MPLS VPLS Implementation

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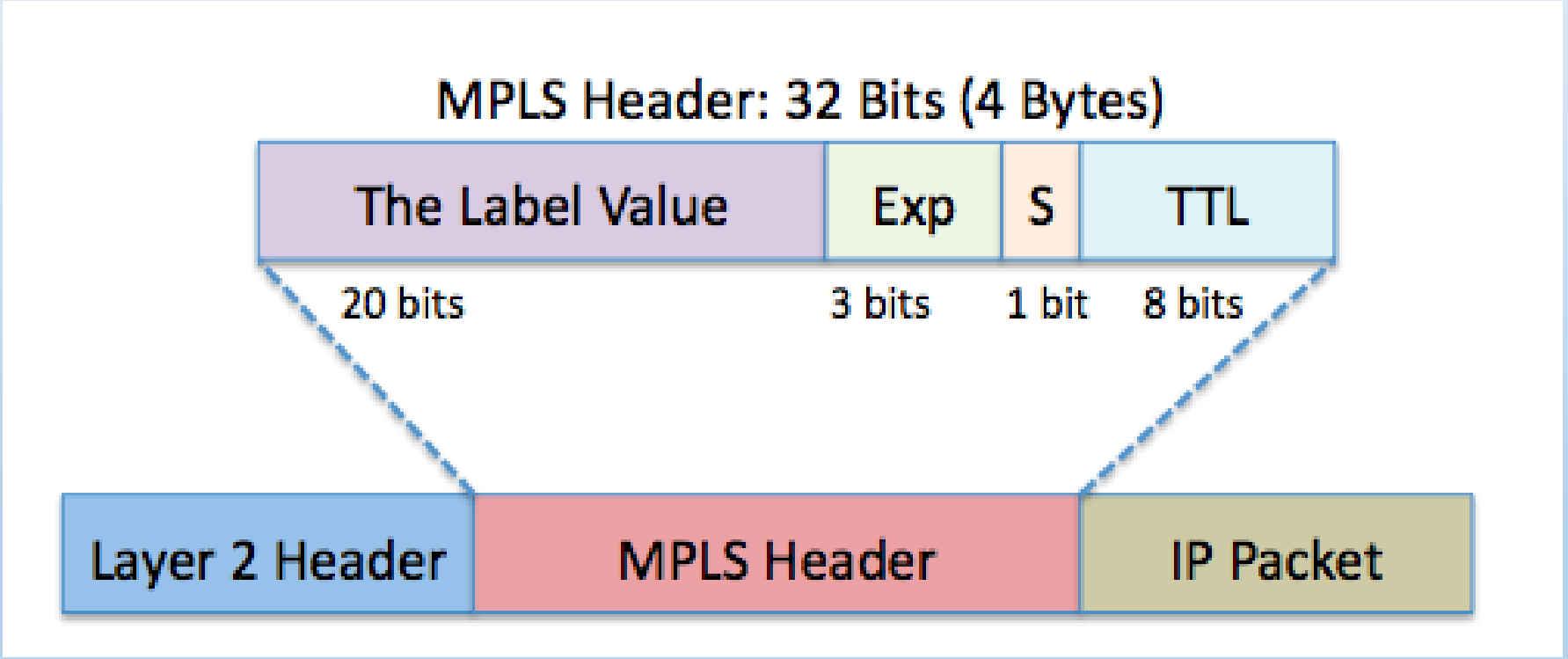
What is MPLS

- 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

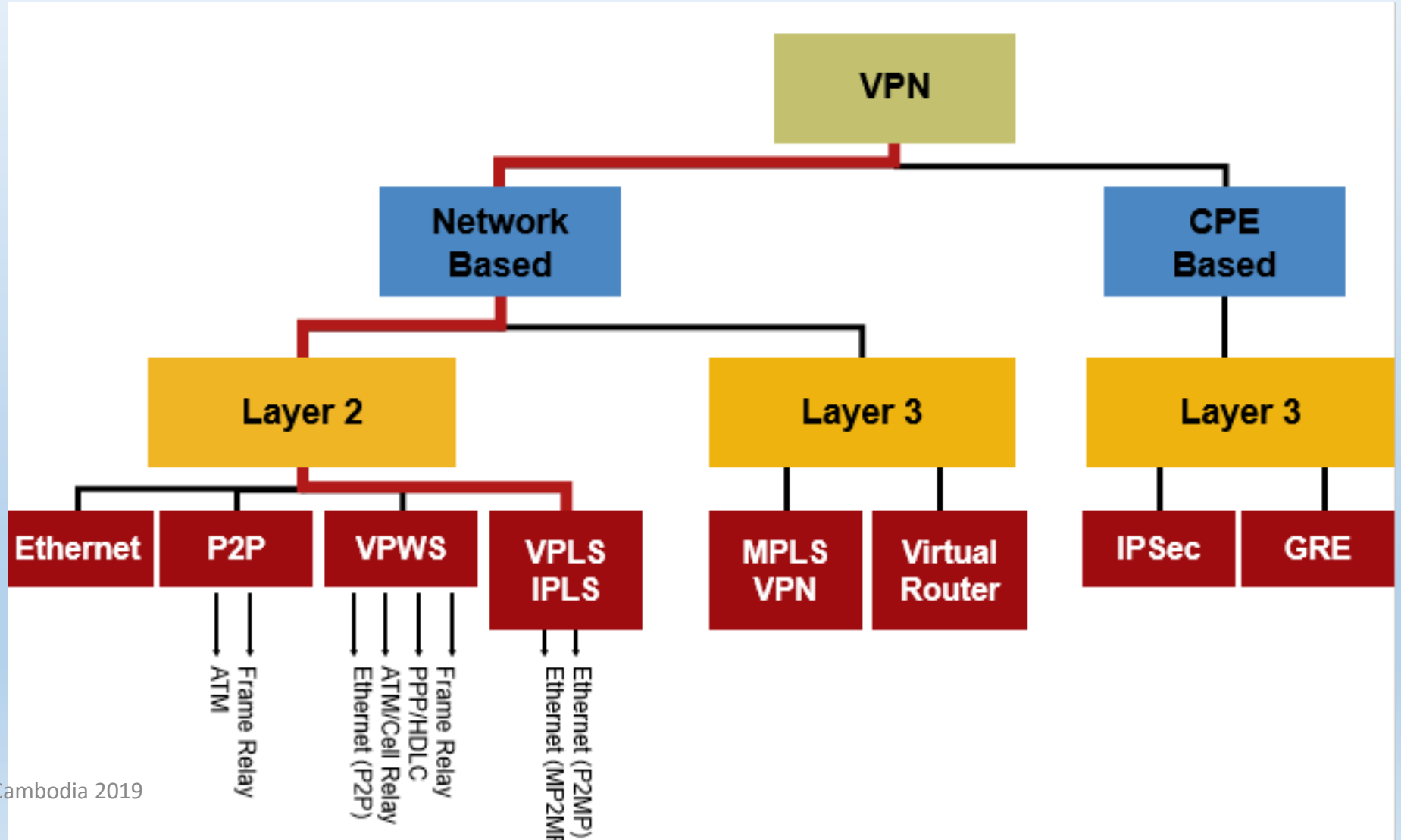
At the final destination router the label is removed.

And the packet is delivered via normal IP routing.

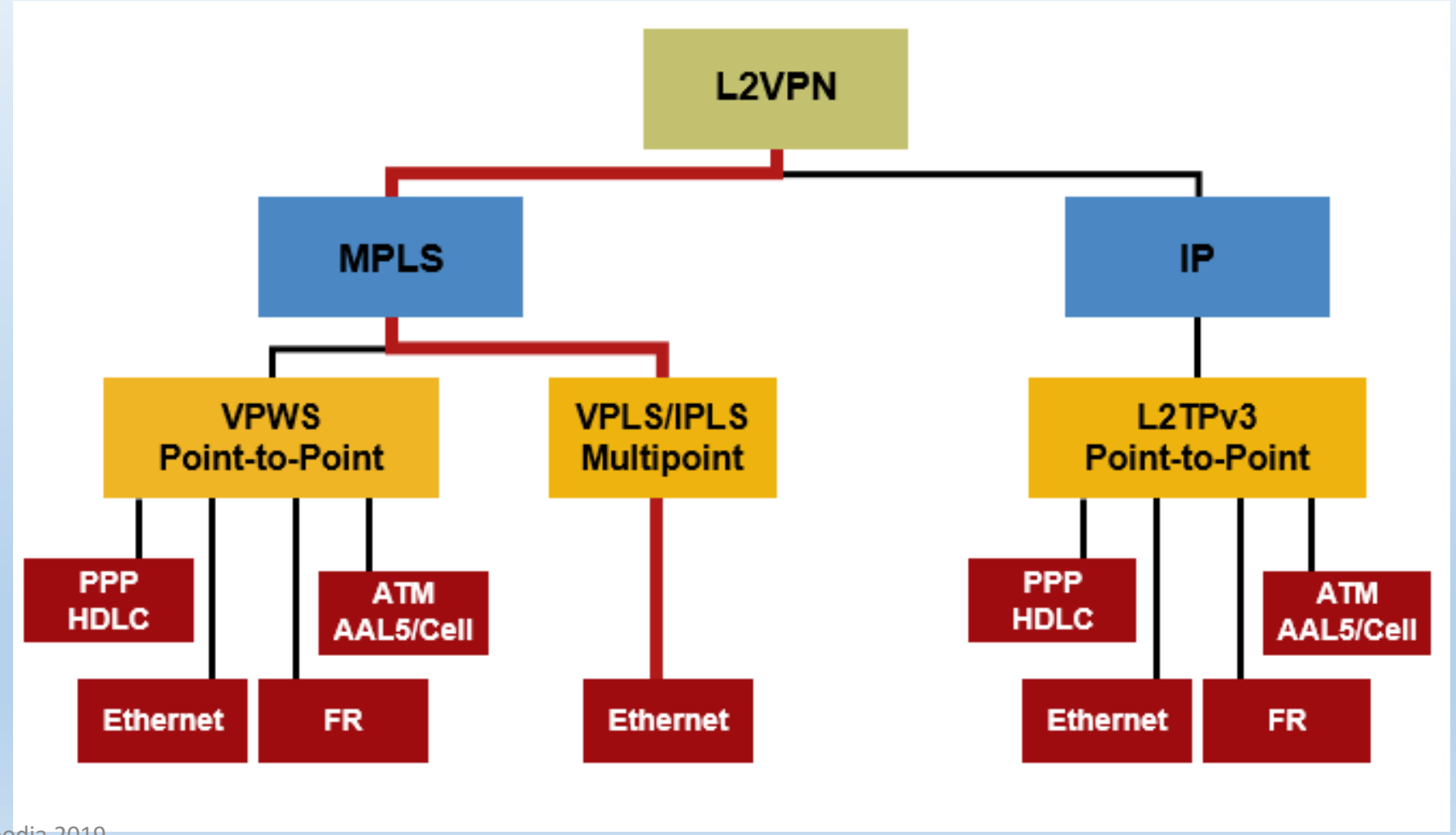
MPLS Operation

- 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

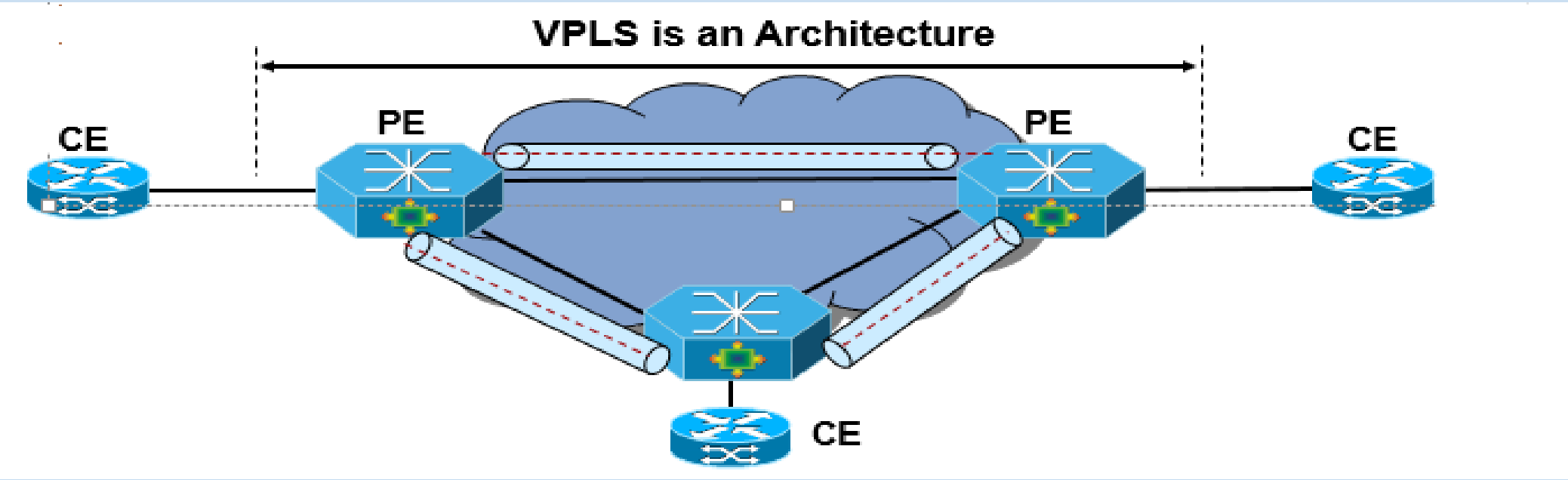


L2VPN Model


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

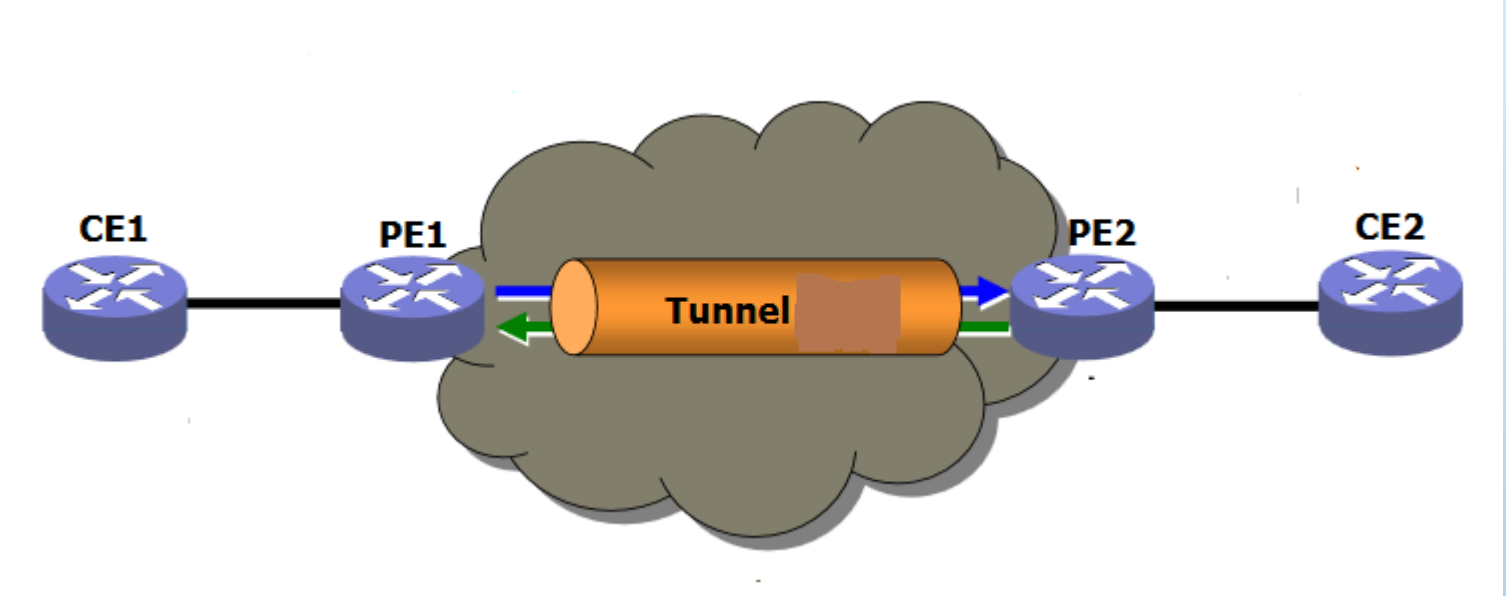
LDP messages sent in the form of TLVs (Type, Length, Value)

