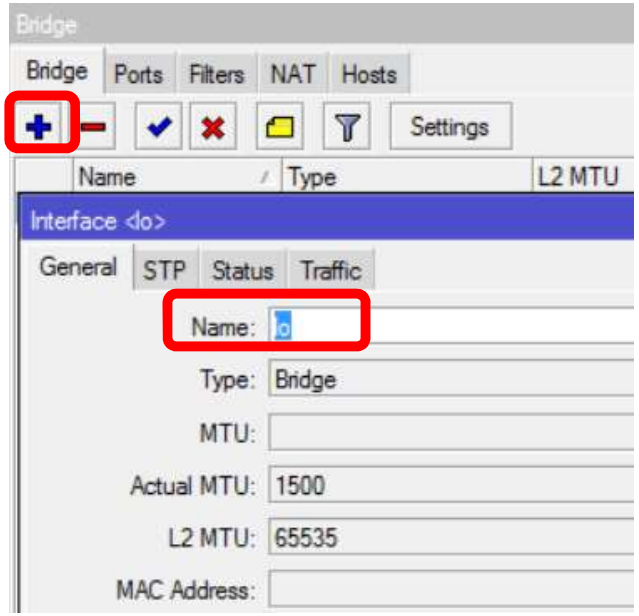
MPLS LDP

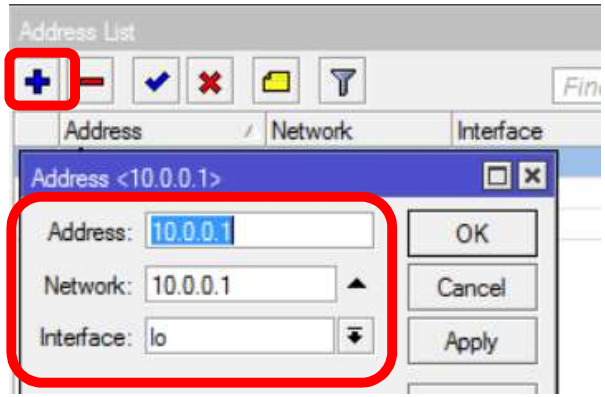
- Label dibuat dan distribusikan secara otomatis oleh Label Distribution Protocol (LDP)
- LDP requirements :
  - Semua Network harus terkoneksi dengan baik secara Routing
  - IP Loopback (rekomendasi)
  - Seluruh Router pada MPLS Network harus menjalankan MPLS.

