

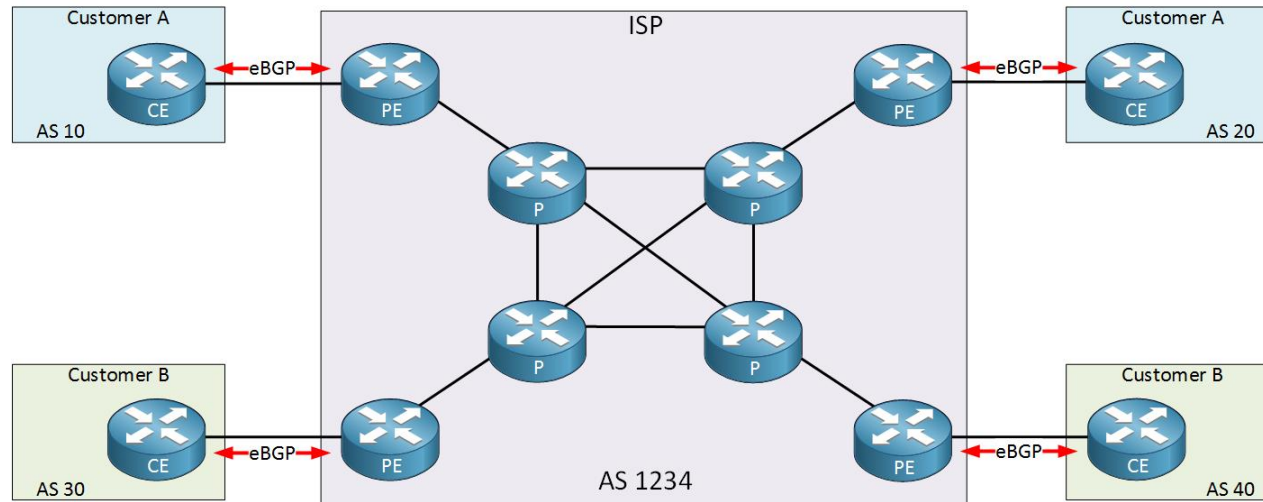
Multi Protocol Label Switching

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MPLS Overview

Service Provider Network

Typical Service Provider Network



- Routing protocols are used to distribute Layer 3 routing Information
- Forwarding is based on the destination address only
- Routing lookups are performed on every hop
- Every router may need full Internet routing information

Introduction to MPLS

MPLS (Multi Protocol Label Switching)

What does multi protocol label switching mean?

Multi protocol: besides IP you can tunnel pretty much anything...IP, IPv6, Ethernet, PPP, frame-relay, etc.

Label switching: forwarding is done based on labels, not by looking up the destination in the routing table.