Label Space Of LDP

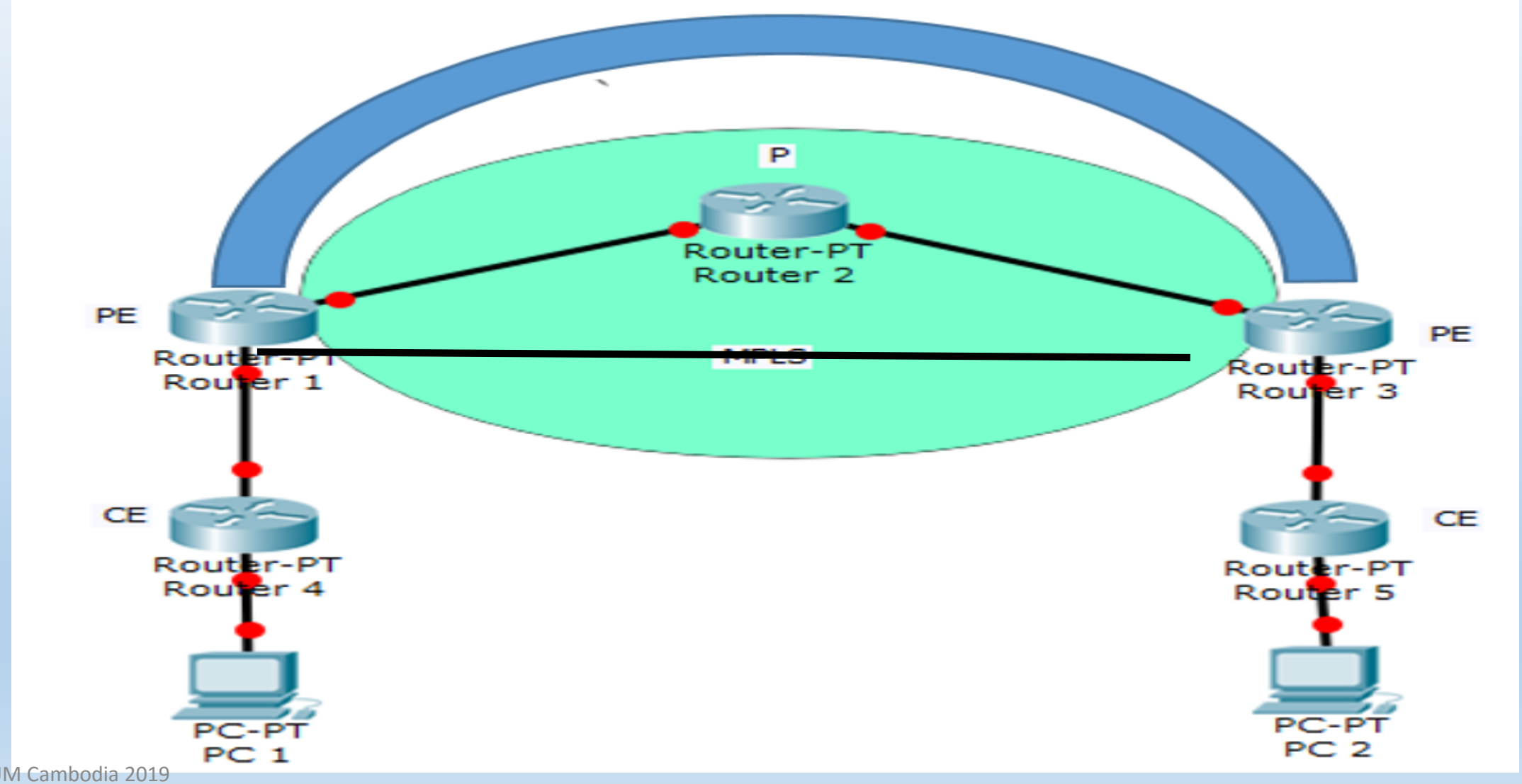
LSRs establish one LDP session per label space. Per-platform label space requires only one LDP session, even if there are multiple parallel links between a pair of LSRs.

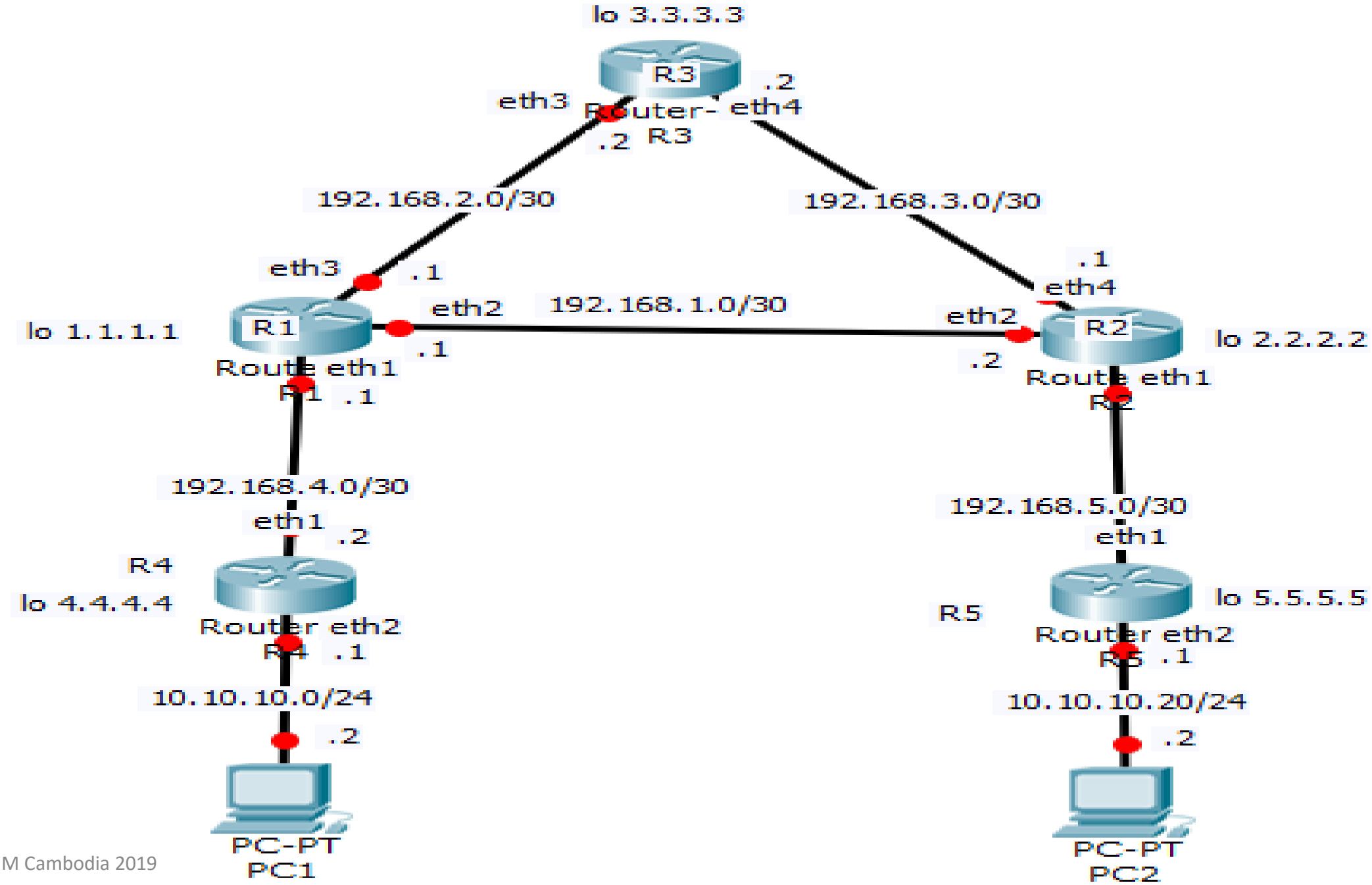
Per-platform label space is announced by setting the label space ID

Tunnel VPN



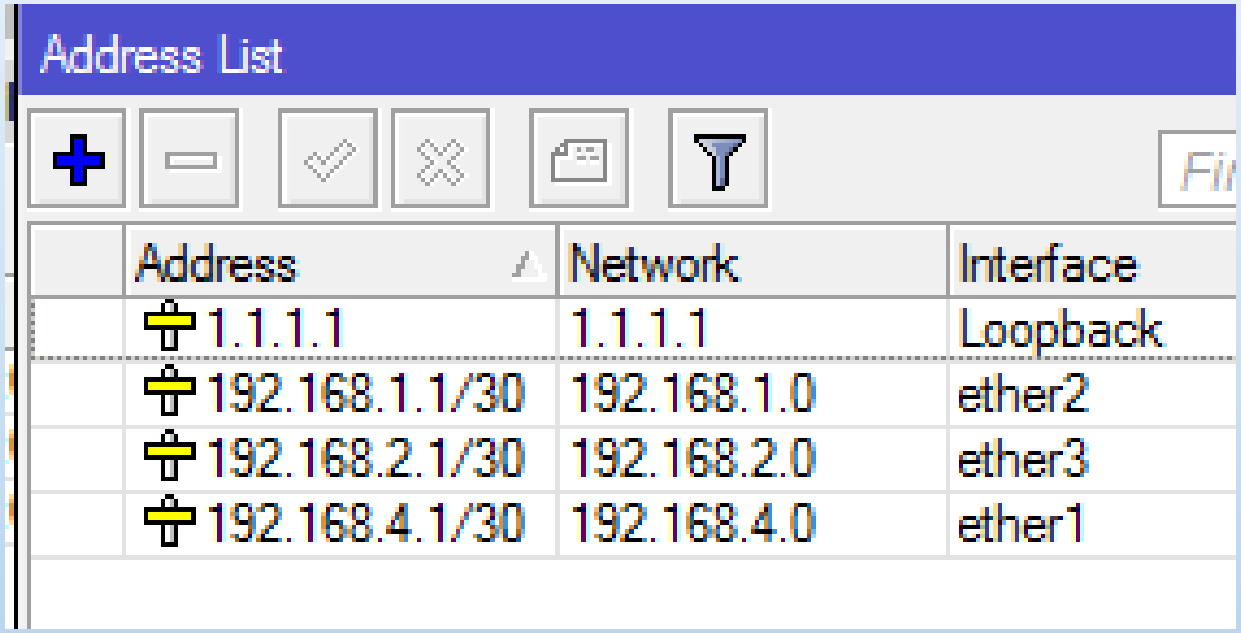
LAB


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

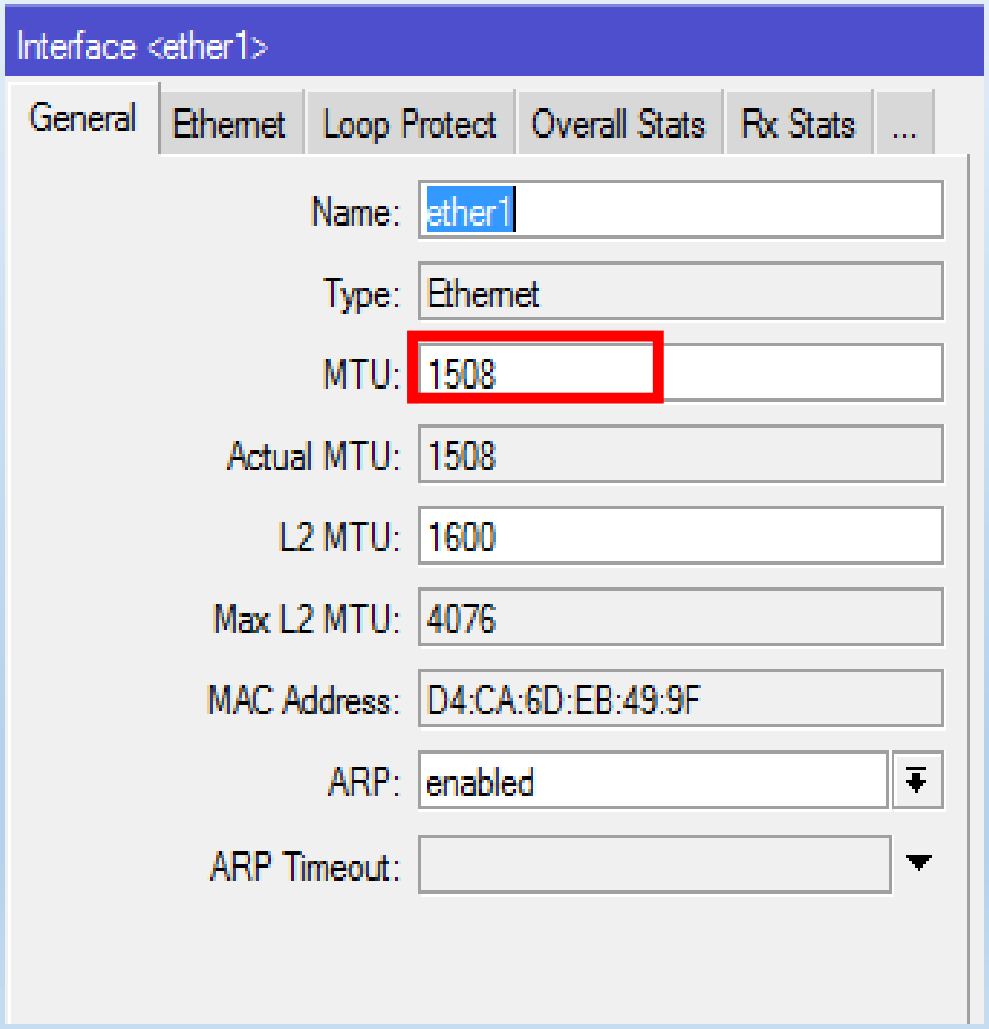

lo 3.3.3.3
R3
Router-
R3
.2
eth3
.2
eth4
192.168.2.0/30
192.168.3.0/30
eth3
.1
.1
eth4
lo 1.1.1.1
R1
Route
eth2
.1
192.168.1.0/30
eth2
.2
R2
Route
lo 2.2.2.2
eth1
R1
.1
eth1
R2
192.168.4.0/30
192.168.5.0/30
eth1
.2
eth1
R4
lo 4.4.4.4
Router
eth2
R4
.1
R5
lo 5.5.5.5
Router
eth2
R5
.1
10.10.10.0/24
10.10.10.20/24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