MPLS Configuration Step

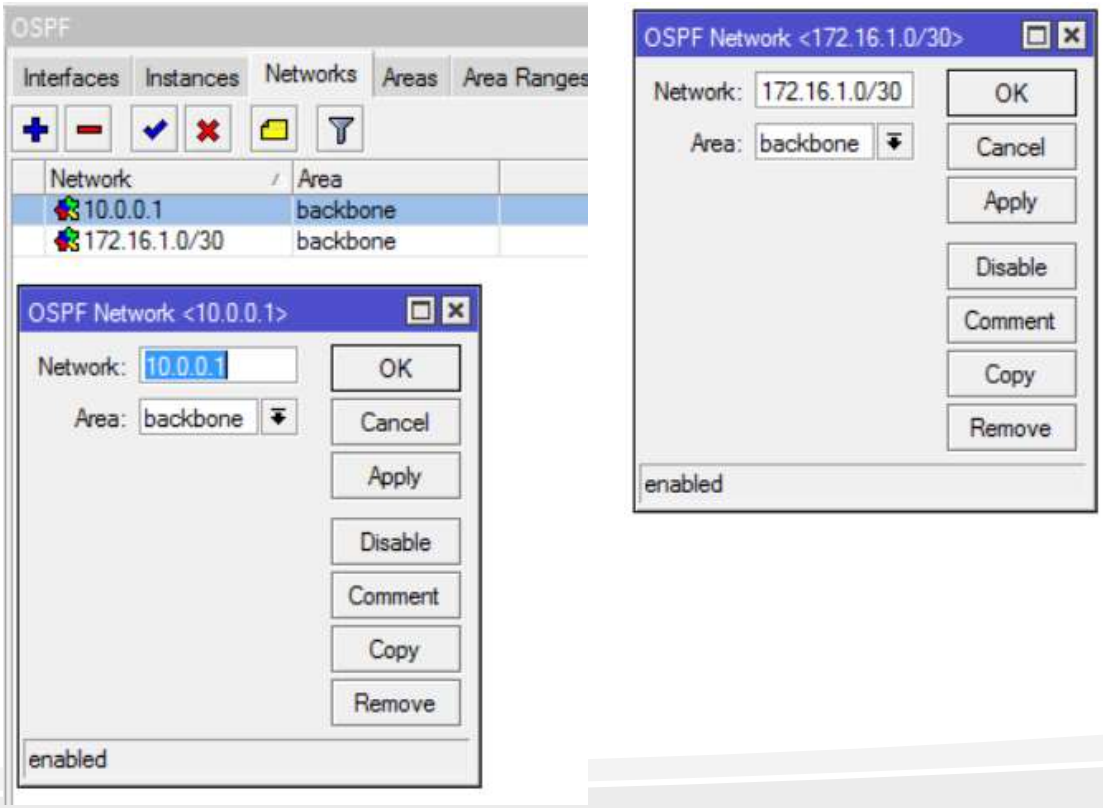
- Pasang IP Address sesuai Diagram
- Tambahkan Interface Bridge sebagai Loopback Interface
- Pasang IP Loopback pada interface Bridge Loopback
- Aktifkan OSPF :
  - Gunakan Area : Backbone
  - Advertise Network Local
  - Advertise IP loopback
- Aktifkan LDP
- Isi LSR-ID dan Transport-Address dengan IP loopback
- Tambahkan LDP Interface (yg terhubung dengan Router MPLS)
- Cek Forwarding Table, Local Binding dan Remote Bindings
- Test Traceroute

