



# MPLS VPLS Implementation

By
Antonius Duty Susilo
Indonesia

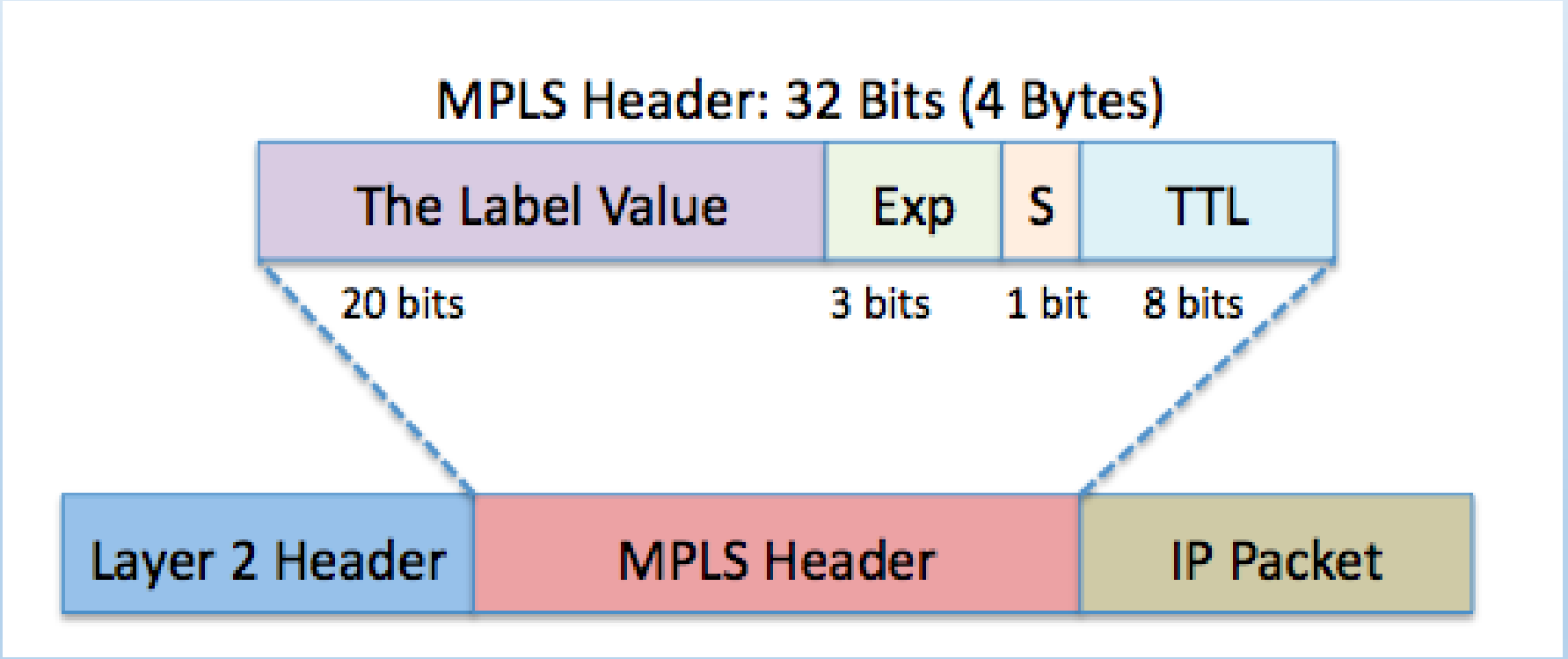
**MUM Cambodia**
**2019**


- Antonius Duty Susilo
- Email : dutymlg@gmail.com
- Mikrotik Trainer And Consultant
- Instructor Cisco Academy, Oracle Academy (Oracle WDP ( Oracle Workspace Development Program)
- Ph.D Student In UTEM Malaysia (Universiti Teknikal Malaysia Melaka)
- Guest Lecturer in POLINEMA ( Politeknik Negeri Malang), STIMATA ( STMIK PPKIA Pradnya Paramita Malang, STIKI (Sekolah Tinggi Informatika dan Komputer Indonesia Malang)

# What is MPLS

- MPLS stands for “Multi-Protocol Label Switching”.
- MPLS is best summarized as a “Layer 2.5 networking protocol”.
- MPLS combines layer 2 switching technology and layer 3 routing technology so that it becomes the best network solution in solving speed, scalability, QOS (Quality of Service), and traffic engineering problems.

# MPLS LABEL FORMAT



# Label Switching

MPLS does “label switching” instead:

The router applies a “label”  based on this information.

Future routers use the label to route the traffic

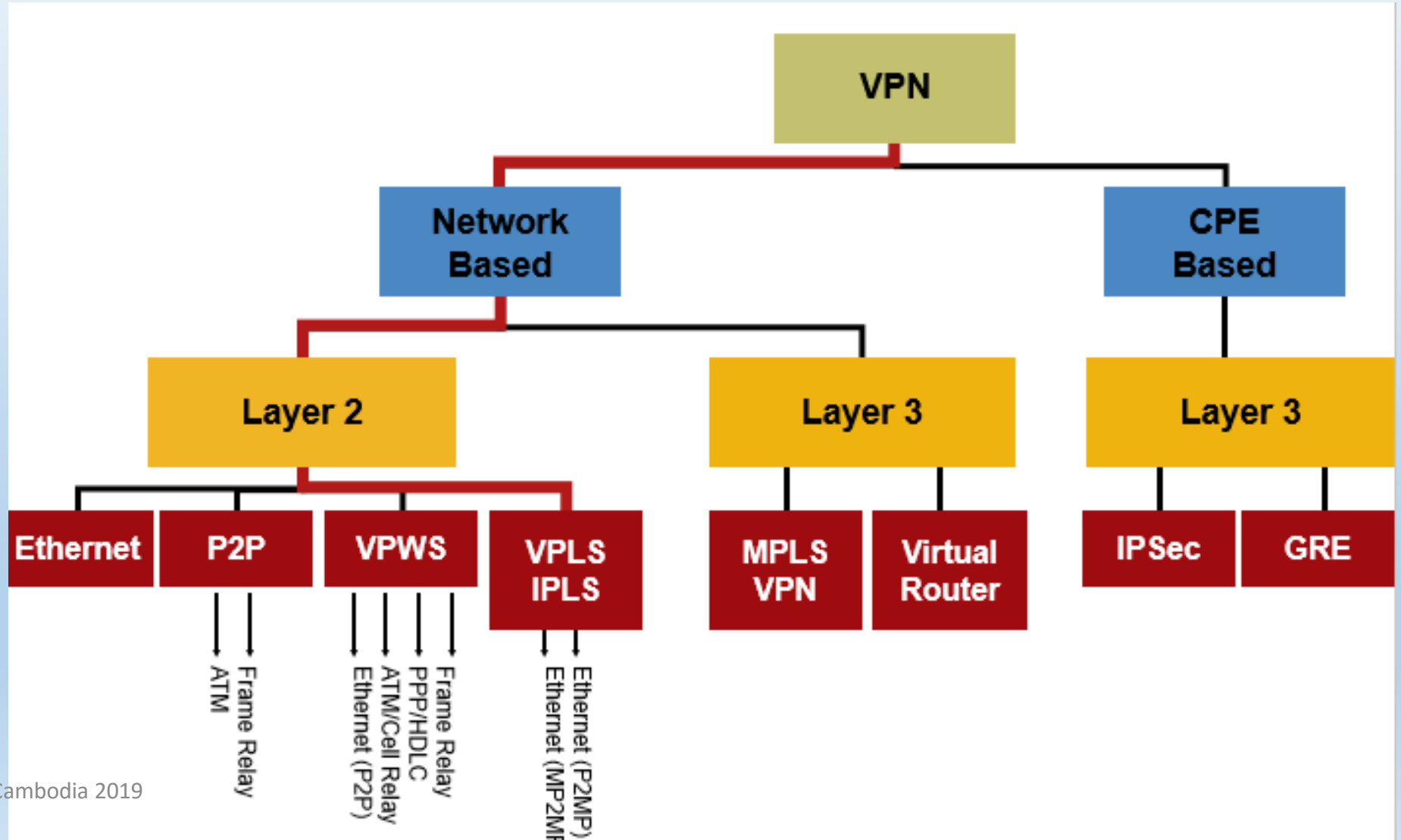
At the final destination router the label is removed.

And the packet is delivered via normal IP routing.

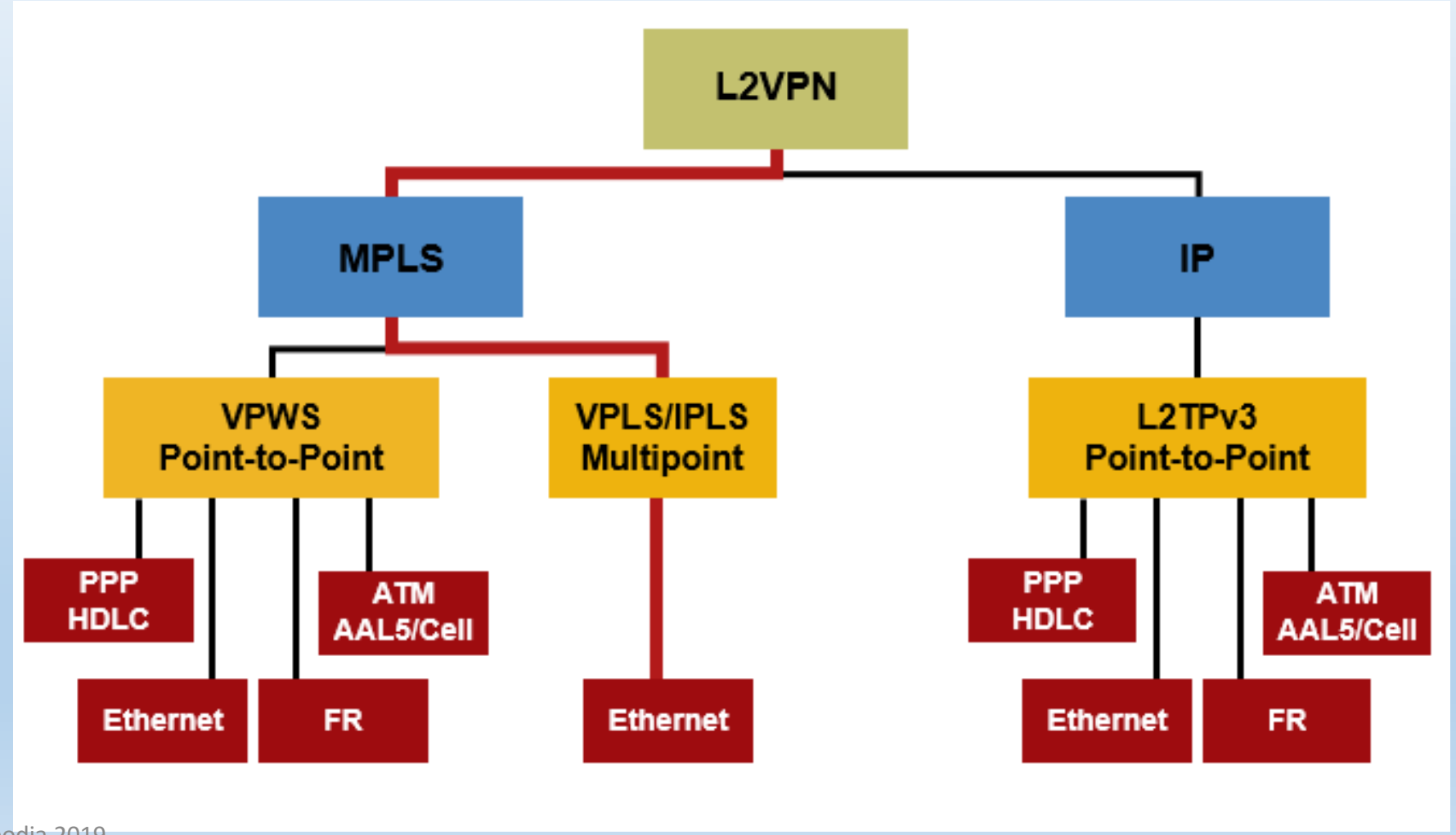
# MPLS Operation

- At ingress LSR (Label Switch Router) of an MPLS domain, an MPLS header is inserted to a packet before the packet is forwarded
- At subsequent LSRs
  - The label is used as an index into a forwarding table that specifies the next hop and a new label.
  - The old label is replaced with the new label, and the packet is forwarded to the next hop.
- Egress LSR strips the label and forwards the packet to final destination based on the IP packet header

# Classification Of VPNs

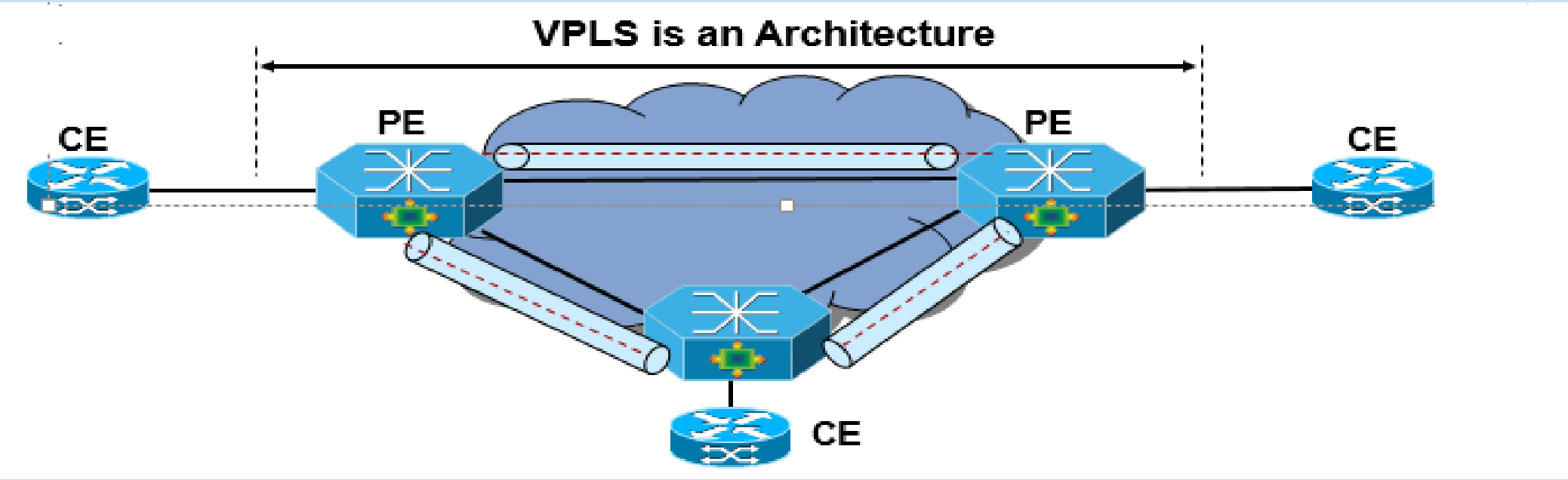


# L2VPN Model


L2VPN
MPLS
IP
VPWS
Point-to-Point
VPLS/IPLS
Multipoint
L2TPv3
Point-to-Point
PPP
HDLC
ATM
AAL5/Cell
Ethernet
FR
Ethernet
PPP
HDLC
ATM
AAL5/Cell
Ethernet
FR

# VPLS

- VPLS defines an architecture allows MPLS networks offer Layer 2 multipoint Ethernet Services
- SP emulates an IEEE Ethernet bridge network (virtual)



# LDP (Label Distribution Protocol)

Label Distribution Protocol – LDP works between adjacent/non-adjacent peers

LDP sessions are established between peers

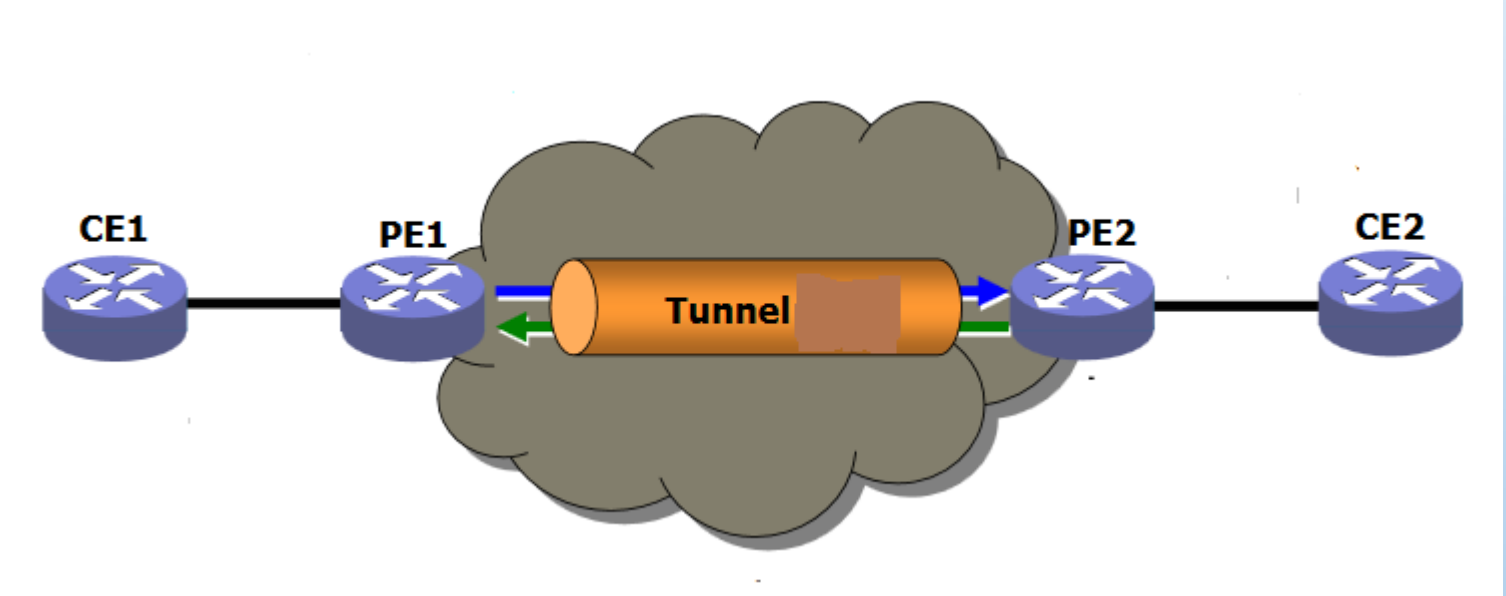
LDP messages sent in the form of TLVs (Type, Length, Value)