R1

IP Address

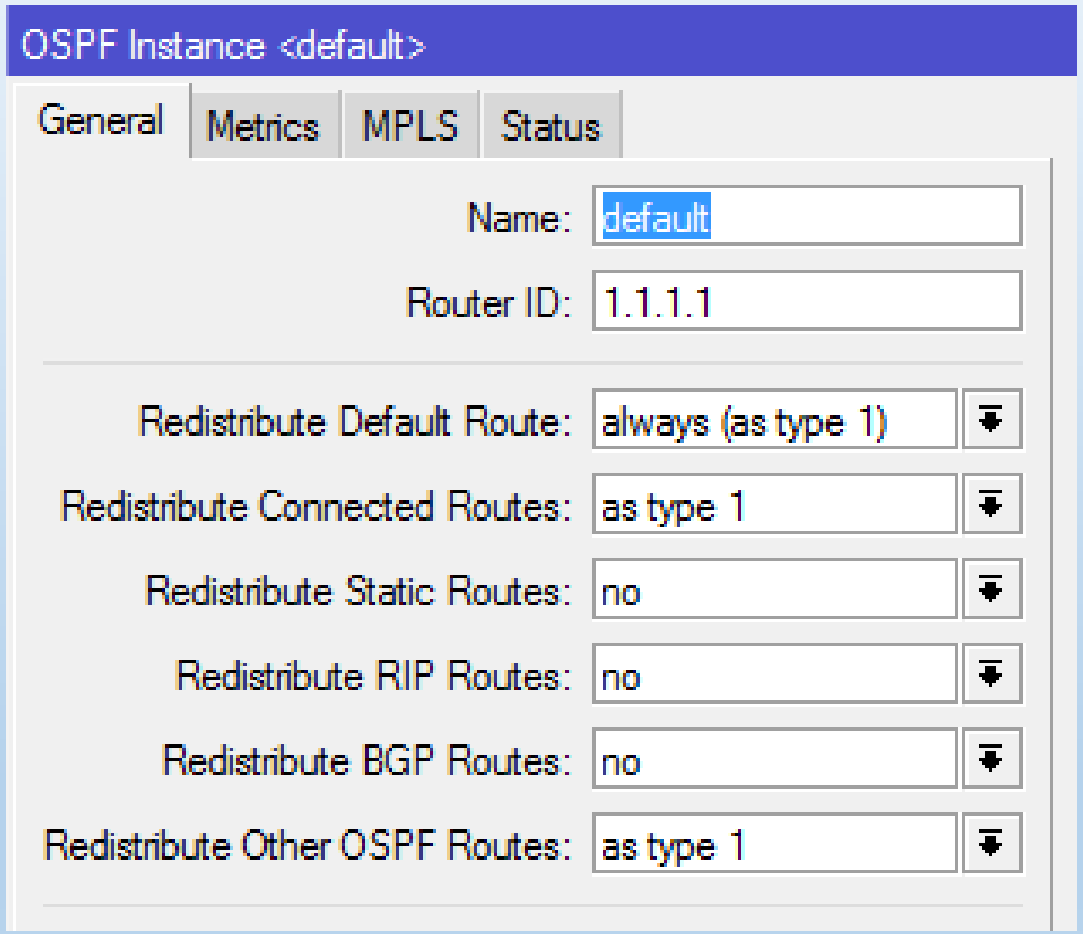


MTU 1508 in eth1, eth2,eth3

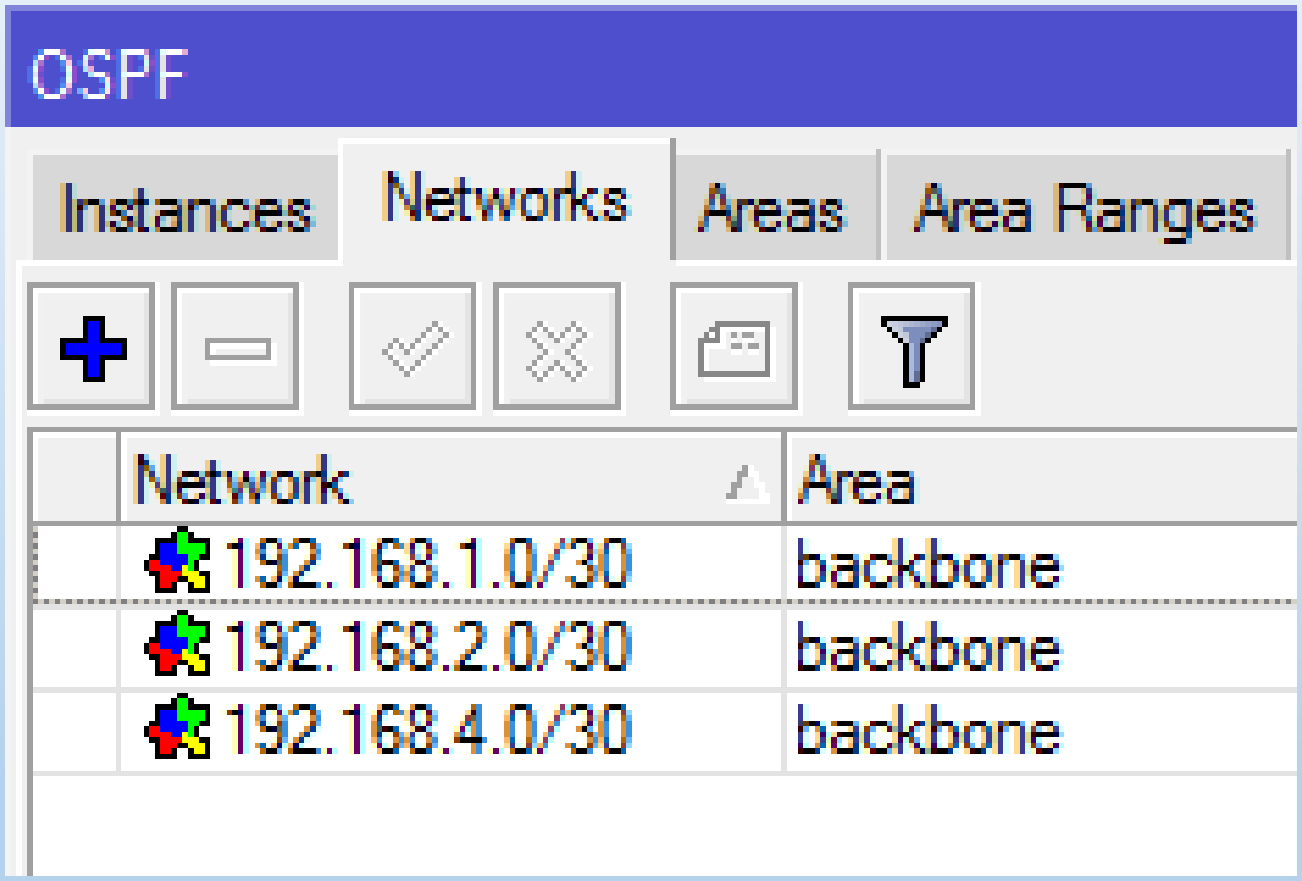


R1

OSPF Instance

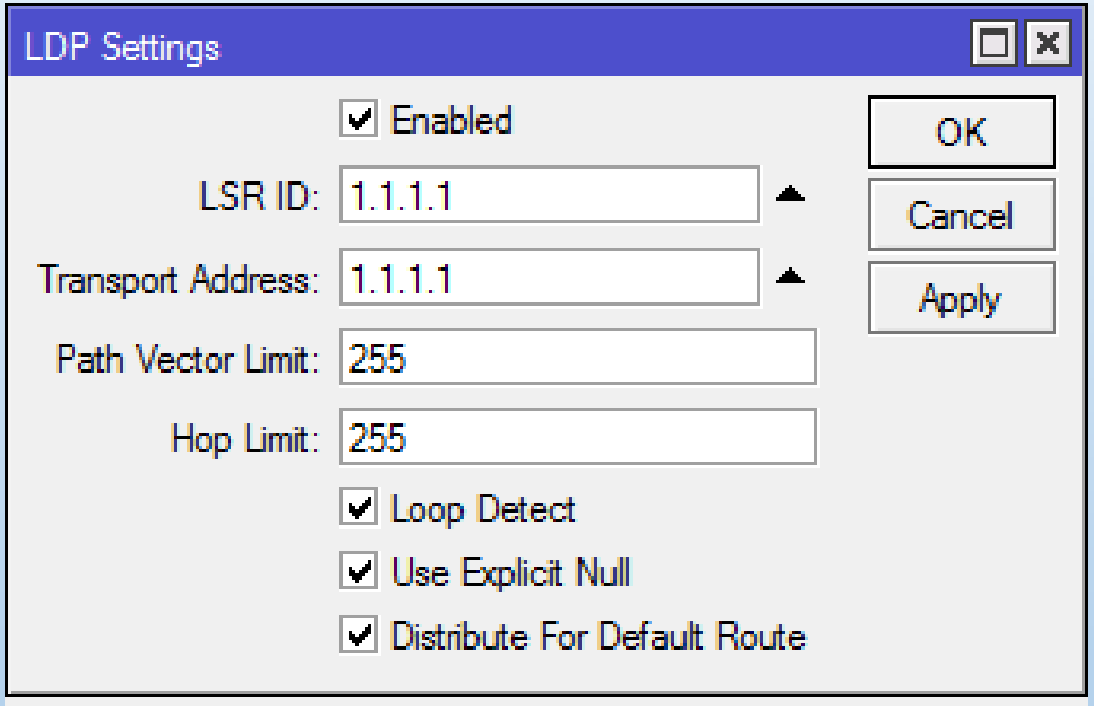


OSPF Networks

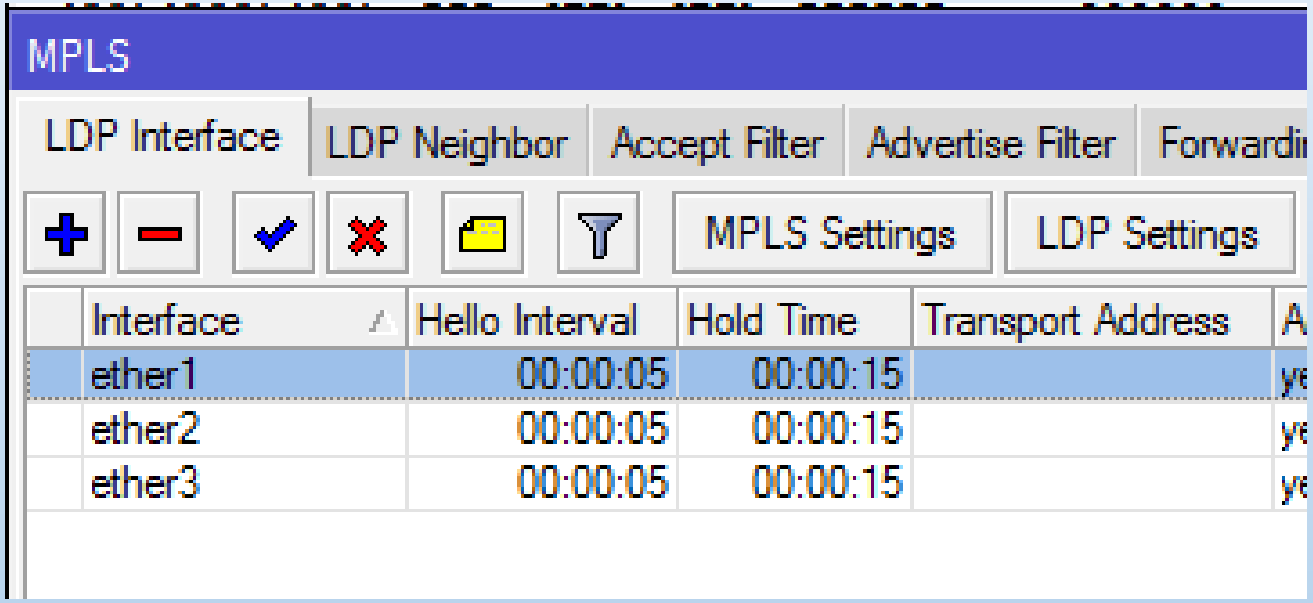


R1

LDP Settings

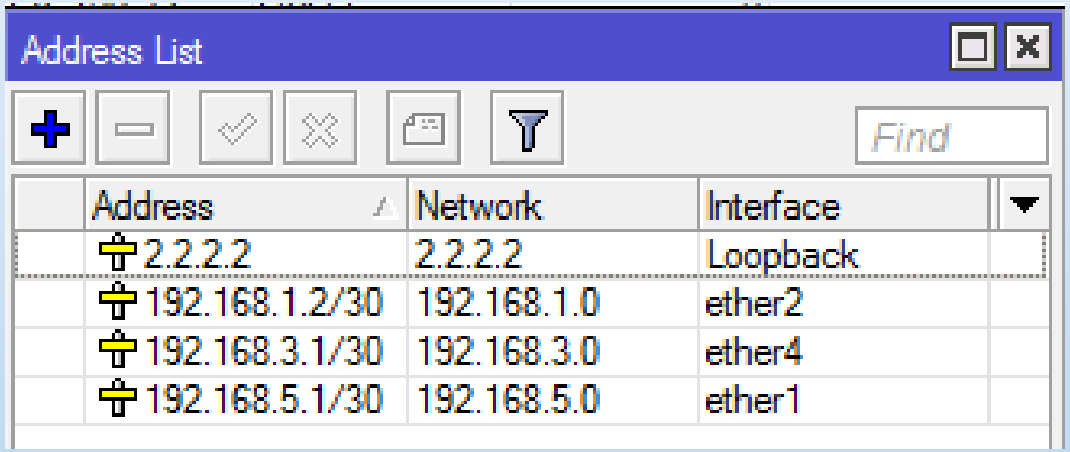


LDP Interface

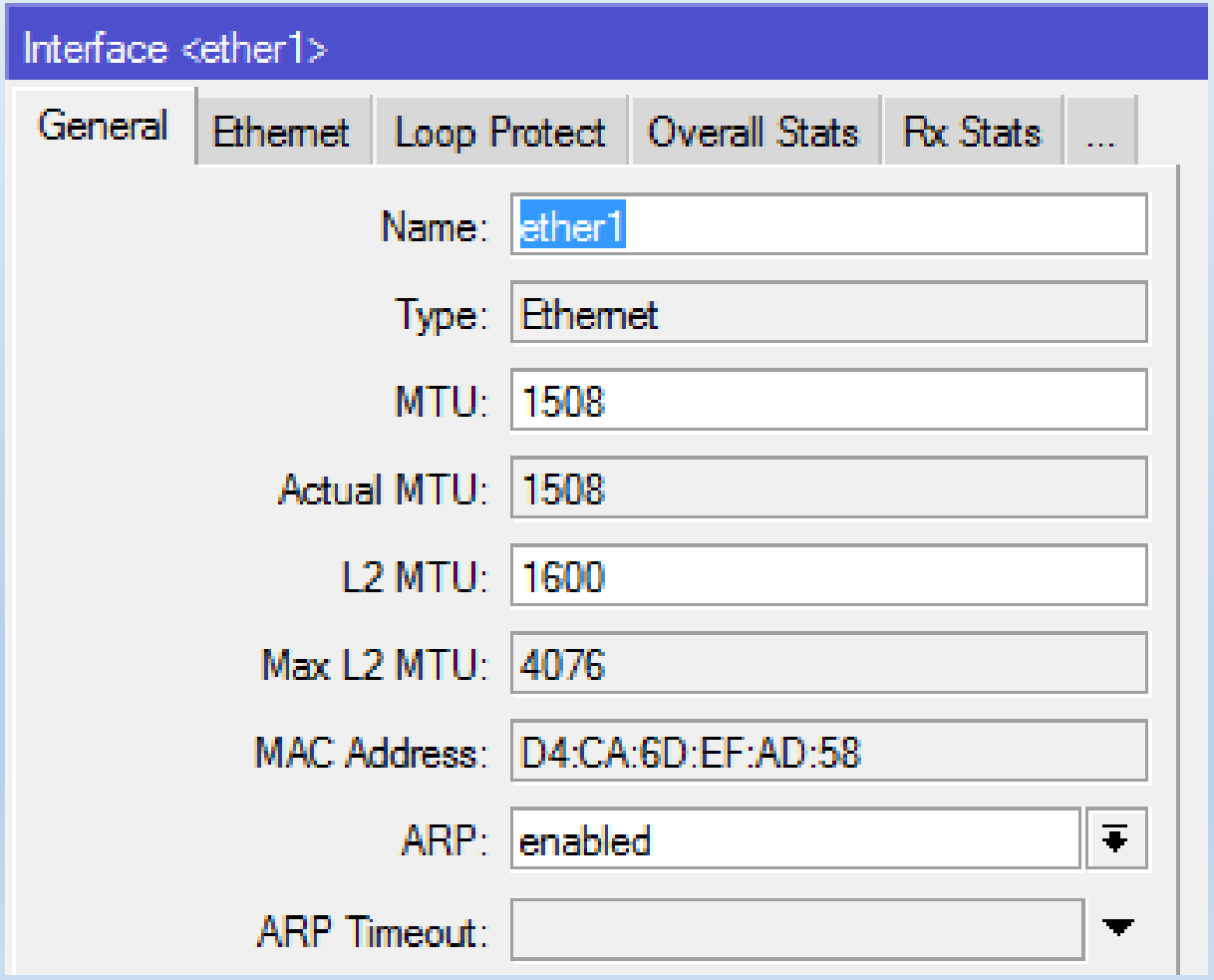


R2

Ether1,2 and 4