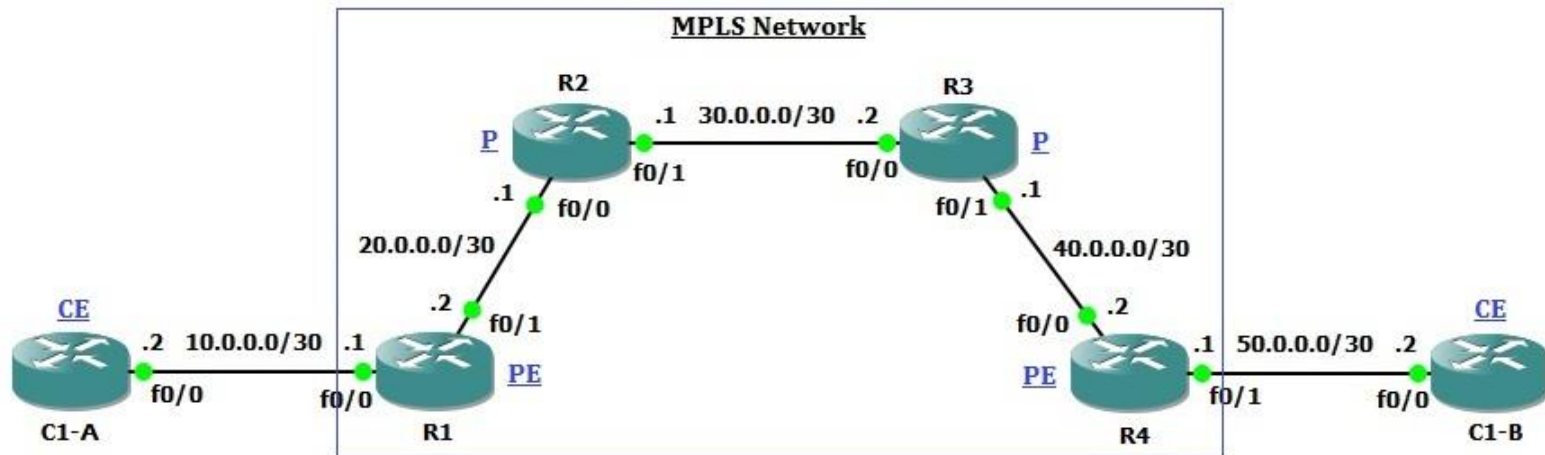
Introduction to MPLS

MPLS

- MPLS is a new forwarding mechanism in which packets are forwarded based on labels
- Labels usually correspond to IP destination networks (equal to traditional IP forwarding)
- Labels can also correspond to other parameters, such as QoS or source address
- MPLS was designed to support forwarding of other protocols as well

Introduction to MPLS

A Simple MPLS Network



Introduction to MPLS

MPLS Node Types

- **PE** (Provider Edge) router
 - Label Edge Router (**LER**)
 - Imposes and removes MPLS labels
- **P** (Provider) Router
 - Label Switching Router (**LSR**)
 - Switches MPLS labeled packets
- **CE** (Customer Edge) Router
 - Connects customer network to MPLS network

Introduction to MPLS

Objective of MPLS

- Only the edge routers will perform a routing lookup
- Core routers switch packets based on simple label lookups and swap labels
- Load sharing across unequal paths can be achieved using TE

MPLS

Objective of MPLS

- **CE** routers are not aware about MPLS. They work on traditional IP routing protocol
- **PE** (LER) primarily labels IP packets and forwards them into the MPLS domain, or removes labels and forwards IP packets out of the MPLS domain
- **P** (LSR) primarily forwards labeled packets (label swapping)

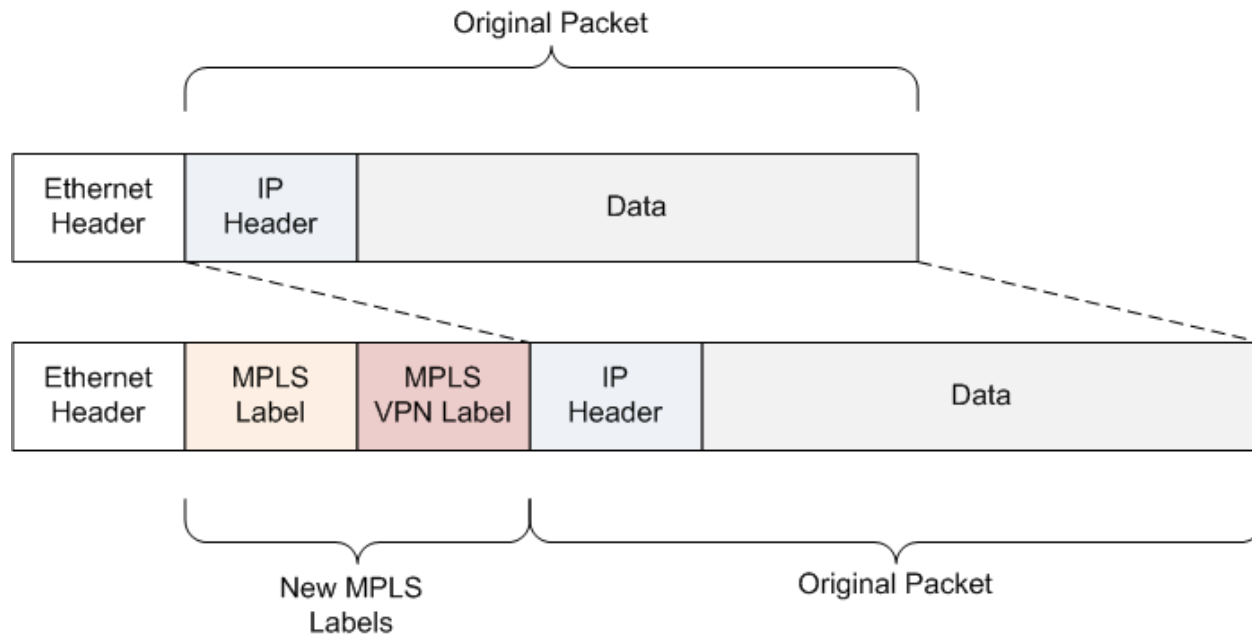
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MPLS Label

