

Routing  
Switching  
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Forum



MPLS

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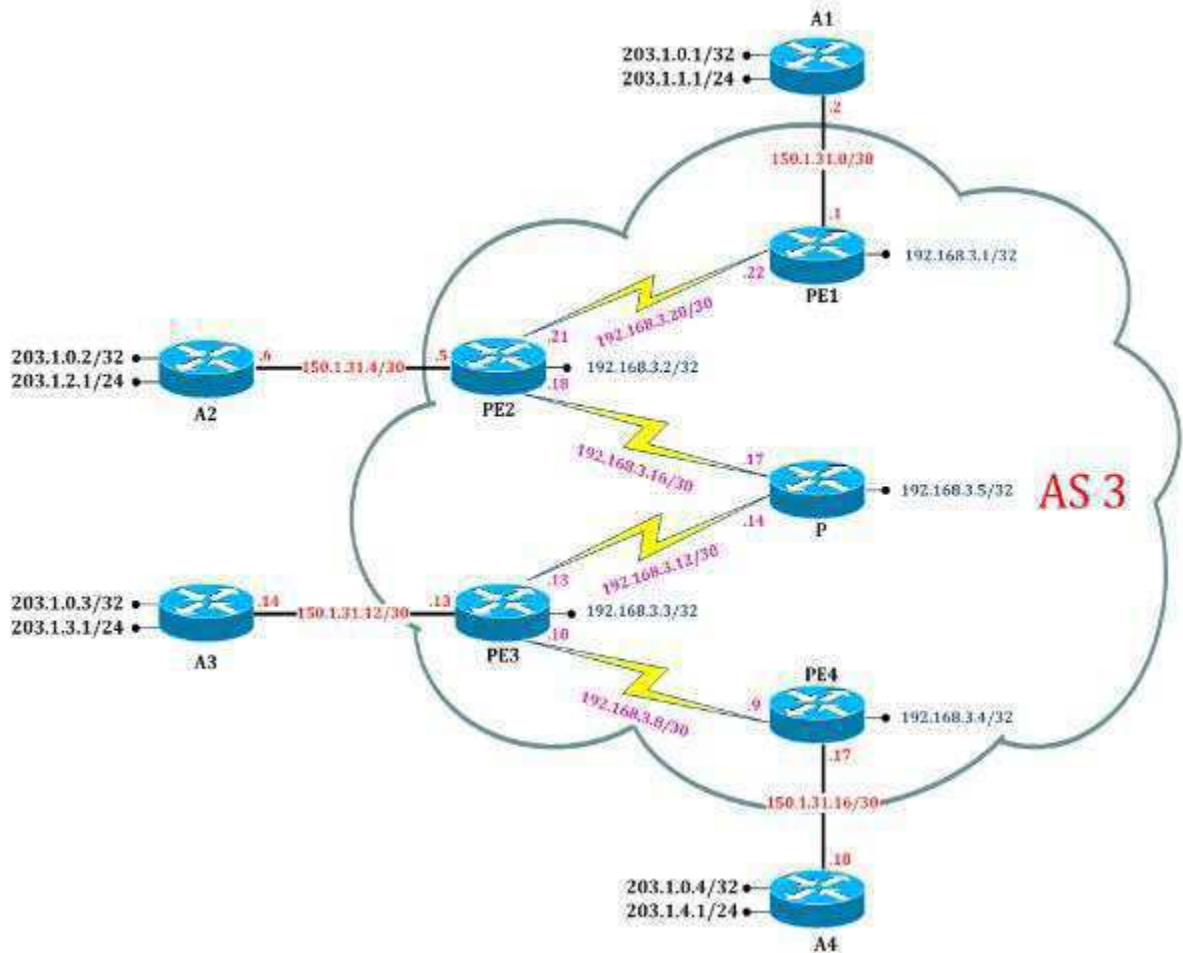
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# Basic MPLS with OSPF

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IOS used: c7200-p-mz.120-32.S.bin



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### A1 Router Initial Config:

```
!  
interface Loopback0  
ip address 203.1.0.1 255.255.255.255  
no ip directed-bro
```

