

# **CCIE Service Provider v3.0**

## **Sample Lab**

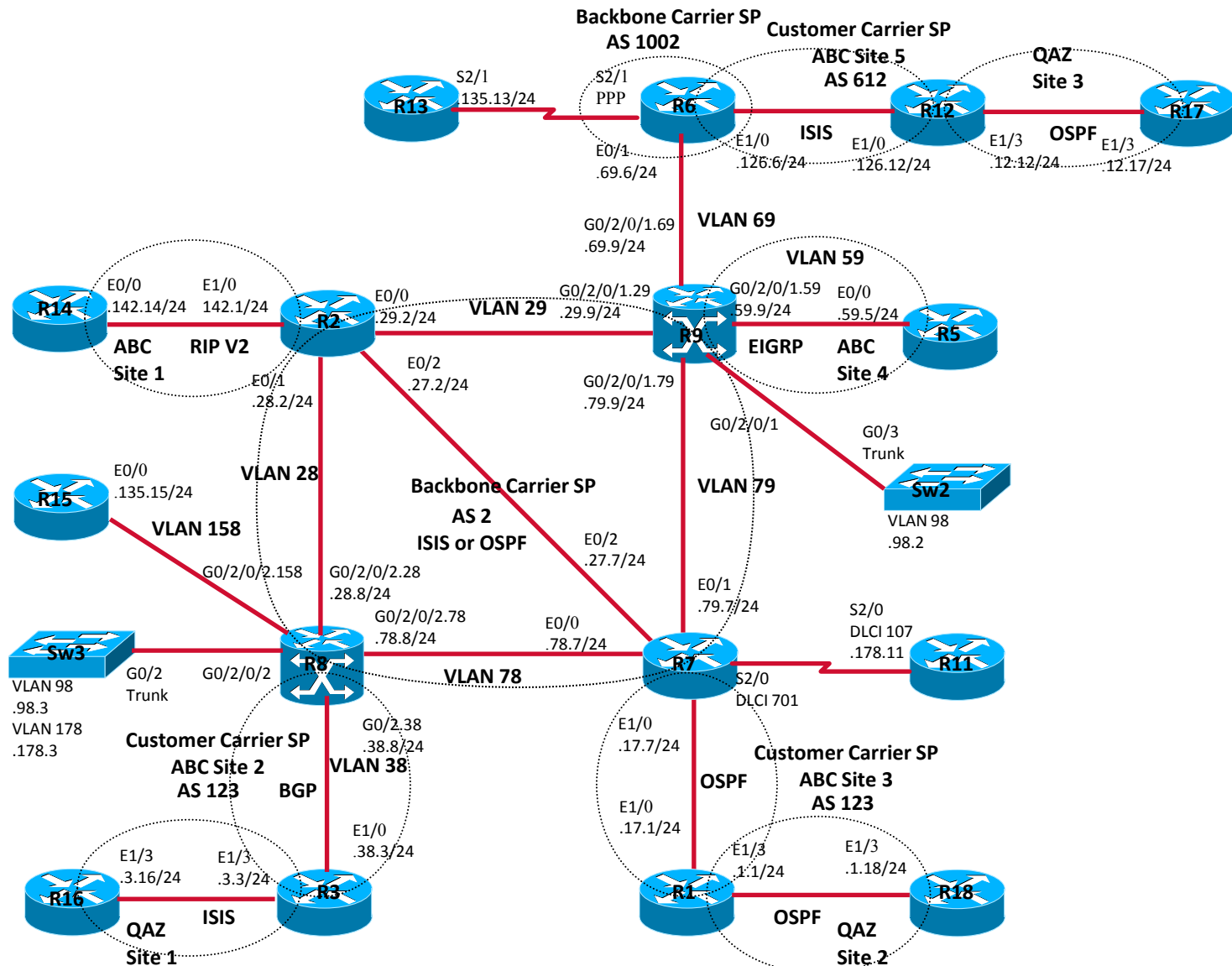
### **Part 2/7**

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**Cisco Systems**

# SP Sample Lab – Main Topology



# SP Sample Lab – Addressing Scheme

- Backbone Carrier SP network Prefix: 2.2.0.0/24, 2002:2:2::/64
- Backbone Carrier SP router Loopback0: 2.2.0.Z/32, 2002:2:2::Z/128
- Customer Carrier SP/VPN network Prefix: 172.2.0.0/24, 2002:172:2::/64
- Customer Carrier SP/VPN router Loopback0: 172.2.0.Z/32, 2002:172:2::Z/128
- End Customer VPN network Prefix: 192.2.0.0/24
- End Customer VPN router Loopback0: 192.2.0.Z/32
- L2 VPN Customer network Prefix: 172.2.0.0/24
- L2 VPN Customer router Loopback0: 172.2.0.Z/32

“Z” is router number, for example “Z” value for R12 is “12”

