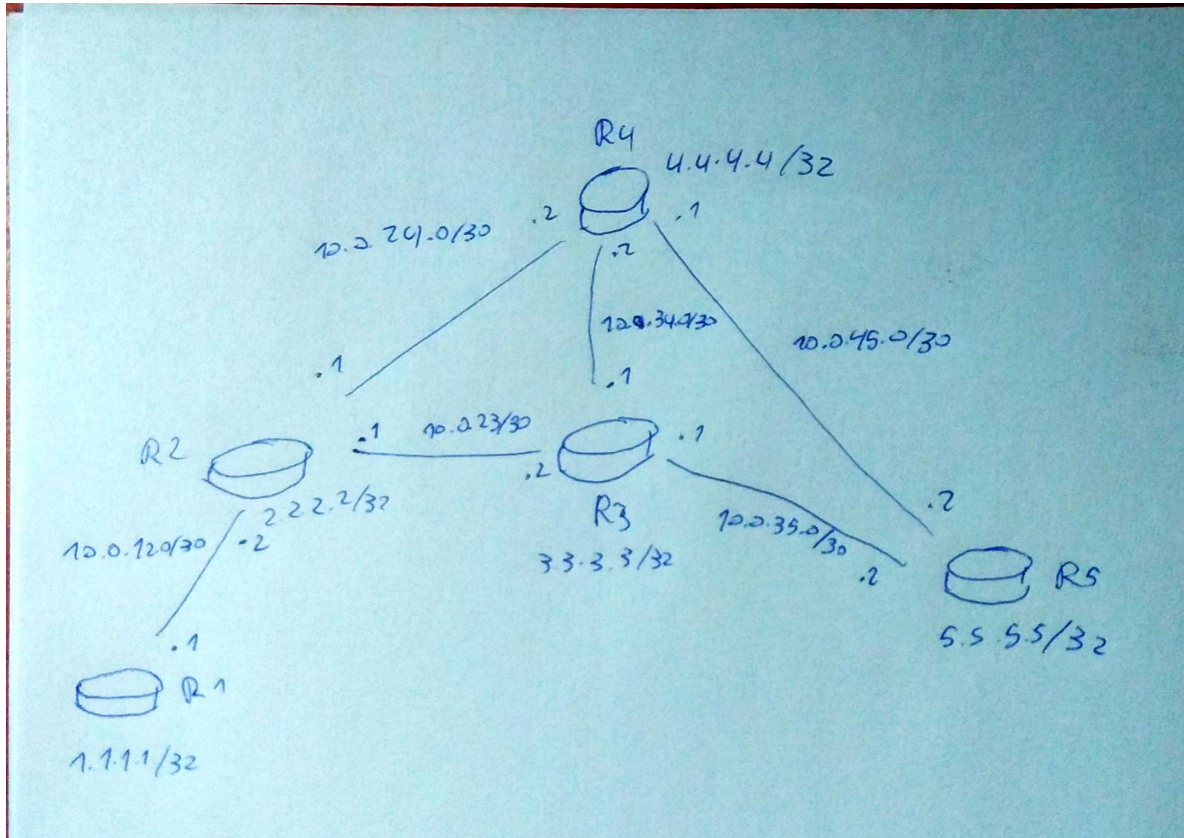


# LAB EXERCISE – MPLS

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## A. CONFIGURATION OF IP ADRESSES OF ROUTERS AND INTERFACES



## B. RUNNING OSPF

```
R1#traceroute 5.5.5.5 source 1.1.1.1
```

Type escape sequence to abort.

Tracing the route to 5.5.5.5

```
 1 10.0.12.2 768 msec 260 msec 20 msec
 2 10.0.24.2 1176 msec 184 msec 48 msec
 3 10.0.45.2 1696 msec 764 msec 316 msec
```

```
R2#traceroute 3.3.3.3 source 2.2.2.2
```

Type escape sequence to abort.