### PE1 Router Initial Config:

```
!  
interface Loopback0  
ip address 192.168.3.1 255.255.255.255  
no ip directed-broadcast
```

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```
!  
interface Loopback1  
ip address 203.1.1.1 255.255.255.0  
no ip directed-broadcast  
!  
interface FastEthernet0/0  
ip address 150.1.31.2 255.255.255.252  
no ip directed-broadcast  
duplex half  
speed auto  
!
```

```
!  
interface Serial2/0  
ip address 192.168.3.22 255.255.255.252  
no ip directed-broadcast  
!  
interface FastEthernet0/0  
ip address 150.1.31.1 255.255.255.252  
no ip directed-broadcast  
duplex half  
speed auto  
!
```

**A2 Router Initial Config:**

```
!  
interface Loopback0  
ip address 203.1.0.2 255.255.255.255  
no ip directed-broadcast  
!  
interface Loopback1  
ip address 203.1.2.1 255.255.255.0  
no ip directed-broadcast  
!  
interface FastEthernet0/0  
ip address 150.1.31.6 255.255.255.252  
no ip directed-broadcast  
duplex half  
speed auto  
!
```

**PE2 Router Initial Config:**

```
!  
interface Loopback0  
ip address 192.168.3.2 255.255.255.255  
no ip directed-broadcast  
!  
interface Serial2/0  
ip address 192.168.3.21 255.255.255.252  
no ip directed-broadcast  
!  
interface Serial2/1  
ip address 192.168.3.18 255.255.255.252  
no ip directed-broadcast  
!  
interface FastEthernet0/0  
ip address 150.1.31.5 255.255.255.252  
no ip directed-broadcast  
duplex half  
speed auto  
!
```

**A3 Router Initial Config:**

```
!  
interface Loopback1  
ip address 203.1.0.3 255.255.255.255
```

**PE3 Router Initial Config:**

```
!  
interface Loopback1  
ip address 192.168.3.3 255.255.255.255
```

```
no ip directed-broadcast
!  
interface Loopback2  
ip address 203.1.3.1 255.255.255.0  
no ip directed-broadcast  
!  
interface FastEthernet0/0  
ip address 150.1.31.14 255.255.255.252  
no ip directed-broadcast  
duplex half  
speed auto  
!
```

```
no ip directed-broadcast  
!  
interface Serial2/0  
ip address 192.168.3.13 255.255.255.252  
no ip directed-broadcast  
no fair-queue  
!  
interface Serial2/1  
ip address 192.168.3.10 255.255.255.252  
no ip directed-broadcast  
!  
interface FastEthernet0/0  
ip address 150.1.3.13 255.255.255.252  
no ip directed-broadcast  
duplex half  
speed auto  
!
```

**A4 Router Initial Config:**

```
!  
interface Loopback1  
ip address 203.1.0.4 255.255.255.255  
no ip directed-broadcast  
!  
interface Loopback2  
ip address 203.1.4.1 255.255.255.0  
no ip directed-broadcast  
!  
interface FastEthernet0/0  
ip address 150.1.31.18 255.255.255.252  
no ip directed-broadcast  
duplex half  
speed auto  
!
```

**PE4 Router Initial Config:**

```
!  
interface Loopback1  
ip address 192.168.3.4 255.255.255.255  
no ip directed-broadcast  
!  
interface Serial2/1  
ip address 192.168.3.9 255.255.255.252  
no ip directed  
!  
interface FastEthernet0/0  
ip address 150.1.31.17 255.255.255.252  
no ip directed-broadcast  
duplex half  
speed auto  
!
```

**P Router Config:**

```
!
```

```

ip cef
mpls label protocol ldp
!
interface Loopback0
ip address 192.168.3.5 255.255.255.255
no ip directed-broadcast
!
ip address 192.168.3.14 255.255.255.252
no ip directed-broadcast tag-switching ip
!
interface Serial2/1
ip address 192.168.3.17 255.255.255.252
no ip directed-broadcast
tag-switching ip
!
router ospf 1
log-adjacency-changes
network 192.168.3.0 0.0.0.255 area 0
!

```

### **Task 1: BASIC MPLS Setup**

#### **1. Configure OSPF on all Provider edge and core routers to learn internal routes.**

Configure OSPF on all PE-routers and P-router