# SP Sample Lab – Setup

- Hardware

- Two XR-12404 with two GigabitEthernet interfaces or equivalent

- Thirteen Cisco 7200 series routers with Ethernet interfaces or equivalent

- Three Cisco 3560G series or equivalent

- Software Operating System

- XR12000-iosxr-k9-3.9.1.tar

- c7200-spservices-mz.122-33.SRE2.bin

- c3560-advipservicesk9-mz.122-46.SE.bin

# SP Sample Lab Questions

	Question, Configuration and Verification
1	IS-IS IPv4/IPv6
2	OSPF IPv4/IPv6
3	BGP unicast IPv4/IPv6
4	MPLS LDP
5	MPLS TE
6	MPLS TE FRR
7	MP-BGP Intra-AS VPNv4
8	MP-BGP Inter-AS VPNv4
9	CSC
10	MP-BGP VPNv6 - 6VPE
11	Multicast VPN
12	AToM
13	VPLS
14	L2TPv3

# MPLS Overview

- Based on the label-swapping and forwarding paradigm
- As a packet enters an MPLS network, it is assigned a label based on its Forwarding Equivalence Class (FEC) as determined at the edge of the MPLS network
- FECs are groups of packets forwarded over the same Label Switched Path (LSP)
- Need a mechanism that will create and distribute labels to establish LSP paths
- Separated into two planes:
  - Control Plane—responsible for maintaining correct label tables among Label Switching Routers
  - Forwarding Plane—uses label carried by packet and label table maintained by LSR to forward the packet

# Label Distribution Protocol

- LDP is a superset of the Cisco-specific Tag Distribution Protocol
- Assigns, distributes, and installs (in forwarding) labels for prefixes advertised by unicast routing protocols  
OSPF, IS-IS, EIGRP, etc.
- Also used for Pseudowire/PW (VC) signaling  
Used for L2VPN control plane signaling
- Uses UDP (port 646) for session discovery and TCP (port 646) for exchange of LDP messages
- LDP operations
  - LDP Peer Discovery
  - LDP Session Establishment
  - MPLS Label Allocation, Distribution, and Updating MPLS forwarding

# Mapping to Lab Exam Blueprint

- This question of the sample lab maps to following sections/sub-sections in the Lab Exam Blueprint document below;

<https://learningnetwork.cisco.com/docs/DOC-9991>

1.0 – Implement, Optimize and Troubleshoot Core IP Technologies

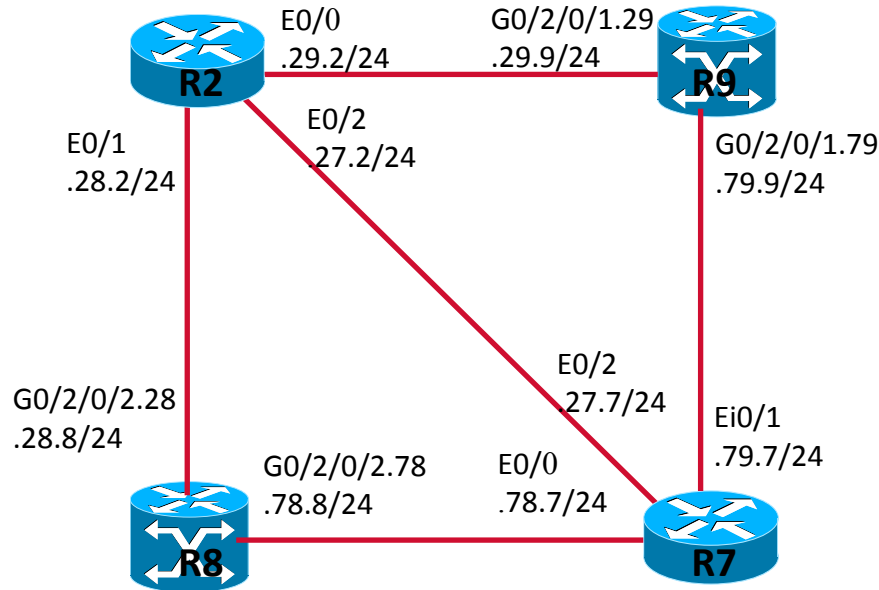
1.4 – Implement, Optimize and Troubleshoot MPLS and LDP

- For more details, please review the Lab Exam Checklist document below;

<https://learningnetwork.cisco.com/docs/DOC-10145>



# MPLS LDP – Sub Topology and Question



- Enable MPLS LDP on above routers, use loopback 0 IP address as router-id
- IS-IS is acting as unicast routing protocol

# MPLS LDP Configuration

## R2 (IOS) configuration

```
mpls label protocol ldp
mpls ldp router-id Loopback0
!
interface Loopback0
ip address 2.2.0.2 255.255.255.255
mpls ip
!
interface Ethernet0/0
ip address 2.2.29.2 255.255.255.0
mpls ip
!
interface Ethernet0/1
ip address 2.2.28.2 255.255.255.0
mpls ip
!
```

```
interface Ethernet0/2
ip address 2.2.27.2 255.255.255.0
mpls ip
!
```