# Label Space Of LDP

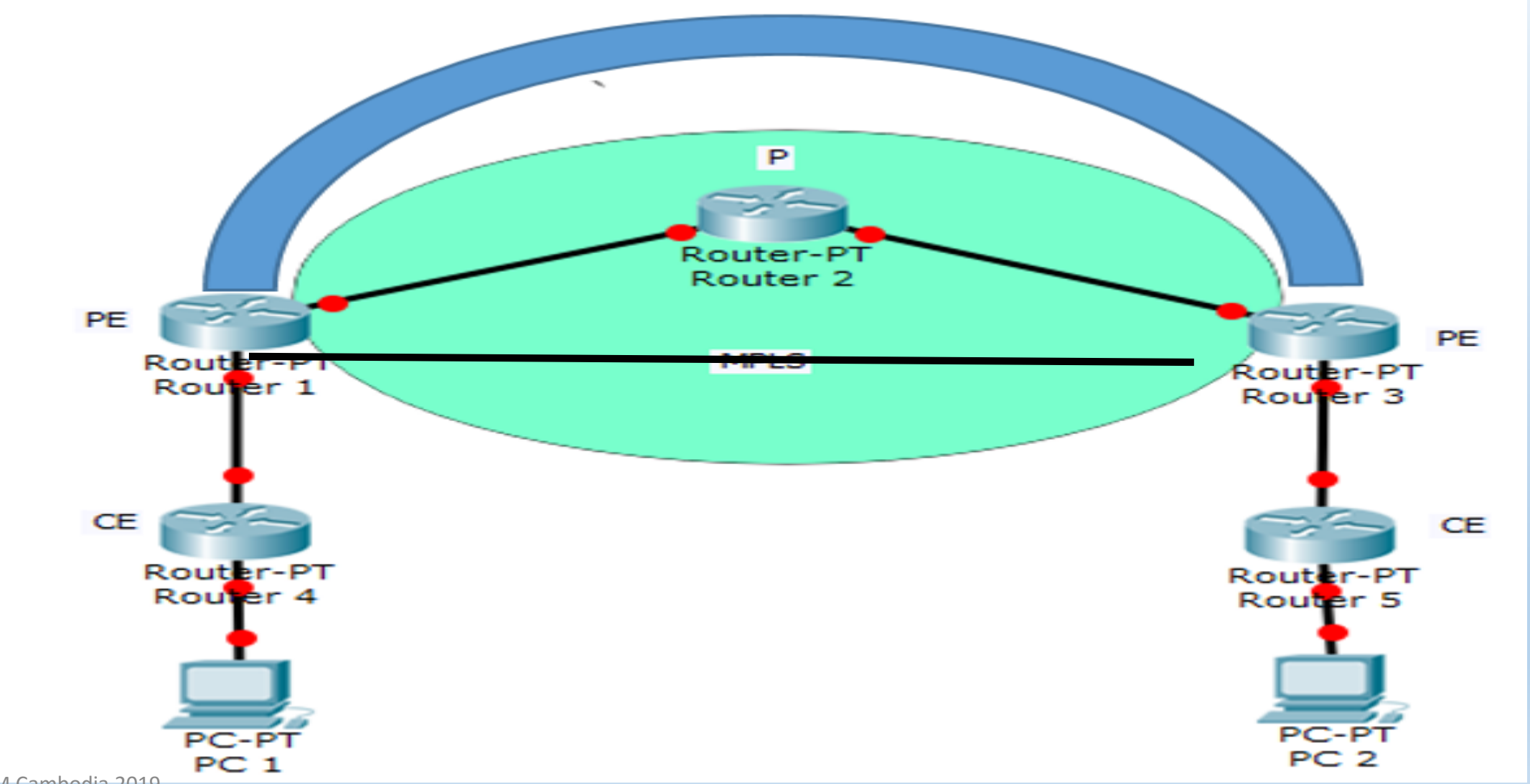
LSRs establish one LDP session per label space. Per-platform label space requires only one LDP session, even if there are multiple parallel links between a pair of LSRs.

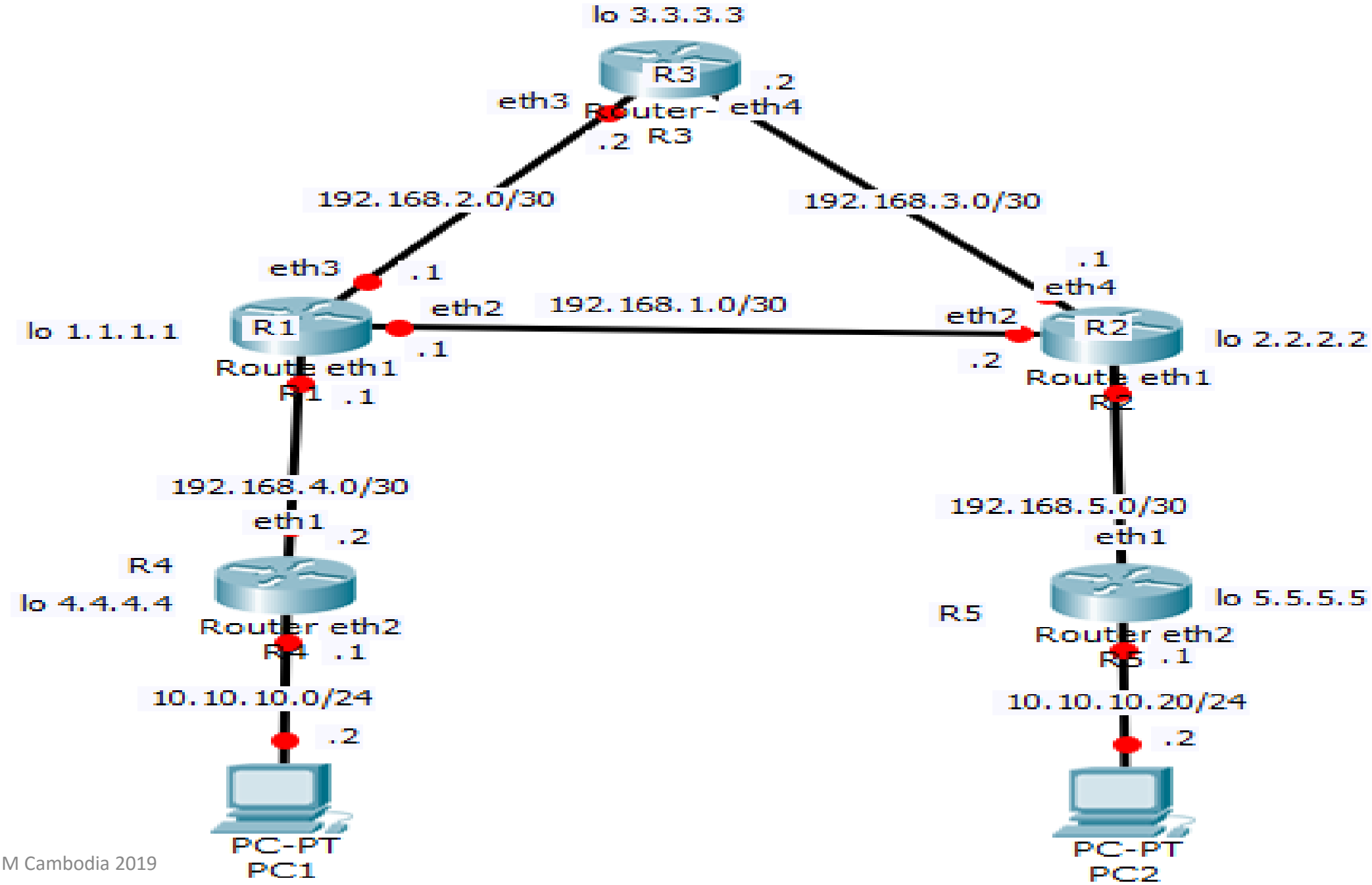
Per-platform label space is announced by setting the label space ID

# Tunnel VPN



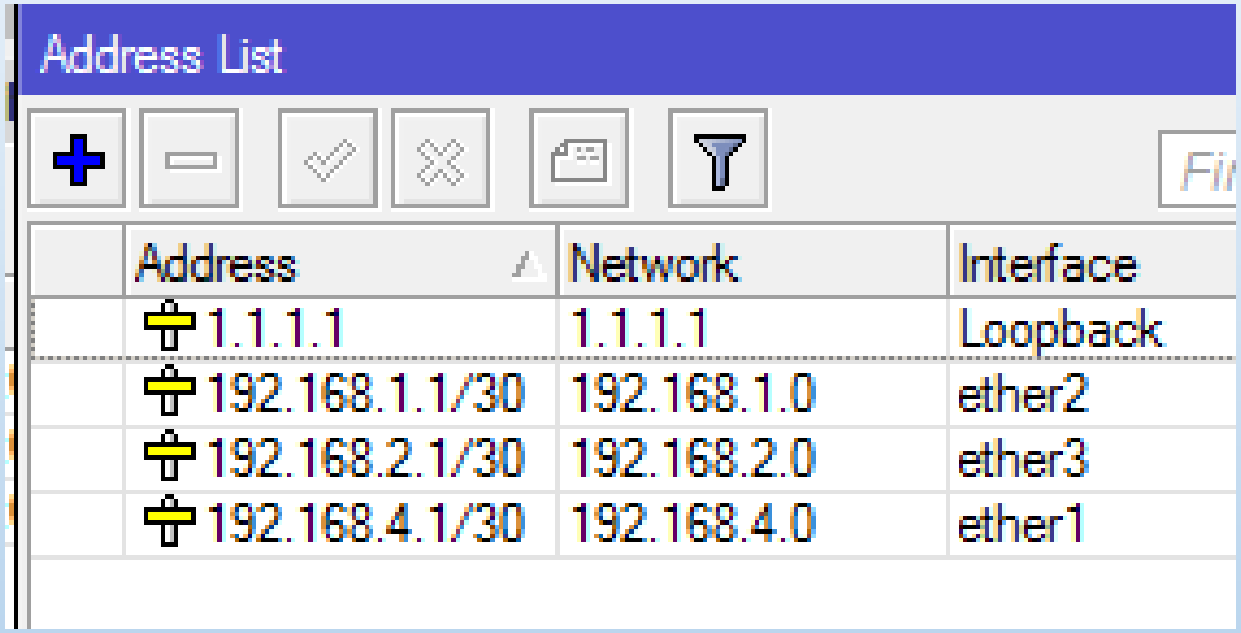
# LAB


P
Router-PT
Router 2
PE
Router-PT
Router 1
MPLS
PE
Router-PT
Router 3
CE
Router-PT
Router 4
CE
Router-PT
Router 5
PC-PT
PC 1
PC-PT
PC 2

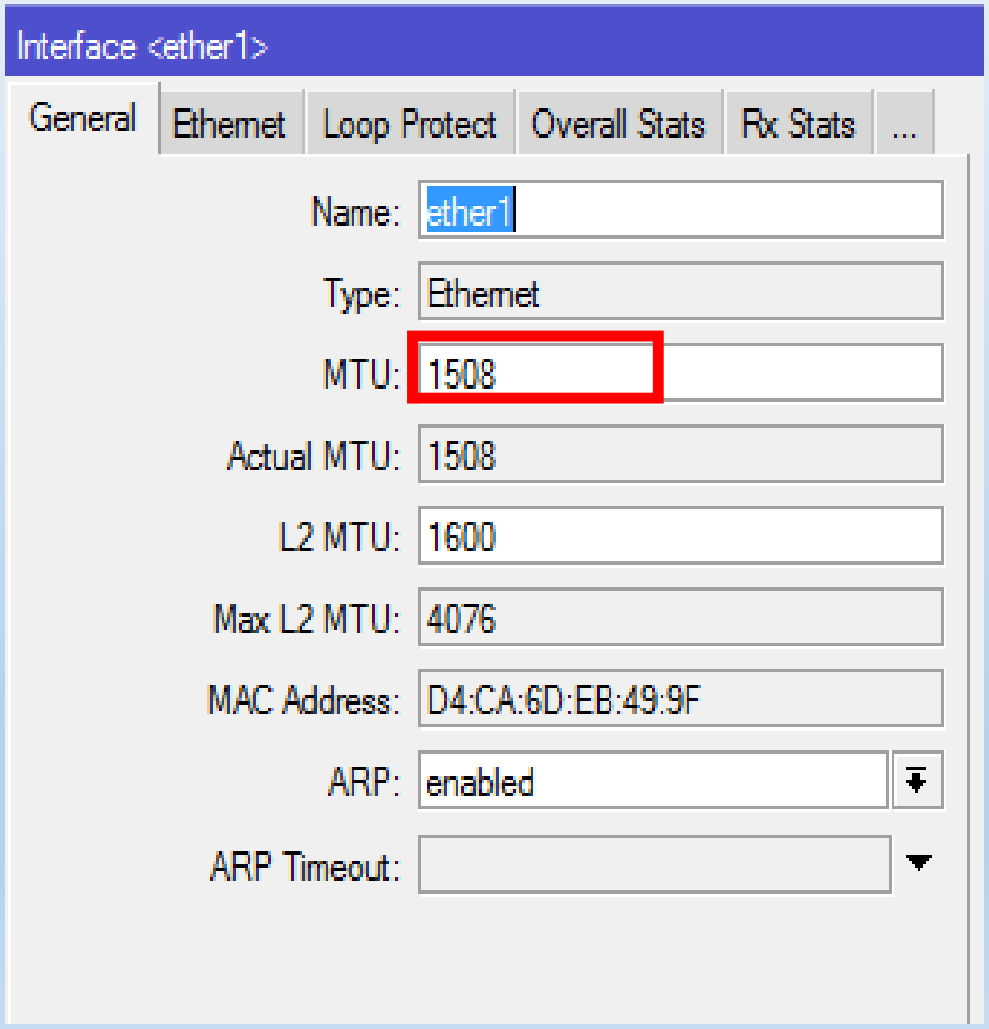

lo 3.3.3.3
R3
Router-
R3
eth3
.2
.2
eth4
192.168.2.0/30
192.168.3.0/30
eth3
.1
.1
eth4
lo 1.1.1.1
R1
Route
R1
eth2
.1
192.168.1.0/30
eth2
.2
R2
Route
R2
eth1
lo 2.2.2.2
eth1
.1
192.168.4.0/30
192.168.5.0/30
eth1
.2
eth1
R4
lo 4.4.4.4
Router
R4
eth2
.1
R5
Router
R5
eth2
.1
lo 5.5.5.5
10.10.10.0/24
10.10.10.20/24
.2
.2
PC-PT
PC1
PC-PT
PC2