Create Loopback

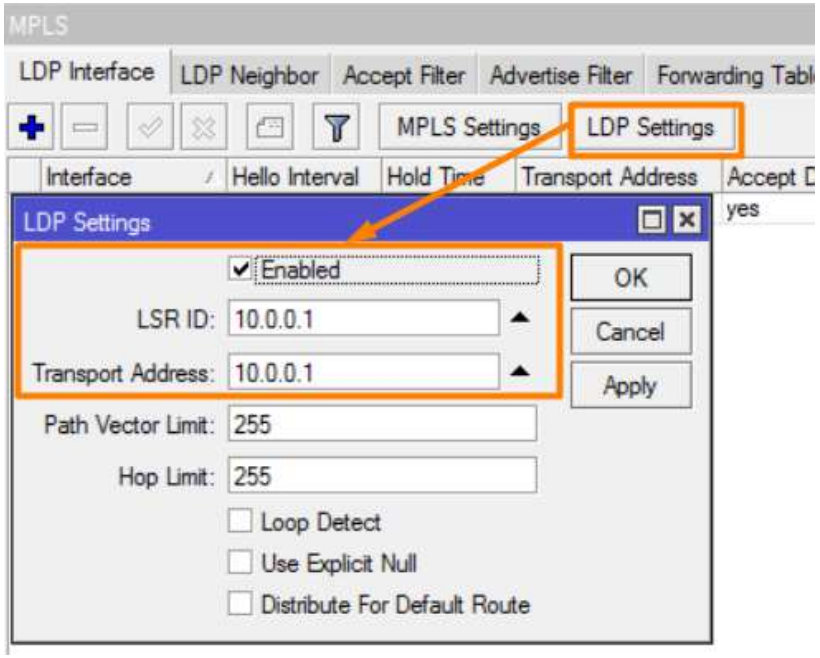


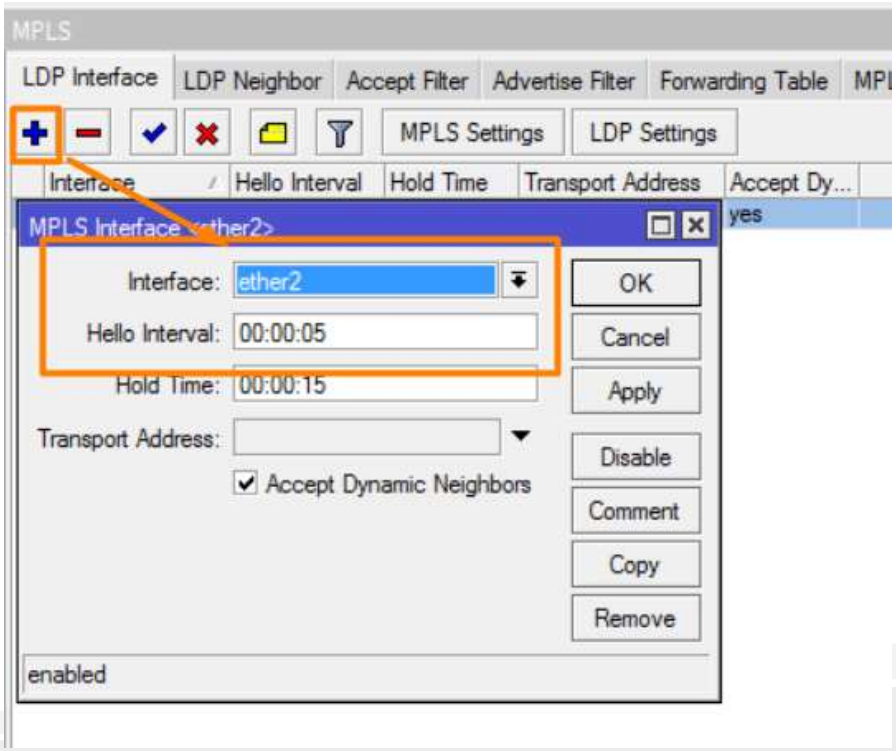


Configure OSPF



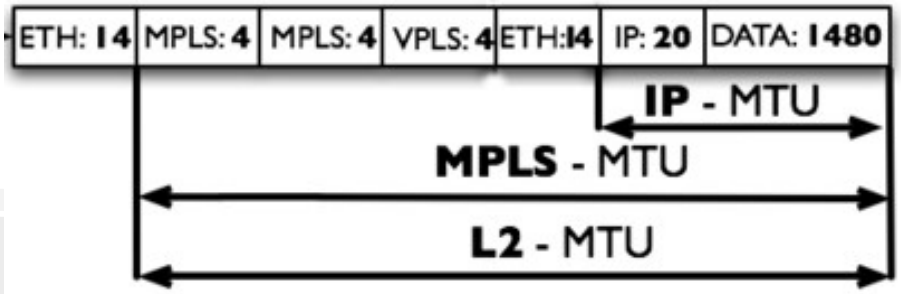
Configure LDP