# MPLS LDP Configuration (Cont.)

## R8 (IOS-XR) configuration

```
interface Loopback0
  ipv4 address 2.2.0.8 255.255.255.255
  !
interface GigabitEthernet0/2/0/2.28
  ipv4 address 2.2.28.8 255.255.255.0
  dot1q vlan 28
  !
interface GigabitEthernet0/2/0/2.78
  ipv4 address 2.2.78.8 255.255.255.0
  dot1q vlan 78
  !
```

```
mpls ldp
  router-id 2.2.0.8
  !
  interface GigabitEthernet0/2/0/2.28
  !
  interface GigabitEthernet0/2/0/2.78
  !
  !
```

# MPLS LDP Configuration (Cont.)

## R7 (IOS) configuration

```
mpls label protocol ldp
mpls ldp router-id Loopback0
!
interface Loopback0
ip address 2.2.0.7 255.255.255.255
mpls ip
!
interface Ethernet0/0
ip address 2.2.78.7 255.255.255.0
mpls ip
!
interface Ethernet0/1
ip address 2.2.79.7 255.255.255.0
mpls ip
```

```
interface Ethernet0/2
ip address 2.2.27.7 255.255.255.0
mpls ip
!
```

# MPLS LDP Configuration (Cont.)

## R9 (IOS-XR) configuration

```
interface Loopback0
  ipv4 address 2.2.0.9 255.255.255.255
!
interface GigabitEthernet0/2/0/1.29
  ipv4 address 2.2.29.9 255.255.255.0
  dot1q vlan 29
!
interface GigabitEthernet0/2/0/1.79
  ipv4 address 2.2.79.9 255.255.255.0
  dot1q vlan 79
!
```

```
mpls ldp
  router-id 2.2.0.9
!
interface GigabitEthernet0/2/0/1.29
!
interface GigabitEthernet0/2/0/1.79
!
!
```

# MPLS LDP Adjacency

R2#show mpls ldp neighbor

Peer LDP Ident: 2.2.0.7:0; Local LDP Ident 2.2.0.2:0

TCP connection: 2.2.0.7.56629 - 2.2.0.2.646

State: Oper; Msgs sent/rcvd: 258/248; Downstream

Up time: 03:19:04

LDP discovery sources:

Ethernet0/2, Src IP addr: 2.2.27.7

Targeted Hello 2.2.0.2 -> 2.2.0.7, active, passive

Addresses bound to peer LDP Ident:

2.2.0.7      2.2.27.7      2.2.78.7      2.2.79.7

Peer LDP Ident: 2.2.0.9:0; Local LDP Ident 2.2.0.2:0

TCP connection: 2.2.0.9.16960 - 2.2.0.2.646

State: Oper; Msgs sent/rcvd: 247/249; Downstream

Up time: 03:18:59

LDP discovery sources:

Ethernet0/0, Src IP addr: 2.2.29.9

Addresses bound to peer LDP Ident:

2.2.0.9      2.2.29.9      2.2.79.9

Peer LDP Ident: 2.2.0.8:0; Local LDP Ident 2.2.0.2:0

TCP connection: 2.2.0.8.36575 - 2.2.0.2.646

State: Oper; Msgs sent/rcvd: 248/243; Downstream

Up time: 03:18:59

LDP discovery sources:

Ethernet0/1, Src IP addr: 2.2.28.8

Addresses bound to peer LDP Ident:

2.2.0.8      2.2.28.8      2.2.78.8

# MPLS LDP Adjacency (Cont.)

RP/0/0/CPU0:R8#show mpls ldp neighbor

Peer LDP Identifier: 2.2.0.7:0

TCP connection: 2.2.0.7:646 - 2.2.0.8:48153

Graceful Restart: No

Session Holdtime: 180 sec

State: Oper; Msgs sent/rcvd: 244/245

Up time: 03:15:48

LDP Discovery Sources:

Targeted Hello (2.2.0.8 -> 2.2.0.7, active/passive)

GigabitEthernet0/2/0/2.78

Addresses bound to this peer:

2.2.0.7      2.2.79.7      2.2.27.7      2.2.78.7

Peer LDP Identifier: 2.2.0.2:0

TCP connection: 2.2.0.2:646 - 2.2.0.8:36575

Graceful Restart: No

Session Holdtime: 180 sec

State: Oper; Msgs sent/rcvd: 239/244

Up time: 03:15:47

LDP Discovery Sources:

GigabitEthernet0/2/0/2.28

Addresses bound to this peer:

2.2.0.2      2.2.29.2      2.2.27.2      2.2.28.2

# MPLS forwarding table

R2#show mpls forwarding-table

Local Label	Outgoing Label or VC	Prefix or Tunnel Id	Bytes Switched	Outgoing interface	Next Hop
17	Pop Label	2.2.0.9/32	362367	Et0/0	2.2.29.9
18	Pop Label	2.2.0.8/32	1042947	Et0/1	2.2.28.8
19	Pop Label	2.2.0.7/32	455	Et0/2	2.2.27.7
21	Pop Label	2.2.79.0/24	0	Et0/2	2.2.27.7
	Pop Label	2.2.79.0/24	0	Et0/0	2.2.29.9
23	Pop Label	2.2.78.0/24	0	Et0/2	2.2.27.7
	Pop Label	2.2.78.0/24	0	Et0/1	2.2.28.8