- Multi Protocol **Label** Switching (**MPLS**) is a type of data-carrying technique for high-performance networks
- **MPLS** directs data from one network node to the next based on short path **labels** rather than long network addresses, avoiding complex lookups in a routing table

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MPLS Label



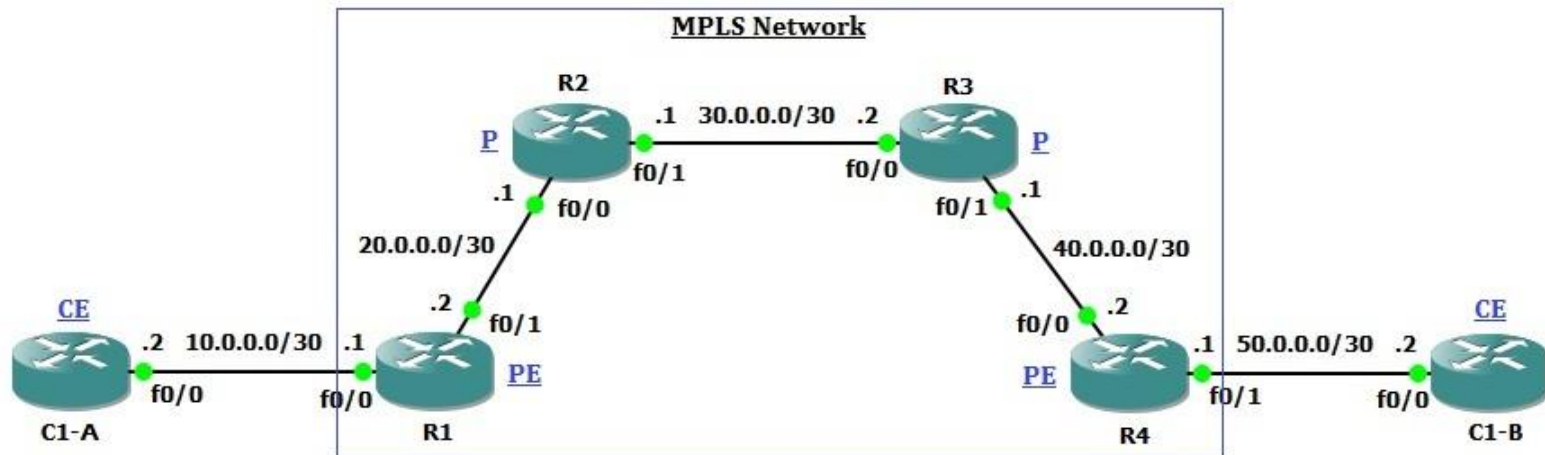
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MPLS Label Operation

- Label imposition/add (**PUSH**)
 - By ingress PE router; receive original packet from source CE, classify and label packets
- Label swapping or switching (**SWAP**)
 - By P router; forward packets using labels; indicates destination
- Label disposition/remove (**POP**)
 - By egress PE router; remove label and forward original packet to destination CE

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A Simple MPLS Network



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Simple MPLS Configuration

Step 1: IP Routing (IGP) Convergence

- Exchange of IP routes
 - OSPF, IS-IS etc.
- Establish IP reachability

Step 2A: Assignment of Local Labels

- Each MPLS node assigns a local label to each route in local routing table
 - In label

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Simple MPLS Configuration

Step 2B: Assignment of Remote Labels

- Local label mapping are sent to connected nodes
- Receiving nodes update MPLS forwarding table
 - Out label