```
(Config)# router ospf 1
```

```
(Config-router)# network 192.168.0.0 0.0.255.255 area 0
```

**Verification:** Nine routes of 192.168.0.0 network should be visible in routing table:

```

PE4#sho ip route
  192.168.3.0/24 is variably subnetted, 9 subnets, 2 masks
C    192.168.3.8/30 is directly connected, Serial2/1
O    192.168.3.12/30 [110/96] via 192.168.3.10, 01:35:03, Serial2/1
O    192.168.3.3/32 [110/49] via 192.168.3.10, 01:35:03, Serial2/1
O    192.168.3.2/32 [110/145] via 192.168.3.10, 01:35:03, Serial2/1
O    192.168.3.1/32 [110/193] via 192.168.3.10, 01:35:03, Serial2/1
O    192.168.3.5/32 [110/97] via 192.168.3.10, 01:35:03, Serial2/1
C    192.168.3.4/32 is directly connected, Loopback0
O    192.168.3.16/30 [110/144] via 192.168.3.10, 01:35:03, Serial2/1
O    192.168.3.20/30 [110/192] via 192.168.3.10, 01:35:03, Serial2/1

```

#### **2. Configure MPLS in the backbone:**

Enable CEF switching and MPLS switching on all PE routers and the P router. Enter the following command on all service provider routers:

```
(Config)# ip cef
```

Default label is TDP if you wish to change this to LDP then give following to Enable LDP Set Label Distribution

Protocol on the router to be LDP and Lo0 as the interface to be used for LDP updates

```
(Config)# mpls label protocol ldp
```

```
(Config)# mpls ldp router-id loopback0
```

**3. Configure MPLS on all core interfaces of all service provider routers. Do not configure MPLS on any interfaces toward customers or external backbones.**

Enter the following command on all links between the service provider routers. Do not configure MPLS on PE-CE links.

```
(Config-if)# tag-switching ip OR mpls ip
```

“tag-switching ip” command if using TDP, “mpls ip” if using LDP.

**Verification:**

**show ip route** – check all ip route;

**show mpls forwarding** – see if labels have been assigned for each route;

**show mpls forwarding details**- details on label;

**show mpls interface**- see if mpls is enabled on an interface;

**show mpls ldp discovery**- see if ldp can discover its neigh;

**show mpls ldp neigh**- see details of neigh.

Display TDP neighbors on the core routers to verify proper TDP operation. You should get a printout similar to the one below:

```
PE3#show tag-switching tdp neighbor
Peer TDP Ident: 192.168.3.5:0; Local TDP Ident 192.168.3.3:0
TCP connection: 192.168.3.5.11003 - 192.168.3.3.711
State: Oper; PIEs sent/rcvd: 5/6; Downstream
Up time: 00:01:52
TDP discovery sources:
  Serial0/0.1, Src IP addr: 192.168.3.14
Addresses bound to peer TDP Ident:
  192.168.3.5    192.168.3.17    192.168.3.14
Peer TDP Ident: 192.168.3.4:0; Local TDP Ident 192.168.3.3:0
TCP connection: 192.168.3.4.11002 - 192.168.3.3.711
State: Oper; PIEs sent/rcvd: 5/5; Downstream
Up time: 00:01:38
TDP discovery sources:
  Serial0/0.2, Src IP addr: 192.168.3.9
Addresses bound to peer TDP Ident:
  192.168.3.4    192.168.20.3    192.168.3.9
```

Display TDP label bindings on your routers to verify that every IGP route has a local label and a label from all TDP neighbors. You should get a printout similar to the one below:

```
PE3#show tag-switching tdp bindings 192.168.3.1 255.255.255.255
tib entry: 192.168.3.1 255.255.255.255, rev 22
local binding: tag: 21
remote binding: tsr: 192.168.3.5:0, tag: 21
remote binding: tsr: 192.168.3.4:0, tag: 20
```

## **Task 2: Understanding TTL propagation**

### **1. Configure default route on all CE-routers (A1, A2, A3, A4)**

Configure default route on A1 customer edge router.