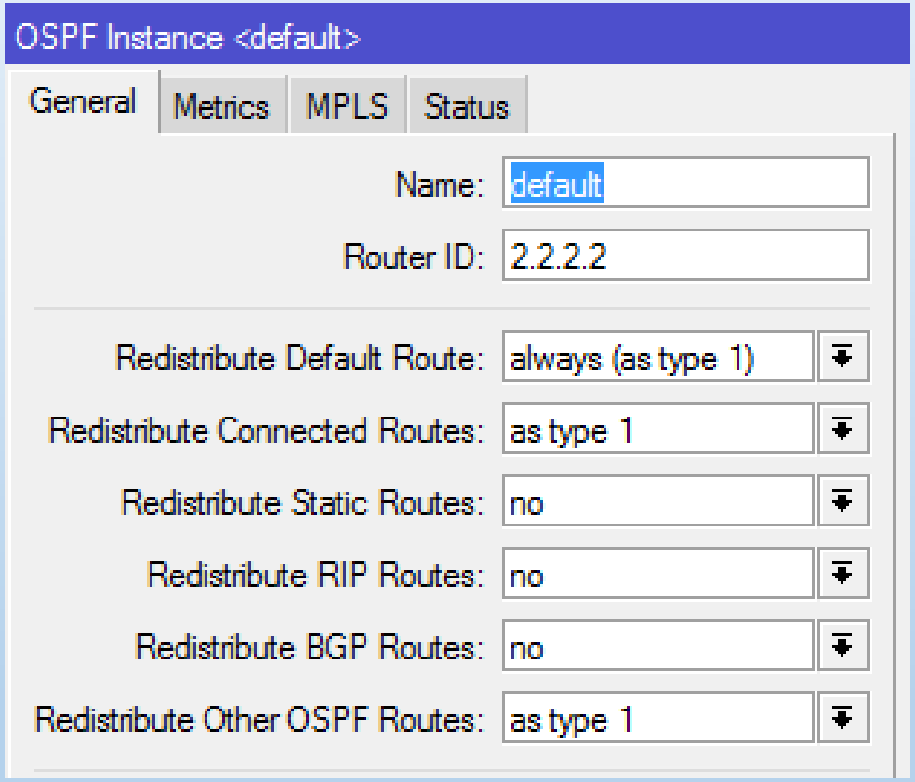


MTU ether1,ether2,ether4

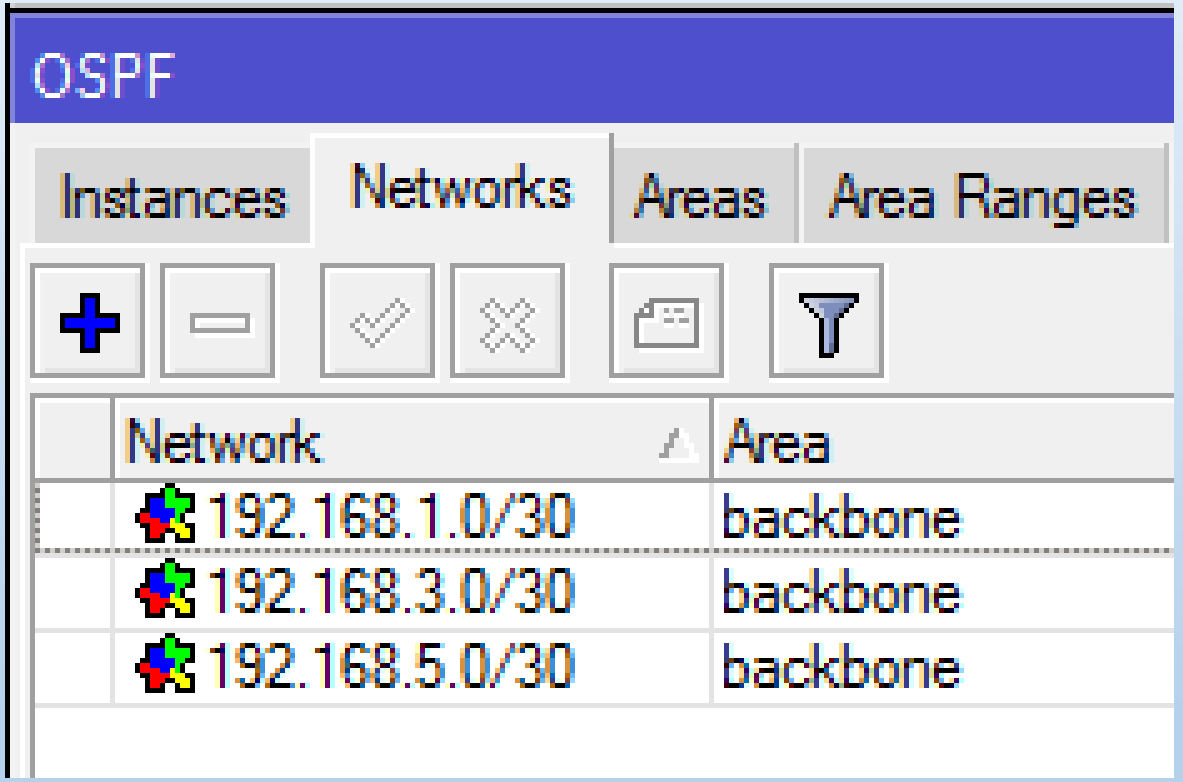


R2

OSPF Instance

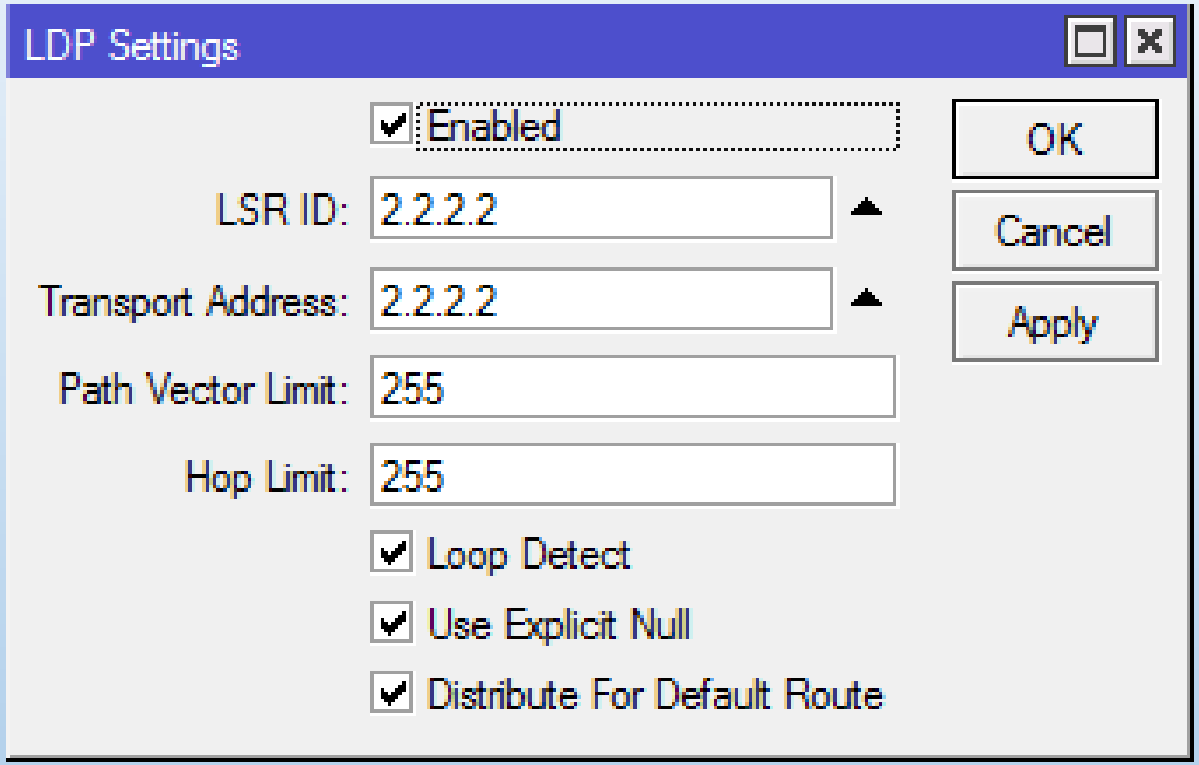


OSPF Networks

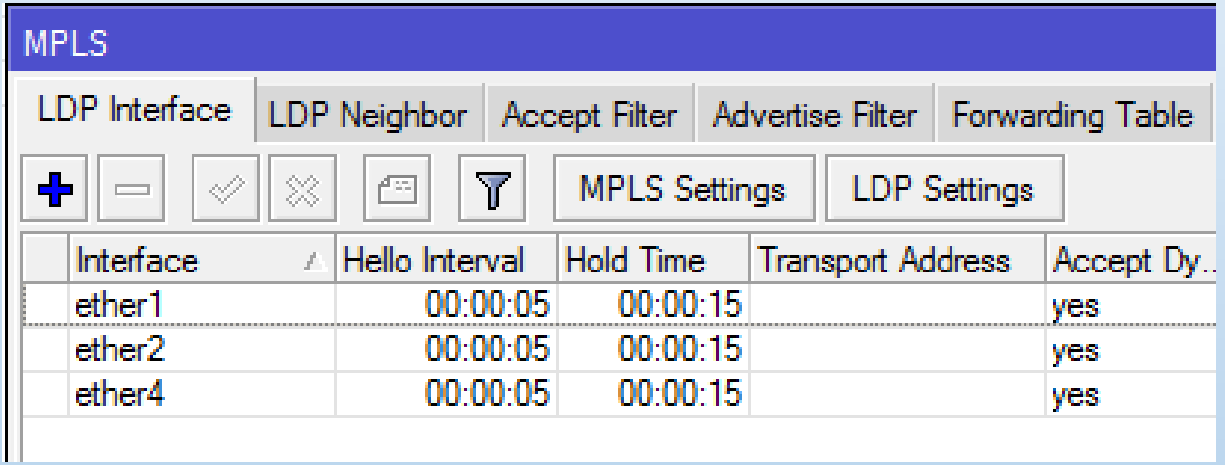


R2

LDP Settings

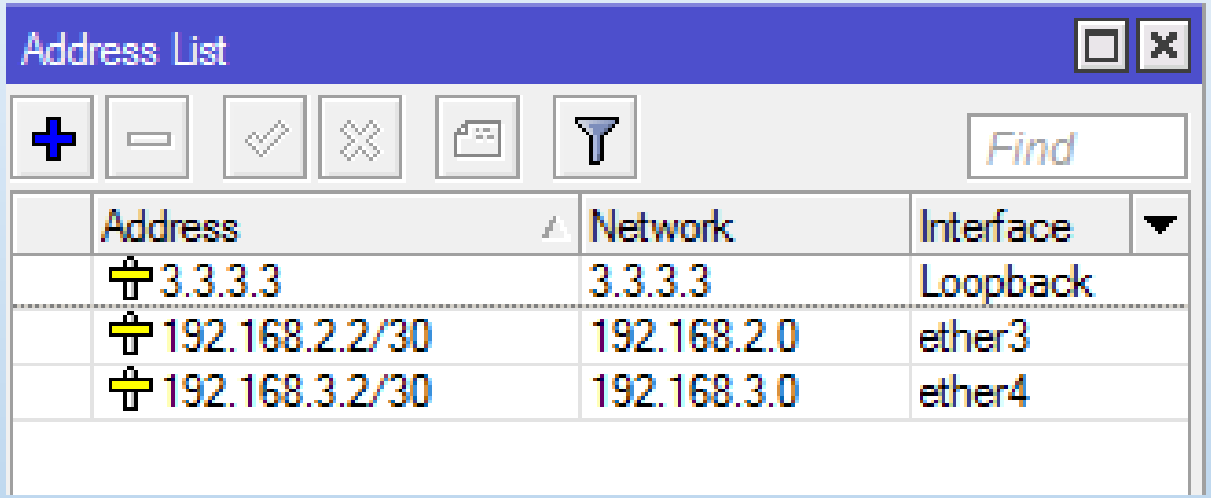


LDP Interface

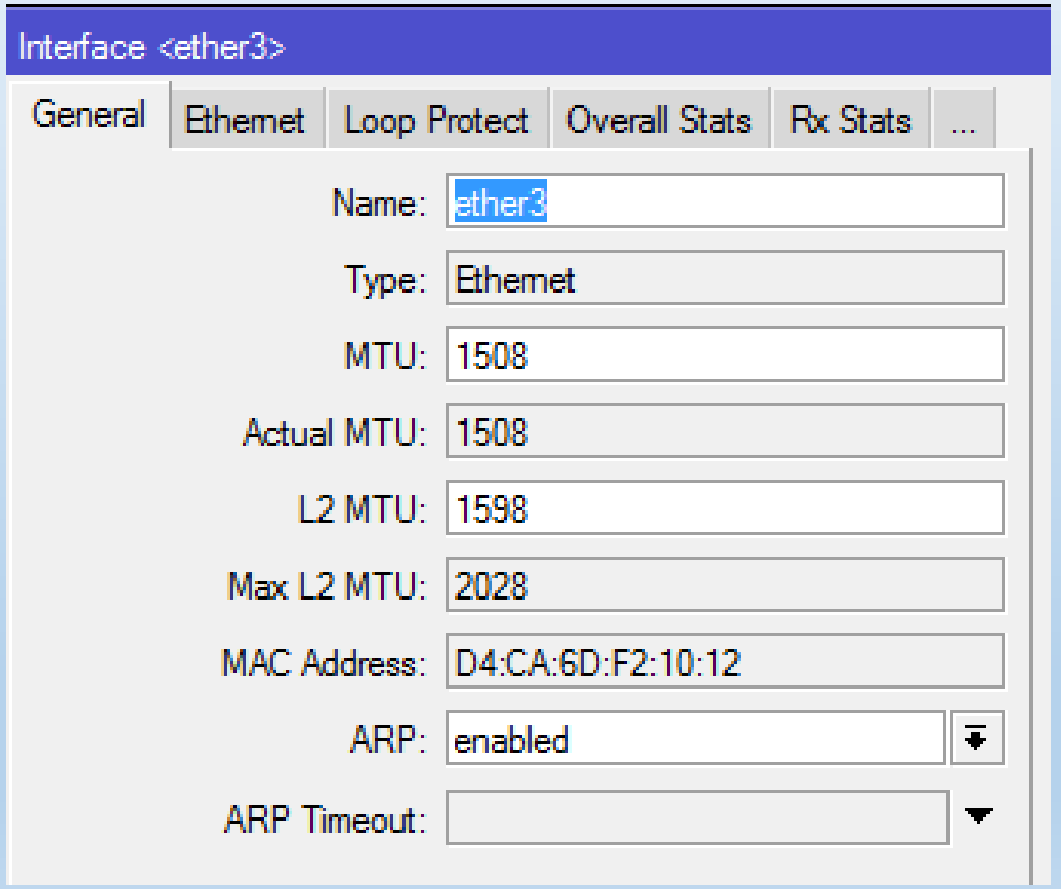


R3

IP Address Interface

