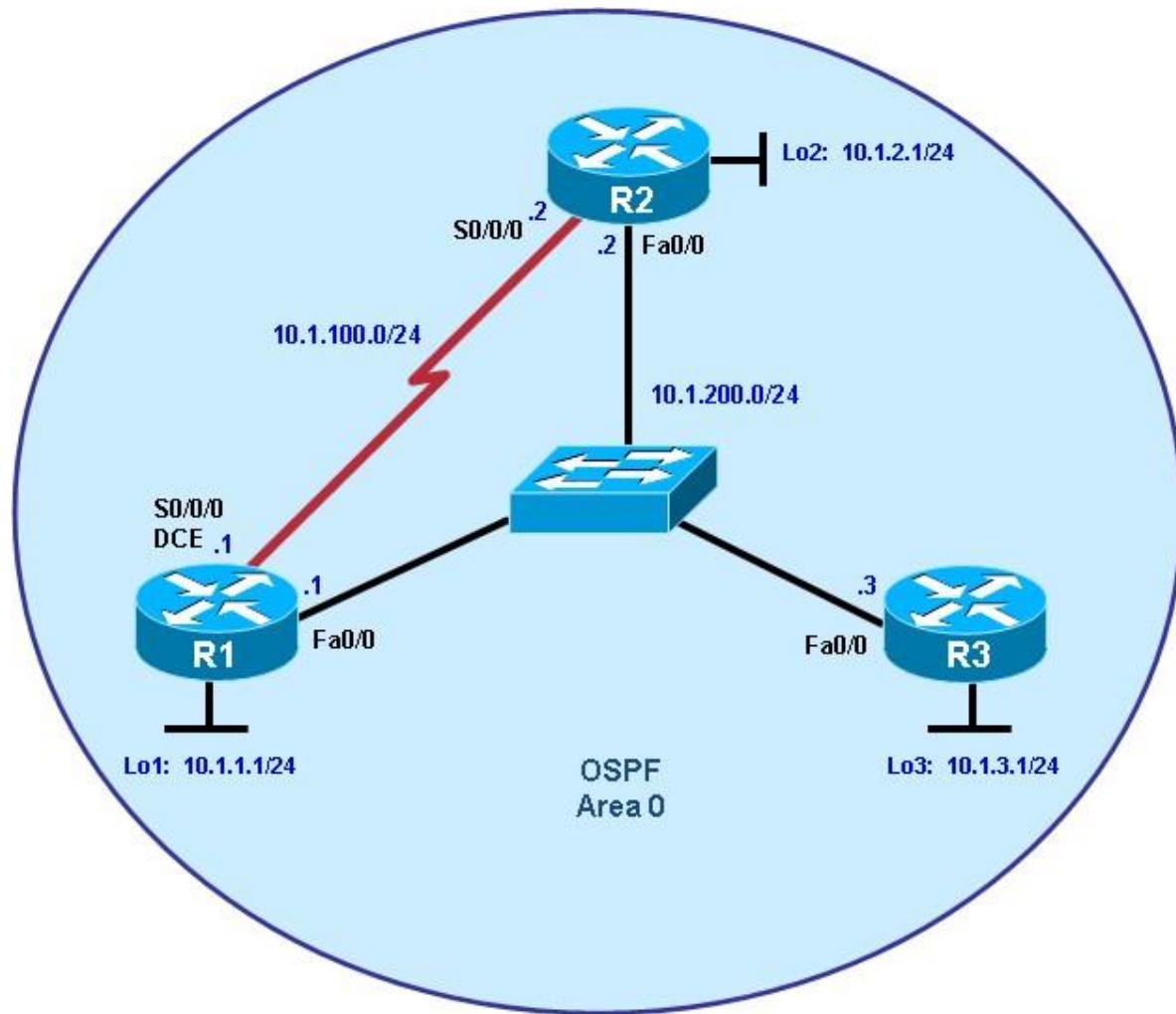


Practical 1-A: Single-Area OSPF Link Costs and Interface Priorities

Topology



Objectives

- Configure single-area OSPF on a router.
- Advertise loopback interfaces into OSPF.
- Verify OSPF adjacencies.
- Verify OSPF routing information exchange.
- Modify OSPF link costs.
- Change interface priorities.
- Utilize debugging commands for troubleshooting.

Required Resources

- 3 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- 1 switch (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- Serial and Ethernet cables

Steps

Step 1: Configure Addressing and Loopbacks

R1

```
configure terminal  
interface Loopback1  
description Engineering Department  
ip address 10.1.1.1 255.255.255.0  
exit  
interface FastEthernet0/0  
ip address 10.1.200.1 255.255.255.0  
no shutdown  
interface Serial0/0/0  
ip address 10.1.100.1 255.255.255.0  
clockrate 64000  
bandwidth 64  
no shutdown
```

R2

```
configure terminal  
interface Loopback2  
description Marketing Department  
ip address 10.1.2.1 255.255.255.0  
exit  
interface FastEthernet0/0  
ip address 10.1.200.2 255.255.255.0  
no shutdown  
interface Serial0/0/0  
ip address 10.1.100.2 255.255.255.0  
bandwidth 64  
no shutdown
```

R3

```
configure terminal  
interface Loopback3  
description Accounting Department  
ip address 10.1.3.1 255.255.255.0  
exit  
interface FastEthernet0/0  
ip address 10.1.200.3 255.255.255.0  
no shutdown
```

Step 2: Add Physical Interfaces to OSPF**R1**

```
configure terminal  
router ospf 1  
network 10.1.100.0 0.0.0.255 area 0  
network 10.1.200.0 0.0.0.255 area 0  
end  
debug ip ospf adj
```

R2

```
configure terminal  
router ospf 1  
network 10.1.100.0 0.0.0.255 area 0  
network 10.1.200.0 0.0.0.255 area 0
```

R3

```
configure terminal  
router ospf 1  
network 10.1.200.0 0.0.0.255 area 0
```

Step 3: Use OSPF Show Commands

```
R1# show ip ospf  
R1# show ip ospf neighbor
```

Step 4: Add Loopback Interfaces to OSPF

R1

```
configure terminal  
router ospf 1  
network 10.1.1.0 0.0.0.255 area 0
```

R2

```
configure terminal  
router ospf 1  
network 10.1.2.0 0.0.0.255 area 0
```

R3

```
configure terminal  
router ospf 1  
network 10.1.3.0 0.0.0.255 area 0
```

Verify:

```
R1# show ip route  
R1# show ip ospf interface Lo1
```

Step 5: Modify OSPF Link Costs**R1**

```
configure terminal  
interface FastEthernet0/0  
ip ospf cost 50
```

R2

```
configure terminal  
interface FastEthernet0/0  
ip ospf cost 50
```

R3

```
configure terminal  
interface FastEthernet0/0  
ip ospf cost 50
```

Verify:

```
R1# show ip route
```

Step 6: Modify Interface Priorities

R1

```
configure terminal  
interface FastEthernet0/0  
ip ospf priority 10
```

R2

```
configure terminal  
interface FastEthernet0/0  
ip ospf priority 5
```

Verify:

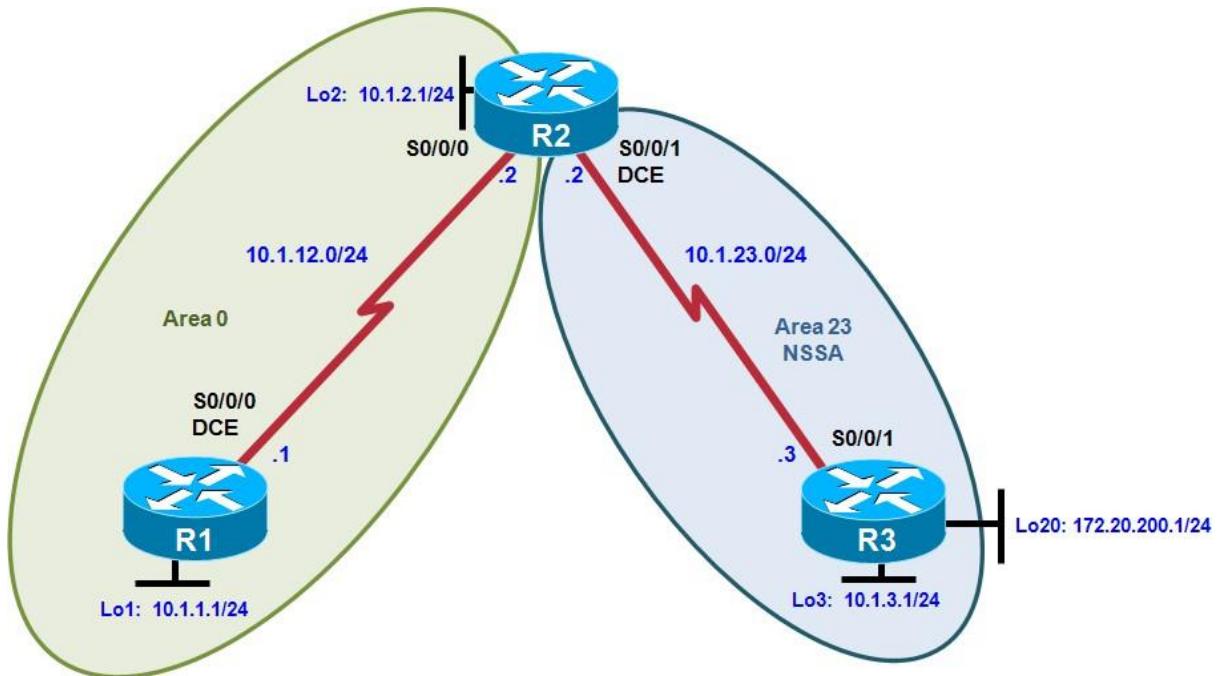
```
R1# show ip ospf neighbor detail
```

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than list all combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device. The table does not include any other type of interface, even though a specific router might contain one. For example, for an ISDN BRI interface, the string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Practical 1-B: Multi-Area OSPF with Stub Areas and Authentication

Topology



Objectives

- Configure multiple-area OSPF on a router.
- Verify multiple-area behavior.
- Configure OSPF stub, totally stubby, and not-so-stubby areas.
- Configure OSPF authentication.

Required Resources

- 3 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- Serial and console cables

Steps

Step 1: Configure Addressing and Loopbacks

R1

```
configure terminal
```

```
interface loopback 1
```

```
description Engineering Department
```

```
ip address 10.1.1.1 255.255.255.0
```

```
interface serial 0/0/0
```

```
ip address 10.1.12.1 255.255.255.0
```

```
no shutdown
```

R2

```
configure terminal
```

```
interface loopback 2
```

```
description Marketing Department
```

```
ip address 10.1.2.1 255.255.255.0
```

```
interface serial 0/0/0
```

```
ip address 10.1.12.2 255.255.255.0
```

```
no shutdown
```

```
interface serial 0/0/1
```

```
ip address 10.1.23.2 255.255.255.0
```

```
no shutdown
```

R3

```
configure terminal
```

```
interface loopback 3
```

```
description Accounting Department
```

```
ip address 10.1.3.1 255.255.255.0
```

```
interface loopback 20
```

```
description Connection to another AS
```

```
ip address 172.20.200.1 255.255.255.0
```

```
interface serial 0/0/1
```

```
ip address 10.1.23.3 255.255.255.0
```

```
no shutdown
```

Step 2: Add Interfaces into OSPF

R1

```
configure terminal
```

```
router ospf 1
```

```
network 10.1.12.0 0.0.0.255 area 0
```

```
network 10.1.1.0 0.0.0.255 area 0
```

```
exit
```

R2

```
configure terminal  
router ospf 1  
network 10.1.12.0 0.0.0.255 area 0  
network 10.1.2.0 0.0.0.255 area 0  
network 10.1.23.0 0.0.0.255 area 23  
exit
```

R3

```
configure terminal  
router ospf 1  
network 10.1.23.0 0.0.0.255 area 23  
network 10.1.3.0 0.0.0.255 area 23  
exit
```

Verify:

```
R1# show ip ospf neighbor
```

```
R2# show ip ospf neighbor
```

Step 3: Configure a Stub Area**R2**

```
configure terminal  
router ospf 1  
area 23 stub
```

R3

```
configure terminal  
router ospf 1  
area 23 stub
```

Verify:

```
R2# show ip ospf neighbor
```

```
R3# show ip ospf neighbor
```

```
R3# show ip route
```

```
R2# show ip ospf
```

Step 4: Configure a Totally Stubby Area

R2

```
configure terminal  
router ospf 1  
area 23 stub no-summary
```

Verify:

```
R3# show ip route
```

Step 5: Configure a Not-So-Stubby Area (NSSA)

R2

```
configure terminal  
router ospf 1  
no area 23 stub  
area 23 nssa
```

R3

```
configure terminal  
router ospf 1  
no area 23 stub  
area 23 nssa  
redistribute connected subnets
```

Verify:

```
R2# show ip ospf
```

```
R2# show ip route
```

```
R1# show ip route
```

```
R3# show ip route
```

Totally Stubby NSSA

R2

```
configure terminal  
router ospf 1  
area 23 nssa no-summary
```

Verify:

```
R3# show ip route
```

Step 6: Configure OSPF Interface Authentication

Plain Authentication (R2-R3 Link)

R2

```
configure terminal
```

```
interface serial 0/0/1
```

```
ip ospf authentication
```

```
ip ospf authentication-key cisco
```

R3

```
configure terminal
```

```
interface serial 0/0/1
```

```
ip ospf authentication
```

```
ip ospf authentication-key cisco
```

Verify:

```
R2# show ip ospf interface serial 0/0/1
```

MD5 Authentication (R1-R2 Link)

R1

```
configure terminal
```

```
interface serial 0/0/0
```

```
ip ospf authentication message-digest
```

```
ip ospf message-digest-key 1 md5 cisco
```

R2

```
configure terminal
```

```
interface serial 0/0/0
```

```
ip ospf authentication message-digest
```

```
ip ospf message-digest-key 1 md5 cisco
```

Verify:

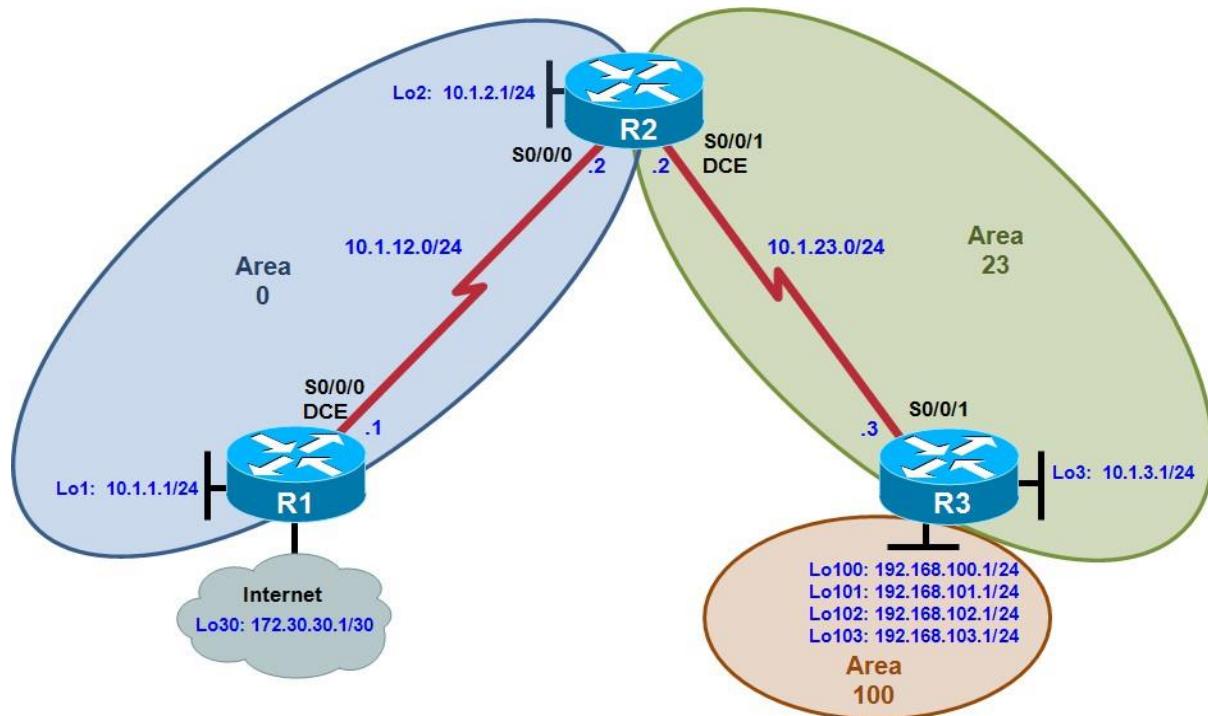
```
R1# show ip ospf interface serial 0/0/0
```

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than list all combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device. The table does not include any other type of interface, even though a specific router might contain one. For example, for an ISDN BRI interface, the string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Practical 2-A: OSPF Virtual Links and Area Summarization

Topology



Objectives

- Configure multi-area OSPF on a router.
- Verify multi-area behavior.
- Create an OSPF virtual link.
- Summarize an area.
- Generate a default route into OSPF.

Required Resources

- 3 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- Serial and console cables

Steps

Step 1: Configure Addressing and Loopbacks

R1

```
configure terminal
```

```
interface loopback 1
```

```
description Engineering Department
```

```
ip address 10.1.1.1 255.255.255.0
```

```
interface loopback 30
ip address 172.30.30.1 255.255.255.252
interface serial 0/0/0
ip address 10.1.12.1 255.255.255.0
no shutdown
```

R2

```
configure terminal
interface loopback 2
description Marketing Department
ip address 10.1.2.1 255.255.255.0
interface serial 0/0/0
ip address 10.1.12.2 255.255.255.0
no shutdown
interface serial 0/0/1
ip address 10.1.23.2 255.255.255.0
no shutdown
```

R3

```
configure terminal
interface loopback 3
description Accounting Department
ip address 10.1.3.1 255.255.255.0
interface loopback 100
ip address 192.168.100.1 255.255.255.0
interface loopback 101
ip address 192.168.101.1 255.255.255.0
interface loopback 102
ip address 192.168.102.1 255.255.255.0
interface loopback 103
ip address 192.168.103.1 255.255.255.0
interface serial 0/0/1
ip address 10.1.23.3 255.255.255.0
```

```
no shutdown
```

Step 2: Add Interfaces into OSPF

R1

```
configure terminal
```

```
router ospf 1
```

```
network 10.1.12.0 0.0.0.255 area 0
```

```
network 10.1.1.0 0.0.0.255 area 0
```

```
exit
```

R2

```
configure terminal
```

```
router ospf 1
```

```
network 10.1.12.0 0.0.0.255 area 0
```

```
network 10.1.2.0 0.0.0.255 area 0
```

```
network 10.1.23.0 0.0.0.255 area 23
```

```
exit
```

R3

```
configure terminal
```

```
router ospf 1
```

```
network 10.1.23.0 0.0.0.255 area 23
```

```
network 10.1.3.0 0.0.0.255 area 23
```

```
exit
```

```
interface loopback 3
```

```
ip ospf network point-to-point
```

Verify:

```
R1# show ip ospf neighbor
```

```
R2# show ip ospf neighbor
```

```
R1# show ip route
```

Step 3: Create a Virtual Link

R3

```
configure terminal
```

```
router ospf 1
```

```
network 192.168.100.0 0.0.3.255 area 100  
area 23 virtual-link 10.1.2.1  
exit
```

R2

```
configure terminal  
router ospf 1  
area 23 virtual-link 192.168.103.1
```

Verify:

```
R2# show ip route  
R2# show ip ospf neighbor  
R2# show ip ospf interface
```

Step 4: Summarize an Area

R3

```
configure terminal  
router ospf 1  
area 100 range 192.168.100.0 255.255.252.0
```

Verify:

```
R2# show ip route  
R2# show ip ospf database  
R3# show ip route
```

Step 5: Generate a Default Route into OSPF

R1

```
configure terminal  
router ospf 1  
default-information originate always
```

Verify:

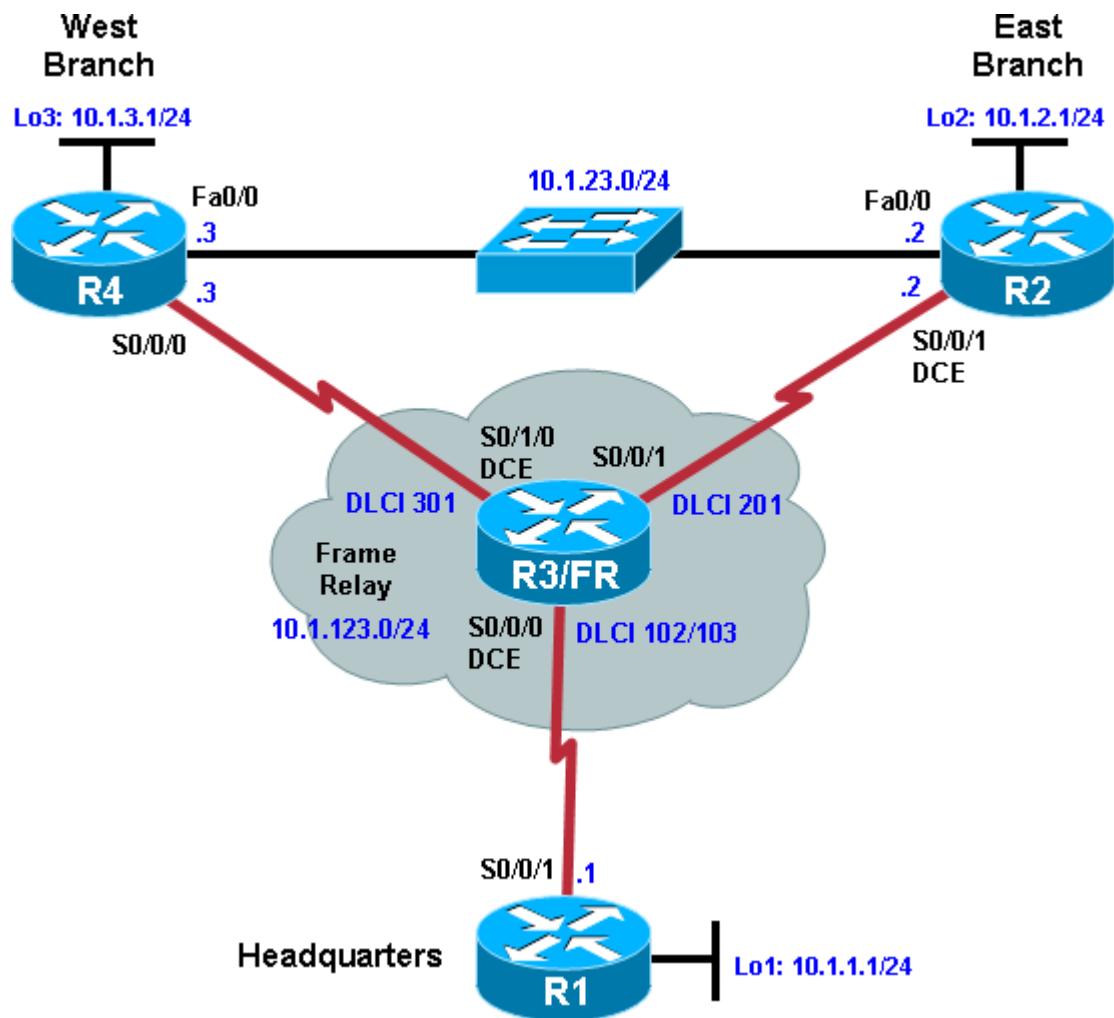
```
R2# show ip route  
R3# show ip route
```