Tracing the route to 3.3.3.3

```
 1 10.0.24.2 4 msec 484 msec 120 msec
 2 10.0.34.1 412 msec 200 msec 48 msec
```

## C. BASIC MPLS CONFIGURATION

```
R1(config)#ip cef
R1(config)#int e0/0
R1(config-if)#mpls ip
R1(config-if)#e
```

## D. VERIFY MPLS/LDP SETUP

I've done the tests on all the routers, but for the sake of brevity I'm only going to put those on router 2:

```
R2#sh ip route 5.5.5.5
Routing entry for 5.5.5.5/32
  Known via "ospf 1", distance 110, metric 21, type intra area
  Last update from 10.0.24.2 on Ethernet0/1, 00:58:18 ago
  Routing Descriptor Blocks:
    * 10.0.24.2, from 5.5.5.5, 00:58:18 ago, via Ethernet0/1
      Route metric is 21, traffic share count is 1
```

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

Local tag	Outgoing tag or VC	Prefix or Tunnel Id	Bytes tag switched	Outgoing interface	Next Hop
16	Pop tag	1.1.1.1/32	0	Et0/0	10.0.12.1
17	18	3.3.3.3/32	0	Et0/1	10.0.24.2
18	Pop tag	4.4.4.4/32	0	Et0/1	10.0.24.2
19	19	5.5.5.5/32	0	Et0/1	10.0.24.2
20	Pop tag	10.0.45.0/30	0	Et0/1	10.0.24.2
21	Pop tag	10.0.34.0/30	0	Et0/1	10.0.24.2
22	22	10.0.35.0/30	0	Et0/1	10.0.24.2

```
R2#show mpls forwarding-table 10.0.45.0 detail
```

Local tag	Outgoing tag or VC	Prefix or Tunnel Id	Bytes tag switched	Outgoing interface	Next Hop
20	Pop tag	10.0.45.0/30	0	Et0/1	10.0.24.2

MAC/Encaps=14/14, MRU=1504, Tag Stack{}

CC0001660001CC03016600018847

No output feature configured

Per-packet load-sharing

Here we can see the explanation of an exact connection, with more details than the previous command.

```
R2#show mpls interfaces
```

Interface	IP	Tunnel	Operational
Ethernet0/0	Yes (ldp)	No	Yes
Ethernet0/1	Yes (ldp)	No	Yes
Ethernet0/2	Yes (ldp)	No	Yes

## E. CHECK PATHS

```
R1#traceroute 5.5.5.5
```

Type escape sequence to abort.

Tracing the route to 5.5.5.5

```
 1 10.0.12.2 [MPLS: Label 19 Exp 0] 152 msec 120 msec 68 msec
 2 10.0.24.2 [MPLS: Label 19 Exp 0] 184 msec 64 msec 84 msec
 3 10.0.45.2 120 msec 76 msec 68 msec
```

The packets take the expected path: R1 – R2 – R4 – R5. And it appears the label of MPLS in the traceroute, for noting that MPLS was used while forwarding

## F. CONFIGURE BASIC TRAFFIC ENGINEERING

### I. ENABLE TRAFFIC ENGINEERING FOR THE ROUTING PROTOCOL

```
R2#conf t
```

Enter configuration commands, one per line. End with CNTL/Z.

```
R2(config)#router ospf 1
```

```
R2(config-router)#mpls traffic-eng area 0
```

```
R2(config-router)#mpls traffic-eng router-id loopback0
```

```
R2(config-router)#exit
```

### II. ENABLE TRAFFIC ENGINEERING CAPABILITIES

```
R2#conf t
```

Enter configuration commands, one per line. End with CNTL/Z.

```
R2(config)#mpls traffic-eng tunnels
```

```
R2(config)#int e0/0
```

```
R2(config-if)#mpls traffic
```

```
R2(config-if)#mpls traffic-eng tunnels
```

```
R2(config-if)#e
```

```
R2(config)#int e0/1
```

```
R2(config-if)#mpls traffic-eng tunnels
```

```
R2(config-if)#e
```

```
R2(config)#int e0/2
```

```
R2(config-if)#mpls traffic-eng tunnels
```

```
R2(config-if)#e
```

```
R2(config)#
```

### III. ENABLE RSVP

```
R2(config)#in e0/1
R2(config-if)#ip rsvp bandwidth 64
R2(config-if)#e
```

```
R4(config)#in e0/1
R4(config-if)#ip rsvp bandwidth 64
R4(config-if)#e
```