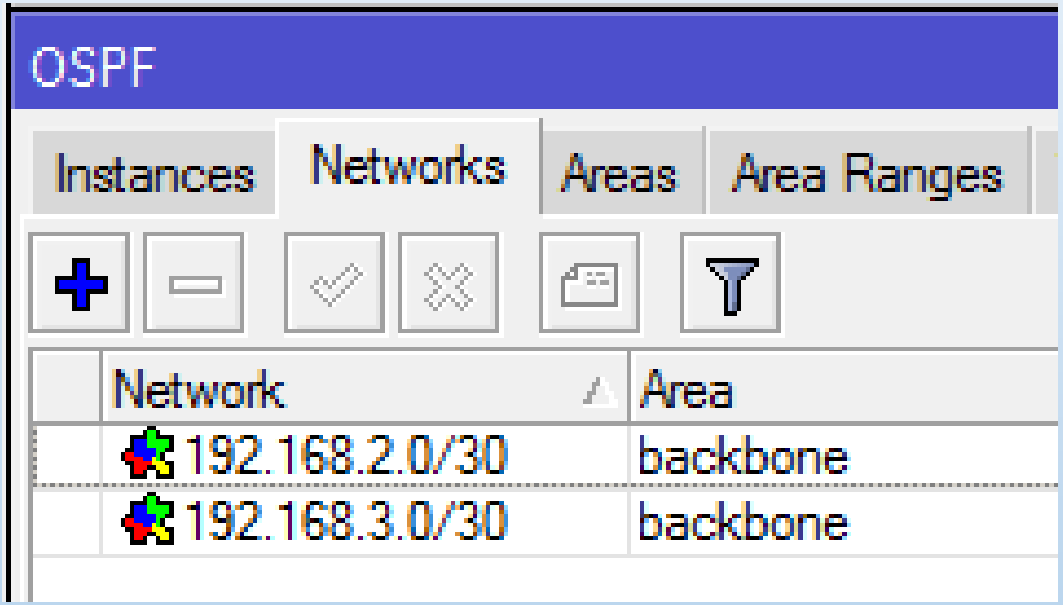


MTU ether 3,ether4

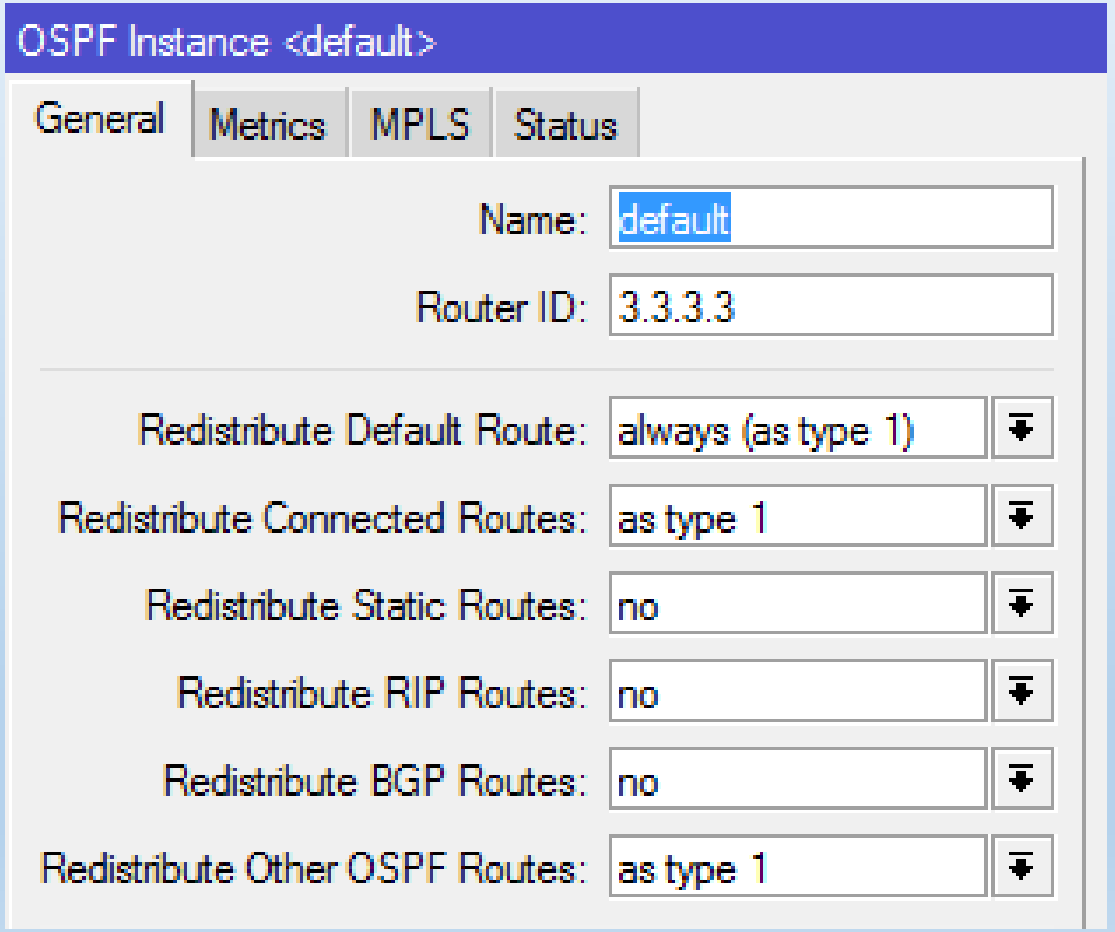


R3

OSPF Networks

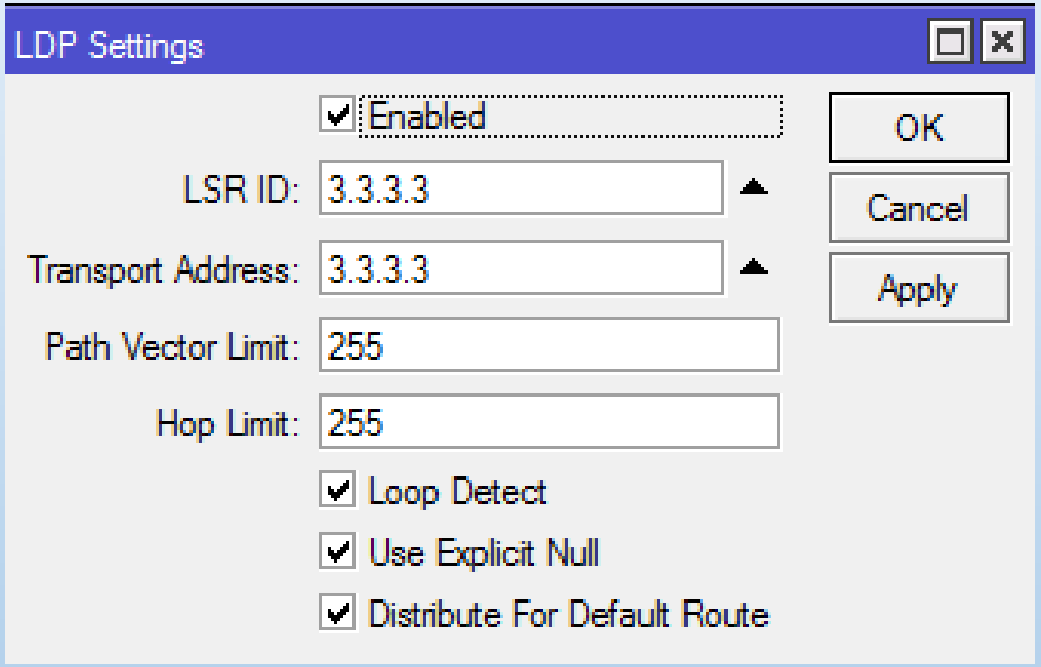


OSPF Instance

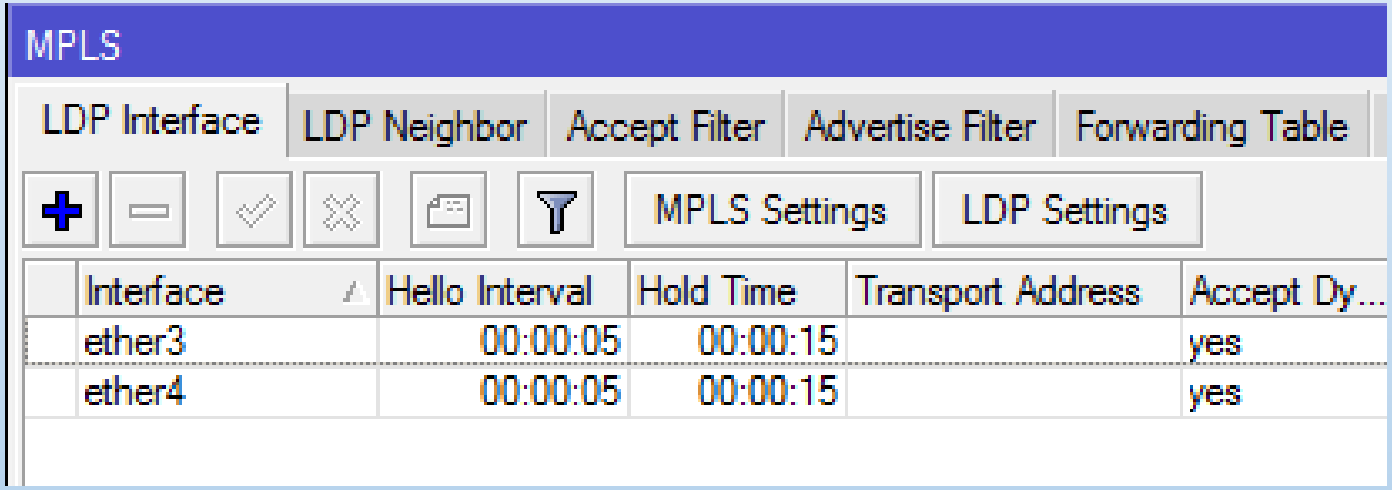


R3

LDP Settings

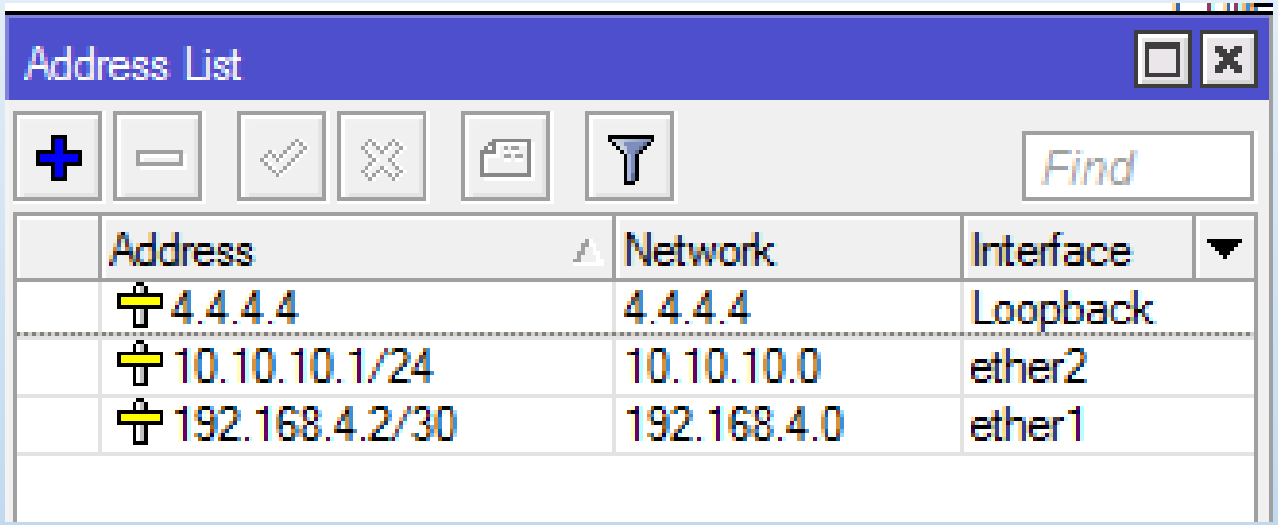


LDP Interface

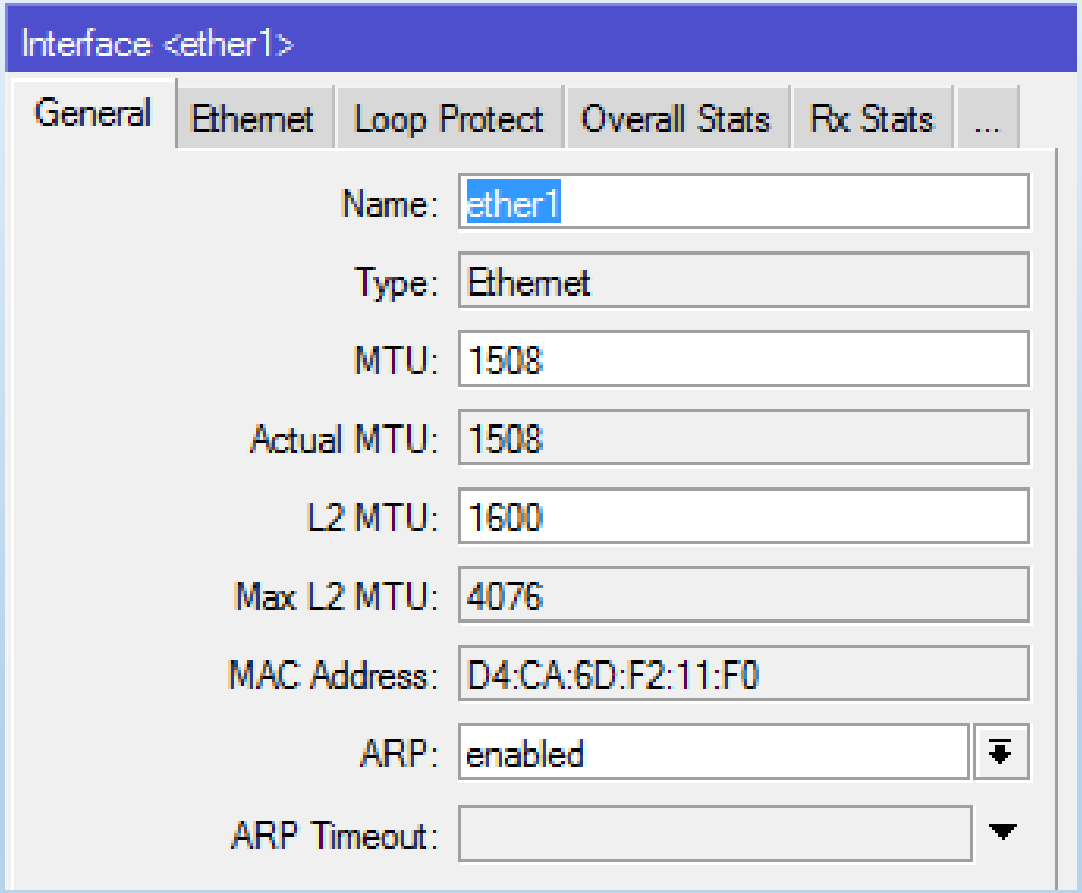


R4

IP Address

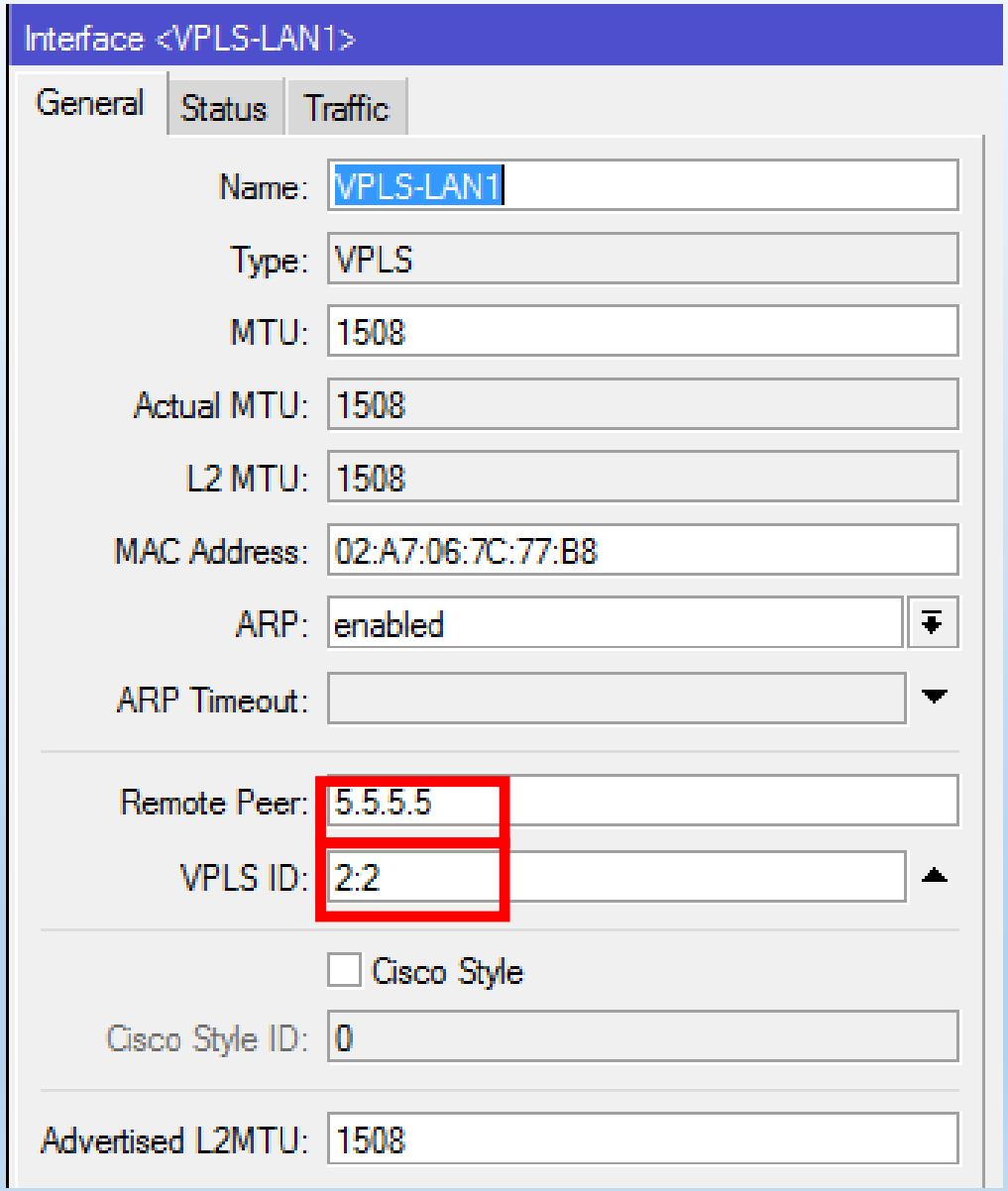