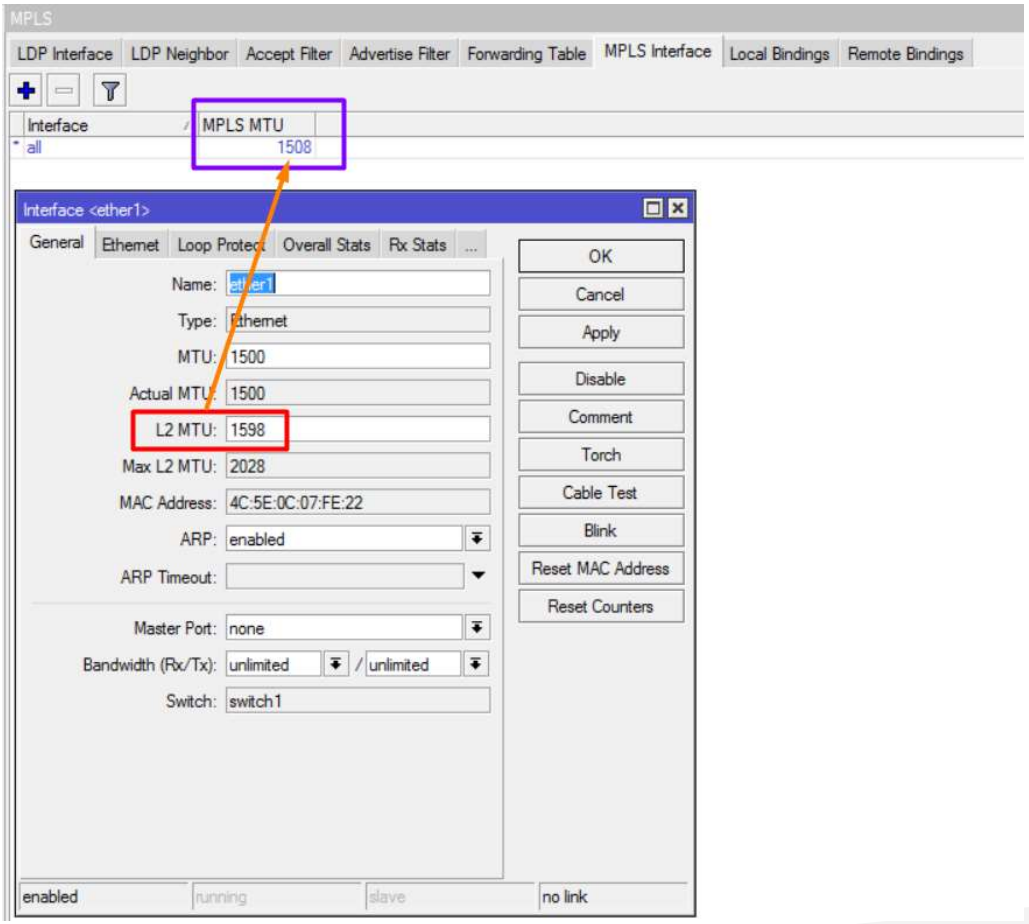




L2MTU

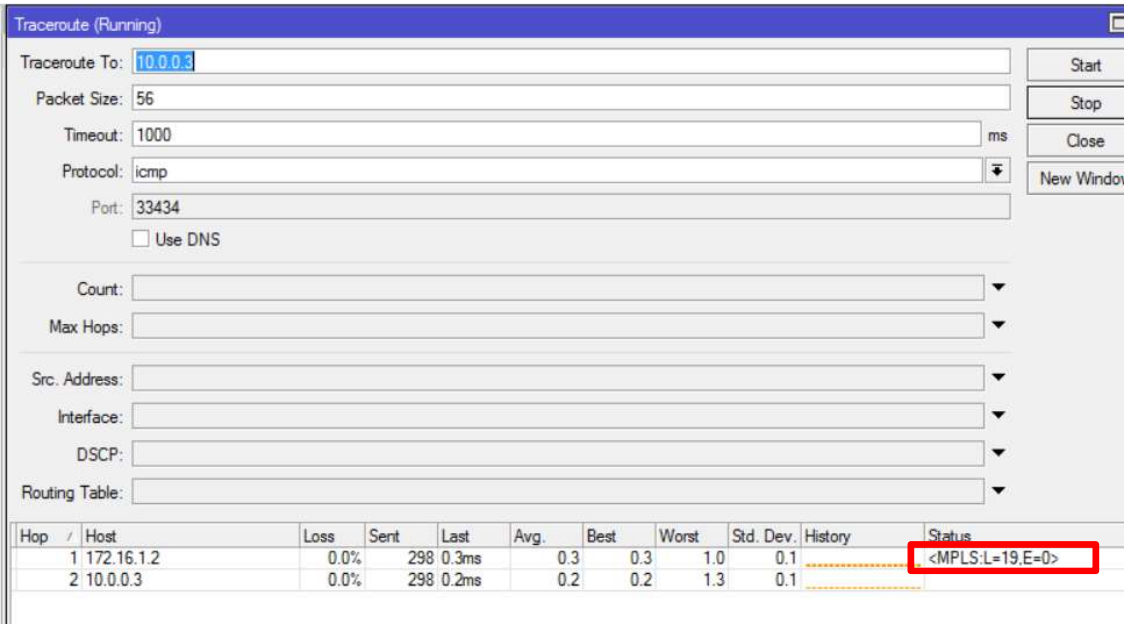
RouterBoard	
RB411 series	ether1:1526
RB433 series	ether1:1526; ether2-ether3:1522
RB450	ether1:1526; ether2-ether5:1522
RB493 series	ether1:1526; ether2-ether9:1522
RB411GL	ether1:1520
RB433GL	ether1-ether3:1520
RB435G	ether1-ether3:1520
RB450G	ether1-ether5:1520
RB493G	ether1-ether9:1520