# R1

## IP Address

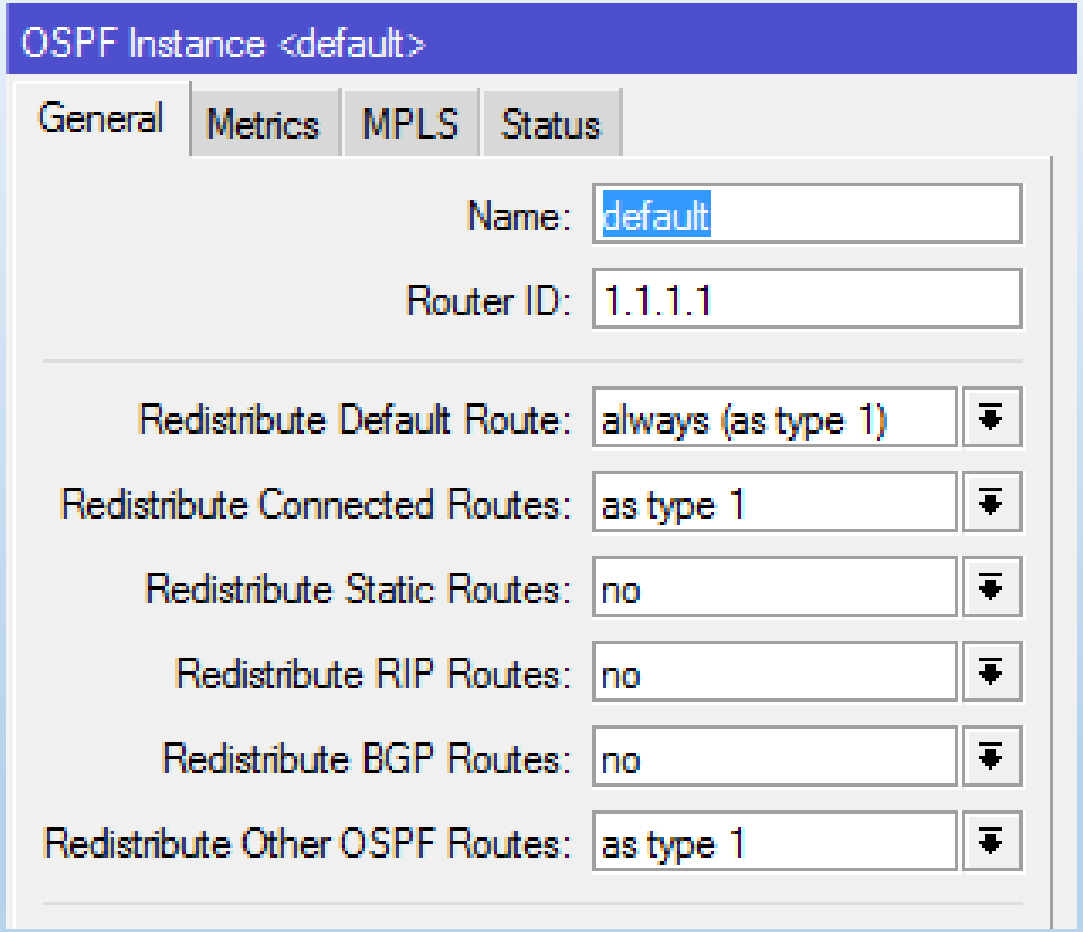



## MTU 1508 in eth1, eth2,eth3

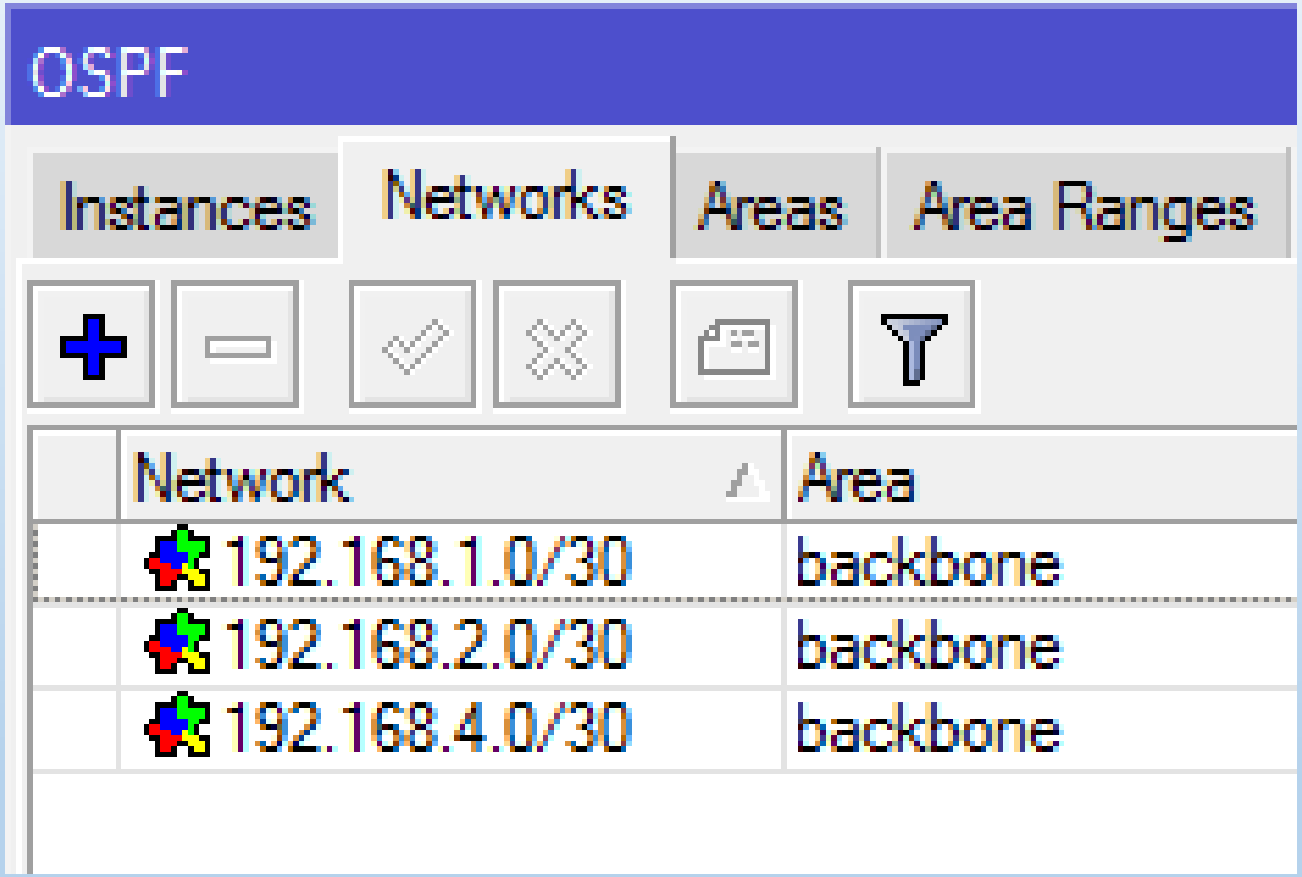


# R1

## OSPF Instance

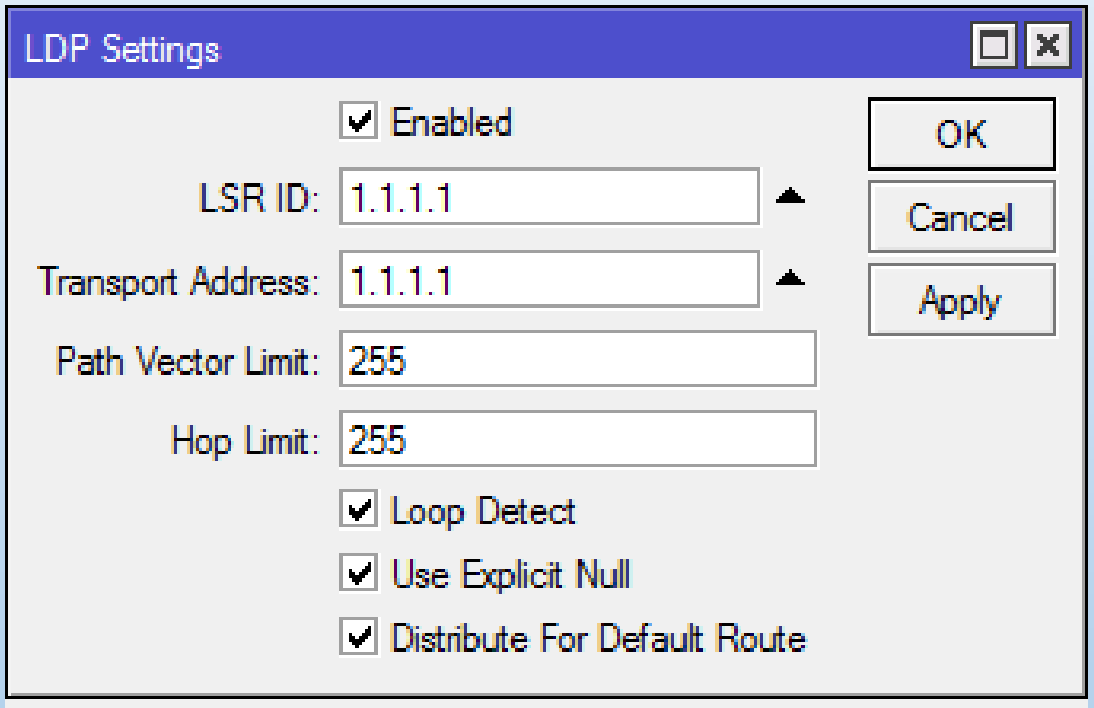



## OSPF Networks

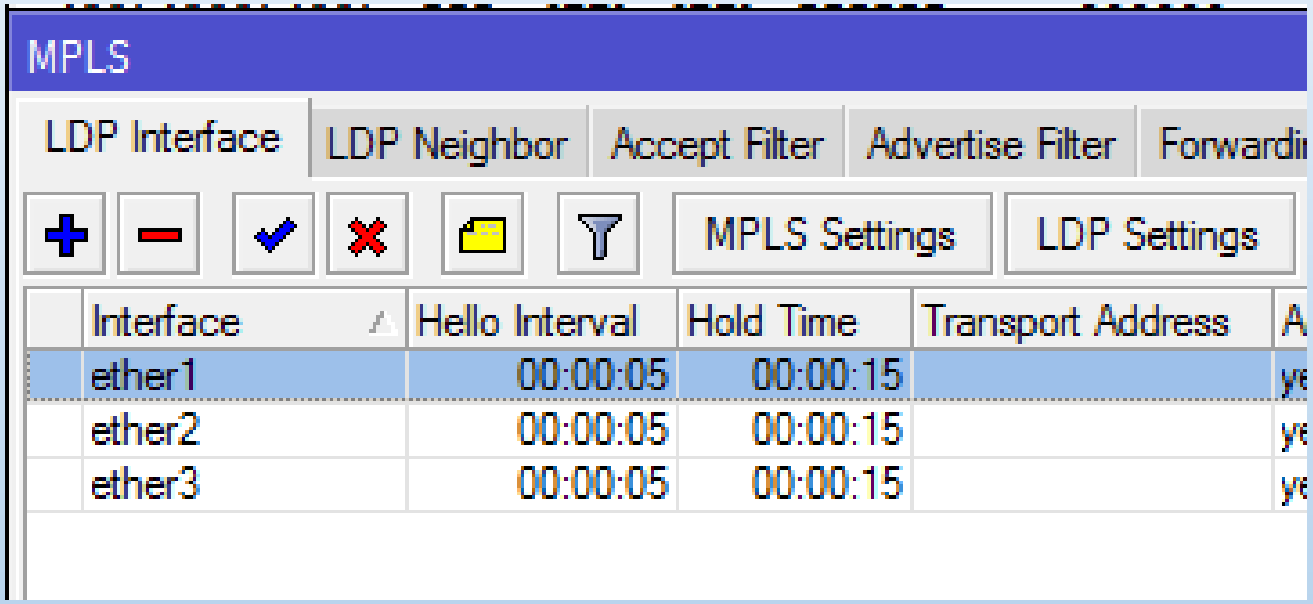


# R1

## LDP Settings

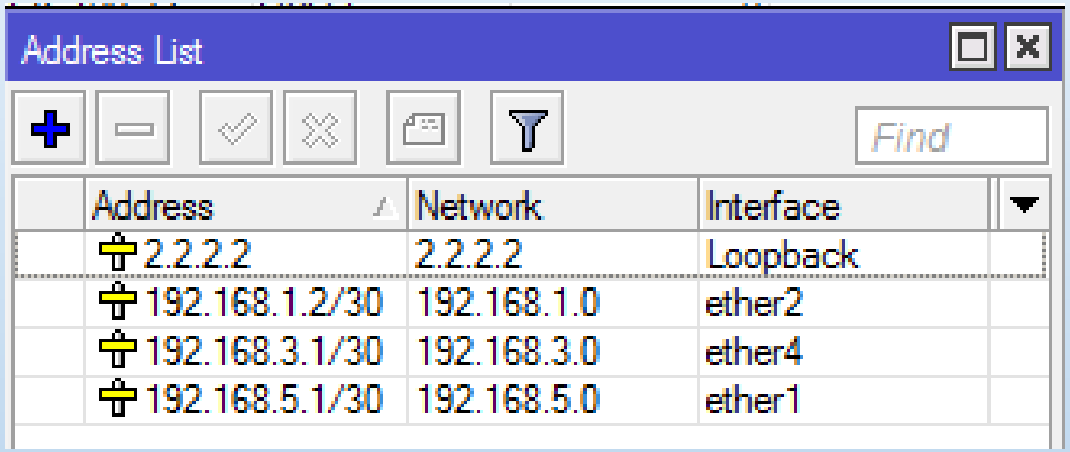



## LDP Interface

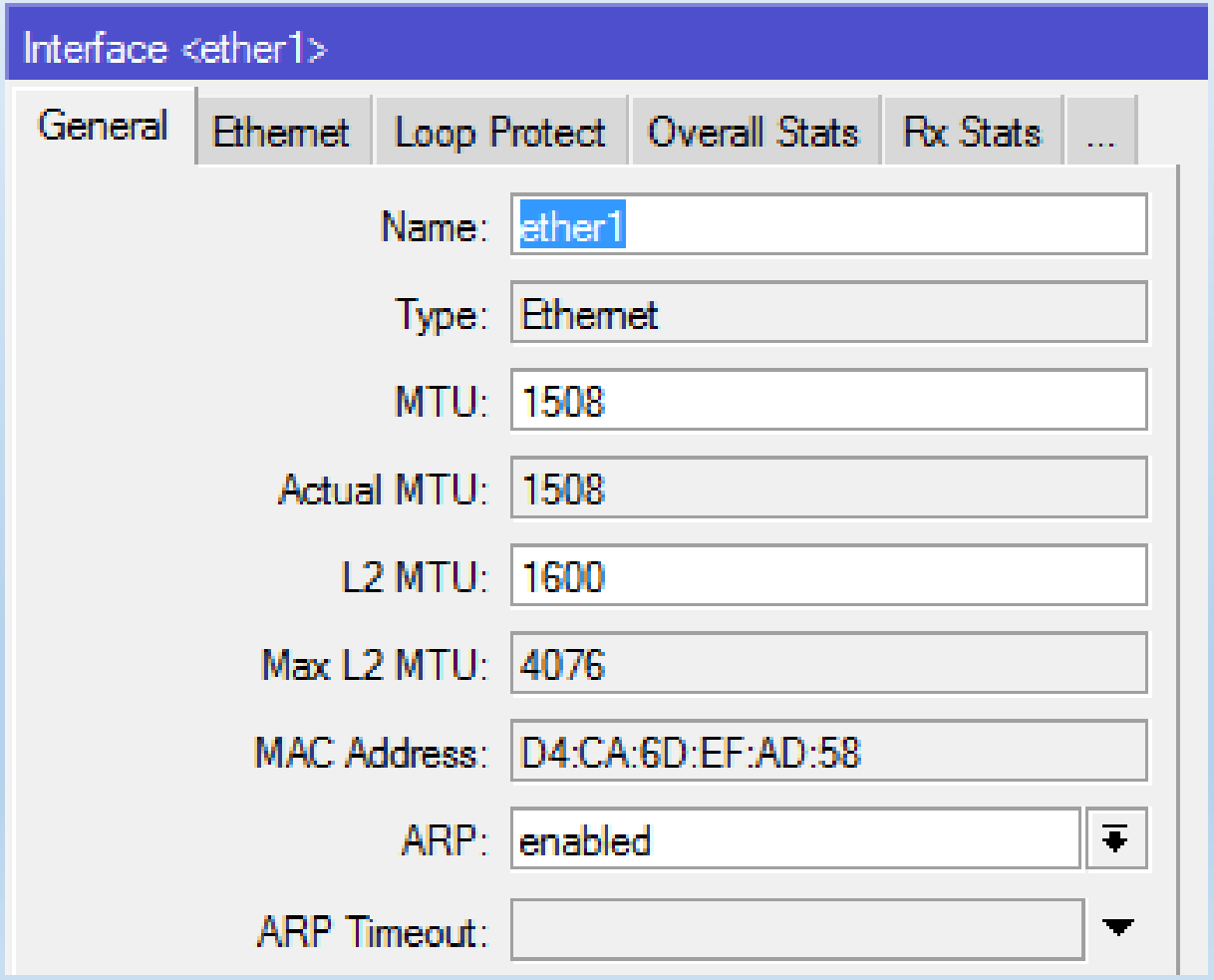


# R2

## Ether1,2 and 4

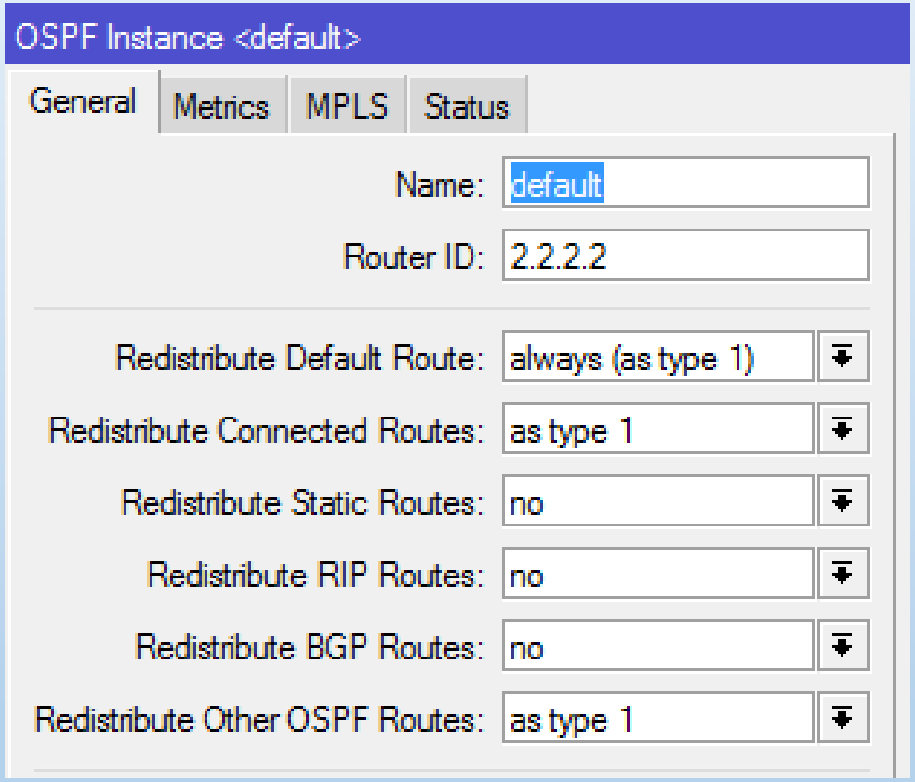



## MTU ether1,ether2,ether4

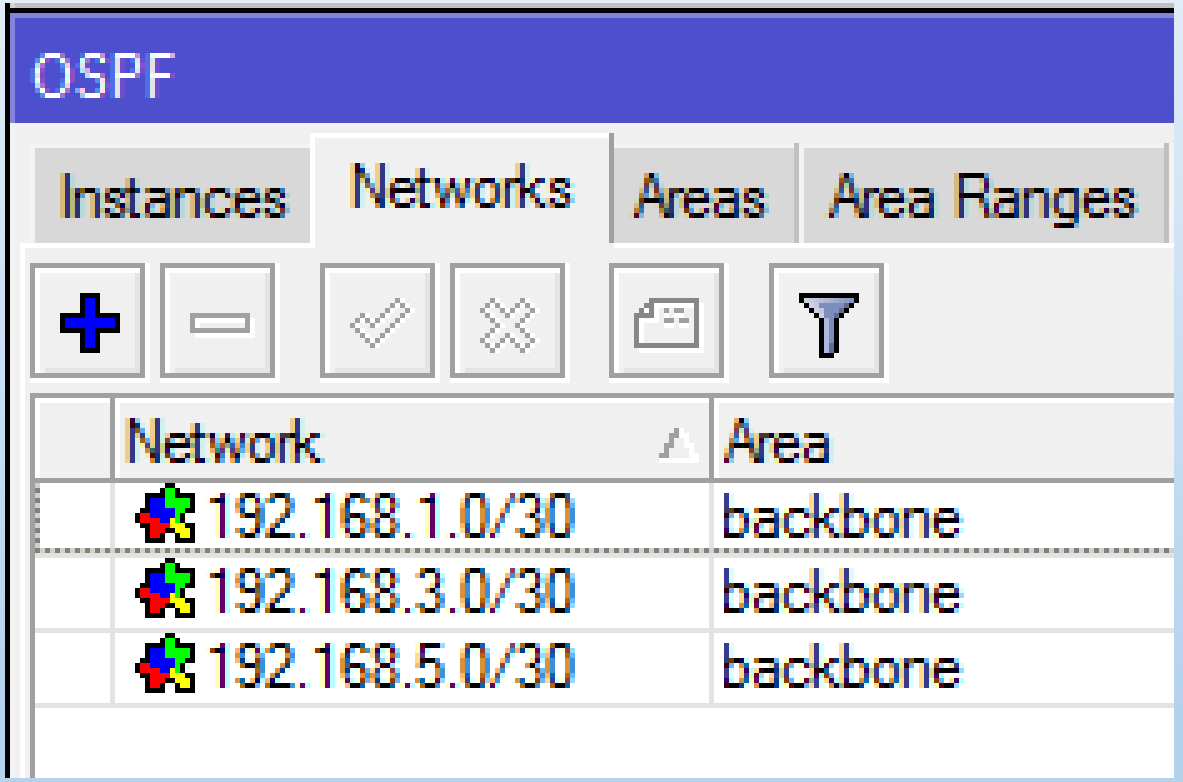


# R2

## OSPF Instance

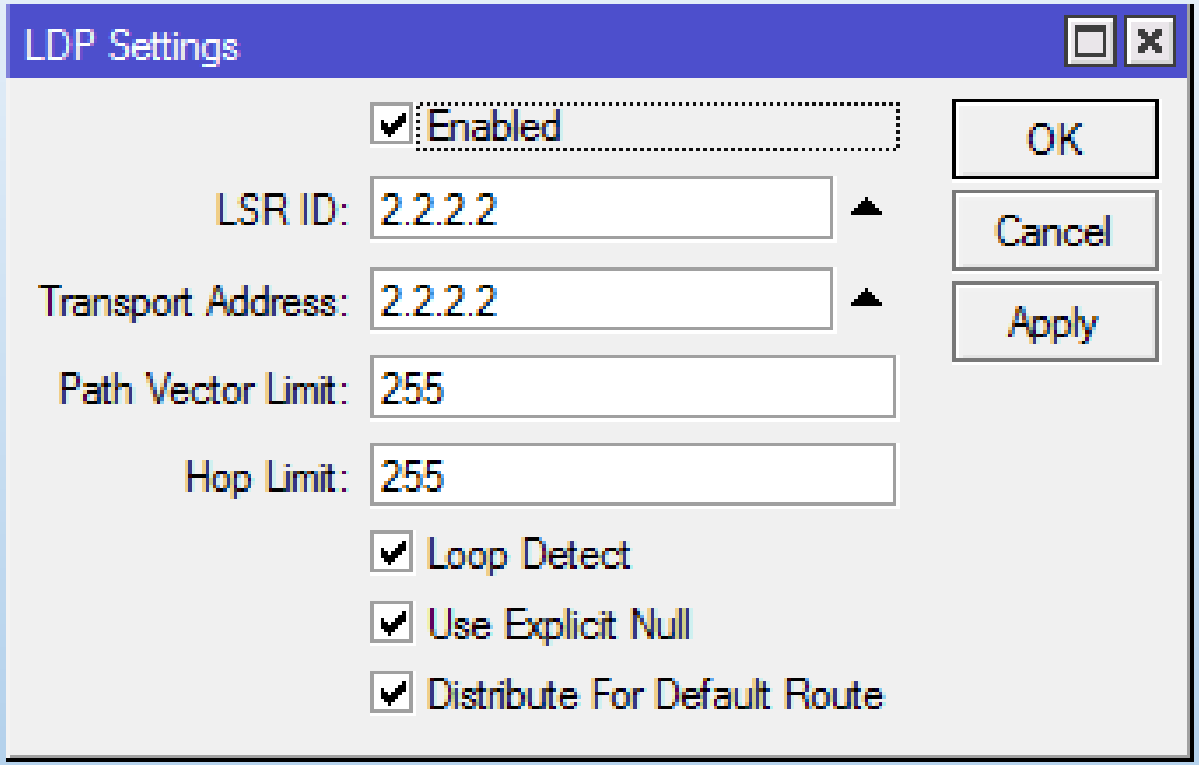



## OSPF Networks

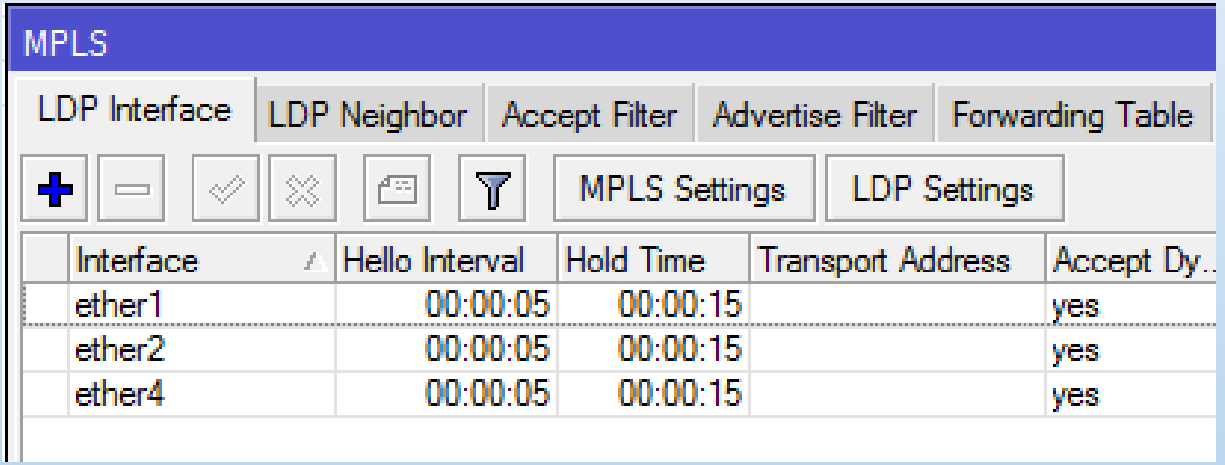


# R2

## LDP Settings

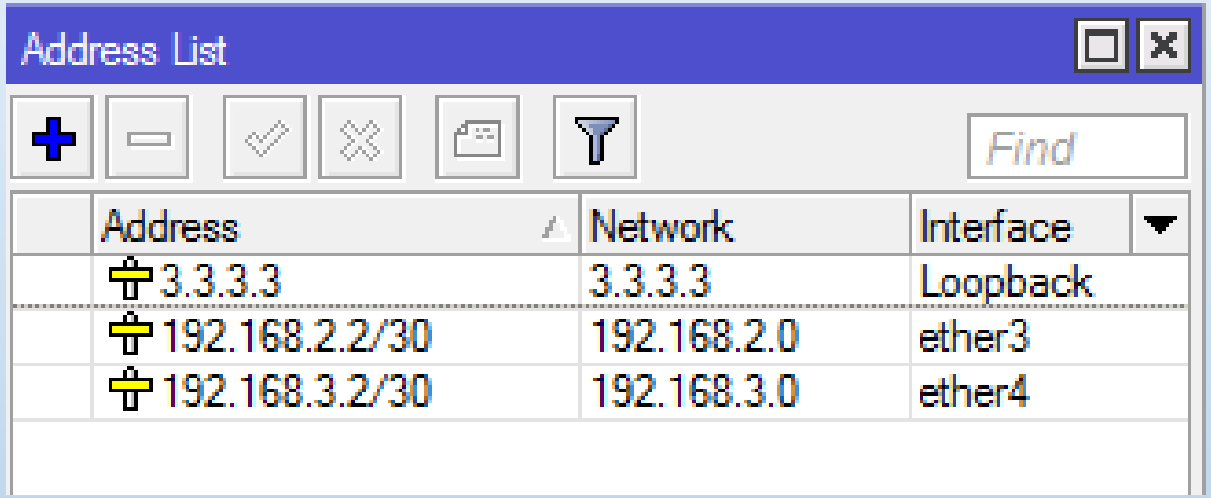



## LDP Interface

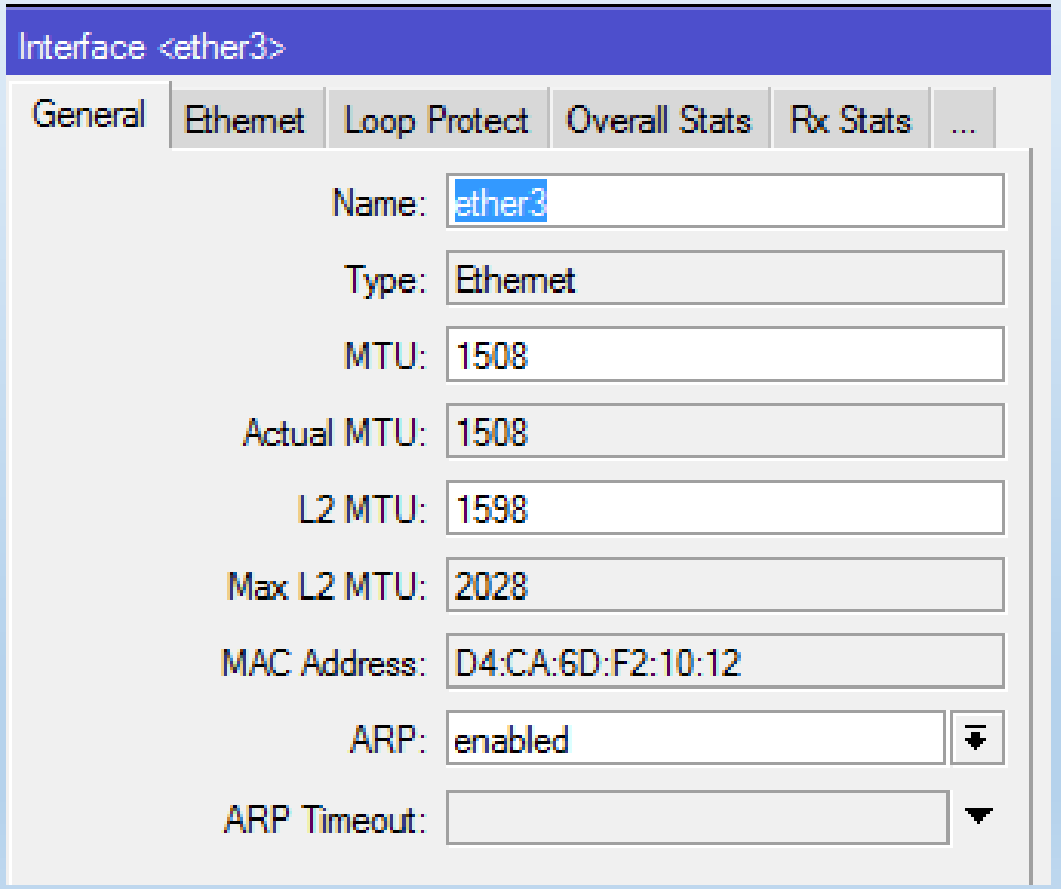


# R3

## IP Address Interface

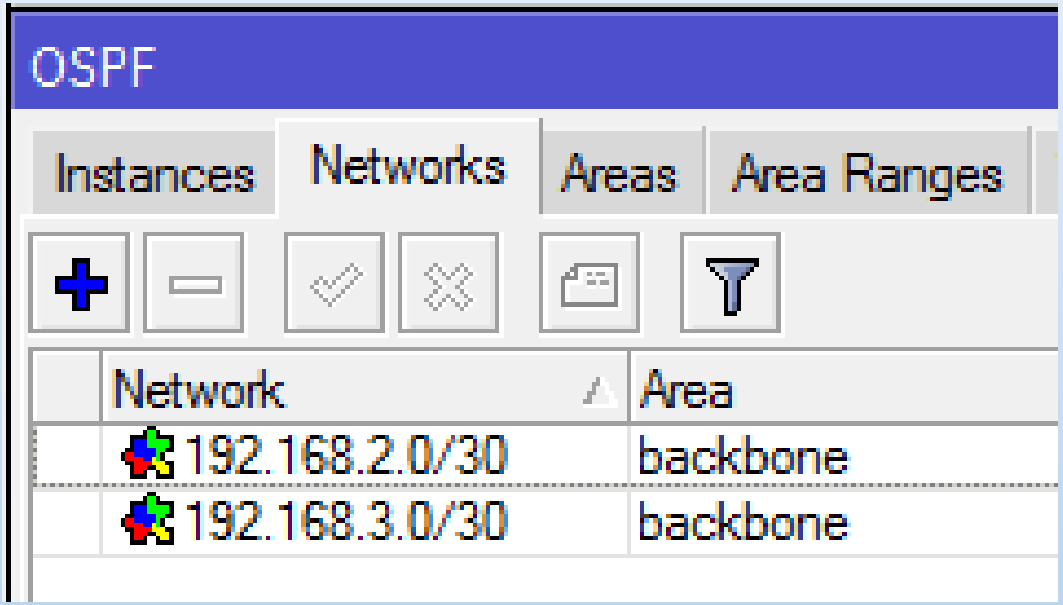



## MTU ether 3,ether4

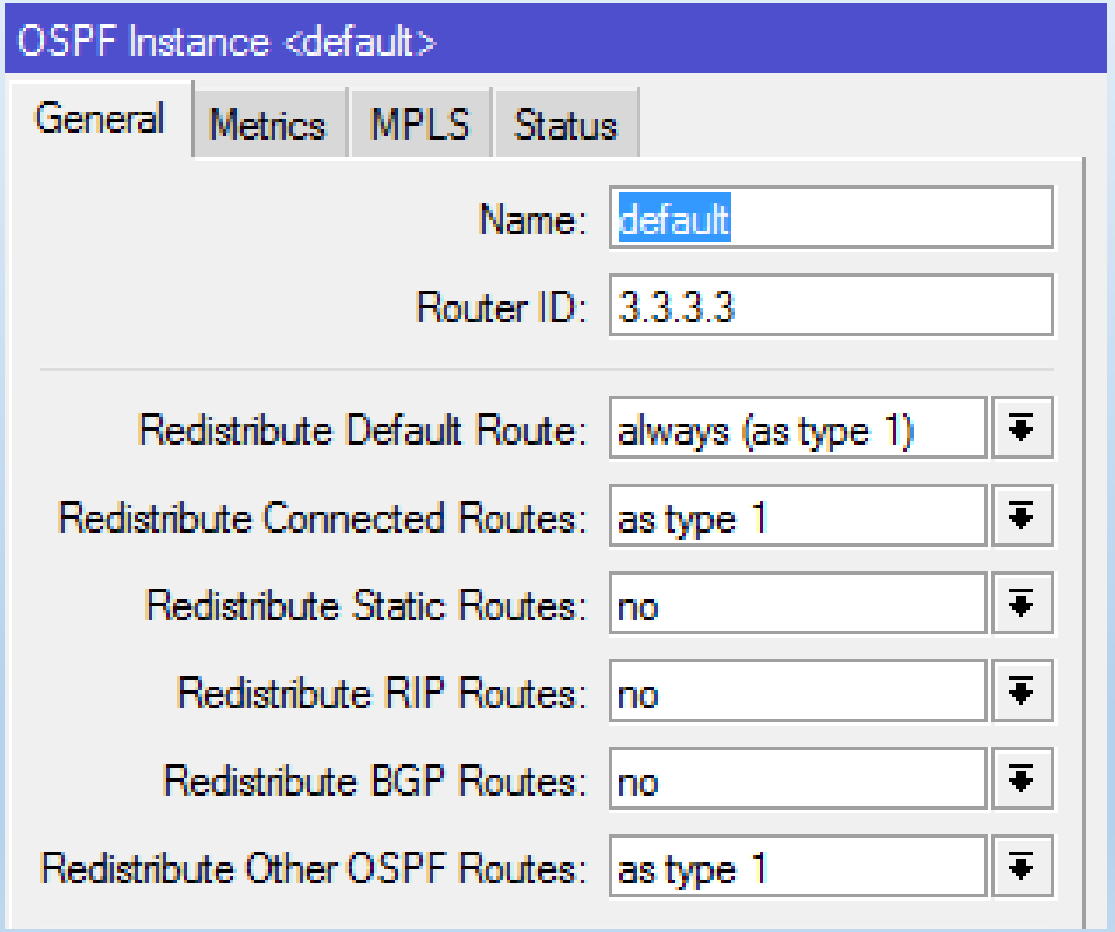


# R3

## OSPF Networks

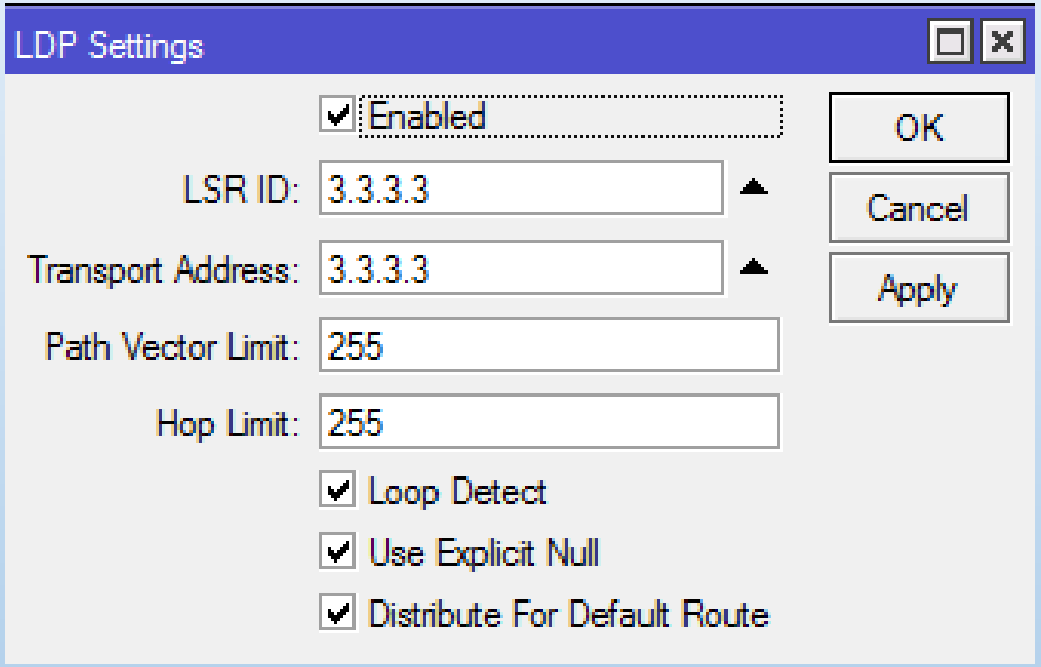