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than list all combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device. The table does not include any other type of interface, even though a specific router might contain one. For example, for an ISDN BRI interface, the string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Practical 2-B: OSPF over Frame Relay

Topology



Objectives

- Configure OSPF over Frame Relay.
- Use non-broadcast and point-to-multipoint OSPF network types.
- Modify default OSPF timers.

Required Resources

- 4 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- 1 switch (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- Serial and Ethernet cables

Steps

Step 1: Configure Frame Relay and Addressing

HQ (R1)

```
configure terminal  
hostname HQ  
interface loopback 1  
ip address 10.1.1.1 255.255.255.0  
interface serial 0/0/1  
ip address 10.1.123.1 255.255.255.0  
encapsulation frame-relay ietf  
no frame-relay inverse-arp  
frame-relay map ip 10.1.123.1 102  
frame-relay map ip 10.1.123.2 102  
frame-relay map ip 10.1.123.3 103  
no shutdown
```

EAST (R2)

```
configure terminal  
hostname EAST  
interface loopback 2  
ip address 10.1.2.1 255.255.255.0  
interface serial 0/0/1  
ip address 10.1.123.2 255.255.255.0  
clock rate 64000  
encapsulation frame-relay ietf  
no frame-relay inverse-arp  
frame-relay map ip 10.1.123.1 201  
frame-relay map ip 10.1.123.2 201  
frame-relay map ip 10.1.123.3 201  
no shutdown  
interface FastEthernet 0/0  
ip address 10.1.23.2 255.255.255.0  
no shutdown
```

WEST (R4)

```
configure terminal
```

```
hostname WEST
interface loopback 3
ip address 10.1.3.1 255.255.255.0
interface serial 0/0/0
ip address 10.1.123.3 255.255.255.0
encapsulation frame-relay ietf
no frame-relay inverse-arp
frame-relay map ip 10.1.123.1 301
frame-relay map ip 10.1.123.2 301
frame-relay map ip 10.1.123.3 301
no shutdown
interface FastEthernet 0/0
ip address 10.1.23.3 255.255.255.0
no shutdown
```

Step 2: Configure the Frame Relay Switch

FRS (R3)

```
hostname FRS
frame-relay switching
interface Serial0/0/0
no ip address
encapsulation frame-relay ietf
frame-relay intf-type dce
frame-relay route 102 interface Serial0/0/1 201
frame-relay route 103 interface Serial0/1/0 301
no shutdown
interface Serial0/0/1
no ip address
encapsulation frame-relay ietf
frame-relay intf-type dce
frame-relay route 201 interface Serial0/0/0 102
no shutdown
```

```
interface Serial0/1/0
no ip address
encapsulation frame-relay ietf
frame-relay intf-type dce
frame-relay route 301 interface Serial0/0/0 103
no shutdown
```

Step 3: Configure OSPF Network Type NBMA

HQ

```
configure terminal
router ospf 1
network 10.1.123.0 0.0.0.255 area 0
network 10.1.1.0 0.0.0.255 area 0
neighbor 10.1.123.2
neighbor 10.1.123.3
```

EAST

```
configure terminal
router ospf 1
network 10.1.123.0 0.0.0.255 area 0
network 10.1.2.0 0.0.0.255 area 0
neighbor 10.1.123.1
```

WEST

```
configure terminal
router ospf 1
network 10.1.123.0 0.0.0.255 area 0
network 10.1.3.0 0.0.0.255 area 0
neighbor 10.1.123.1
```

Verify:

```
HQ# show ip ospf neighbor
```

Step 4: Change Network Type to Point-to-Multipoint

HQ

```
configure terminal
```

```
router ospf 1
no neighbor 10.1.123.2
no neighbor 10.1.123.3
interface serial 0/0/1
ip ospf network point-to-multipoint
frame-relay map ip 10.1.123.2 102 broadcast
frame-relay map ip 10.1.123.3 103 broadcast
```

EAST

```
configure terminal
router ospf 1
no neighbor 10.1.123.1
interface serial 0/0/1
ip ospf network point-to-multipoint
frame-relay map ip 10.1.123.1 201 broadcast
frame-relay map ip 10.1.123.3 201 broadcast
```

WEST

```
configure terminal
router ospf 1
no neighbor 10.1.123.1
interface serial 0/0/0
ip ospf network point-to-multipoint
frame-relay map ip 10.1.123.1 301 broadcast
frame-relay map ip 10.1.123.2 301 broadcast
```

Verify:

```
HQ# clear ip ospf process
HQ# show ip ospf neighbor
EAST# show ip route
EAST# show ip ospf interface serial 0/0/1
```

Step 5: Change OSPF Timers

EAST

```
configure terminal
```

```

router ospf 1
network 10.1.23.0 0.0.0.255 area 0
interface FastEthernet 0/0
ip ospf hello-interval 5
ip ospf dead-interval 15

```

WEST

```

configure terminal
router ospf 1
network 10.1.23.0 0.0.0.255 area 0
interface FastEthernet 0/0
ip ospf hello-interval 5
ip ospf dead-interval 15

```

Verify:

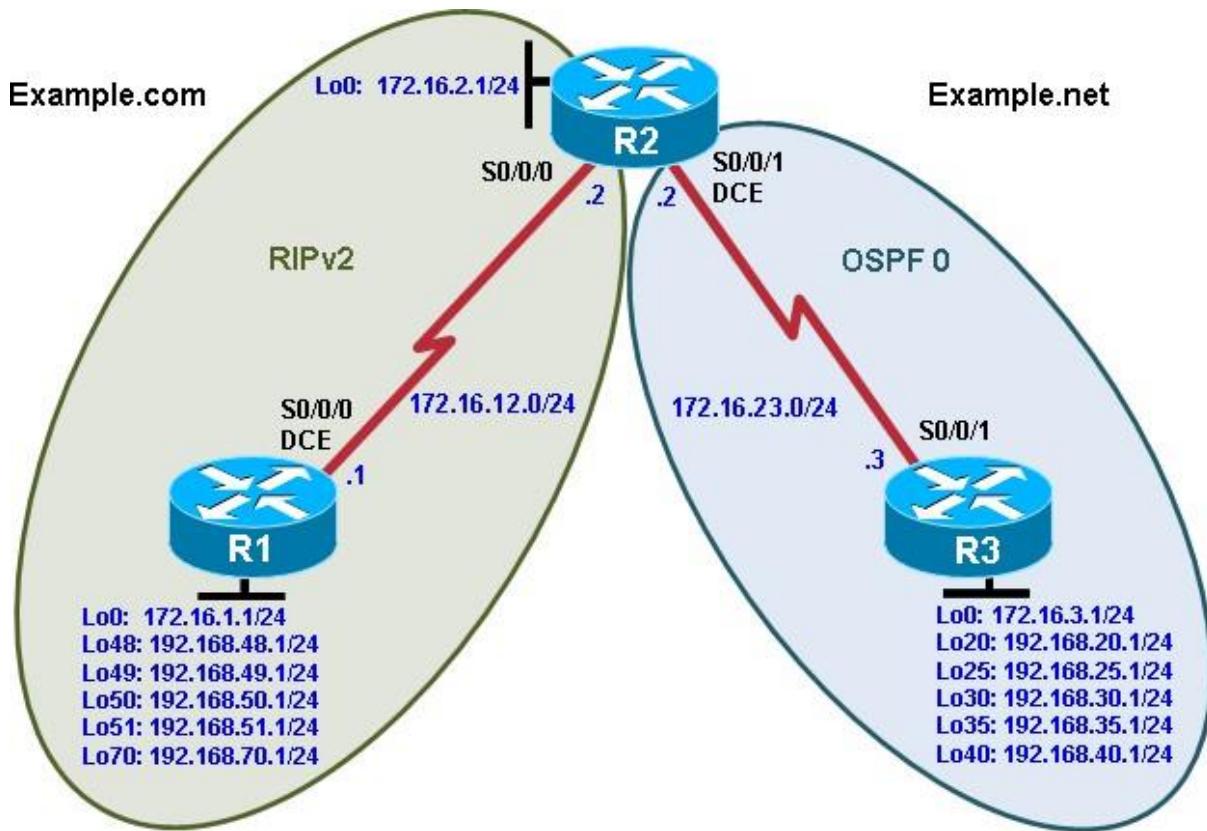
EAST# show ip ospf interface FastEthernet 0/0