MTU ether1 , ether2

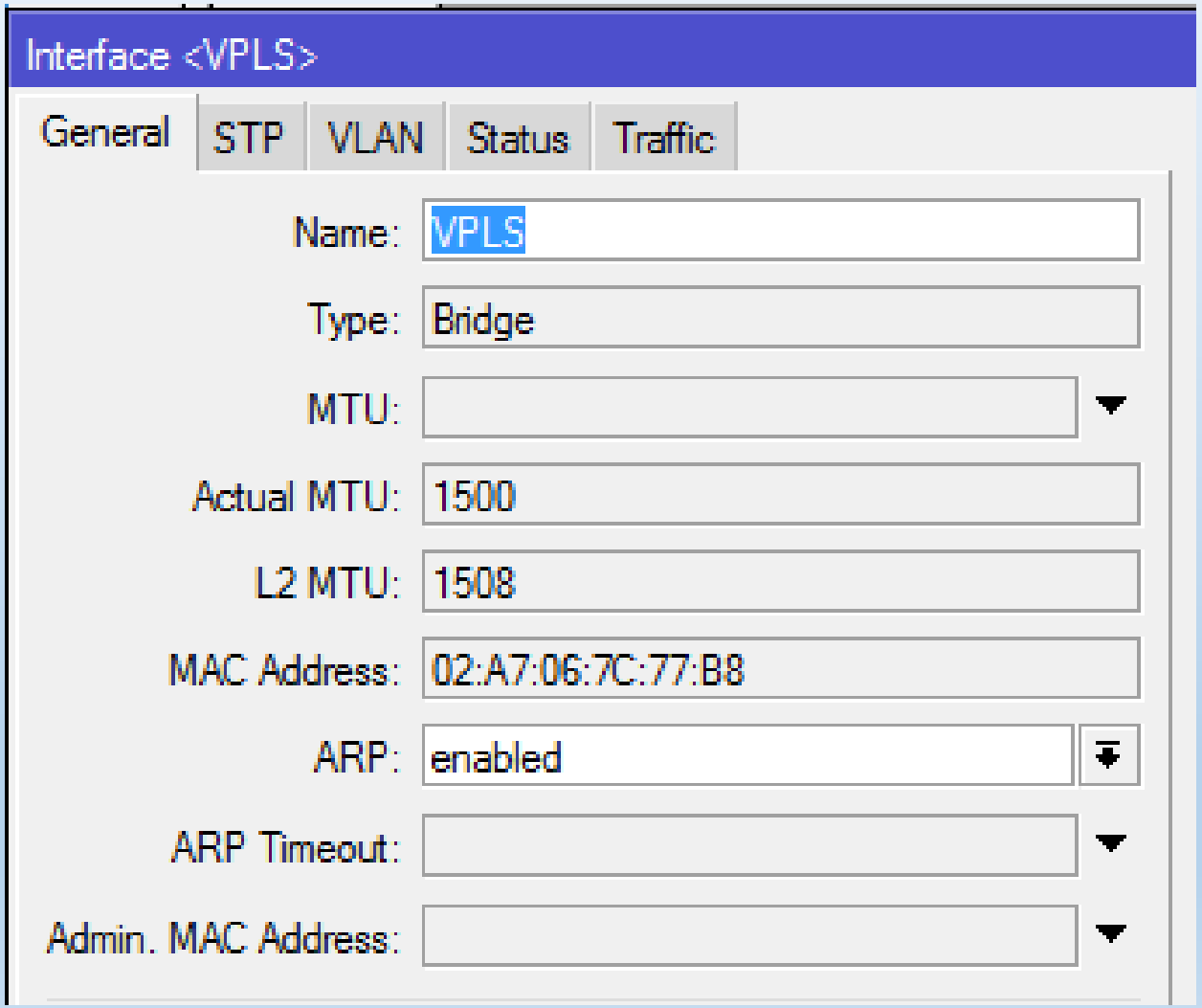


R4

VPLS Interface

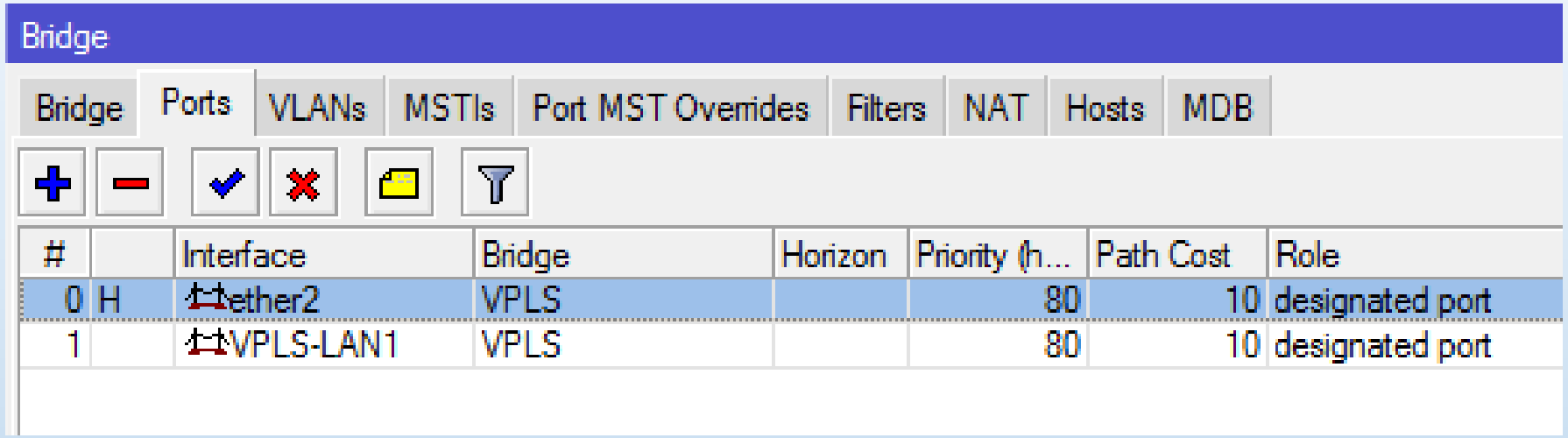


Bridge Interface

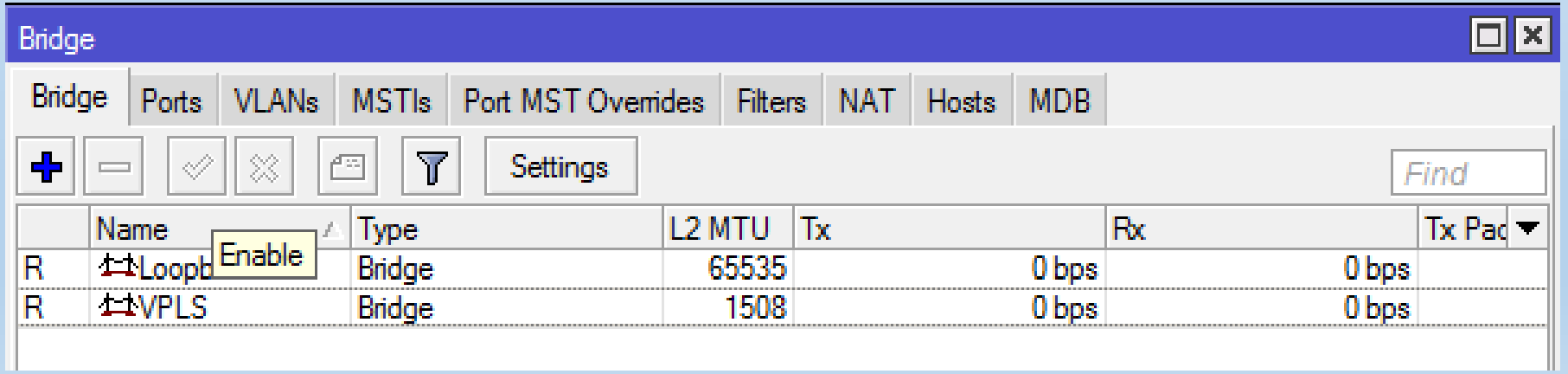


R4

Port Bridge

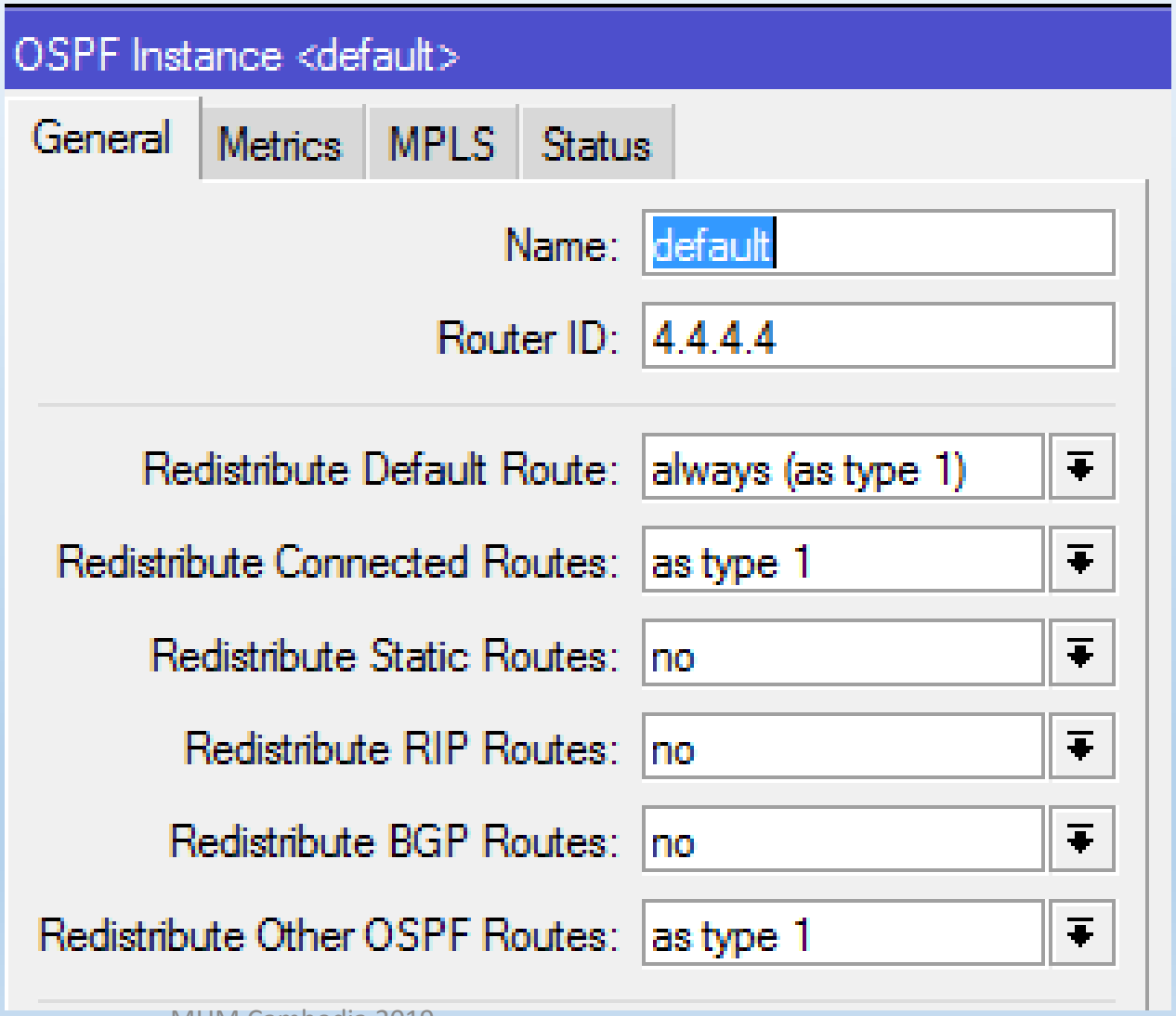


Name of Bridge

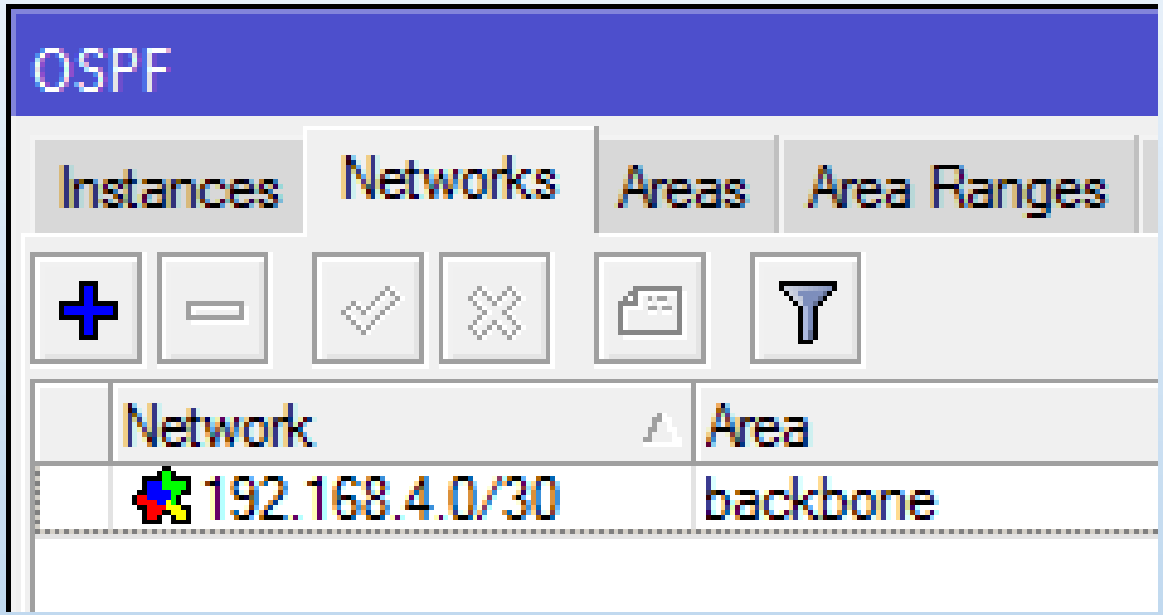


R4

OSPF Instance

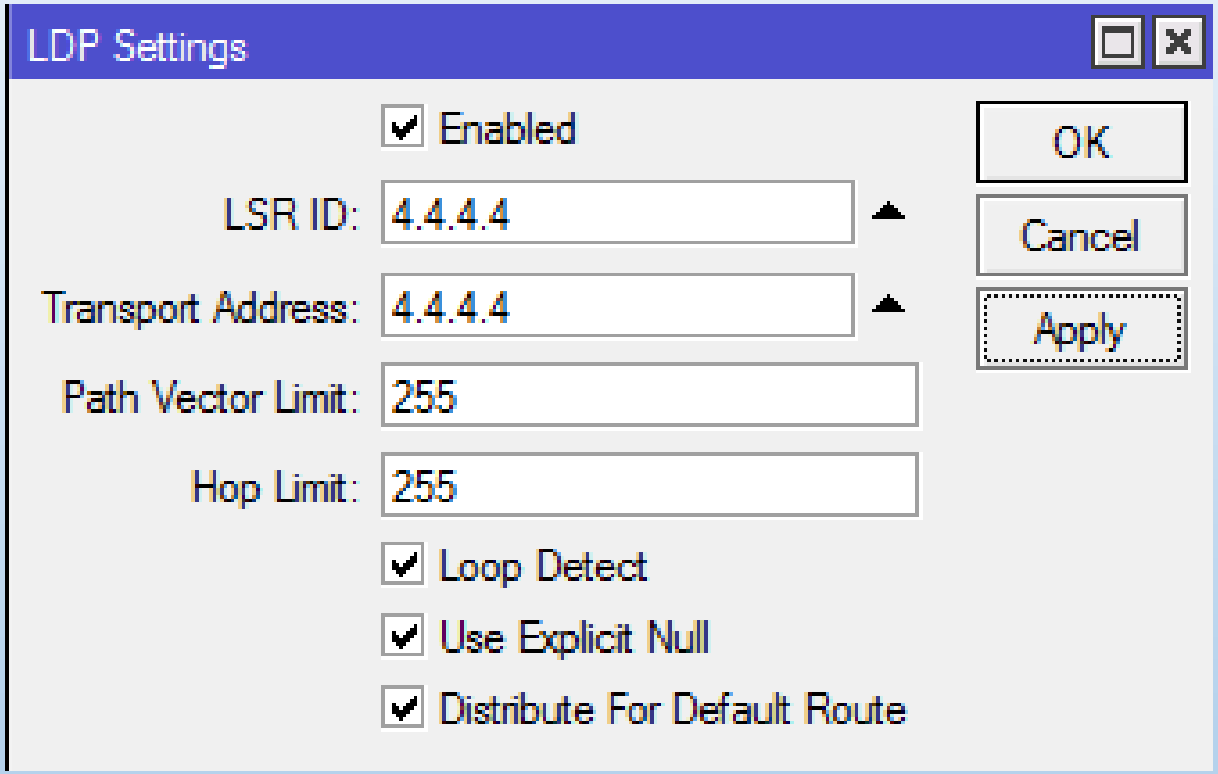