## OSPF Instance

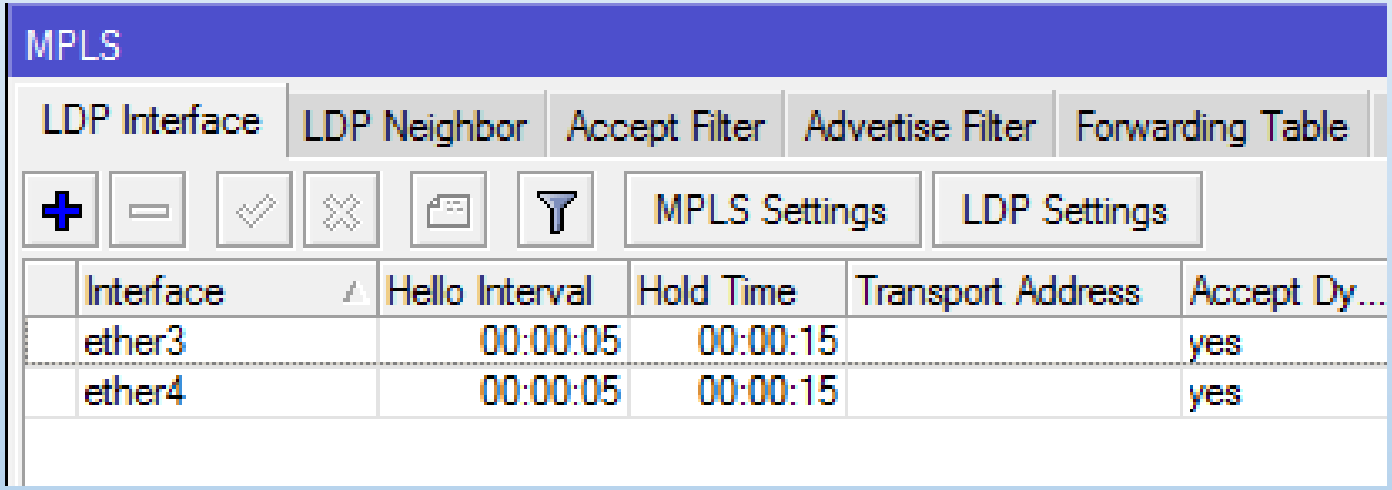


# R3

## LDP Settings

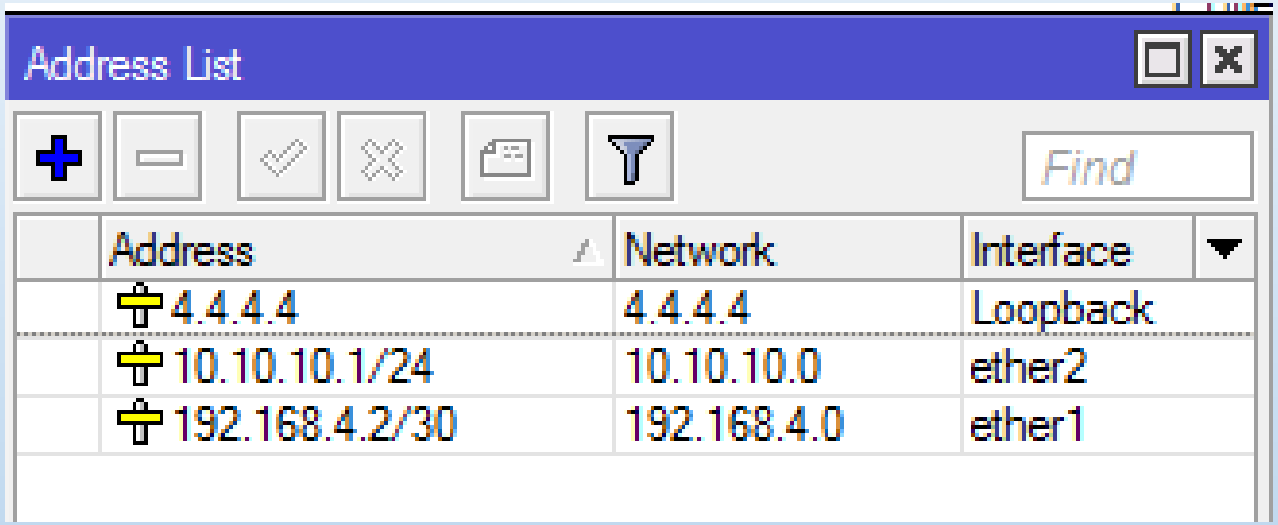



## LDP Interface

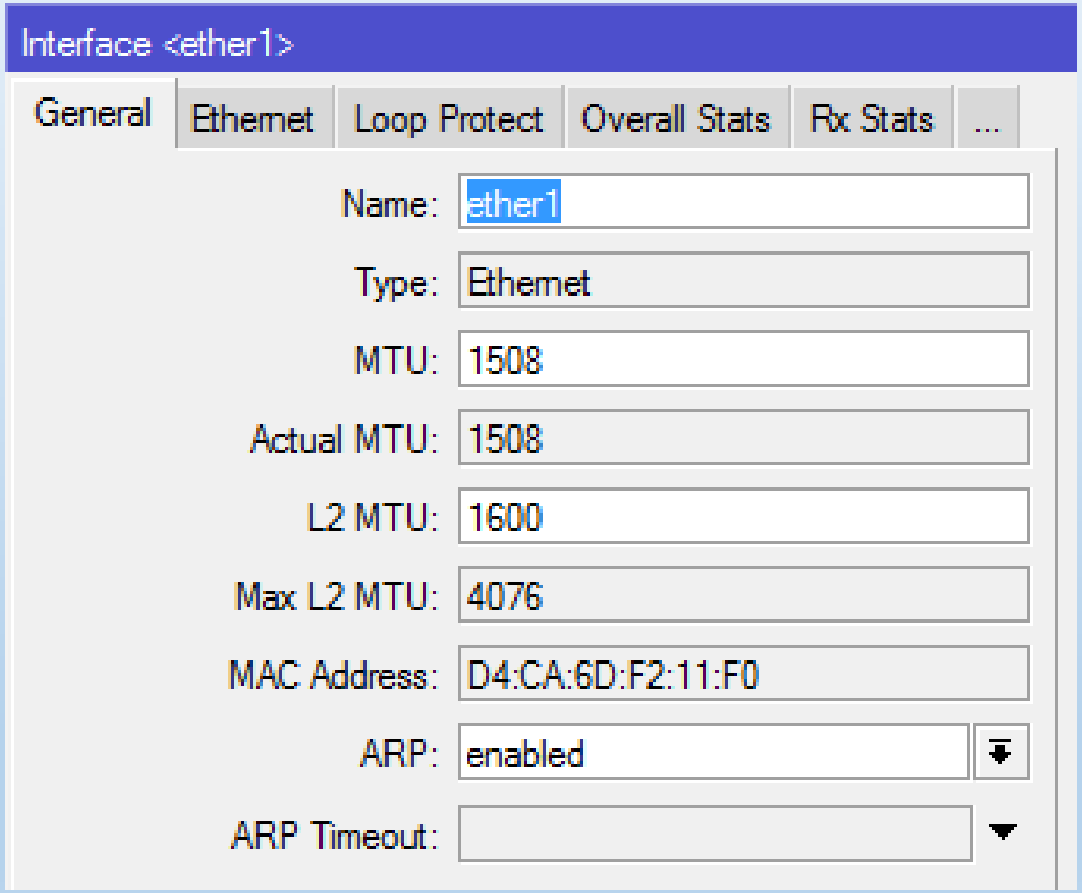


# R4

## IP Address

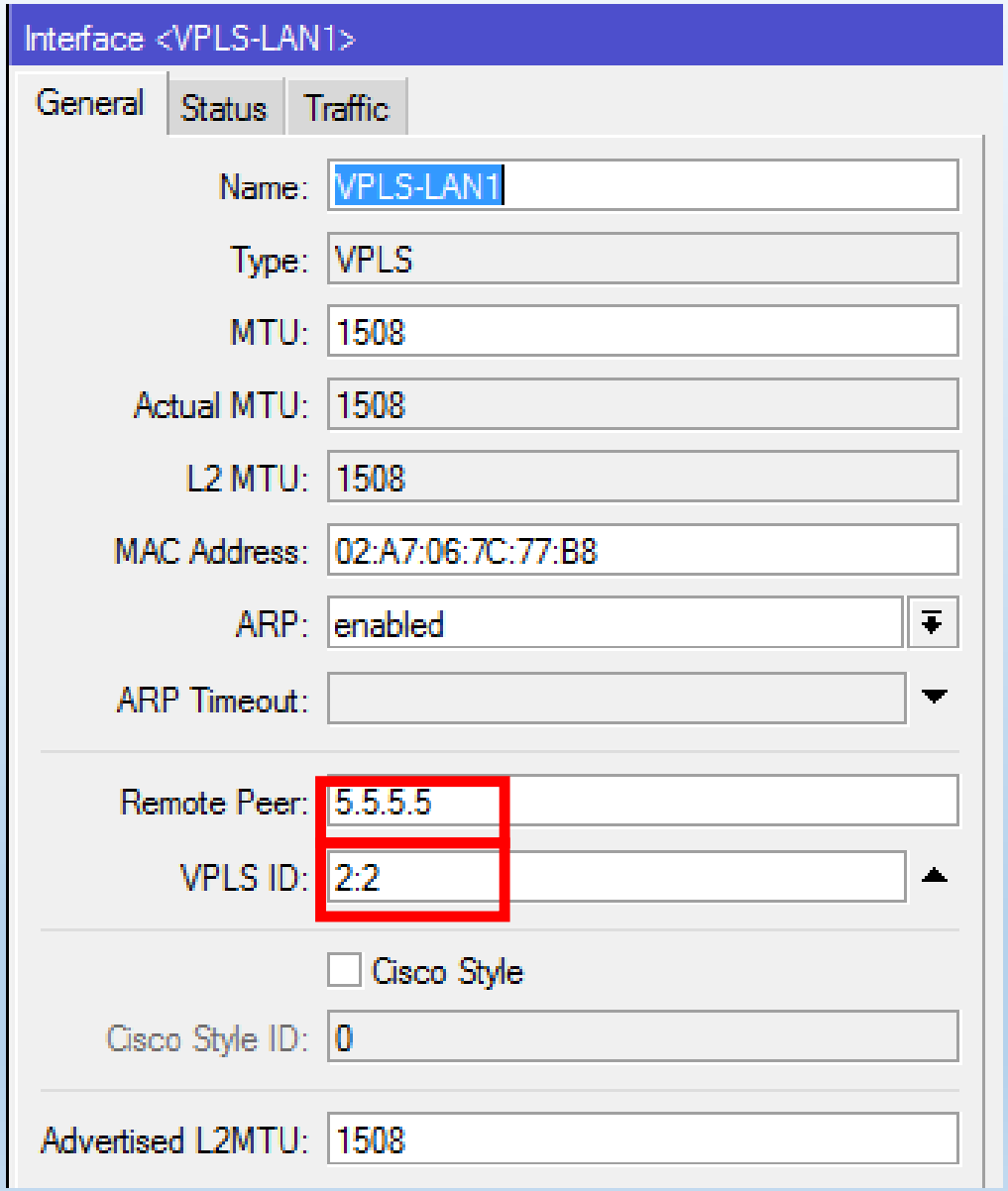



## MTU ether1 , ether2

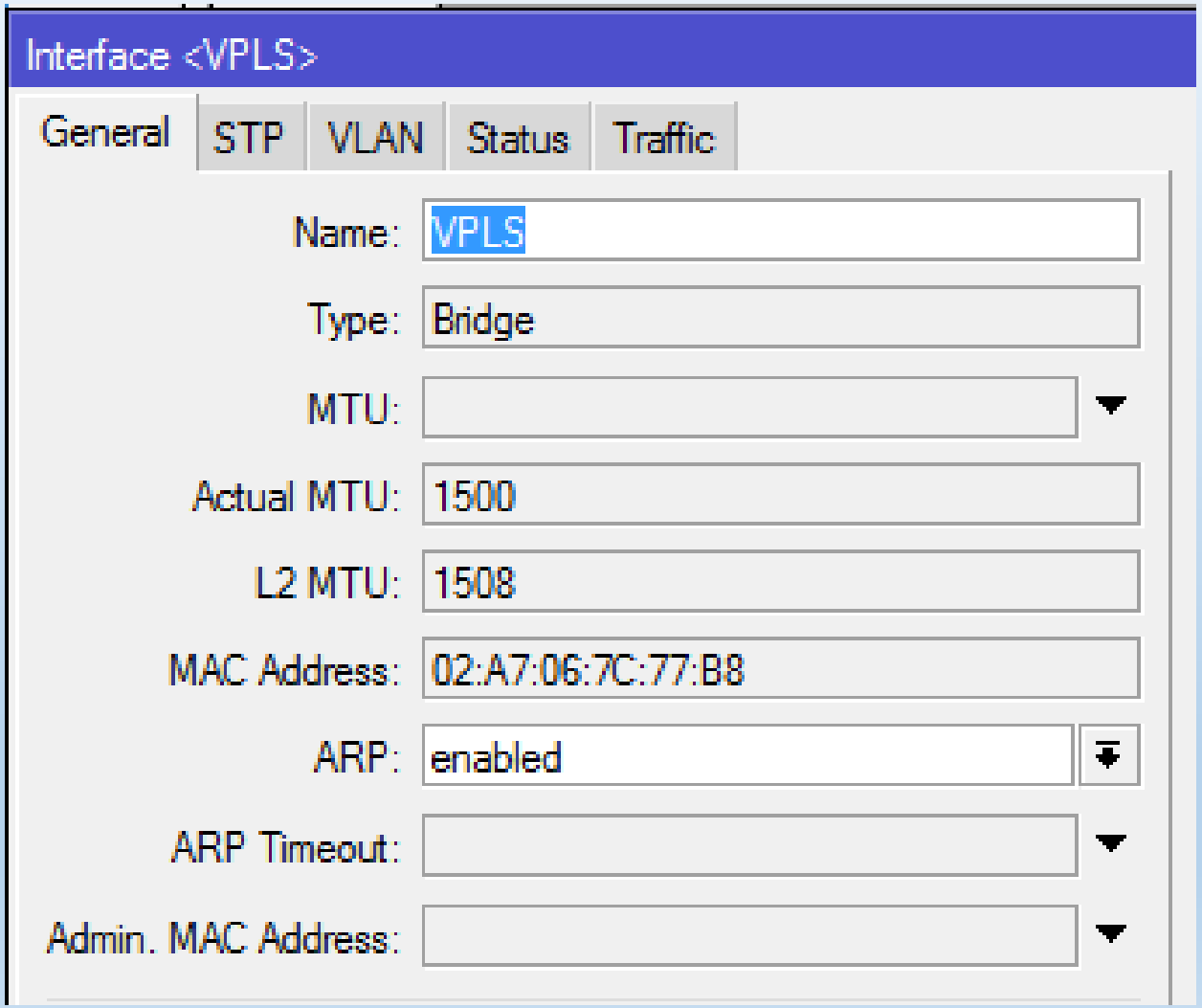


# R4

## VPLS Interface

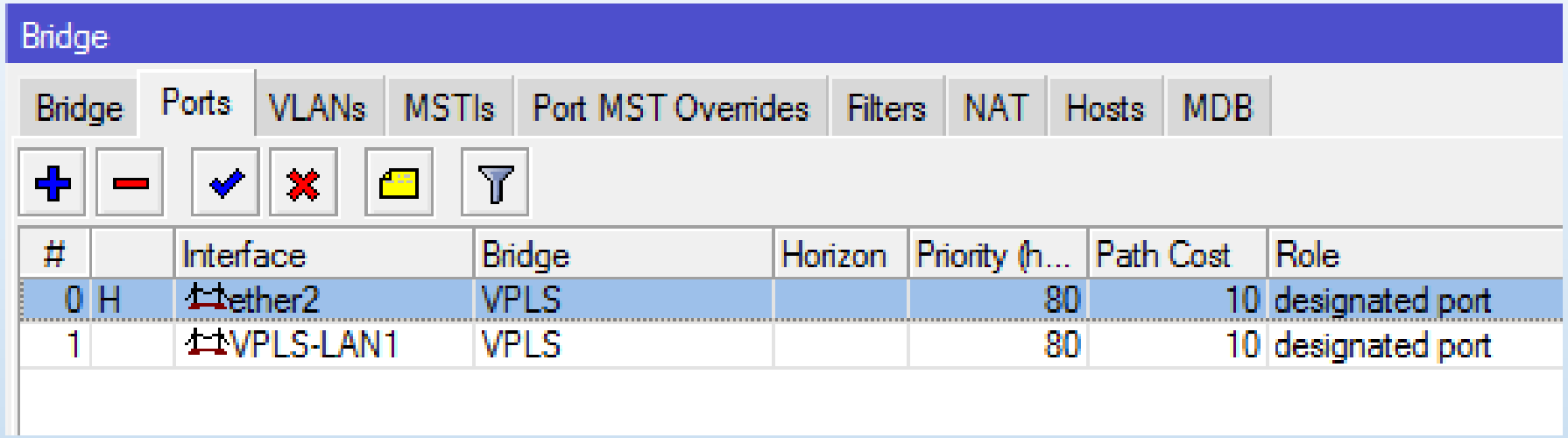



## Bridge Interface

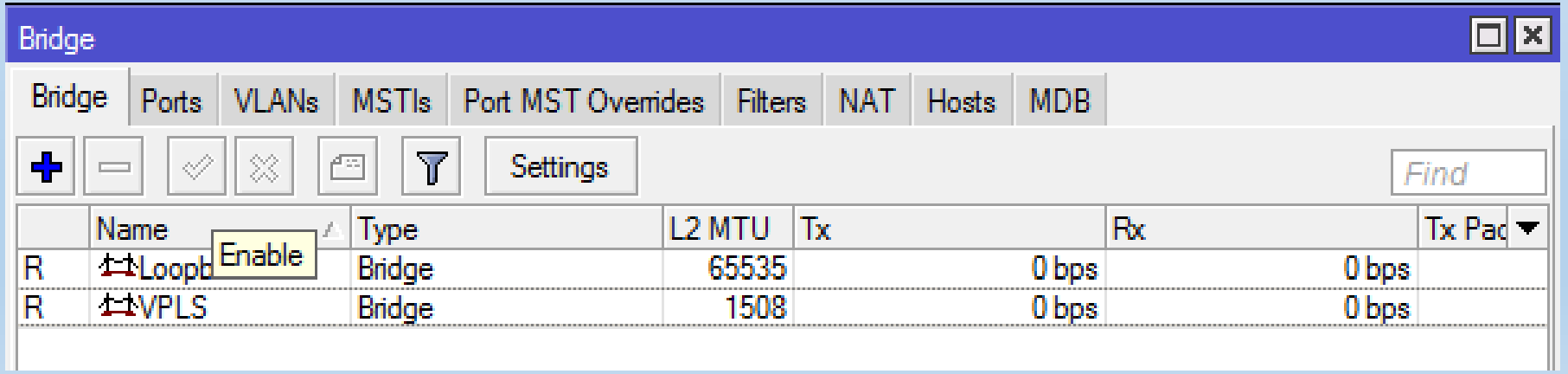


# R4

Port Bridge

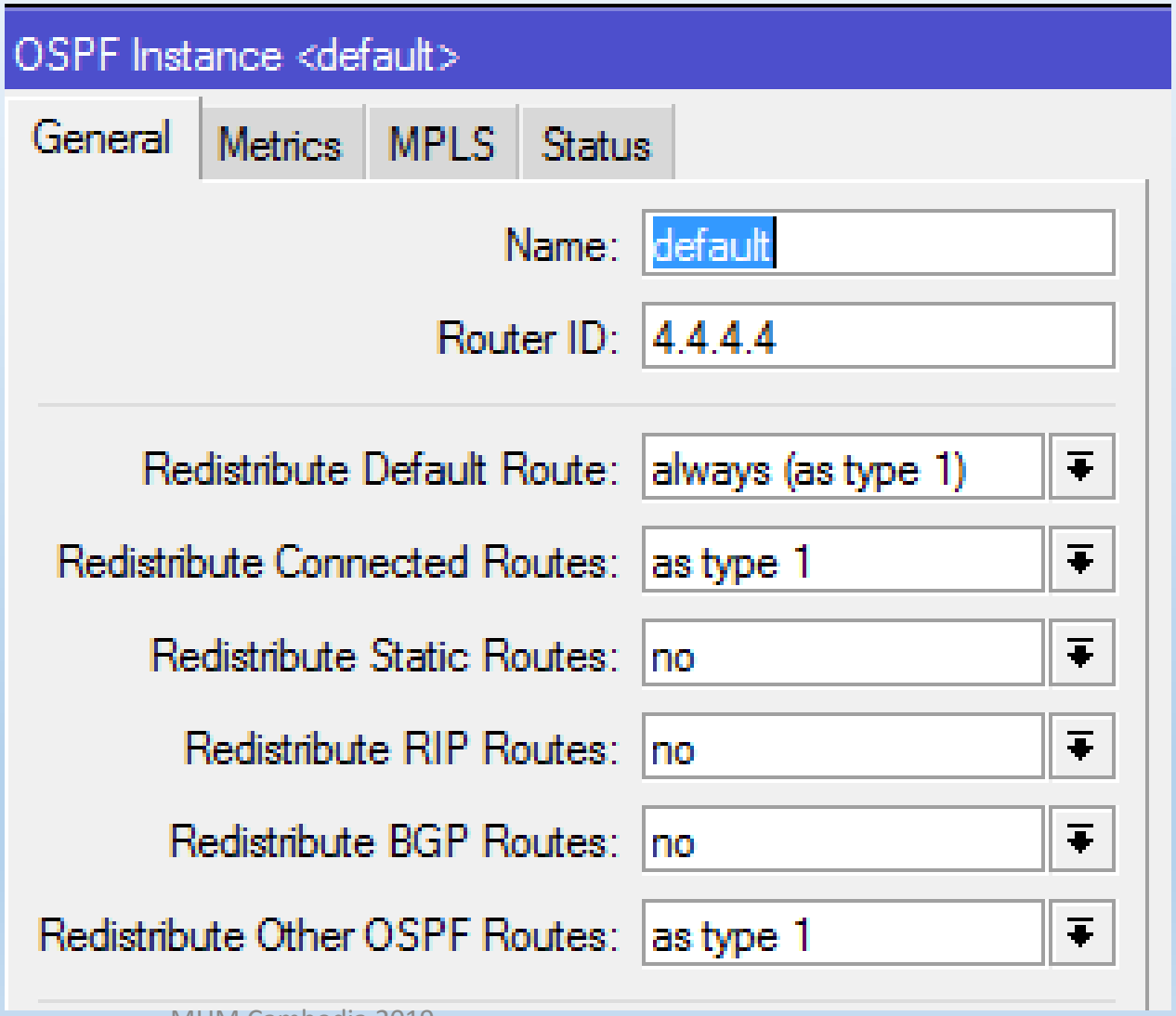



Name of Bridge

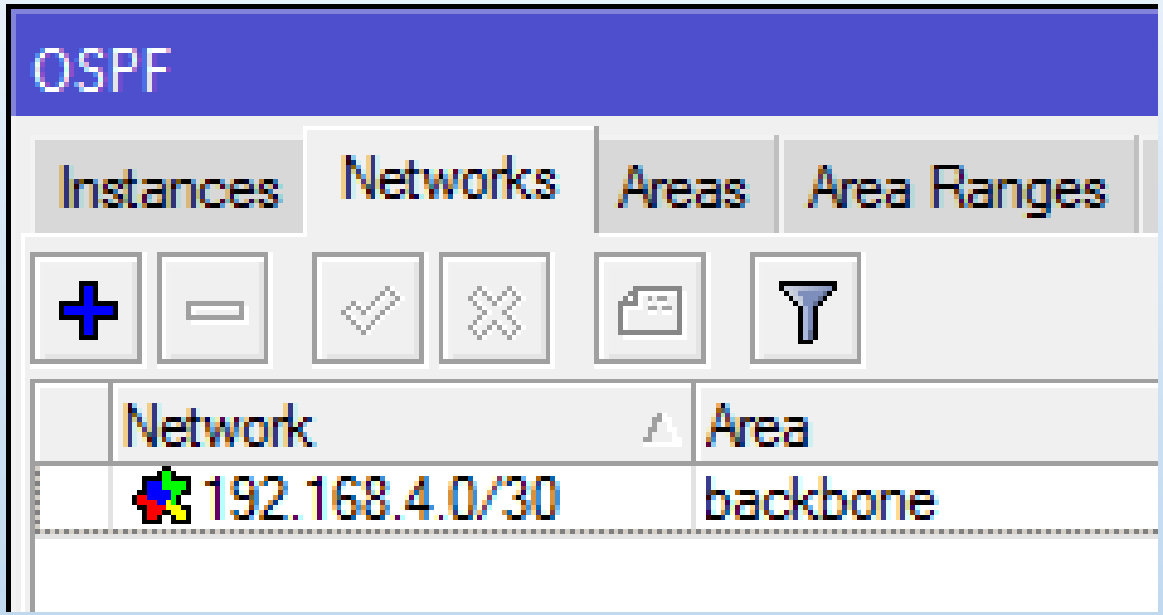


# R4

## OSPF Instance

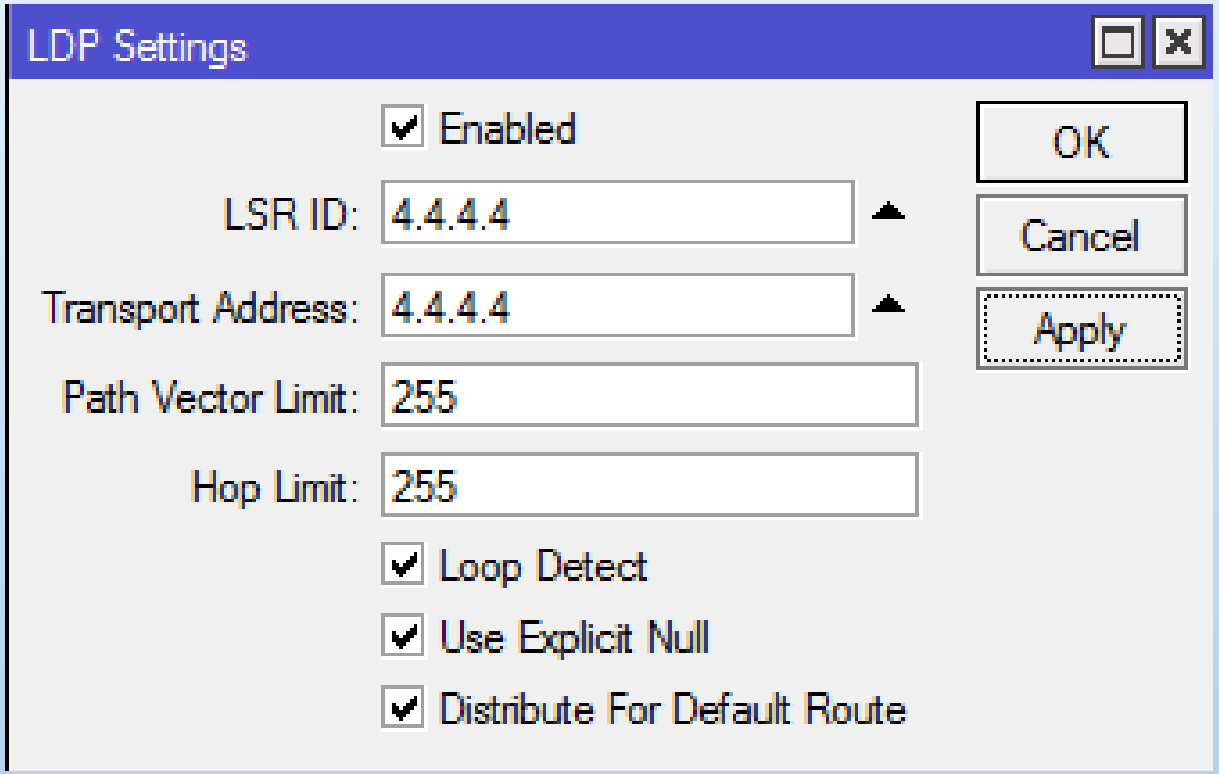



## OSPF Network

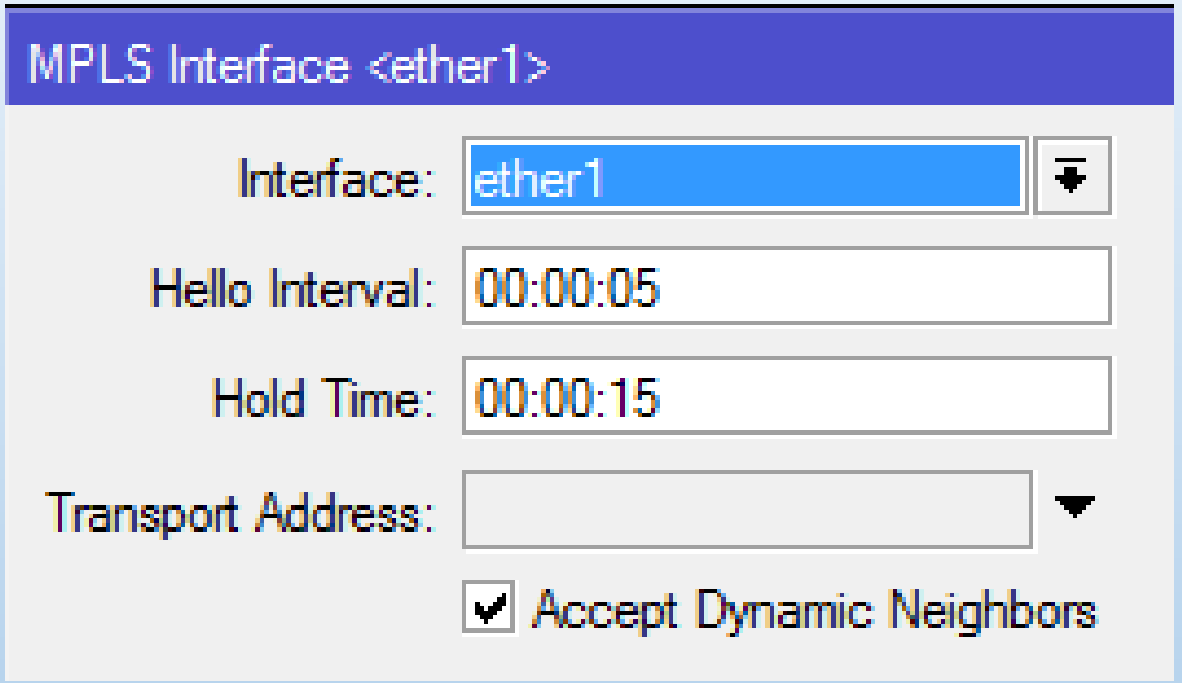


# R4

## LDP Settings

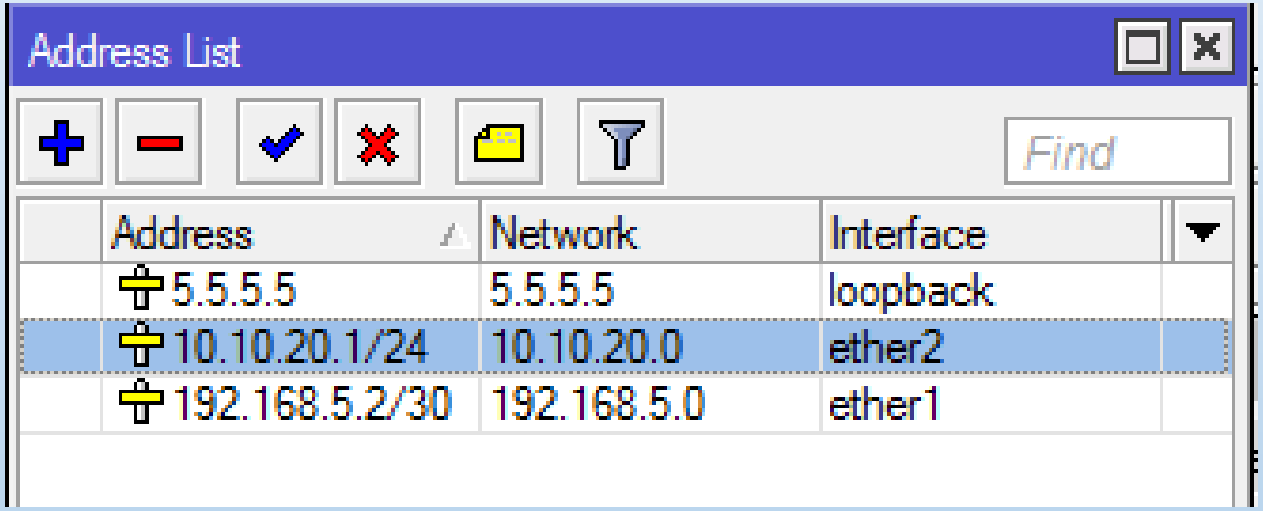



## MPLS Interface

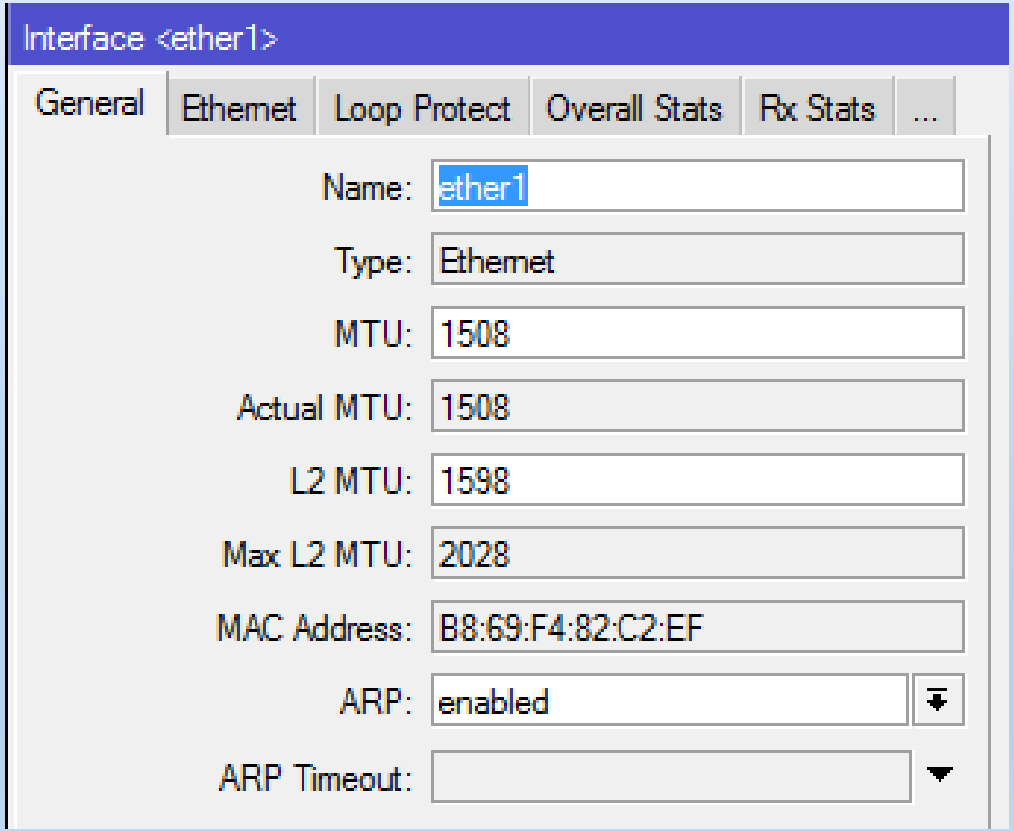


# R5

## IP Address



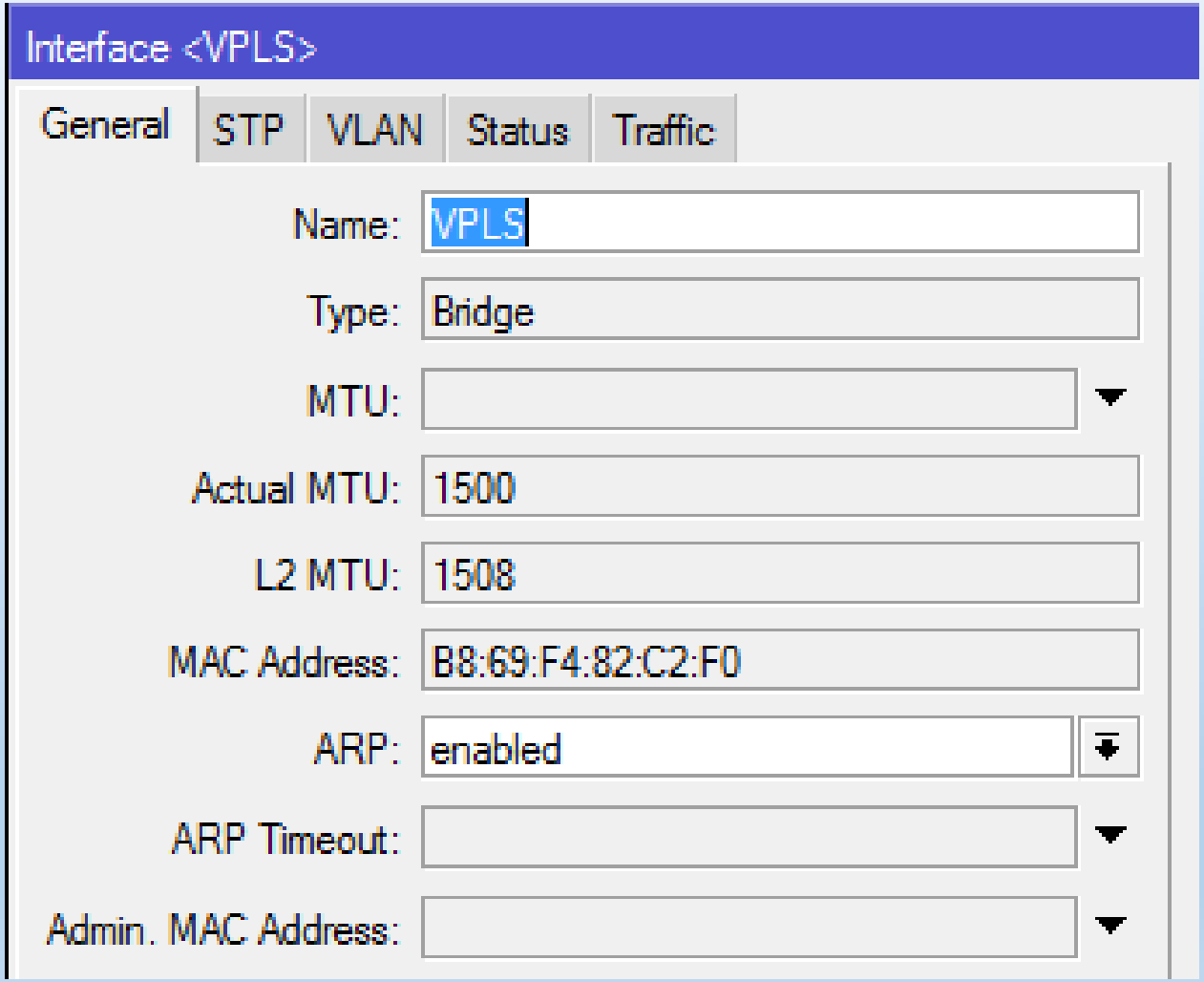

## MTU ether1

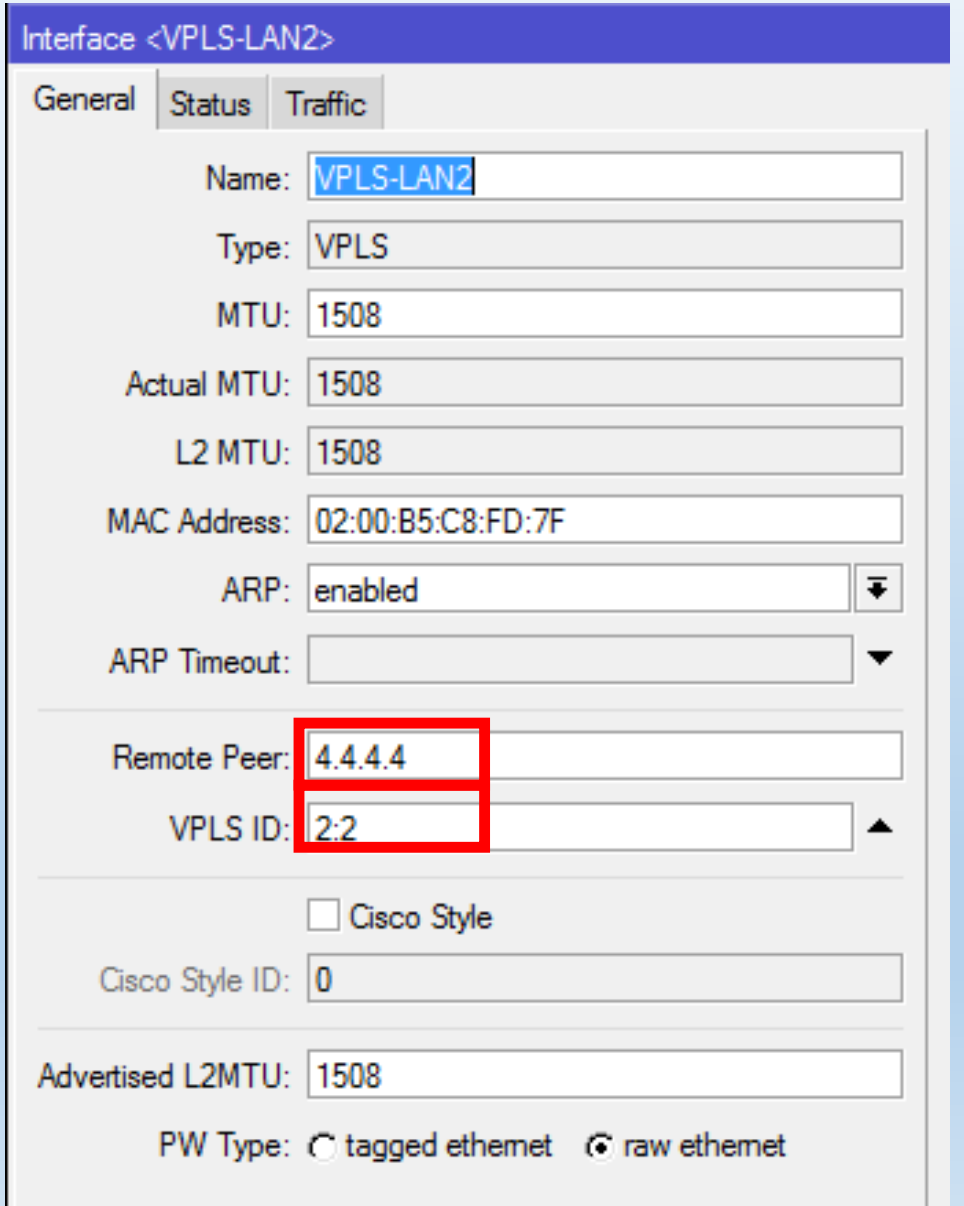