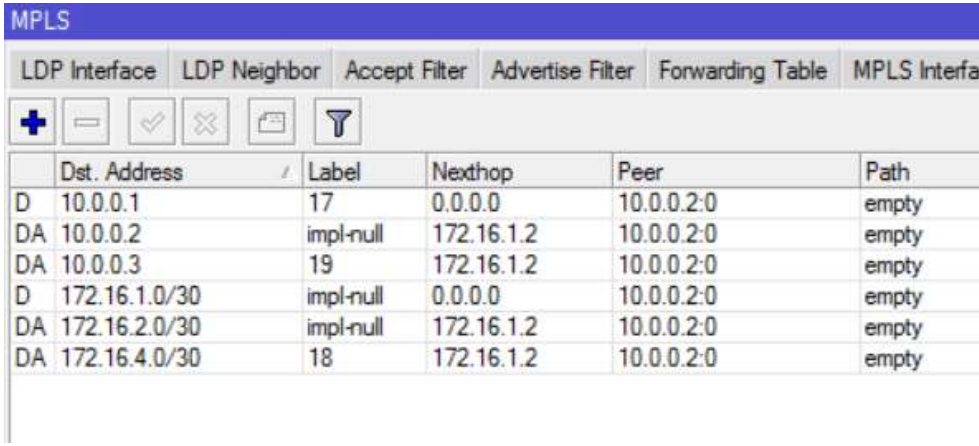


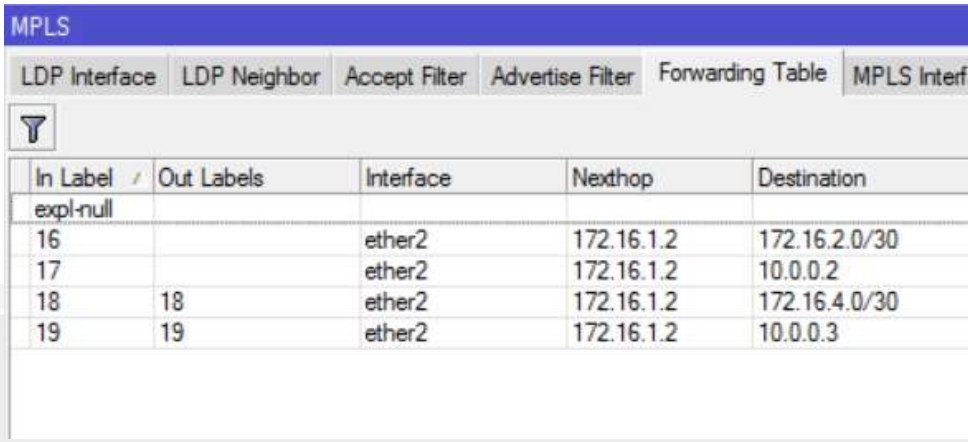


VPLS – MPLS
L2MTU: **1526**

Test Traceroute MPLS & Check MPLS







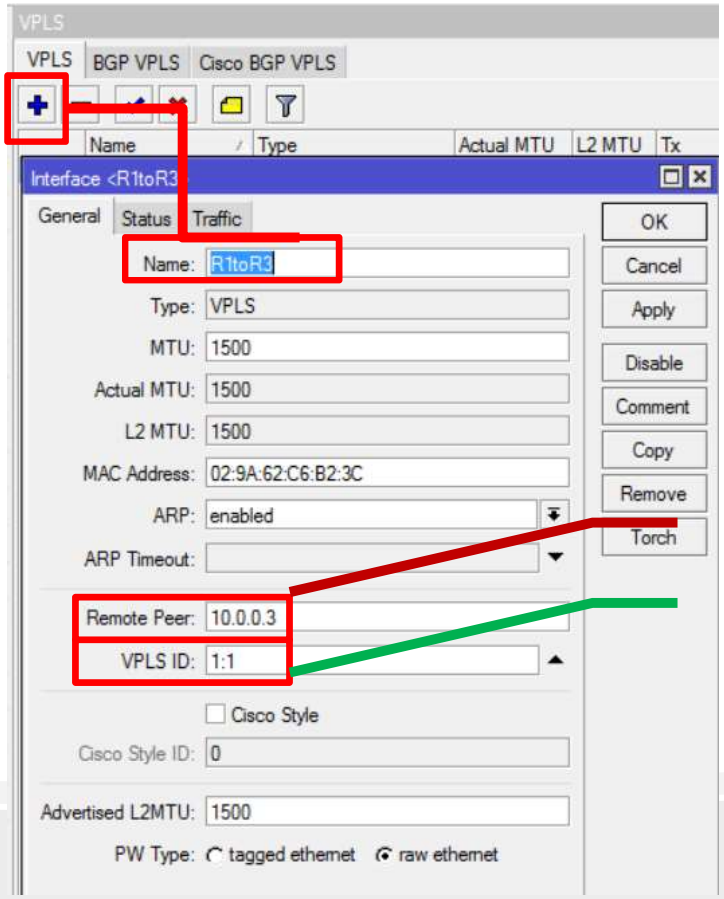
MPLS SUKSES !!

VPLS Configuration Step

- Create Interface VPLS
- Create Bridge Port
- Masukan Interface VPLS dan Ether yg ke arah site dalam Bridge Port
- Test Ping antar Site