### IV. SET UP TUNNEL TO BE USED FOR TE

```
R1(config)#interface tunnel1
R1(config-if)#no sh
R1(config-if)#mpls ip
R1(config-if)#ip unnumbered loopback0
R1(config-if)#no ip directed-broadcast
R1(config-if)#tunnel destination 5.5.5.5
R1(config-if)#tunnel mode mpls traffic-eng
R1(config-if)#tunnel mpls traffic-eng autoroute announce
R1(config-if)#tunnel mpls traffic-eng priority 5
R1(config-if)#tunnel mpls traffic-eng bandwidth 256
R1(config-if)#tunnel mpls traffic-eng path-option 2 dynamic
```

```
R5(config)#interface tunnel1
R5(config-if)#
R5(config-if)#no sh
R5(config-if)#mpls ip
R5(config-if)#ip unnumbered loopback0
R5(config-if)#no ip directed-broadcast
R5(config-if)#tunnel destination 1.1.1.1
R5(config-if)#tunnel mode mpls traffic-eng
R5(config-if)#tunnel mpls traffic-eng autoroute announce
R5(config-if)#tunnel mpls traffic-eng priority 5
R5(config-if)#tunnel mpls traffic-eng bandwidth 256
R5(config-if)#tunnel mpls traffic-eng path-option 2 dynamic
R5(config-if)#e
```

```
R1#show mpls traffic-eng tunnels
```

Name: R1\_t1 (Tunnel1) Destination: 5.5.5.5

Status:

Admin: up Oper: down Path: not valid Signalling: Down  
path option 2, type dynamic

Config Parameters:

Bandwidth: 256 kbps (Global) Priority: 5 5 Affinity: 0x0/0xFFFF  
Metric Type: TE (default)  
AutoRoute: enabled LockDown: disabled Loadshare: 256 bw-based  
auto-bw: disabled

History:  
Tunnel:  
Time since created: 3 minutes, 59 seconds

There are no differences, so the route will be the same

```
R1#traceroute 5.5.5.5 source 1.1.1.1
```

Type escape sequence to abort.  
Tracing the route to 5.5.5.5

```
 1 10.0.12.2 [MPLS: Label 19 Exp 0] 192 msec 72 msec 84 msec
 2 10.0.24.2 [MPLS: Label 19 Exp 0] 60 msec 64 msec 72 msec
 3 10.0.45.2 64 msec 56 msec 60 msec
```

```
R2(config)#int e0/2
R2(config-if)#ip rsvp bandwidth 64
R2(config-if)#e
```

```
R3(config)#in e0/2
R3(config-if)#ip rsvp bandwidth 64
R3(config-if)#e
```

## V. SET UP EXPLICIT PATH TUNNEL

```
R1(config)#int tunnel2
R1(config-if)#mpls ip
R1(config-if)#ip unnumbered loopback0
R1(config-if)#tunnel destination 5.5.5.5
R1(config-if)#tunnel mode mpls traffic-eng
R1(config-if)#tunnel mpls traffic-eng autoroute announce
R1(config-if)#tunnel mpls traffic-eng priority 2
R1(config-if)#tunnel mpls traffic-eng bandwidth 256
R1(config-if)#tunnel mpls traffic-eng path-option 1 explicit name MyPath
R1(config-if)#ip explicit-path name MyPath enable
R1(cfg-ip-expl-path)#next-address 2.2.2.2
Explicit Path name MyPath:
  1: next-address 2.2.2.2
R1(cfg-ip-expl-path)#next-address 3.3.3.3
Explicit Path name MyPath:
  1: next-address 2.2.2.2
  2: next-address 3.3.3.3
R1(cfg-ip-expl-path)#next-address 4.4.4.4
Explicit Path name MyPath:
  1: next-address 2.2.2.2
  2: next-address 3.3.3.3
  3: next-address 4.4.4.4
R1(cfg-ip-expl-path)#next-address 5.5.5.5
Explicit Path name MyPath:
```

```
1: next-address 2.2.2.2
2: next-address 3.3.3.3
3: next-address 4.4.4.4
4: next-address 5.5.5.5
R1(cfg-ip-expl-path)#exi
```

```
R1#sh ip int br
```