Name of Bridge

# R5

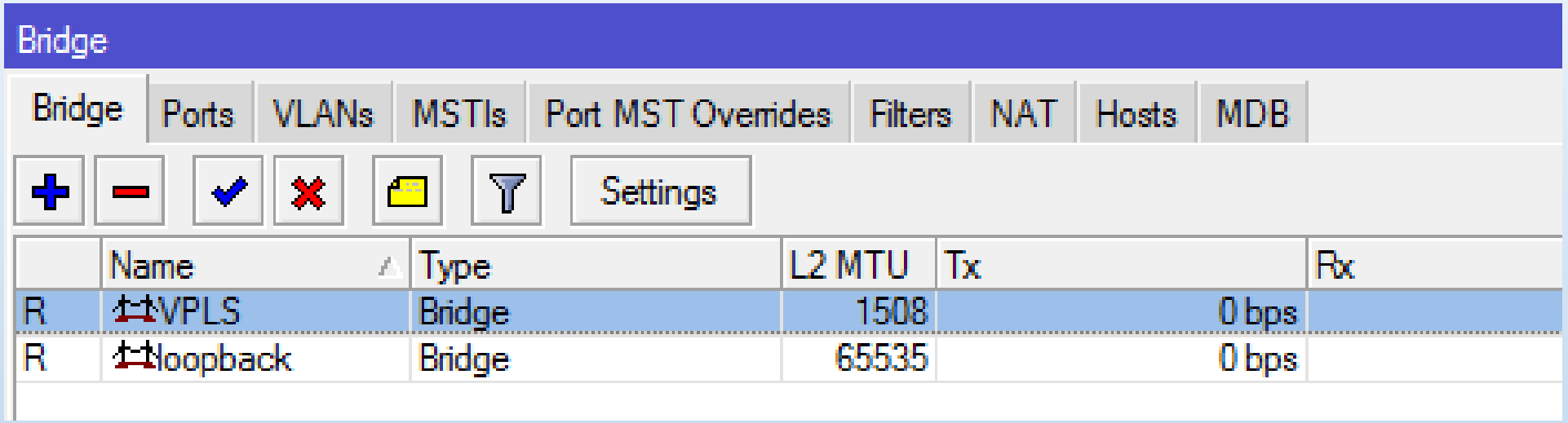
VPLS-LAN2 Interface



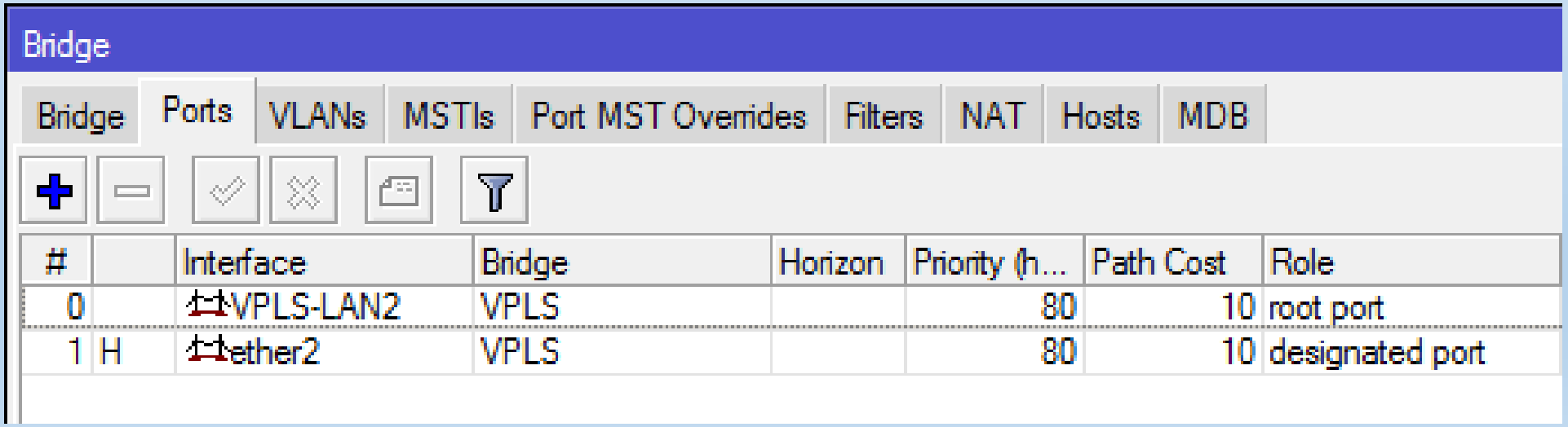



# R5

Bridge

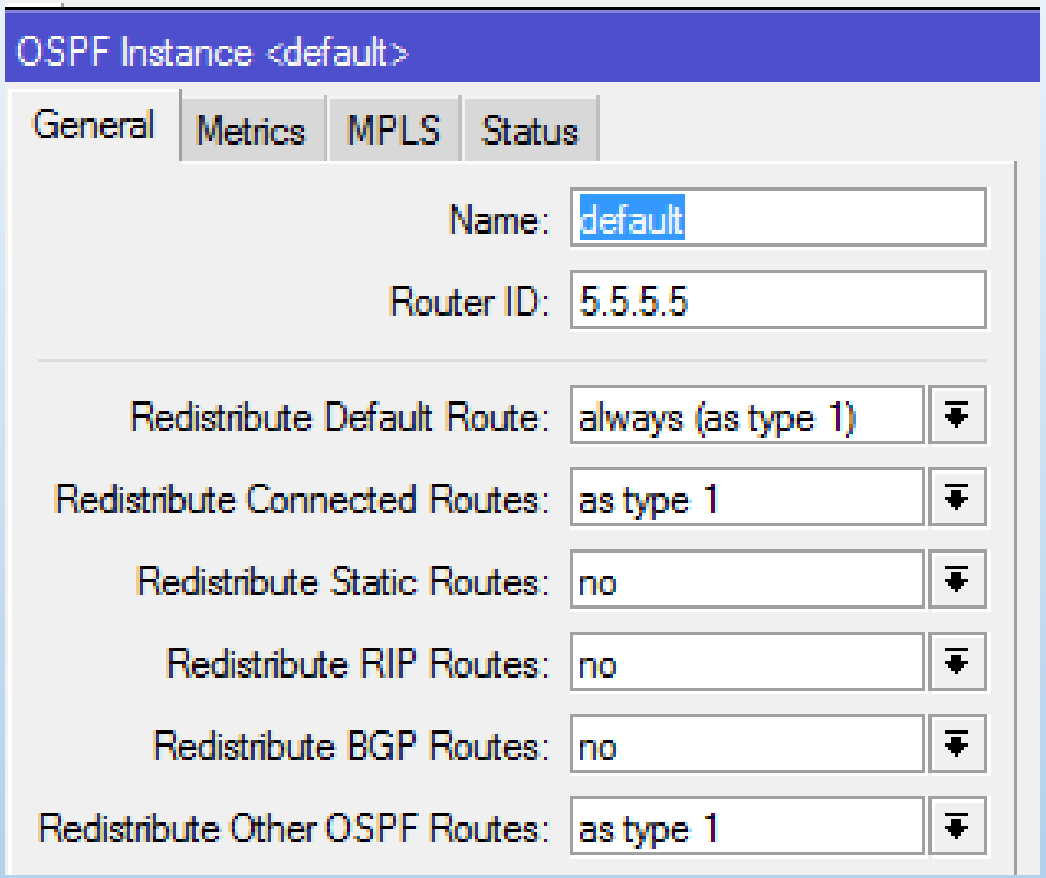



Bridge Ports

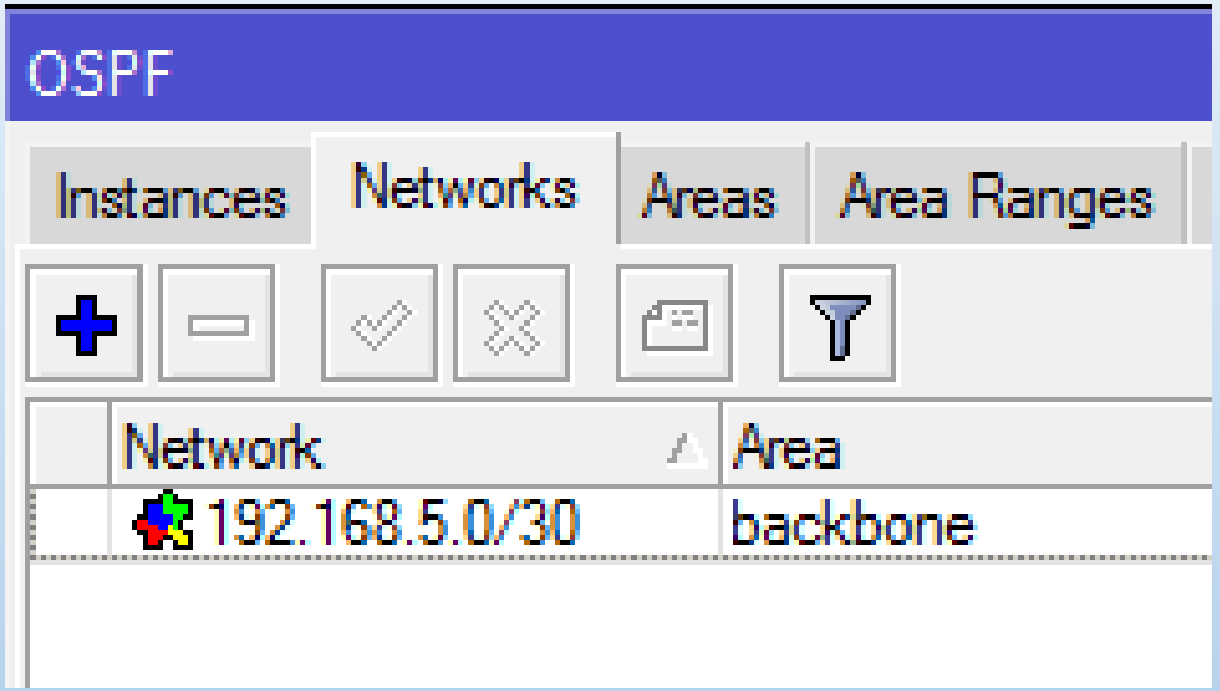


# R5

## OSPF Instance

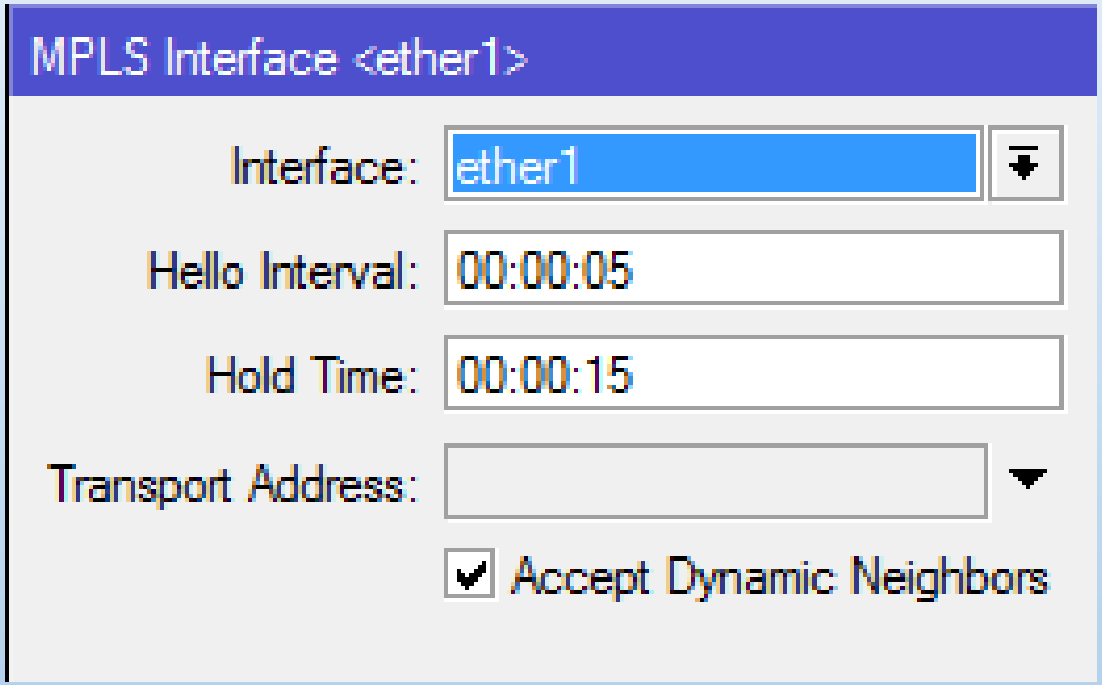



## OSPF Network

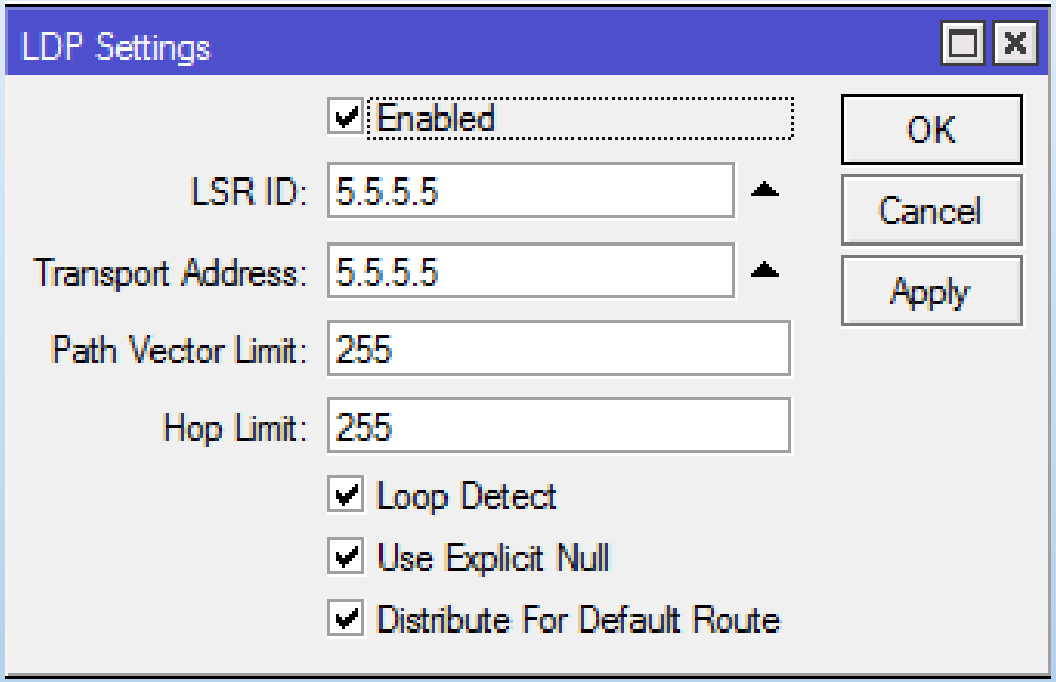


# R5

## VPLS Interface




## LDP Settings



R1

MPLS

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

| | Transport | Send ... | Peer | Local Transport | Addresses |
|---|---|---|---|---|---|
| DO | 2.2.2.2 | no | 2.2.2.2:0 | 1.1.1.1 | 2.2.2.2, 192.168.1.2, 192.168.3.1, 192.168.5.1 |
| DO | 3.3.3.3 | no | 3.3.3.3:0 | 1.1.1.1 | 3.3.3.3, 192.168.2.2, 192.168.3.2 |
| DO | 4.4.4.4 | no | 4.4.4.4:0 | 1.1.1.1 | 4.4.4.4, 10.10.10.1, 192.168.4.2 |

R2

MPLS

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

| | Transport | Send ... | Peer | Local Transport | Addresses |
|---|---|---|---|---|---|