A2

Create Interface VPLS



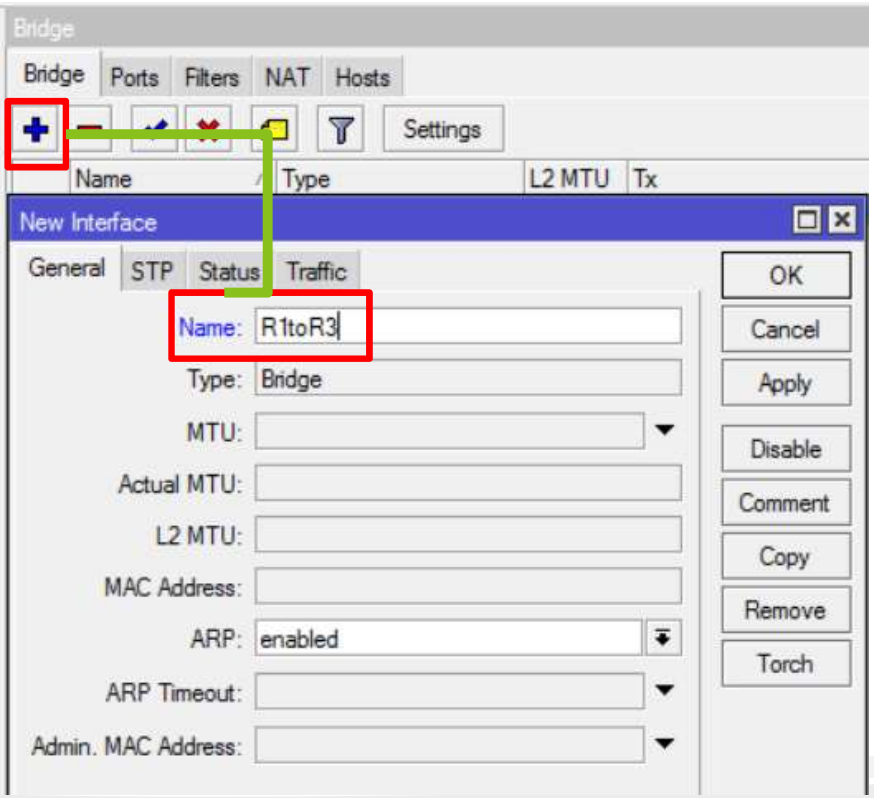
Isikan dengan IP Loopback Remote Peer

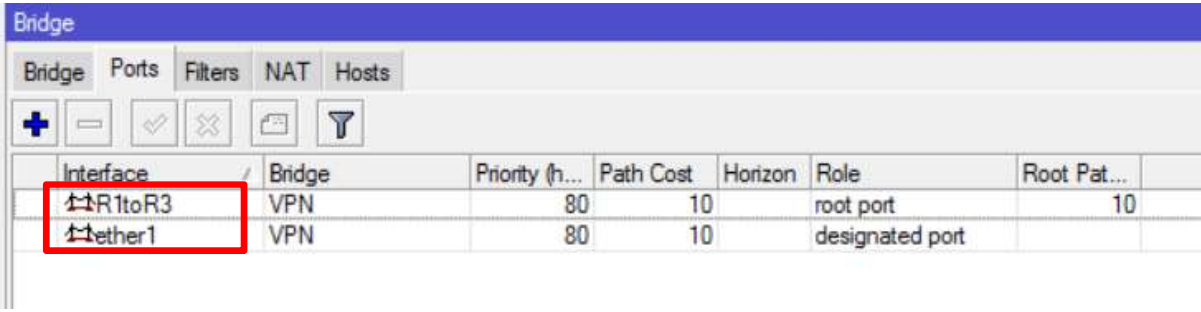
VPLS ID / Tunnel ID harus sama dengan Remote