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than list all combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device. The table does not include any other type of interface, even though a specific router might contain one. For example, for an ISDN BRI interface, the string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Practical 3-A: Redistribution Between RIP and OSPF

Topology



Objectives

- Review configuration and verification of RIP and OSPF.
- Configure passive interfaces in RIP and OSPF.
- Filter routing updates using distribute lists.
- Redistribute static routes into RIP.
- Redistribute RIP routes into OSPF.
- Redistribute OSPF routes into RIP.
- Originate a default route into OSPF.
- Set a default seed metric.
- Modify OSPF external network types.
- Configure summary addresses.

Required Resources

- 3 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- Serial and console cables

Steps

Step 1: Configure Loopbacks and Assign Addresses

R1

```
configure terminal  
interface Loopback0  
ip address 172.16.1.1 255.255.255.0  
interface Loopback48  
ip address 192.168.48.1 255.255.255.0  
interface Loopback49  
ip address 192.168.49.1 255.255.255.0  
interface Loopback50  
ip address 192.168.50.1 255.255.255.0  
interface Loopback51  
ip address 192.168.51.1 255.255.255.0  
interface Loopback70  
ip address 192.168.70.1 255.255.255.0  
interface Serial0/0/0  
ip address 172.16.12.1 255.255.255.0  
bandwidth 64  
no shutdown
```

R2

```
configure terminal  
interface Loopback0  
ip address 172.16.2.1 255.255.255.0  
interface Serial0/0/0  
ip address 172.16.12.2 255.255.255.0  
bandwidth 64  
no shutdown  
interface Serial0/0/1  
ip address 172.16.23.2 255.255.255.0  
bandwidth 64
```

```
no shutdown
```

R3

```
configure terminal
```

```
interface Loopback0
```

```
ip address 172.16.3.1 255.255.255.0
```

```
interface Loopback20
```

```
ip address 192.168.20.1 255.255.255.0
```

```
interface Loopback25
```

```
ip address 192.168.25.1 255.255.255.0
```

```
interface Loopback30
```

```
ip address 192.168.30.1 255.255.255.0
```

```
interface Loopback35
```

```
ip address 192.168.35.1 255.255.255.0
```

```
interface Loopback40
```

```
ip address 192.168.40.1 255.255.255.0
```

```
interface Serial0/0/1
```

```
ip address 172.16.23.3 255.255.255.0
```

```
bandwidth 64
```

```
no shutdown
```

Step 2: Configure RIPv2

R1

```
configure terminal
```

```
router rip
```

```
version 2
```

```
no auto-summary
```

```
network 172.16.0.0
```

```
network 192.168.48.0
```

```
network 192.168.49.0
```

```
network 192.168.50.0
```

```
network 192.168.51.0
```

```
network 192.168.70.0
```

R2

configure terminal

router rip

version 2

no auto-summary

network 172.16.0.0

Verify:

R1# show ip route rip

R2# show ip route rip

R1# show ip rip database

R2# show ip rip database

Step 3: Configure Passive Interfaces in RIP

R2

configure terminal

router rip

passive-interface serial 0/0/1

R1

configure terminal

router rip

passive-interface loopback 0

passive-interface loopback 48

passive-interface loopback 49

passive-interface loopback 50

passive-interface loopback 51

passive-interface loopback 70

Alternative on R1:

configure terminal

router rip

passive-interface default

no passive-interface Serial0/0/0

Verify:

```
R2# show ip protocols
```

```
R1# show ip route rip
```

Step 4: Summarize a Supernet with RIP

R1

```
configure terminal
```

```
ip route 192.168.48.0 255.255.252.0 null0
```

```
router rip
```

```
redistribute static
```

Verify:

```
R1# show ip route
```

```
R2# show ip route
```

Step 5: Suppress Routes Using Prefix Lists

R1

```
configure terminal
```

```
ip prefix-list RIP-OUT permit 192.168.48.0/22
```

```
ip prefix-list RIP-OUT deny 192.168.48.0/22 le 24
```

```
ip prefix-list RIP-OUT permit 0.0.0.0/0 le 32
```

```
router rip
```

```
distribute-list prefix RIP-OUT out serial0/0/0
```

Verify:

```
R2# show ip route rip
```

```
R2# show ip rip database
```

Step 6: Configure OSPF

R2

```
configure terminal
```

```
router ospf 1
```

```
network 172.16.23.0 0.0.0.255 area 0
```

R3

```
configure terminal
```

```
router ospf 1
```

```
network 172.16.0.0 0.0.0.255.255 area 0
```

```
network 192.168.0.0 0.0.255.255 area 0
```

Verify:

```
R2# show ip ospf neighbor
```

```
R3# show ip ospf neighbor
```

```
R2# show ip route ospf
```

Step 7: Configure Passive Interfaces in OSPF

R3

```
configure terminal
```

```
router ospf 1
```

```
passive-interface loopback 0
```

Alternative on R3:

```
configure terminal
```

```
router ospf 1
```

```
passive-interface default
```

```
no passive-interface serial 0/0/1
```

Verify:

```
R3# show ip protocols
```

Step 8: Allow One-Way Redistribution

R2

```
configure terminal
```

```
router rip
```

```
redistribute ospf 1 metric 4
```

```
router ospf 1
```

```
default-information originate always
```

Verify:

```
R2# show ip protocols
```

```
R1# show ip route rip
```

```
R3# show ip route ospf
```

Step 9: Redistribute Between Two Routing Protocols

R2

```
configure terminal
```

```
router ospf 1  
no default-information originate always  
redistribute rip subnets
```

Verify:

```
R3# show ip route ospf
```

Step 10: Set a Default Seed Metric

R2

configure terminal

```
router ospf 1  
default-metric 10000
```

Verify:

```
R3# show ip route ospf
```

Step 11: Change OSPF External Network Type

R2

configure terminal

```
router ospf 1  
redistribute rip subnets metric-type 1
```

Verify:

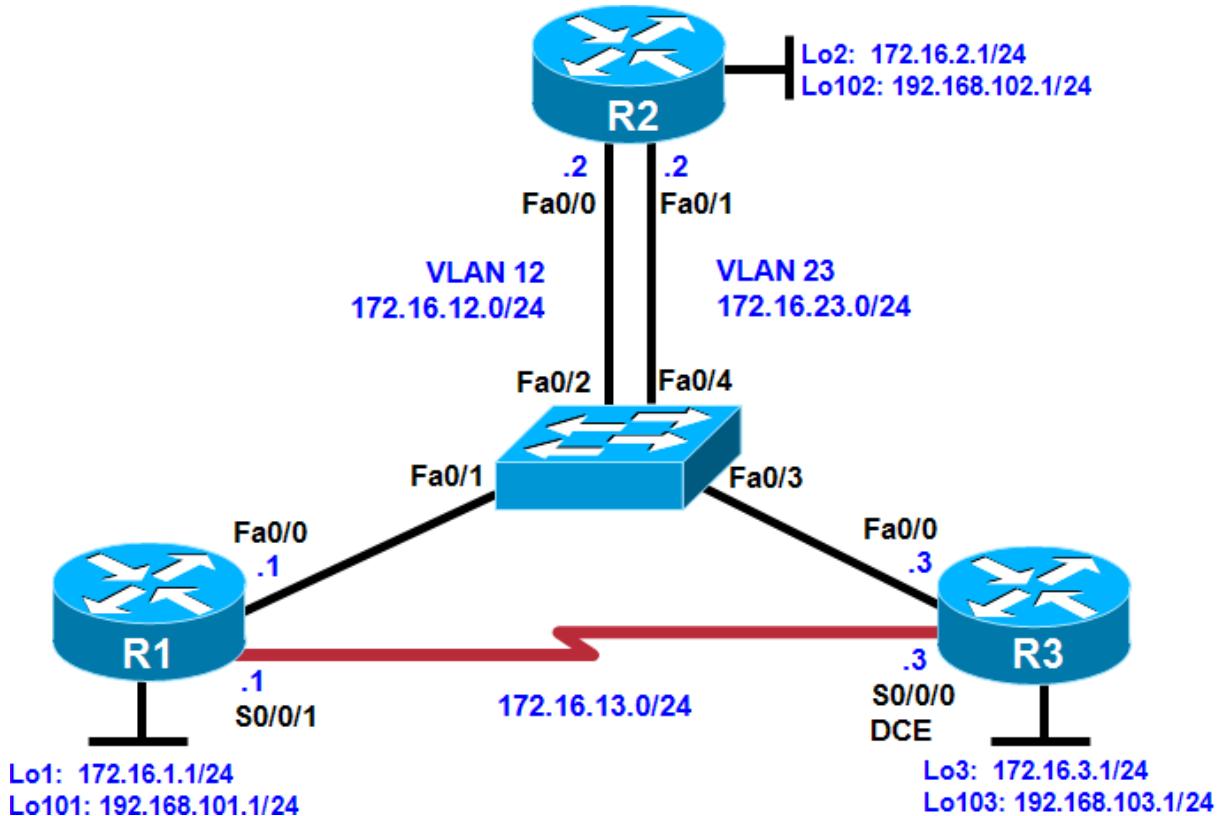
```
R3# show ip route ospf
```

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than list all combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device.

Practical 3-B: Manipulating Administrative Distances

Topology



Objectives

- Configure RIP on a router.
- Configure OSPF on a router.
- Manipulate administrative distances.
- Compare routing protocol behavior.

Required Resources

- 3 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- 1 switch (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- Serial and Ethernet cables

Steps

Step 1: Review Default Administrative Distances

- Connected: 0
- Static: 1
- EIGRP Summary Route: 5

- External BGP: 20
- EIGRP: 90
- IGRP: 100
- OSPF: 110
- IS-IS: 115
- RIP: 120
- EGP: 140
- On-Demand Routing (ODR): 160
- External EIGRP: 170
- Internal BGP: 200
- Unknown: 255

Step 2: Configure Router Loopbacks and Addressing

R1

```
configure terminal  
interface loopback 1  
ip address 172.16.1.1 255.255.255.0  
interface loopback 101  
ip address 192.168.101.1 255.255.255.0  
interface fastethernet 0/0  
ip address 172.16.12.1 255.255.255.0  
no shutdown  
interface serial 0/0/1  
bandwidth 64  
ip address 172.16.13.1 255.255.255.0  
no shutdown
```

R2

```
configure terminal  
interface loopback 2  
ip address 172.16.2.1 255.255.255.0  
interface loopback 102  
ip address 192.168.102.1 255.255.255.0
```

```
interface fastethernet 0/0
ip address 172.16.12.2 255.255.255.0
no shutdown
interface fastethernet 0/1
ip address 172.16.23.2 255.255.255.0
no shutdown
```

R3

```
configure terminal
interface loopback 3
ip address 172.16.3.1 255.255.255.0
interface loopback 103
ip address 192.168.103.1 255.255.255.0
interface fastethernet 0/0
ip address 172.16.23.3 255.255.255.0
no shutdown
interface serial 0/0/0
bandwidth 64
```

```
ip address 172.16.13.3 255.255.255.0
clock rate 64000
no shutdown
```

Step 3: Configure Switch VLANs

Switch

```
configure terminal
vlan 12
name R1-R2
vlan 23
name R2-R3
exit
interface fastEthernet 0/1
description To R1 Fa0/0
switchport mode access
```

```
switchport access vlan 12
interface fastEthernet 0/2
description To R2 Fa0/0
switchport mode access
switchport access vlan 12
interface fastEthernet 0/3
description To R3 Fa0/0
switchport mode access
switchport access vlan 23
interface fastEthernet 0/4
description To R2 Fa0/1
switchport mode access
switchport access vlan 23
```

Step 4: Configure RIP

R1

```
configure terminal
router rip
version 2
no auto-summary
network 172.16.0.0
network 192.168.101.0
```

R2

```
configure terminal
router rip
version 2
no auto-summary
network 172.16.0.0
network 192.168.102.0
```

R3

```
configure terminal
router rip
```

```
version 2  
no auto-summary  
network 172.16.0.0  
network 192.168.103.0
```

Verify:

```
R1# show ip route rip
```

```
R2# show ip route rip
```

```
R3# show ip route rip
```

Step 5: Configure OSPF

R1

```
configure terminal  
interface loopback 1  
ip ospf network point-to-point  
interface loopback 101  
ip ospf network point-to-point  
router ospf 1  
network 172.16.0.0 0.0.255.255 area 0  
network 192.168.101.0 0.0.0.255 area 0
```

R2

```
configure terminal  
interface loopback 2  
ip ospf network point-to-point  
interface loopback 102  
ip ospf network point-to-point  
router ospf 1  
network 172.16.0.0 0.0.255.255 area 0  
network 192.168.102.0 0.0.0.255 area 0
```

R3

```
configure terminal  
interface loopback 3  
ip ospf network point-to-point
```

```
interface loopback 103
ip ospf network point-to-point
router ospf 1
network 172.16.0.0 0.0.255.255 area 0
network 192.168.103.0 0.0.0.255 area 0
```

Verify:

```
R1# show ip ospf neighbor
```

```
R1# show ip route
```

```
R2# show ip ospf neighbor
```

```
R2# show ip route
```

```
R3# show ip ospf neighbor
```

```
R3# show ip route
```

Step 6: Modify the Routing Protocol Distance

R1

```
configure terminal
```

```
router rip
```

```
distance 100
```

R2

```
configure terminal
```

```
router rip
```

```
distance 100
```

R3

```
configure terminal
```

```
router rip
```

```
distance 100
```

Verify:

```
R1# show ip route
```

```
R2# show ip route
```

```
R3# show ip route
```

```
R1# show ip protocols
```