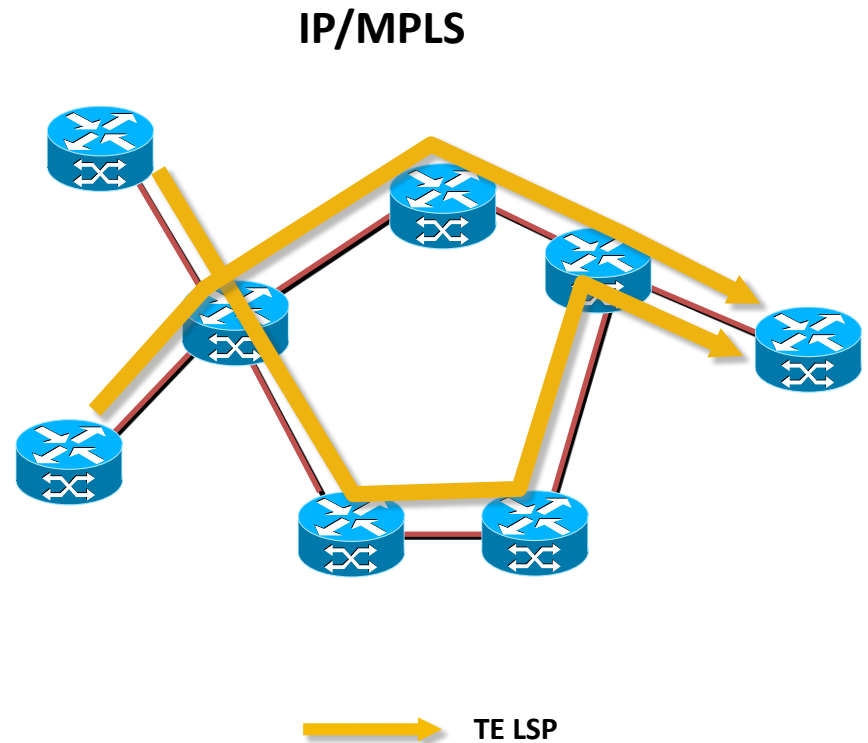
RP/0/0/CPU0:R8#show mpls forwarding

Local Label	Outgoing Label	Prefix or ID	Outgoing Interface	Next Hop Switched	Bytes
16002	Pop	2.2.0.2/32	Gi0/2/0/2.28	2.2.28.2	173494
16003	17	2.2.0.9/32	Gi0/2/0/2.28	2.2.28.2	300861
	21	2.2.0.9/32	Gi0/2/0/2.78	2.2.78.7	330246
16004	Pop	2.2.27.0/24	Gi0/2/0/2.28	2.2.28.2	0
	Pop	2.2.27.0/24	Gi0/2/0/2.78	2.2.78.7	0
16006	Pop	2.2.79.0/24	Gi0/2/0/2.78	2.2.78.7	0
16007	Pop	2.2.29.0/24	Gi0/2/0/2.28	2.2.28.2	0
16014	Pop	2.2.0.7/32	Gi0/2/0/2.78	2.2.78.7	72967



# MPLS Traffic Engineering Overview

- Introduces **explicit routing**
- Supports **constraint-based routing**
- Supports **admission control**
- Provides **protection** capabilities
- Uses **RSVP-TE** to establish LSPs
- Uses **ISIS/OSPF extensions** to advertise link attributes



# Mapping to Lab Exam Blueprint

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<https://learningnetwork.cisco.com/docs/DOC-9991>

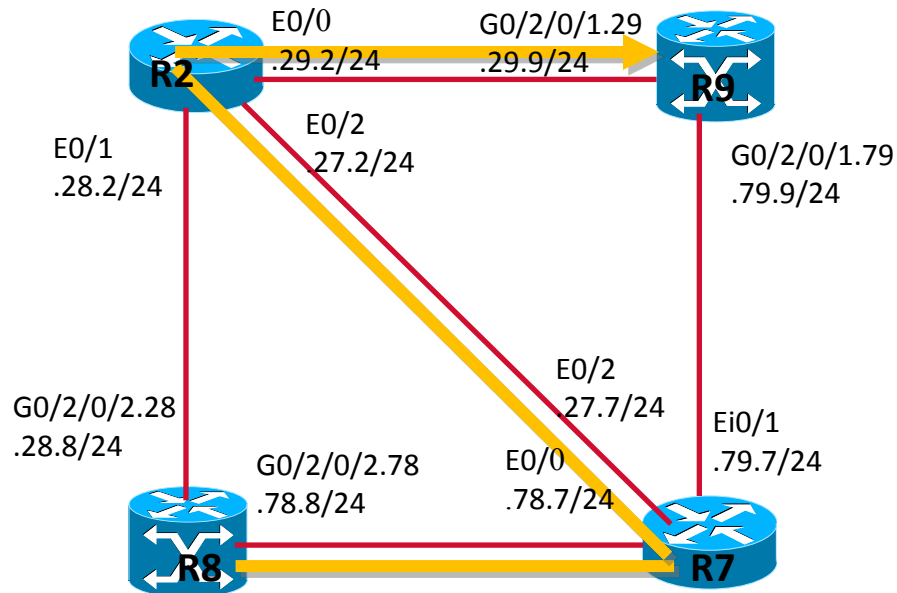
1.0 – Implement, Optimize and Troubleshoot Core IP Technologies