Slide 32

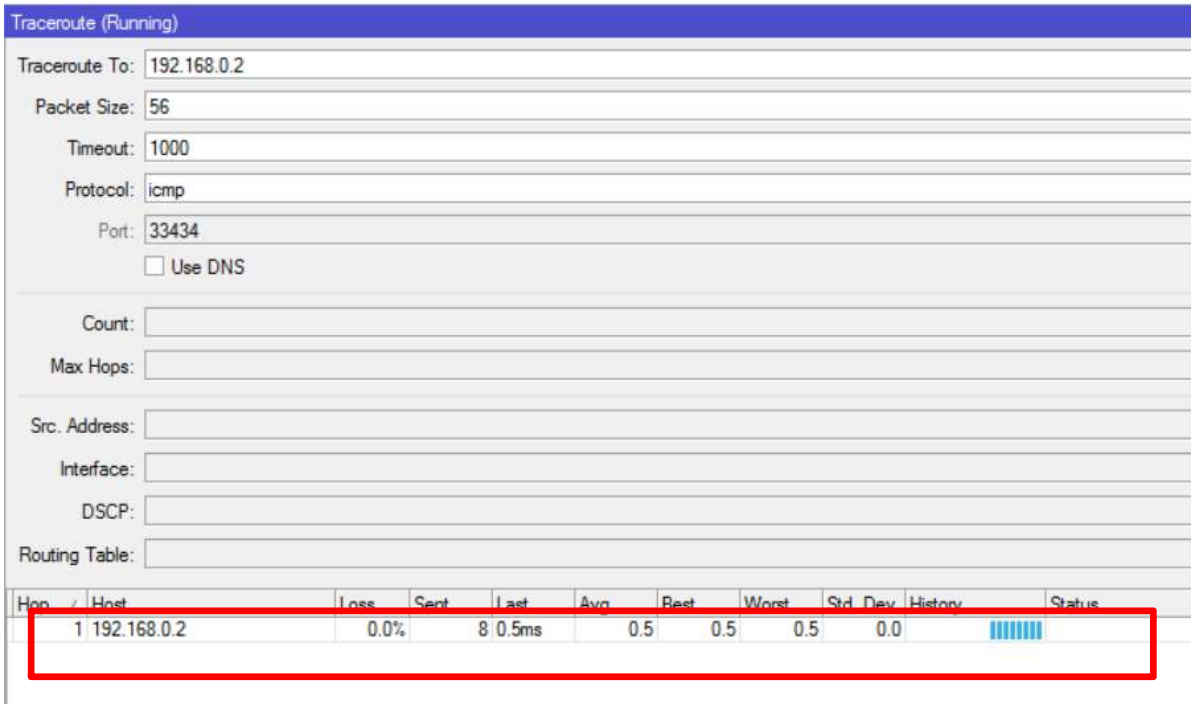
A2 Author, 10/13/2016

Create Bridge VPN dan masukan VPLS + Ether





Test Ping



VPLS SUKSES !!

From EoIP to VPLS : Configuration

- **Add IP Address and Loopback**

```
#on R1
/interface bridge
add name=lo
/ip address
add address=10.0.0.1 interface=lo network=10.0.0.1
add address=172.16.1.1/30 interface=ether2 network=172.16.1.0

#on R2
/interface bridge
add name=lo
/ip address
add address=10.0.0.2 interface=lo network=10.0.0.2
add address=172.16.1.2/30 interface=ether1 network=172.16.1.0
add address=172.16.2.1/30 interface=ether2 network=172.16.2.0

#on R3
/interface bridge
add name=lo
/ip address
add address=10.0.0.3 interface=lo network=10.0.0.3
add address=172.16.2.2/30 interface=ether1 network=172.16.2.0
```

From EoIP to VPLS : Configuration

- **Enable OSPF Routing Protocol**

#on R1

```
/routing ospf network
add area=backbone network=10.0.0.1/32
add area=backbone network=172.16.1
```

#on R2

```
/routing ospf network
add area=backbone network=10.0.0.2/32
add area=backbone network=172.16.1.0/30
add area=backbone network=172.16.2.0/30
```

#on R3

```
/routing ospf network
add area=backbone network=10.0.0.3/32
add area=backbone network=172.16.2.0/30
```

From EoIP to VPLS : Configuration

- **Enable LDP**

```
#on R1
/mpls ldp
         set enabled=yes lsr-id=10.0.0.1 \
         transport-address=10.0.0.1
/mpls ldp interface
         add interface=ether2
#on R2
/mpls ldp
         set enabled=yes lsr-id=10.0.0.2 \
         transport-address=10.0.0.2
/mpls ldp interface
         add interface=ether1
         add interface=ether2
#on R3
/mpls ldp
         set enabled=yes lsr-id=10.0.0.3 \
         transport-address=10.0.0.3
/mpls ldp interface
         add interface=ether1
```

From EoIP to VPLS : Configuration

- **Configure VPLS**

```
#on R1
/interface vpls add name=R1toR3 remote-peer=10.0.0.3 \
        vpls-id=1:1
/interface bridge port add bridge=vpn interface=R1toR3


#on R3
/interface vpls add name=R3toR1 remote-peer=10.0.0.1 \
        vpls-id=1:1
/interface bridge port add bridge=vpn interface=R3toR1
```

From EoIP to VPLS : Configuration

- **Create Bridge & Insert VPLS Port + Ether**

```
#on R1
/interface bridge port add bridge=vpn interface=R1toR3
/interface bridge port
add bridge=vpn interface=ether1
add bridge=vpn interface=R1toR3

#on R3
/interface bridge port add bridge=vpn interface=R3toR1
/interface bridge port
add bridge=vpn interface=ether2
add bridge=vpn interface=R3toR1
```

SUMMARY

- MPLS meningkatkan :
  - Performance jaringan
  - Efesiensi dalam jaringan
  - Skalabilitas dalam jaringan
  - Mempermudah konfigurasi dan manage Jaringan
  - Menambah jumlah kemungkinan solusi VPN
- MPLS dapat melakukan Bandwidth Optimizing
- MPLS dapat melakukan Redundant dan Fail Over Link

THANK YOU

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