OSPF Network

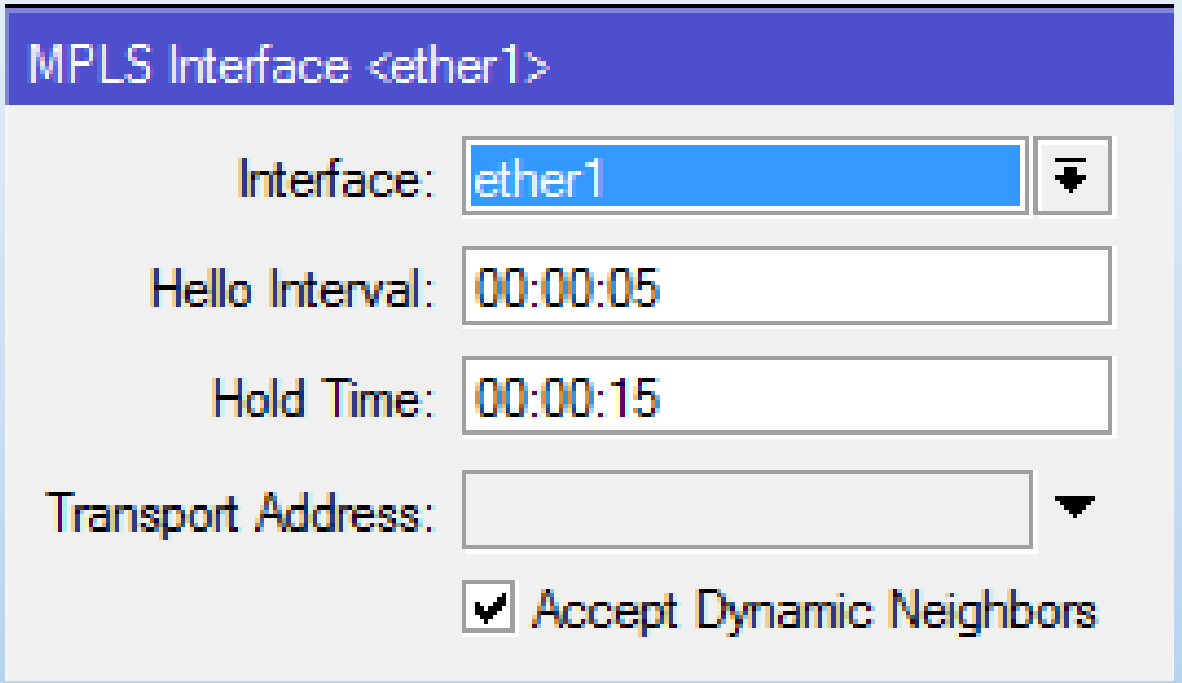


R4

LDP Settings

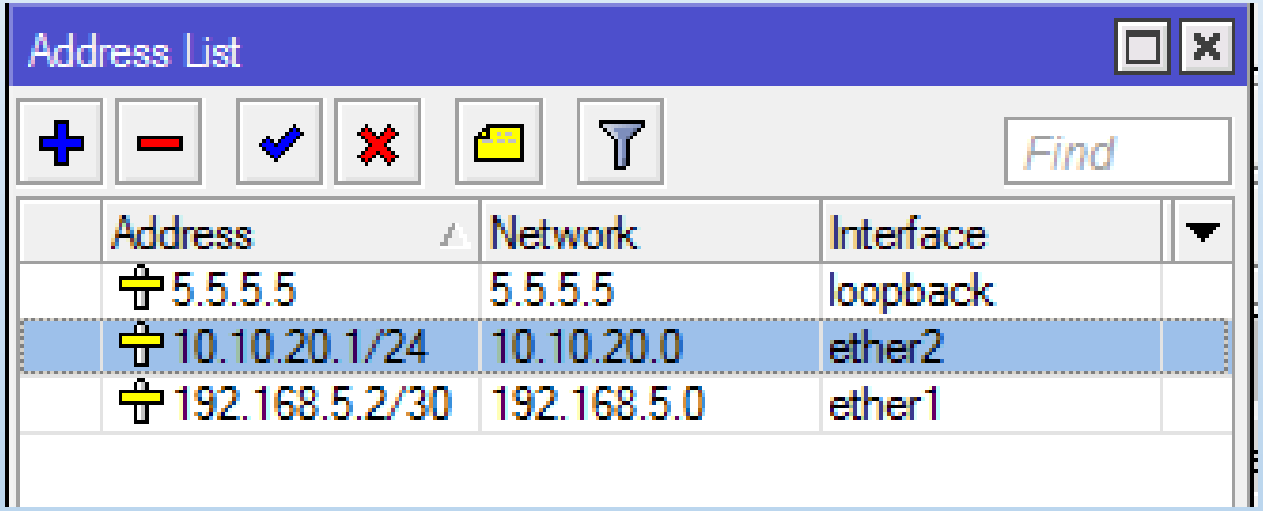


MPLS Interface

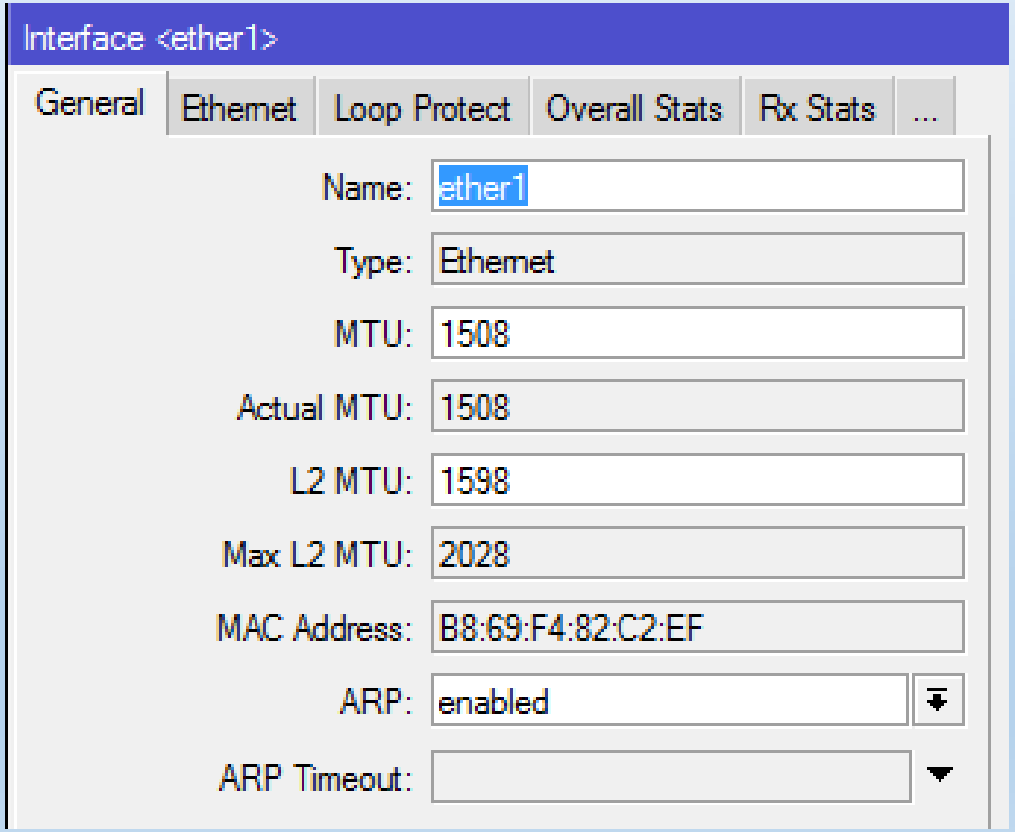


R5

IP Address



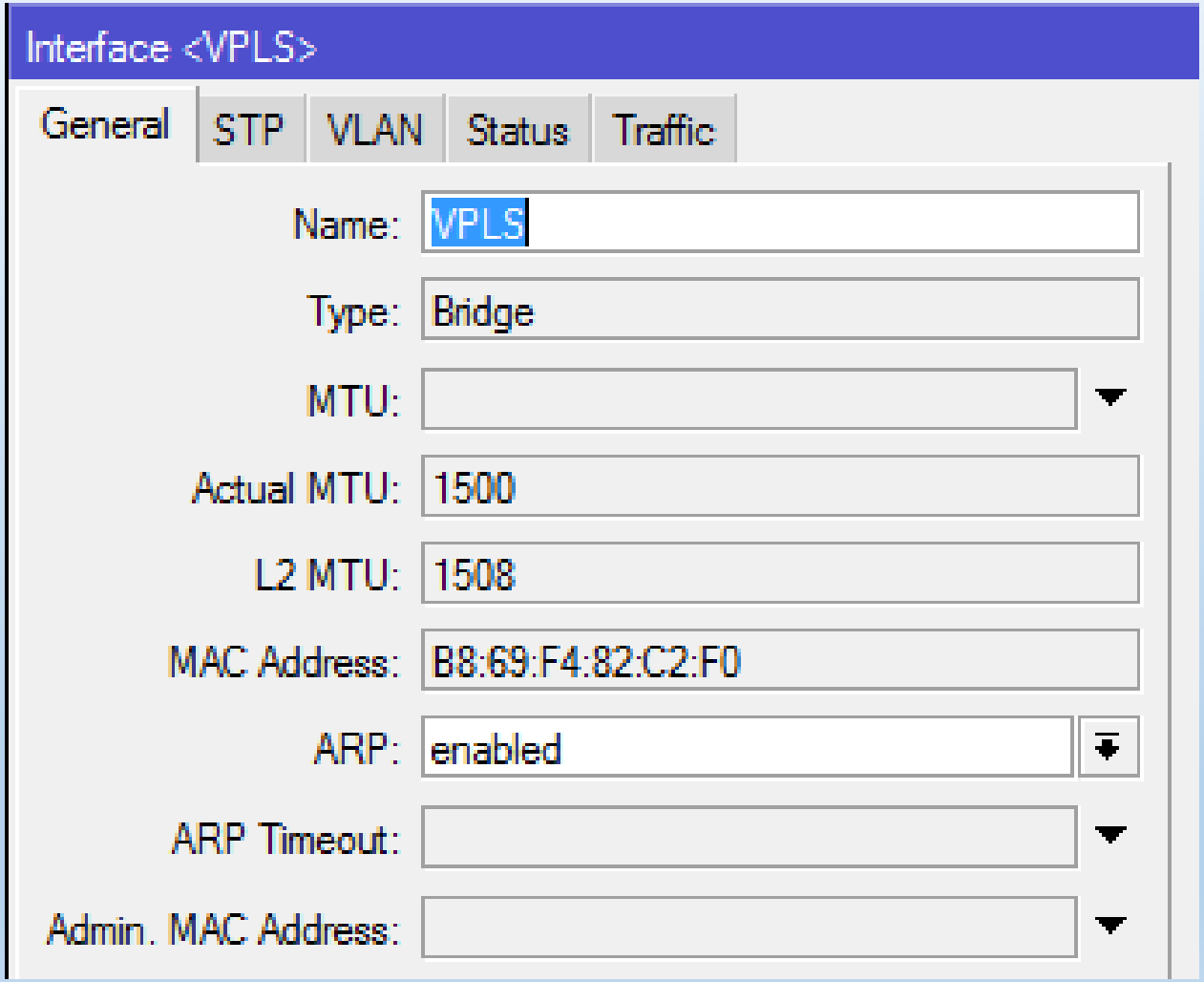
MTU ether1

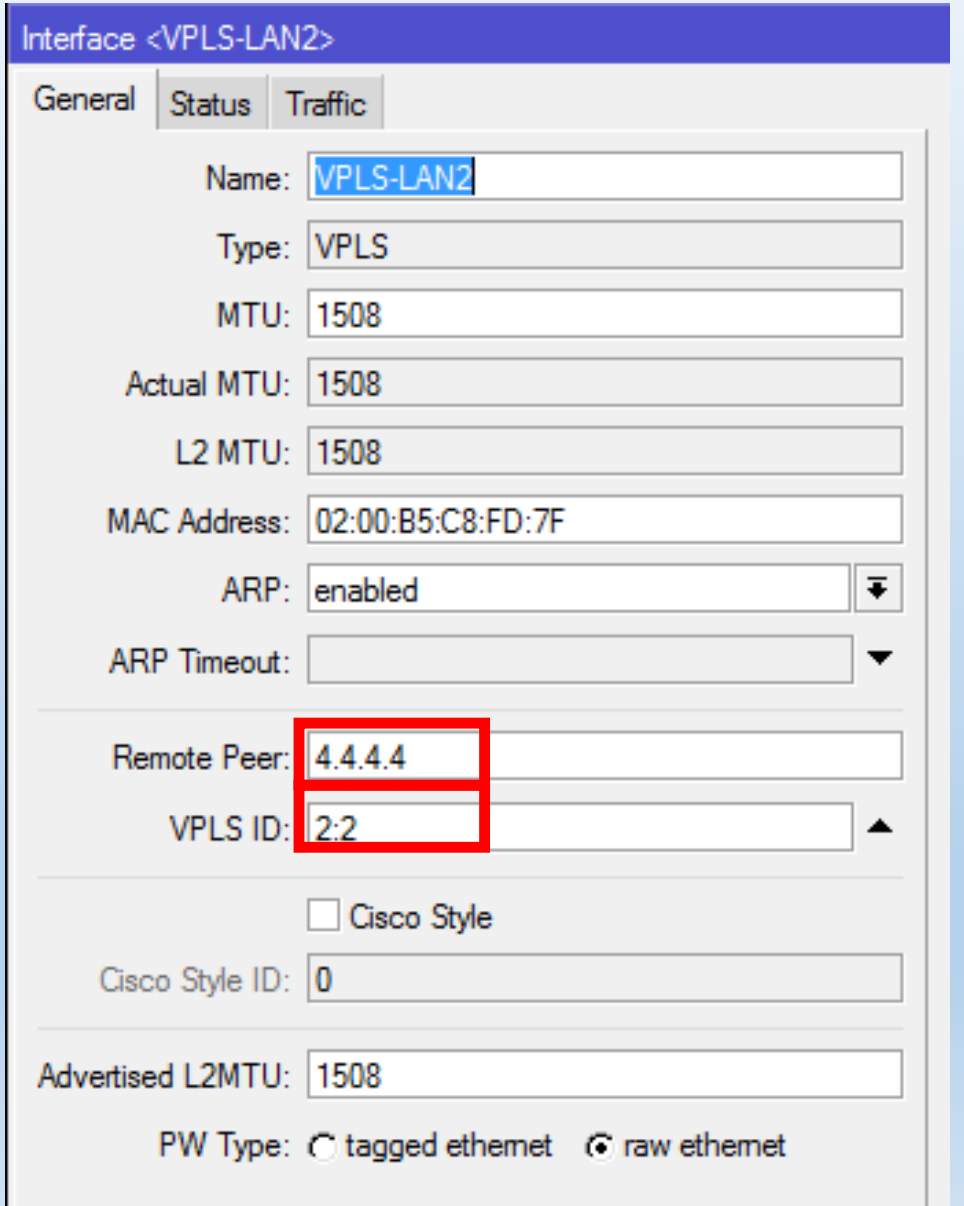


Name of Bridge

R5

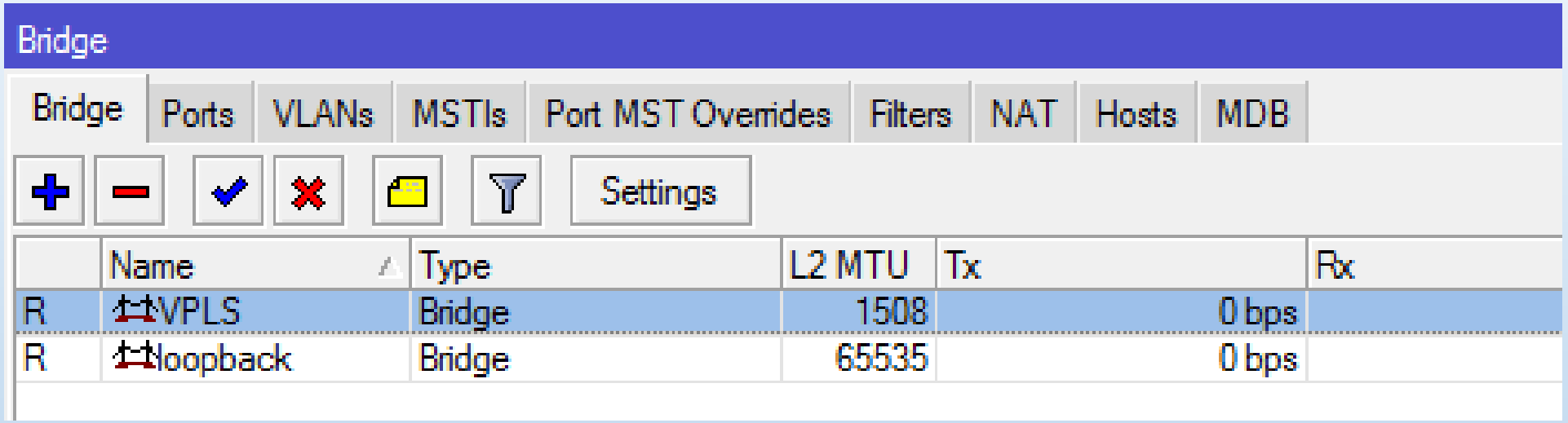
VPLS-LAN2 Interface