1.5 – Implement, Optimize and Troubleshoot MPLS Traffic Engineering

- For more details, please review the Lab Exam Checklist document below;

<https://learningnetwork.cisco.com/docs/DOC-10145>

# MPLS TE – Sub Topology and Question



- Configure MPLS TE tunnel 89 on R8, the tunnel path follows through R7 and R2 to reach R9
- Configure auto-route to follow traffic along tunnel 89
- Configure Tunnel bandwidth of 2Mbps
- Ensure traffic from R8 to R9 loopback0 follow the tunnel 89

# MPLS TE Configuration

## R2 (IOS) configuration

```
mpls traffic-eng tunnels
!  
interface Ethernet0/0  
ip address 2.2.29.2 255.255.255.0  
ip router isis  
mpls traffic-eng tunnels  
mpls ip  
ip rsvp bandwidth 25000  
!  
interface Ethernet0/1  
ip address 2.2.28.2 255.255.255.0  
ip router isis  
mpls traffic-eng tunnels  
mpls ip  
ip rsvp bandwidth 25000  
!
```

```
interface Ethernet0/2  
ip address 2.2.27.2 255.255.255.0  
ip router isis  
mpls traffic-eng tunnels  
mpls ip  
ip rsvp bandwidth 25000  
!  
router isis  
net 47.0002.0000.0000.0002.00  
is-type level-1  
metric-style wide  
mpls traffic-eng router-id Loopback0  
mpls traffic-eng level-1  
!
```

# MPLS TE Configuration (Cont.)

## R7 (IOS) configuration

```
mpls traffic-eng tunnels
!  
interface Ethernet0/0  
ip address 2.2.78.7 255.255.255.0  
ip router isis  
mpls traffic-eng tunnels  
mpls ip  
ip rsvp bandwidth 25000  
!  
interface Ethernet0/1  
ip address 2.2.79.7 255.255.255.0  
ip router isis  
mpls traffic-eng tunnels  
mpls ip  
ip rsvp bandwidth 25000  
!
```

```
interface Ethernet0/2  
ip address 2.2.27.7 255.255.255.0  
ip router isis  
mpls traffic-eng tunnels  
mpls ip  
ip rsvp bandwidth 25000  
!  
router isis  
net 47.0002.0000.0000.0007.00  
is-type level-1  
metric-style wide  
mpls traffic-eng router-id Loopback0  
mpls traffic-eng level-1  
!
```

# MPLS TE Configuration (Cont.)

## R8 (IOS-XR) configuration

```
explicit-path name exp_8t9
index 10 next-address strict ipv4 unicast 2.2.78.7
index 20 next-address strict ipv4 unicast 2.2.27.2
index 30 next-address strict ipv4 unicast 2.2.29.9
!
interface tunnel-te89
ipv4 unnumbered Loopback0
priority 7 7
autoroute announce
signalled-bandwidth 2000
destination 2.2.0.9
path-option 1 explicit name exp_8t9
!
```

```
router isis abc
is-type level-1
net 47.0002.0000.0000.0008.00
address-family ipv4 unicast
metric-style wide
mpls traffic-eng level-1
mpls traffic-eng router-id Loopback0
!
mpls traffic-eng
interface GigabitEthernet0/2/0/2.28
!
interface GigabitEthernet0/2/0/2.78
!
rsvp
interface GigabitEthernet0/2/0/2.28
bandwidth 80000
!
interface GigabitEthernet0/2/0/2.78
bandwidth 80000
```

# MPLS TE Configuration (Cont.)

## R9 (IOS-XR) configuration

```
router isis abc
is-type level-1
net 47.0002.0000.0000.0009.00
address-family ipv4 unicast
metric-style wide
mpls traffic-eng level-1
mpls traffic-eng router-id Loopback0
!
mpls traffic-eng
interface GigabitEthernet0/2/0/2.29
!
interface GigabitEthernet0/2/0/2.79
!
rsvp
interface GigabitEthernet0/2/0/2.29
bandwidth 80000
!
interface GigabitEthernet0/2/0/2.79
bandwidth 80000
```

# MPLS TE Tunnel

RP/0/0/CPU0:R8#show mpls traffic-eng tunnels 89

Name: tunnel-te89 Destination: 2.2.0.9

Status:

Admin: up Oper: up Path: valid Signalling: connected  
path option 1, type explicit exp\_8t9 (Basis for Setup, path weight 30)  
G-PID: 0x0800 (derived from egress interface properties)  
Bandwidth Requested: 2000 kbps CT0

Config Parameters:

Bandwidth: 2000 kbps (CT0) Priority: 7 7 Affinity: 0x0/0xffff  
Metric Type: TE (default)  
AutoRoute: enabled LockDown: disabled Policy class: not set  
Loadshare: 0 equal loadshares  
Auto-bw: disabled  
Direction: unidirectional  
Endpoint switching capability: unknown, encoding type: unassigned  
Transit switching capability: unknown, encoding type: unassigned  
Fast Reroute: Disabled, Protection Desired: None