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Configuring MPLS

R1

```
conf t
```

```
mpls label range 100 199
```

```
mpls ip
```

```
interface fastEthernet 0/0
```

```
mpls ip
```

```
exit
```

```
interface fastEthernet 0/1
```

```
mpls ip
```

```
exit
```

and also on R2, R3 and R4

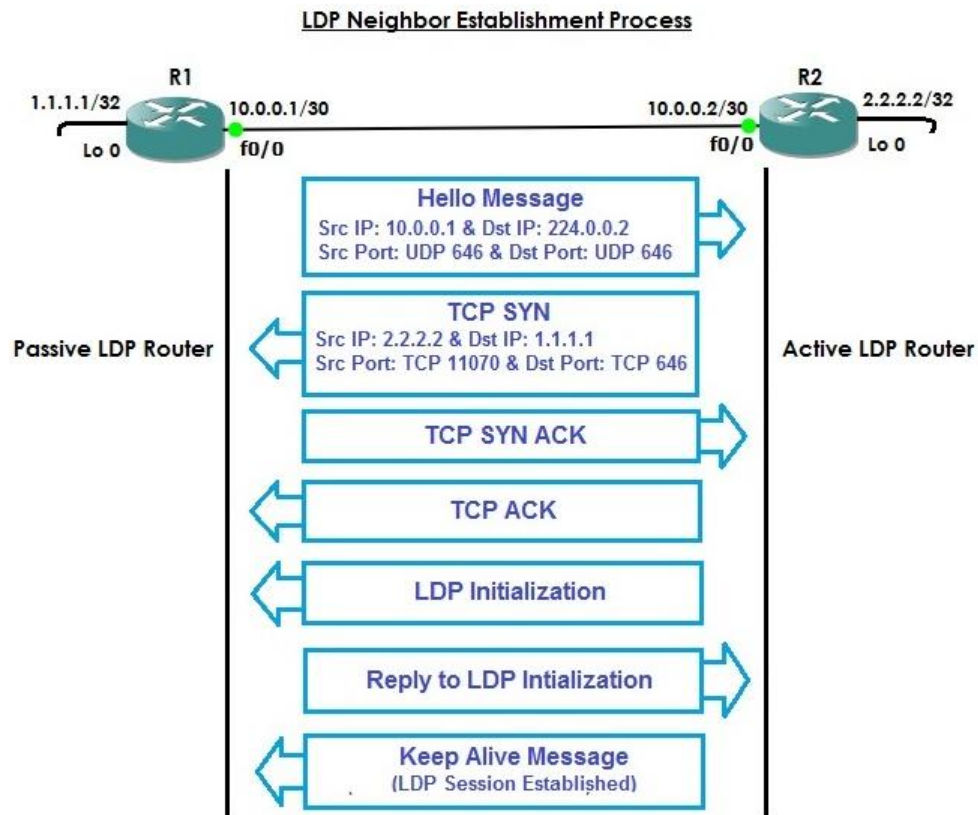
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Imposing/Adding MPLS Label

```
R1#show mpls ldp bindings local
lib entry: 10.0.0.0/30, rev 10
    local binding: label: imp-null
lib entry: 20.0.0.0/30, rev 12
    local binding: label: imp-null
lib entry: 30.0.0.0/30, rev 14
    local binding: label: 101
lib entry: 40.0.0.0/30, rev 16
    local binding: label: 102
lib entry: 50.0.0.0/30, rev 18
    local binding: label: 103
```

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LDP Neighbor Relationship



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Exchanging Labels Between Routers

LIB = Label Information Base

show mpls ldp bindings

Network/Route	R1	R2	R3	R4
10.0.0.0/30	imp-null	200	309	409
20.0.0.0/30	imp-null	imp-null	310	410
30.0.0.0/30	101	imp-null	imp-null	411
40.0.0.0/30	102	202	imp-null	imp-null
50.0.0.0/30	103	201	311	imp-null

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Exchanging Labels Between Routers

Network/Route	R1		R2		R3		R4	
10.0.0.0/30	Local	imp-null	Local	200	Local	309	Local	409
	From R2	200	From R1	imp-null	From R2	200	From R3	309
			From R3	309	From R4	409		
20.0.0.0/30	Local	imp-null	Local	imp-null	Local	310	Local	410
	From R2	imp-null	From R1	imp-null	From R2	imp-null	From R3	310
			From R3	310	From R4	410		
30.0.0.0/30	Local	101	Local	imp-null	Local	imp-null	Local	411
	From R2	imp-null	From R1	101	From R2	imp-null	From R3	imp-null
			From R3	imp-null	From R4	411		
40.0.0.0/30	Local	102	Local	201	Local	imp-null	Local	imp-null
	From R2	202	From R1	102	From R2	201	From R3	imp-null
			From R3	imp-null	From R4	imp-null		
50.0.0.0/30	Local	103	Local	201	Local	311	Local	imp-null
	From R2	201	From R1	103	From R2	201	From R3	311
			From R3	311	From R4	imp-null		