| DO | 1.1.1.1 | no | 1.1.1.1:0 | 2.2.2.2 | 1.1.1.1, 192.168.1.1, 192.168.2.1, 192.168.4.1 |
| DO | 3.3.3.3 | no | 3.3.3.3:0 | 2.2.2.2 | 3.3.3.3, 192.168.2.2, 192.168.3.2 |
| DO | 5.5.5.5 | no | 5.5.5.5:0 | 2.2.2.2 | 5.5.5.5, 10.10.20.2, 192.168.5.2 |

R3

MPLS

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

| | Transport | Send ... | Peer | Local Transport | Addresses |
|---|---|---|---|---|---|
| DO | 1.1.1.1 | no | 1.1.1.1:0 | 3.3.3.3 | 1.1.1.1, 192.168.1.1, 192.168.2.1, 192.168.4.1 |
| DO | 2.2.2.2 | no | 2.2.2.2:0 | 3.3.3.3 | 2.2.2.2, 192.168.1.2, 192.168.3.1, 192.168.5.1 |

R4

MPLS

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

| | Transport | Send ... | Peer | Local Transport | Addresses |
|---|---|---|---|---|---|
| DO | 1.1.1.1 | no | 1.1.1.1:0 | 4.4.4.4 | 1.1.1.1, 192.168.1.1, 192.168.2.1, 192.168.4.1 |
| DOT | 5.5.5.5 | yes | 5.5.5.5:0 | 4.4.4.4 | 5.5.5.5, 10.10.20.2, 192.168.5.2 |

R5

MPLS

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