```
(Config)# ip route 0.0.0.0 0.0.0.0 150.1.31.1
```

Configure default route on A2 customer edge router.

```
(Config)# ip route 0.0.0.0 0.0.0.0 150.1.31.5
```

Configure default route on A3 customer edge router.

```
(Config)# ip route 0.0.0.0 0.0.0.0 150.1.31.13
```

Configure default route on A4 customer edge router.

```
(Config)# ip route 0.0.0.0 0.0.0.0 150.1.31.17
```

## 2. Configure default route on all PE-routers (PE1, PE2, PE3, PE4)

Configure static routes on PE1 router to reach loopbacks on A1 customer edge router.

```
(Config)# ip route 203.1.0.1 255.255.255.255 150.1.31.2
```

```
(Config)# ip route 203.1.1.0 255.255.255.0 150.1.31.2
```

Configure static routes on PE2 router to reach loopbacks on A2 customer edge router.

```
(Config)# ip route 203.1.0.2 255.255.255.255 150.1.31.6
```

```
(Config)# ip route 203.1.2.0 255.255.255.0 150.1.31.6
```

Configure static routes on PE3 router to reach loopbacks on A3 customer edge router.

```
(Config)# ip route 203.1.0.3 255.255.255.255 150.1.31.14
```

```
(Config)# ip route 203.1.3.0 255.255.255.0 150.1.31.14
```

Configure static routes on PE4 router to reach loopbacks on A4 customer edge router.

```
(Config)# ip route 203.1.0.4 255.255.255.255 150.1.31.18
```

```
(Config)# ip route 203.1.4.0 255.255.255.0 150.1.31.18
```

## 3. Redistribute static route in OSPF domain on all PE-routers

Redistribute static routes on PE1, PE2, PE3, PE4.

```
(Config)# router ospf 1
```

```
(Config-router)# redistribute static subnet
```

```
(Config-router)# redistribute connected subnet
```

### Verification:

```
A1#show ip route
```

```
Gateway of last resort is 150.1.31.1 to network 0.0.0.0
```

```
C    203.1.1.0/24 is directly connected, Loopback1
    203.1.0.0/32 is subnetted, 1 subnets
C      203.1.0.1 is directly connected, Loopback0
    150.1.0.0/30 is subnetted, 1 subnets
C      150.1.31.0 is directly connected, FastEthernet0/0
S*   0.0.0.0/0 [1/0] via 150.1.31.1
```

```
PE1#show ip route
```

```
S    203.1.1.0/24 [1/0] via 150.1.31.2
    203.1.0.0/32 is subnetted, 1 subnets
S    203.1.0.1 [1/0] via 150.1.31.2
```

Perform trace from A1 toward 203.1.4.1 you should see all your core routers in the path. A sample trace printout is shown below:

```
A1#trace 203.1.4.1
```

```
Type escape sequence to abort.
```

```
Tracing the route to 203.1.4.1
```

```
  1 150.1.31.1 84 msec 44 msec 72 msec
```

```
2 192.168.3.21 328 msec 432 msec 280 msec
3 192.168.3.17 376 msec 276 msec 268 msec
4 192.168.3.13 296 msec 292 msec 196 msec
5 192.168.3.9 456 msec 336 msec 268 msec
6 150.1.31.18 436 msec * 292 msec
```

### **Task 3: Disable IP TTL Propagation**

#### **4. Disable IP TTL propagation on all service provider routers that perform labeling of incoming IP packets.**

Disable TTL propagation on all PE routers with the following command:

**(Config)#no tag-switching ip propagate-ttl**

#### **Verification:**

Perform trace from A1 toward 203.1.4.1 you should see only the ingress and egress core router in the path. A sample trace printout is shown below:

**A2#trace 128.1.4.1**

Type escape sequence to abort.

Tracing the route to 192.168.20.20

```
1 150.1.31.1 84 msec 44 msec 72 msec
2 192.168.3.9 456 msec 336 msec 268 msec
3 150.1.31.18 436 msec * 292 msec
```

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