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Exchanging Labels Between Routers

LFIB = Label Forwarding Information Base

show mpls forwarding-table

```
R1#show mpls forwarding-table
```

Local Label	Outgoing Label	Prefix or Tunnel Id	Bytes Switched	Label	Outgoing interface	Next Hop
101	Pop Label	30.0.0.0/30	0		Fa0/1	20.0.0.1
102	202	40.0.0.0/30	0		Fa0/1	20.0.0.1
103	201	50.0.0.0/30	0		Fa0/1	20.0.0.1

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Analyzing Label Based Forwarding

```
R1#show mpls forwarding-table 50.0.0.0 30
```

Local Label	Outgoing Label	Prefix or Tunnel Id	Bytes Switched	Label	Outgoing interface	Next Hop
103	201	50.0.0.0/30	0		Fa0/1	20.0.0.1

```
R2#show mpls forwarding-table 50.0.0.0 30
```

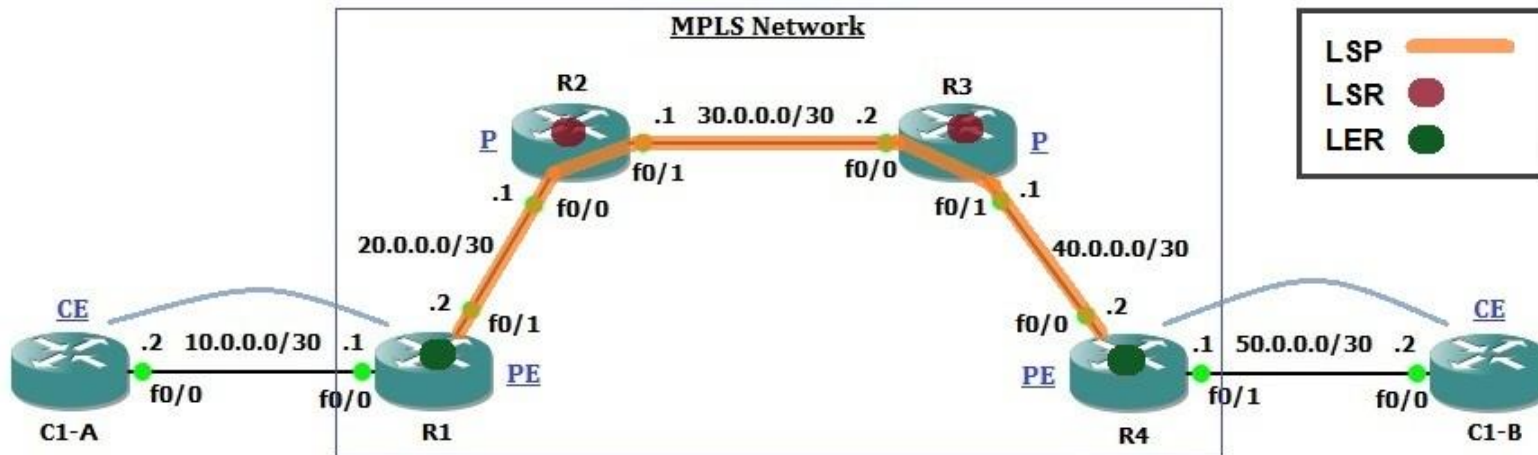
Local Label	Outgoing Label	Prefix or Tunnel Id	Bytes Switched	Label	Outgoing interface	Next Hop
201	311	50.0.0.0/30	0		Fa0/1	30.0.0.2

```
R3#show mpls forwarding-table 50.0.0.0 30
```

Local Label	Outgoing Label	Prefix or Tunnel Id	Bytes Switched	Label	Outgoing interface	Next Hop
311	Pop Label	50.0.0.0/30	0		Fa0/1	40.0.0.2

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Label Switching Path (LSP)



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Additional MPLS Services

- MPLS L3 VPN
- MPLS L2 VPN
- MPLS TE

Thank You