Find

| | Transport | Send ... | Peer | Local Transport | Addresses |
|---|---|---|---|---|---|
| DO | 2.2.2.2 | no | 2.2.2.2:0 | 5.5.5.5 | 2.2.2.2, 192.168.1.2, 192.168.3.1, 192.168.5.1 |
| DOT | 4.4.4.4 | yes | 4.4.4.4:0 | 5.5.5.5 | 4.4.4.4, 10.10.10.2, 192.168.4.2 |

# Ping Test From PC 1

```
C:\Users\Duty>ping 10.10.10.1

Pinging 10.10.10.1 with 32 bytes of data:
Reply from 10.10.10.1: bytes=32 time<1ms TTL=64
Reply from 10.10.10.1: bytes=32 time<1ms TTL=64
Reply from 10.10.10.1: bytes=32 time<1ms TTL=64
Reply from 10.10.10.1: bytes=32 time<1ms TTL=64

Ping statistics for 10.10.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\Duty>ping 10.10.10.2

Pinging 10.10.10.2 with 32 bytes of data:
Reply from 10.10.10.2: bytes=32 time<1ms TTL=128
Reply from 10.10.10.2: bytes=32 time<1ms TTL=128

Ping statistics for 10.10.10.2:
    Packets: Sent = 2, Received = 2, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
Control-C
^C
C:\Users\Duty>ping 10.10.20.1