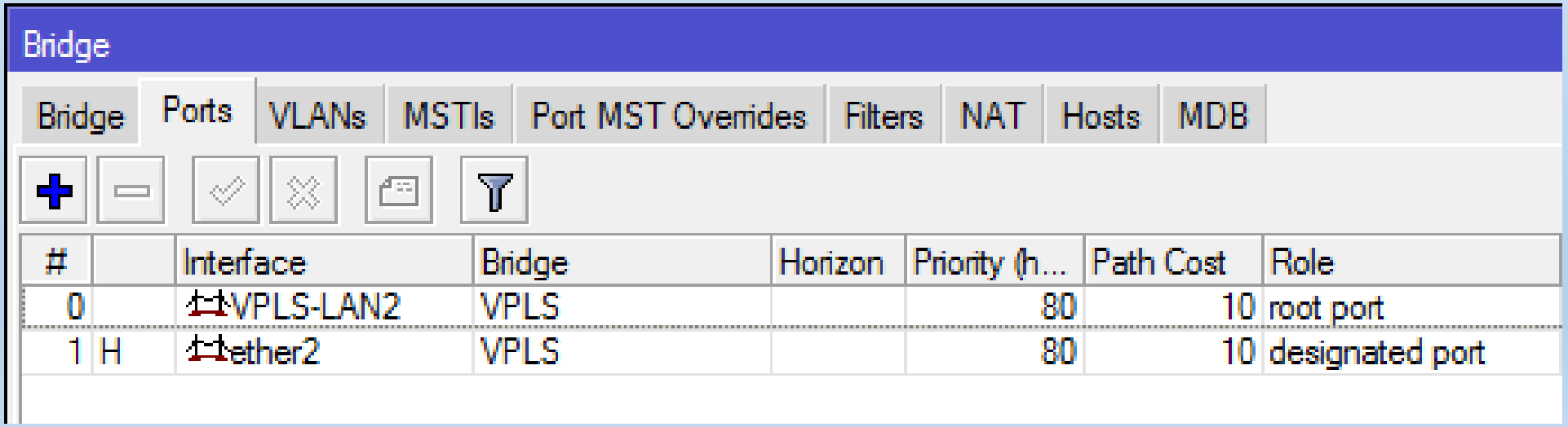


R5

Bridge

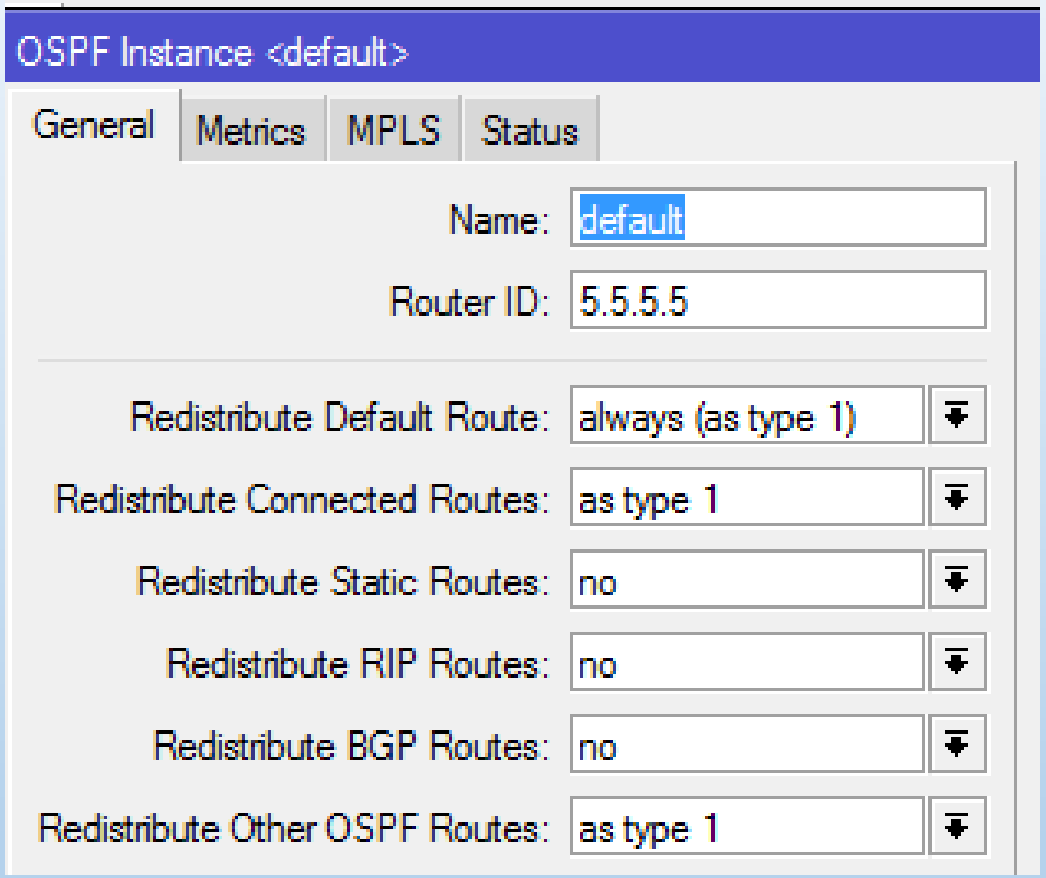


Bridge Ports

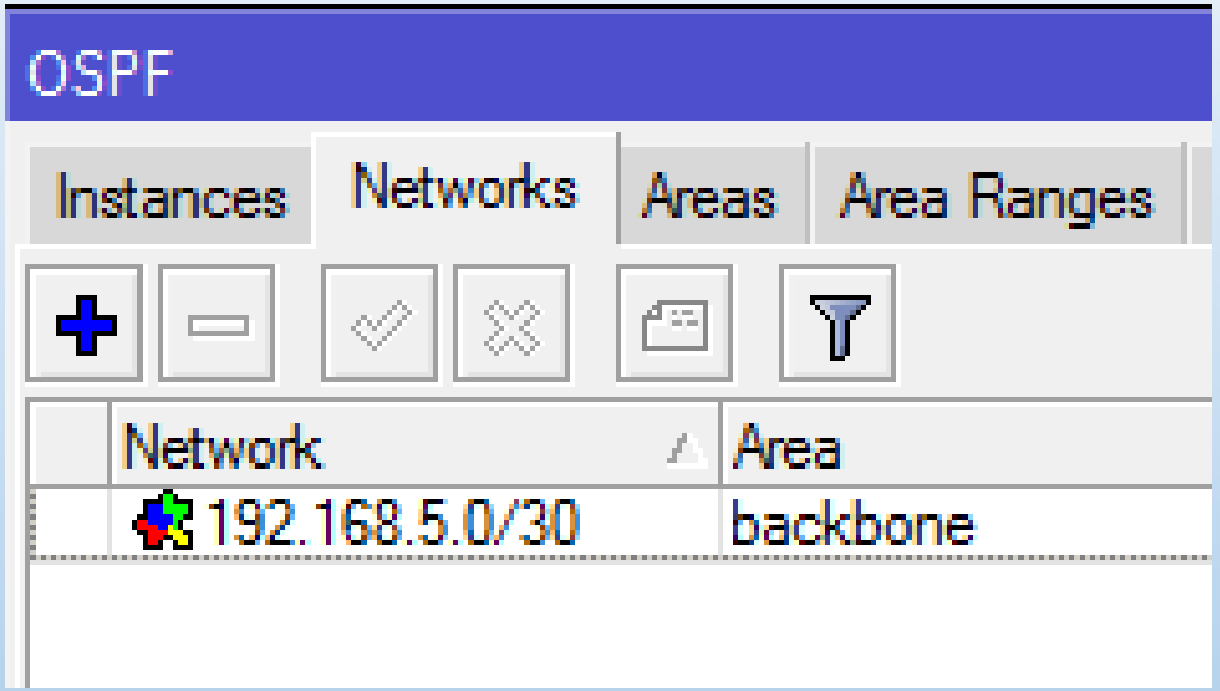


R5

OSPF Instance

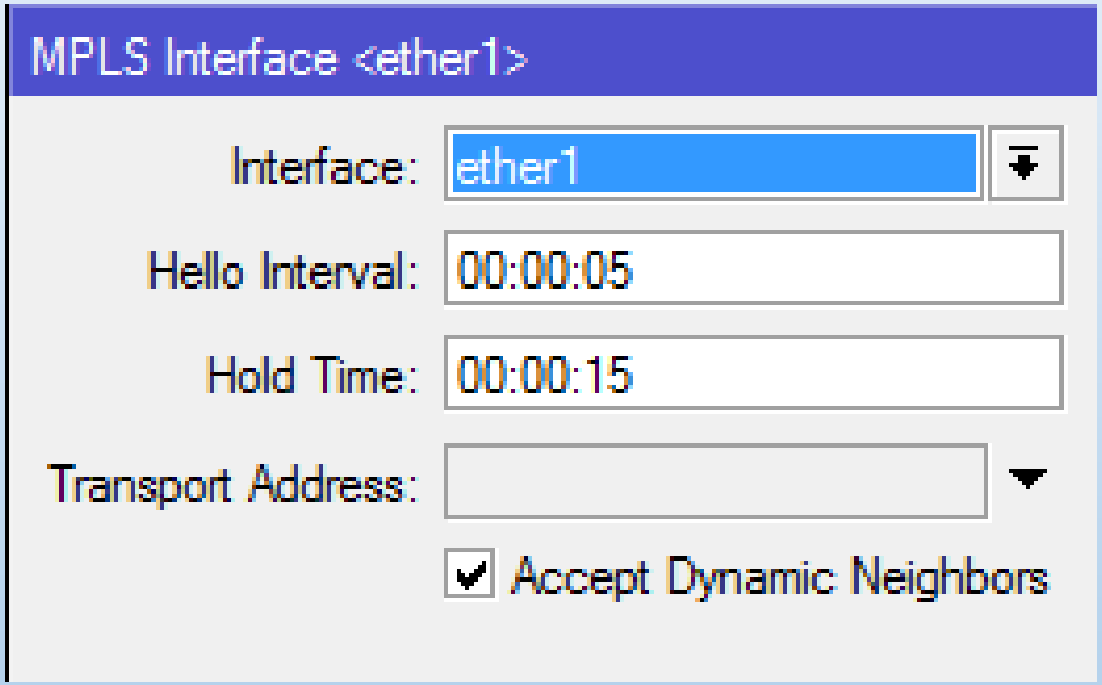


OSPF Network

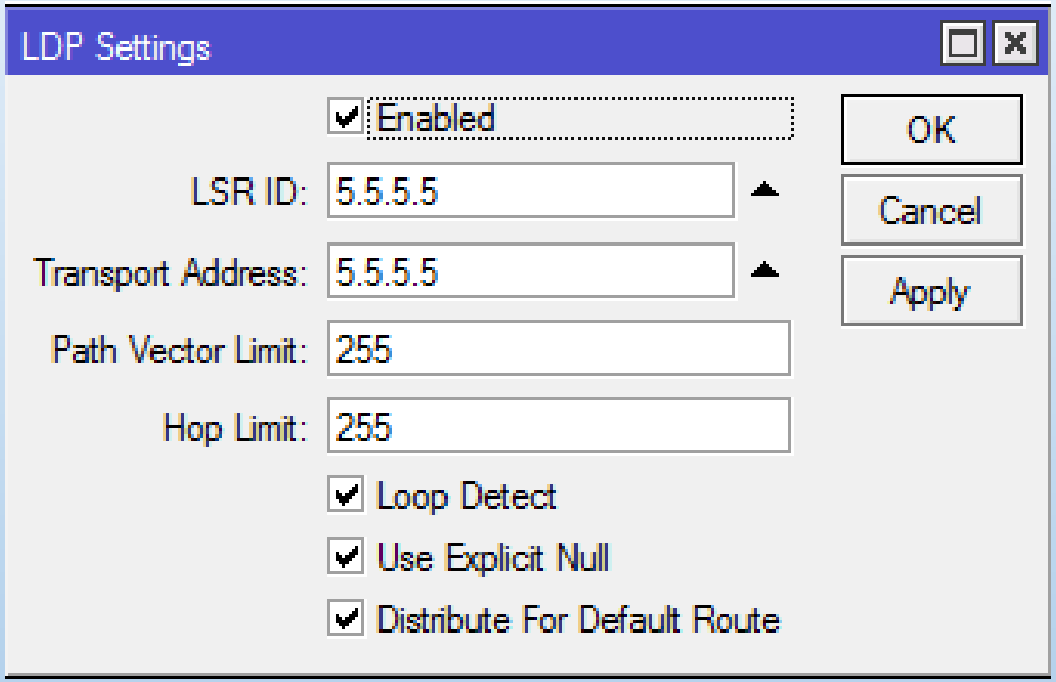


R5

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

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