Path info (ISIS abc level-1):

Hop0: 2.2.78.8  
Hop1: 2.2.78.7  
Hop2: 2.2.27.2  
Hop3: 2.2.29.2  
Hop4: 2.2.29.9  
Hop5: 2.2.0.9



# MPLS TE Tunnel (Cont.)

R7#show mpls traffic-eng tunnels

LSP Tunnel R8\_t89 is signalled, connection is up

InLabel : Ethernet0/0, 19

OutLabel : Ethernet0/2, 34

RSVP Signalling Info:

Src 2.2.0.8, Dst 2.2.0.9, Tun\_Id 89, Tun\_Instance 4016

RSVP Path Info:

My Address: 2.2.27.7

Explicit Route: 2.2.27.2 2.2.29.2 2.2.29.9 2.2.0.9

Record Route: NONE

Tspec: ave rate=2000 kbits, burst=1000 bytes, peak rate=2000 kbits

RSVP Resv Info:

Record Route: 2.2.0.2(34) 2.2.0.9(3)

2.2.29.9(3)

Fspec: ave rate=2000 kbits, burst=1000 bytes, peak rate=2000 kbits

# MPLS TE Tunnel (Cont.)

R2#show mpls traffic-eng tunnels

LSP Tunnel R8\_t89 is signalled, connection is up

InLabel : Ethernet0/2, 34

OutLabel : Ethernet0/0, implicit-null

FRR OutLabel : Tunnel279, implicit-null

RSVP Signalling Info:

Src 2.2.0.8, Dst 2.2.0.9, Tun\_Id 89, Tun\_Instance 4016

RSVP Path Info:

My Address: 2.2.29.2

Explicit Route: 2.2.29.9 2.2.0.9

Record Route: NONE

Tspec: ave rate=2000 kbits, burst=1000 bytes, peak rate=2000 kbits

RSVP Resv Info:

Record Route: 2.2.0.9(3) 2.2.29.9(3)

Fspec: ave rate=2000 kbits, burst=1000 bytes, peak rate=2000 kbits

# MPLS TE Tunnel (Cont.)

RP/0/0/CPU0:R9#show mpls traffic-eng tunnels

LSP Tunnel 2.2.0.8 89 [4016] is signalled, connection is up

Tunnel Name: R8\_t89 Tunnel Role: Tail

InLabel: GigabitEthernet0/2/0/1.29, implicit-null

Signalling Info:

Src 2.2.0.8 Dst 2.2.0.9, Tun ID 89, Tun Inst 4016, Ext ID 2.2.0.8

Router-IDs: upstream 2.2.0.2

local 2.2.0.9

Path Info:

Incoming Address: 2.2.29.9

Incoming Explicit Route:

Strict, 2.2.29.9

Strict, 2.2.0.9

Record Route: None

Tspec: avg rate=2000 kbits, burst=1000 bytes, peak rate=2000 kbits

Session Attributes: Local Prot: Set, Node Prot: Not Set, BW Prot: Not Set

Resv Info:

Record Route: None

Fspec: avg rate=0 kbits, burst=0 bytes, peak rate=0 kbits

# Routing table and MPLS table

RP/0/0/CPU0:R8#show route ipv4 isis

```
i L1 2.2.0.2/32 [115/20] via 2.2.28.2, 05:06:13, GigabitEthernet0/2/0/2.28
i L1 2.2.0.7/32 [115/20] via 2.2.78.7, 05:06:13, GigabitEthernet0/2/0/2.78
i L1 2.2.0.9/32 [115/20] via 2.2.0.9, 00:42:43, tunnel-te89
i L1 2.2.27.0/24 [115/20] via 2.2.78.7, 05:06:13, GigabitEthernet0/2/0/2.78
    [115/20] via 2.2.28.2, 05:06:13, GigabitEthernet0/2/0/2.28
i L1 2.2.29.0/24 [115/20] via 2.2.28.2, 05:06:13, GigabitEthernet0/2/0/2.28
i L1 2.2.79.0/24 [115/20] via 2.2.78.7, 05:06:13, GigabitEthernet0/2/0/2.78
```

RP/0/0/CPU0:R8#show mpls forwarding

Local Label	Outgoing Label	Prefix or ID	Outgoing Interface	Next Hop	Bytes Switched
16002	Pop	2.2.0.2/32	Gi0/2/0/2.28	2.2.28.2	106
16003	Pop	2.2.0.9/32	tt89	2.2.0.9	1200
16004	Pop	2.2.27.0/24	Gi0/2/0/2.28	2.2.28.2	0
	Pop	2.2.27.0/24	Gi0/2/0/2.78	2.2.78.7	0
16006	Pop	2.2.79.0/24	Gi0/2/0/2.78	2.2.78.7	0
16007	Pop	2.2.29.0/24	Gi0/2/0/2.28	2.2.28.2	0