Interface	IP-Address	OK?	Method	Status
Ethernet0/0	10.0.12.1	YES	manual	up
Ethernet0/1	unassigned	YES	unset	administratively down
Ethernet0/2	unassigned	YES	unset	administratively down
Ethernet0/3	unassigned	YES	unset	administratively down
Loopback0	1.1.1.1	YES	manual	up
Tunnel1	1.1.1.1	YES	TFTP	administratively down
Tunnel2	1.1.1.1	YES	TFTP	up

We verify that the link and routing protocol is up for the tunnel interfaces.

## VI. ADDITIONAL INFO

```
![2019_12_20 11_05 Office Lens](D:\arturo\Descargas\Telegram Desktop\2019_12_20
11_05 Office Lens.jpg)R1#show ip ospf mpls traffic-eng link
```

```
OSPF Router with ID (1.1.1.1) (Process ID 1)
```

```
Area 0 MPLS TE not initialized
```

```
R1#show ip ospf database opaque-area
```

```
OSPF Router with ID (1.1.1.1) (Process ID 1)
```

```
Type-10 Opaque Link Area Link States (Area 0)
```

```
LS age: 1281
Options: (No TOS-capability, DC)
LS Type: Opaque Area Link
Link State ID: 1.0.0.0
Opaque Type: 1
Opaque ID: 0
Advertising Router: 2.2.2.2
LS Seq Number: 80000004
Checksum: 0xDB62
Length: 140
Fragment number : 0
```

```
MPLS TE router ID : 2.2.2.2
```

```
Link connected to Point-to-Point network
```

```
Link ID : 1.1.1.1
Interface Address : 10.0.12.2
Neighbor Address : 10.0.12.1
Admin Metric : 10
Maximum bandwidth : 1250000
Maximum reservable bandwidth : 64000
```

Number of Priority : 8  
Priority 0 : 64000      Priority 1 : 64000  
Priority 2 : 64000      Priority 3 : 64000  
Priority 4 : 64000      Priority 5 : 64000  
Priority 6 : 64000      Priority 7 : 64000  
Affinity Bit : 0x0  
IGP Metric : 10

Number of Links : 1

LS age: 1283  
Options: (No TOS-capability, DC)  
LS Type: Opaque Area Link  
Link State ID: 1.0.0.1  
Opaque Type: 1  
Opaque ID: 1  
Advertising Router: 2.2.2.2  
LS Seq Number: 80000005  
Checksum: 0xF537  
Length: 132  
Fragment number : 1

Link connected to Point-to-Point network

Link ID : 4.4.4.4  
Interface Address : 10.0.24.1  
Neighbor Address : 10.0.24.2  
Admin Metric : 10  
Maximum bandwidth : 1250000  
Maximum reservable bandwidth : 64000  
Number of Priority : 8  
Priority 0 : 64000      Priority 1 : 64000  
Priority 2 : 64000      Priority 3 : 64000  
Priority 4 : 64000      Priority 5 : 64000  
Priority 6 : 64000      Priority 7 : 64000  
Affinity Bit : 0x0  
IGP Metric : 10

Number of Links : 1

LS age: 1034  
Options: (No TOS-capability, DC)  
LS Type: Opaque Area Link  
Link State ID: 1.0.0.2  
Opaque Type: 1  
Opaque ID: 2  
Advertising Router: 2.2.2.2  
LS Seq Number: 80000004  
Checksum: 0xAD5E  
Length: 132  
Fragment number : 2

Link connected to Point-to-Point network

Link ID : 3.3.3.3  
Interface Address : 10.0.23.1  
Neighbor Address : 10.0.23.2  
Admin Metric : 100  
Maximum bandwidth : 1250000  
Maximum reservable bandwidth : 8000

Number of Priority : 8

Priority 0 : 8000

Priority 1 : 8000

Priority 2 : 8000

Priority 3 : 8000

Priority 4 : 8000

Priority 5 : 8000

Priority 6 : 8000

Priority 7 : 8000

Affinity Bit : 0x0

IGP Metric : 100

Number of Links : 1