Pinging 10.10.20.1 with 32 bytes of data:
Reply from 10.10.20.1: bytes=32 time=1ms TTL=61
Reply from 10.10.20.1: bytes=32 time<1ms TTL=61
Reply from 10.10.20.1: bytes=32 time<1ms TTL=61
Reply from 10.10.20.1: bytes=32 time<1ms TTL=61
```

# Trace Route From PC1 to PC2 (Normal and Ether2 (R1) is Down)

```
C:\Users\Duty>tracert 10.10.20.1

Tracing route to 10.10.20.1 over a maximum of 30 hops

  1    <1 ms    <1 ms    <1 ms  10.10.10.1
  2    <1 ms    <1 ms    <1 ms  192.168.4.1
  3    <1 ms    <1 ms    <1 ms  192.168.1.2
  4    <1 ms    <1 ms    <1 ms  10.10.20.1

Trace complete.

C:\Users\Duty>tracert 10.10.20.1

Tracing route to 10.10.20.1 over a maximum of 30 hops

  1    <1 ms    <1 ms    <1 ms  10.10.10.1
  2     1 ms    <1 ms     5 ms  192.168.4.1
  3     1 ms    <1 ms    <1 ms  192.168.2.2
  4    <1 ms    <1 ms    <1 ms  192.168.3.1
  5     5 ms    <1 ms    <1 ms  10.10.20.1

Trace complete.
```

# Thank You

dutymlg@gmail.com
+62 85102077829