# Connection and path verification

```
RP/0/0/CPU0:R8#ping 2.2.0.9 source 2.2.0.8
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 2.2.0.9, timeout is 2 seconds:

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 18/19/21 ms

```
RP/0/0/CPU0:R8#traceroute 2.2.0.9 source 2.2.0.8
```

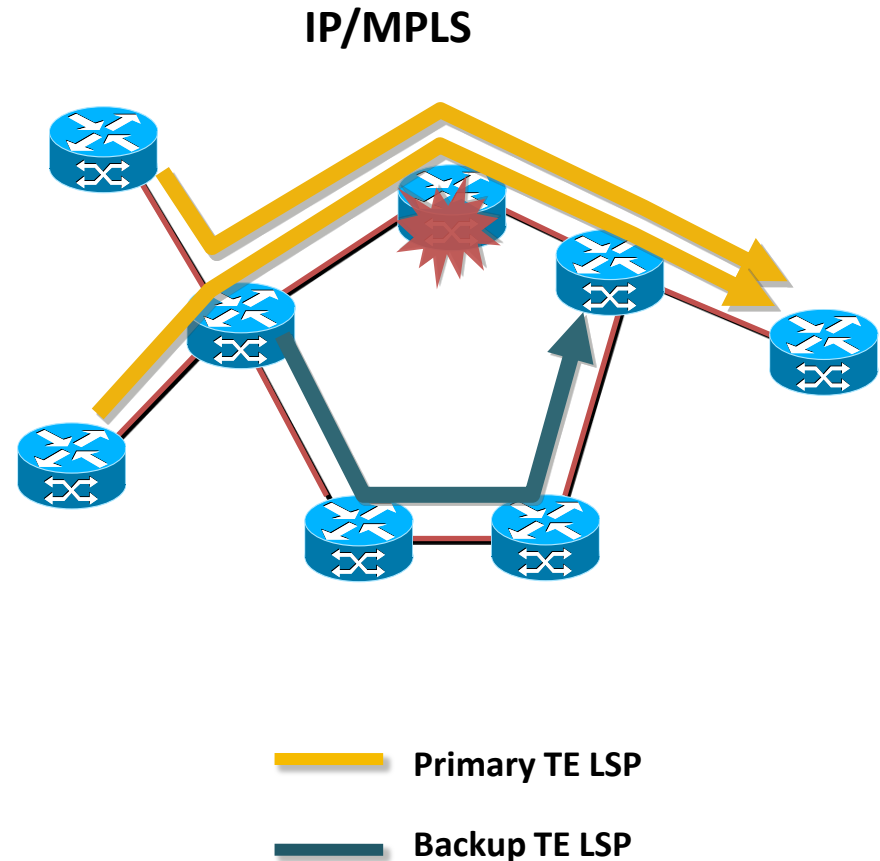
Type escape sequence to abort.

Tracing the route to 2.2.0.9

```
1 2.2.78.7 [MPLS: Label 19 Exp 0] 20 msec 28 msec 18 msec
2 2.2.27.2 [MPLS: Label 34 Exp 0] 20 msec 20 msec 18 msec
3 2.2.29.9 22 msec * 18 msec
```

# MPLS TE Fast Re-Route (FRR)

- Subsecond recovery against node/link failures
- Scalable 1:N protection
- Greater protection granularity
- Cost-effective alternative to optical protection
- Bandwidth protection



# Mapping to Lab Exam Blueprint

- This question of the sample lab maps to following sections/sub-sections in the Lab Exam Blueprint document below;

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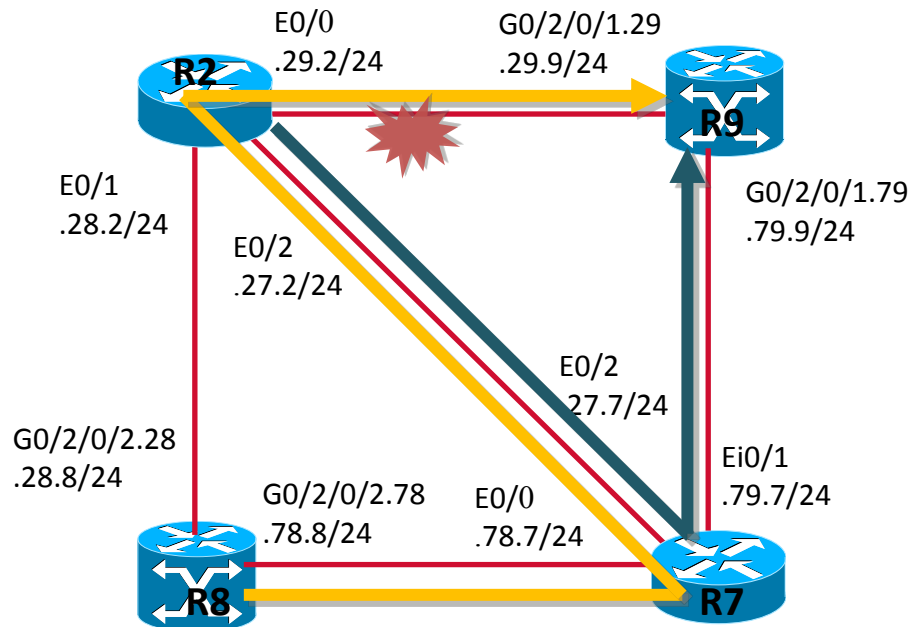
1.0 – Implement, Optimize and Troubleshoot Core IP Technologies

1.8 – Implement, Optimize and Troubleshoot High availability

- For more details, please review the Lab Exam Checklist document below;

<https://learningnetwork.cisco.com/docs/DOC-10145>

# MPLS TE FRR – Sub Topology and Question



- The Primary tunnel 89 on R8 has configured in Question 5 (Refer to part 2/7)
- Configure Backup tunnel 279 on R2 to protect the Ethernet link between R2 and R9, tunnel 279 is from R2 to R9 through R7. If R2 Eth0/2 detect link problem, it switches Tunnel 89 traffic into tunnel 279



# MPLS TE FRR Configuration

## R2 (IOS) configuration

```
interface Tunnel279
ip unnumbered Loopback0
mpls ip
tunnel destination 2.2.0.9
tunnel mode mpls traffic-eng
tunnel mpls traffic-eng path-option 10 explicit name 2t9
!
interface Ethernet0/0
ip address 2.2.29.2 255.255.255.0
ip router isis
mpls traffic-eng tunnels
mpls traffic-eng backup-path Tunnel279
mpls ip
ip rsvp bandwidth 25000
!
ip explicit-path name 2t9 enable
next-address 2.2.27.7
next-address 2.2.79.9
!
```

# MPLS TE FRR Configuration (Cont.)

## R8 (IOS-XR) configuration

```
explicit-path name expp_8t9
index 10 next-address strict ipv4 unicast 2.2.78.7
index 20 next-address strict ipv4 unicast 2.2.27.2
index 30 next-address strict ipv4 unicast 2.2.29.9
!
interface tunnel-te89
ipv4 unnumbered Loopback0
priority 7 7
autoroute announce
signalled-bandwidth 2000
destination 2.2.0.9
fast-reroute
path-option 1 explicit name expp_8t9
!
```

# MPLS TE FRR Tunnel

RP/0/0/CPU0:R8#show mpls traffic-eng tunnels 89

Name: tunnel-te89 Destination: 2.2.0.9

Status:

Admin: up Oper: up Path: valid Signalling: connected  
path option 1, type explicit exp\_8t9 (Basis for Setup, path weight 30)  
G-PID: 0x0800 (derived from egress interface properties)  
Bandwidth Requested: 2000 kbps CT0

Config Parameters:

Bandwidth: 2000 kbps (CT0) Priority: 7 7 Affinity: 0x0/0xffff  
Metric Type: TE (default)  
AutoRoute: enabled LockDown: disabled Policy class: not set  
Loadshare: 0 equal loadshares  
Auto-bw: disabled  
Direction: unidirectional  
Endpoint switching capability: unknown, encoding type: unassigned  
Transit switching capability: unknown, encoding type: unassigned  
Fast Reroute: Enabled, Protection Desired: Any

# MPLS TE FRR Tunnel (Cont.)

R2#show mpls traffic-eng tunnels backup

R2\_t279

LSP Head, Tunnel279, Admin: up, Oper: up

Src 2.2.0.2, Dest 2.2.0.9, Instance 1

Fast Reroute Backup Provided:

Protected i/fs: Et0/0

Protected Isps: 1 Active Isps: 0

Backup BW: any pool unlimited; inuse: 2000 kbps

R2#show mpls traffic-eng fast-reroute database

Headend frr information:

Protected tunnel	In-label	Out intf/label	FRR intf/label	Status
------------------	----------	----------------	----------------	--------

LSP midpoint frr information:

LSP identifier	In-label	Out intf/label	FRR intf/label	Status
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2.2.0.8 89 [1392]	34	Et0/0:implicit-n	Tu279:implicit-n	ready
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# Verification

Shutdown R2 Ethernet0/0, FRR takes effect, R8 traffic should follow path of R8-R7-R2-R7-R9

```
RP/0/0/CPU0:R8#traceroute 2.2.0.9 source 2.2.0.8
```

Type escape sequence to abort.

Tracing the route to 2.2.0.9

```
1 2.2.78.7 [MPLS: Label 19 Exp 0] 27 msec 24 msec 18 msec
2 2.2.27.2 [MPLS: Label 34 Exp 0] 18 msec 21 msec 21 msec
3 2.2.27.7 [MPLS: Label 18 Exp 0] 18 msec 20 msec 19 msec
4 2.2.79.9 21 msec * 18 msec
```

```
R2#show mpls traffic-eng tunnels backup
```

```
R2_t279
```

LSP Head, Tunnel279, Admin: up, Oper: up

Src 2.2.0.2, Dest 2.2.0.9, Instance 1

Fast Reroute Backup Provided:

Protected i/fs: Et0/0

Protected lsps: 1 Active lsps: 1

Backup BW: any pool unlimited; inuse: 2000 kbps



**CISCO**