Step 7: Modify Distance Based on Route Source

R1

```
configure terminal  
router ospf 1  
distance 85 192.168.100.0 0.0.3.255
```

R2

```
configure terminal  
router ospf 1  
distance 85 192.168.100.0 0.0.3.255
```

R3

```
configure terminal  
router ospf 1  
distance 85 192.168.100.0 0.0.3.255
```

Verify:

```
R1# show ip protocols
```

```
R1# show ip route
```

Step 8: Modify Distance Based on an Access List

R1

```
configure terminal  
access-list 1 permit 172.16.0.0 0.0.255.255  
router rip  
distance 65 0.0.0.0 255.255.255.255 1
```

R2

```
configure terminal  
access-list 1 permit 172.16.0.0 0.0.255.255  
router rip  
distance 65 0.0.0.0 255.255.255.255 1
```

R3

```
configure terminal  
access-list 1 permit 172.16.0.0 0.0.255.255  
router rip
```

```
distance 65 0.0.0.0 255.255.255.255 1
```

Verify:

```
R1# show ip protocols
```

```
R1# show ip route
```

```
R2# show ip protocols
```

```
R2# show ip route
```

```
R3# show ip protocols
```

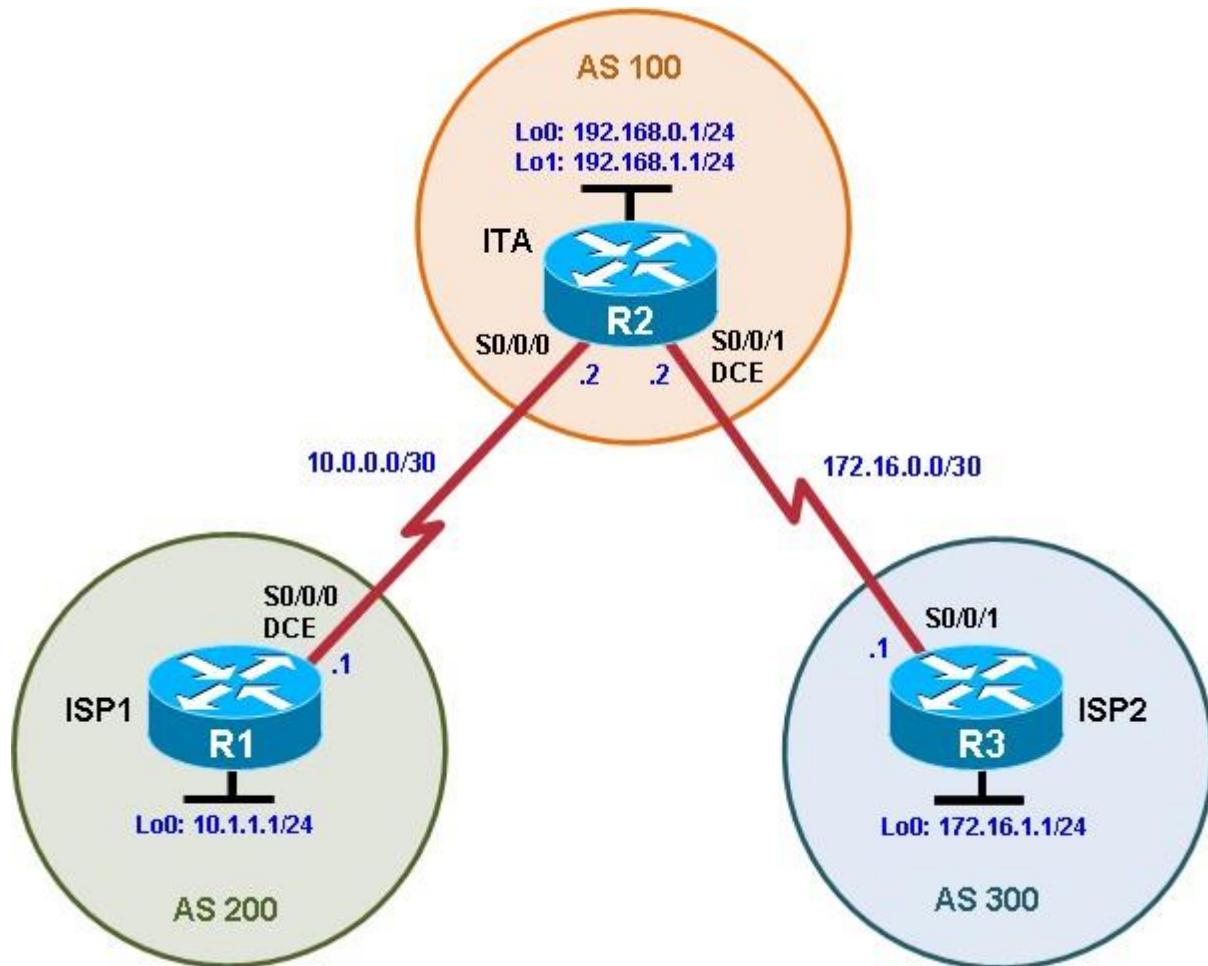
```
R3# show ip route
```

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than list all combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device. The table does not include any other type of interface, even though a specific router might contain one. For example, for an ISDN BRI interface, the string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Practical 4-A: Configuring BGP with Default Routing

Topology



Objectives

- Configure BGP to exchange routing information with two ISPs.

Required Resources

- 3 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- Serial and console cables

Steps

Step 1: Prepare the Routers

- Cable the network as shown.
- Erase startup configuration and reload each router.

Step 2: Configure Hostname and Interface Addresses

ISP1 (R1)

hostname ISP1

interface Lo0

description ISP1 Internet Network

ip address 10.1.1.1 255.255.255.0

interface Serial0/0/0

description ISP1 -> ITA

ip address 10.0.0.1 255.255.255.252

clock rate 128000

no shutdown

ITA (R2)

hostname ITA

interface Lo0

description Core router network link 1

ip address 192.168.0.1 255.255.255.0

interface Lo1

description Core router network link 2

ip address 192.168.1.1 255.255.255.0

interface Serial0/0/0

description ITA -> ISP1

ip address 10.0.0.2 255.255.255.252

no shutdown

interface Serial0/0/1

description ITA -> ISP2

ip address 172.16.0.2 255.255.255.252

clock rate 128000

no shutdown

ISP2 (R3)

hostname ISP2

interface Lo0

description ISP2 Internet Network

ip address 172.16.1.1 255.255.255.0

```
interface Serial0/0/1
description ISP2 -> ITA
ip address 172.16.0.1 255.255.255.252
no shutdown
```

Verify:

- Ping between directly connected routers.

Step 3: Configure BGP on ISP Routers

ISP1

```
configure terminal
router bgp 200
neighbor 10.0.0.2 remote-as 100
network 10.1.1.0 mask 255.255.255.0
```

ISP2

```
configure terminal
router bgp 300
neighbor 172.16.0.2 remote-as 100
network 172.16.1.0 mask 255.255.255.0
```

Step 4: Configure BGP on ITA Router

ITA

```
configure terminal
router bgp 100
neighbor 10.0.0.1 remote-as 200
neighbor 172.16.0.1 remote-as 300
network 192.168.0.0
network 192.168.1.0
```

Verify:

```
ITA# show ip route
```

Step 5: Verify BGP

Verify:

```
ITA# show ip bgp
```

```
ISP1# show ip bgp
```

ISP1# configure terminal

interface Loopback0

shutdown

ITA# show ip bgp

ISP1# configure terminal

interface Loopback0

no shutdown

ITA# show ip bgp neighbors

Step 6: Configure Route Filters

ITA

configure terminal

access-list 1 permit 192.168.0.0 0.0.1.255

router bgp 100

neighbor 10.0.0.1 distribute-list 1 out

neighbor 172.16.0.1 distribute-list 1 out

Verify:

ISP2# show ip route

ITA# clear ip bgp *

ISP2# show ip route

ISP1# show ip route

Step 7: Configure Primary and Backup Routes Using Floating Static Routes

ITA

configure terminal

ip route 0.0.0.0 0.0.0.0 10.0.0.1 210

ip route 0.0.0.0 0.0.0.0 172.16.0.1 220

ISP1

configure terminal

interface loopback 100

ip address 192.168.100.1 255.255.255.0

Verify:

ITA# show ip route

```
ITA# ping 192.168.100.1 source 192.168.1.1
```

Step 8: Configure Primary and Backup Routes Using Default Network

ITA

```
configure terminal
```

```
no ip route 0.0.0.0 0.0.0.0 10.0.0.1 210
```

```
no ip route 0.0.0.0 0.0.0.0 172.16.0.1 220
```

```
ip default-network 192.168.100.0
```

```
ip route 0.0.0.0 0.0.0.0 172.16.0.1 220
```

ISP1

```
configure terminal
```

```
router bgp 200
```

```
network 192.168.100.0
```

Verify:

```
ITA# show ip route
```

```
ITA# clear ip bgp 10.0.0.1
```

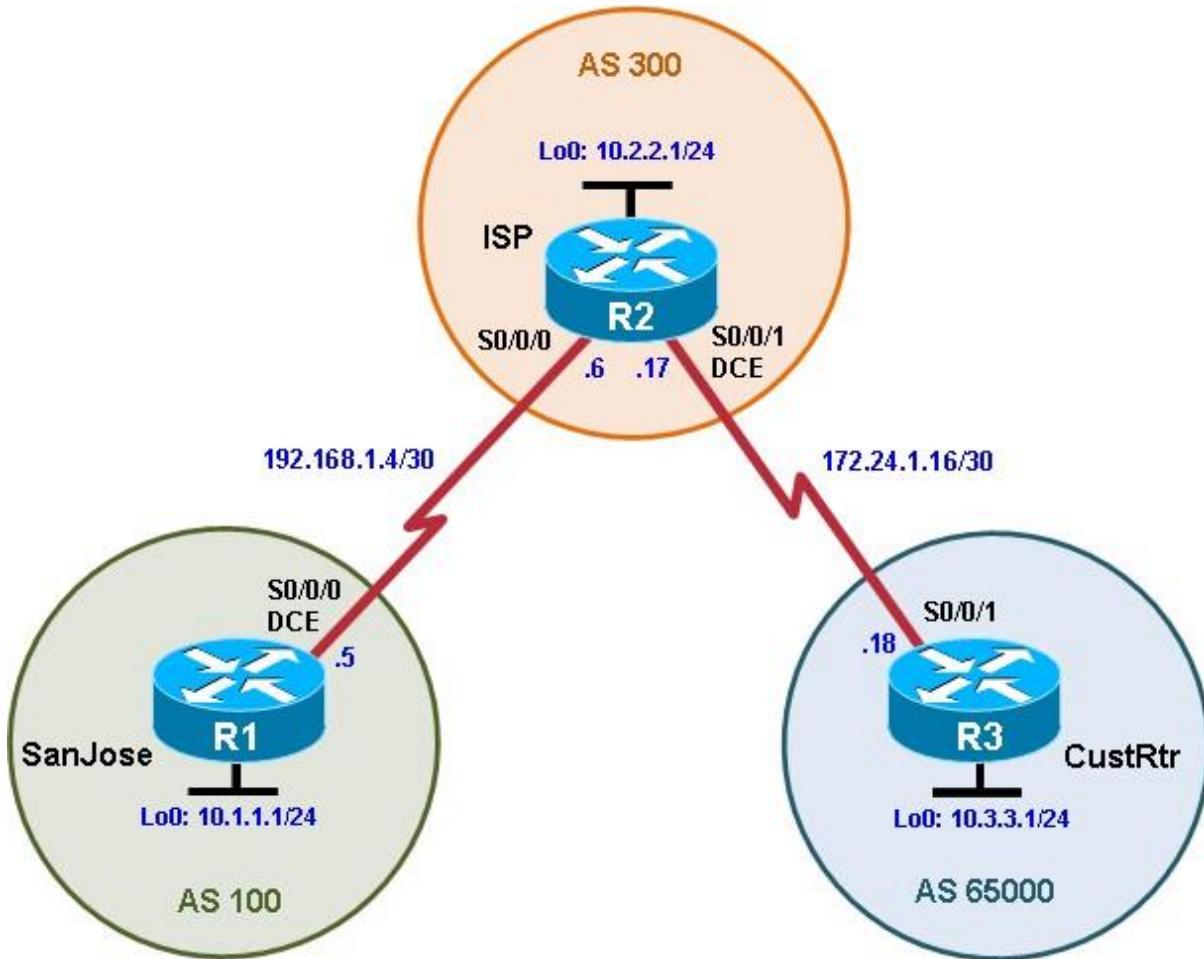
```
ITA# show ip route
```

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than list all combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device. The table does not include any other type of interface, even though a specific router might contain one. For example, for an ISDN BRI interface, the string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Practical 4-B: Using the AS_PATH Attribute

Topology



Objectives

- Use BGP commands to prevent private AS numbers from being advertised to the outside world.
- Use the AS_PATH attribute to filter BGP routes based on their source AS numbers.

Required Resources

- 3 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- Serial and console cables

Steps

Step 1: Prepare the Routers

- Cable the network as shown.
- Erase startup configuration and reload each router.

Step 2: Configure Hostname and Interface Addresses

SanJose (R1)

```
hostname SanJose  
interface Loopback0  
ip address 10.1.1.1 255.255.255.0  
interface Serial0/0/0  
ip address 192.168.1.5 255.255.255.252  
clock rate 128000  
no shutdown
```

ISP (R2)

```
hostname ISP  
interface Loopback0  
ip address 10.2.2.1 255.255.255.0  
interface Serial0/0/0  
ip address 192.168.1.6 255.255.255.252  
no shutdown  
interface Serial0/0/1  
ip address 172.24.1.17 255.255.255.252  
clock rate 128000  
no shutdown
```

CustRtr (R3)

```
hostname CustRtr  
interface Loopback0  
ip address 10.3.3.1 255.255.255.0  
interface Serial0/0/1  
ip address 172.24.1.18 255.255.255.252  
no shutdown
```

Step 3: Configure BGP

SanJose

```
configure terminal  
router bgp 100
```

```
neighbor 192.168.1.6 remote-as 300  
network 10.1.1.0 mask 255.255.255.0
```

ISP

```
configure terminal  
router bgp 300  
neighbor 192.168.1.5 remote-as 100  
neighbor 172.24.1.18 remote-as 65000  
network 10.2.2.0 mask 255.255.255.0
```

CustRtr

```
configure terminal  
router bgp 65000  
neighbor 172.24.1.17 remote-as 300  
network 10.3.3.0 mask 255.255.255.0
```

Verify:

```
ISP# show ip bgp neighbors
```

Step 4: Remove the Private AS

ISP

```
configure terminal  
router bgp 300  
neighbor 192.168.1.5 remove-private-as
```

Verify:

```
ISP# clear ip bgp *
```

```
SanJose# show ip route
```

```
SanJose# ping 10.3.3.1 source 10.1.1.1
```

```
SanJose# show ip bgp
```

Step 5: Use the AS_PATH Attribute to Filter Routes

ISP

```
configure terminal  
ip as-path access-list 1 deny ^100$  
ip as-path access-list 1 permit .*  
router bgp 300
```

```
neighbor 172.24.1.18 filter-list 1 out
```

Verify:

```
ISP# clear ip bgp *
```

```
ISP# show ip route
```

```
CustRtr# show ip route
```

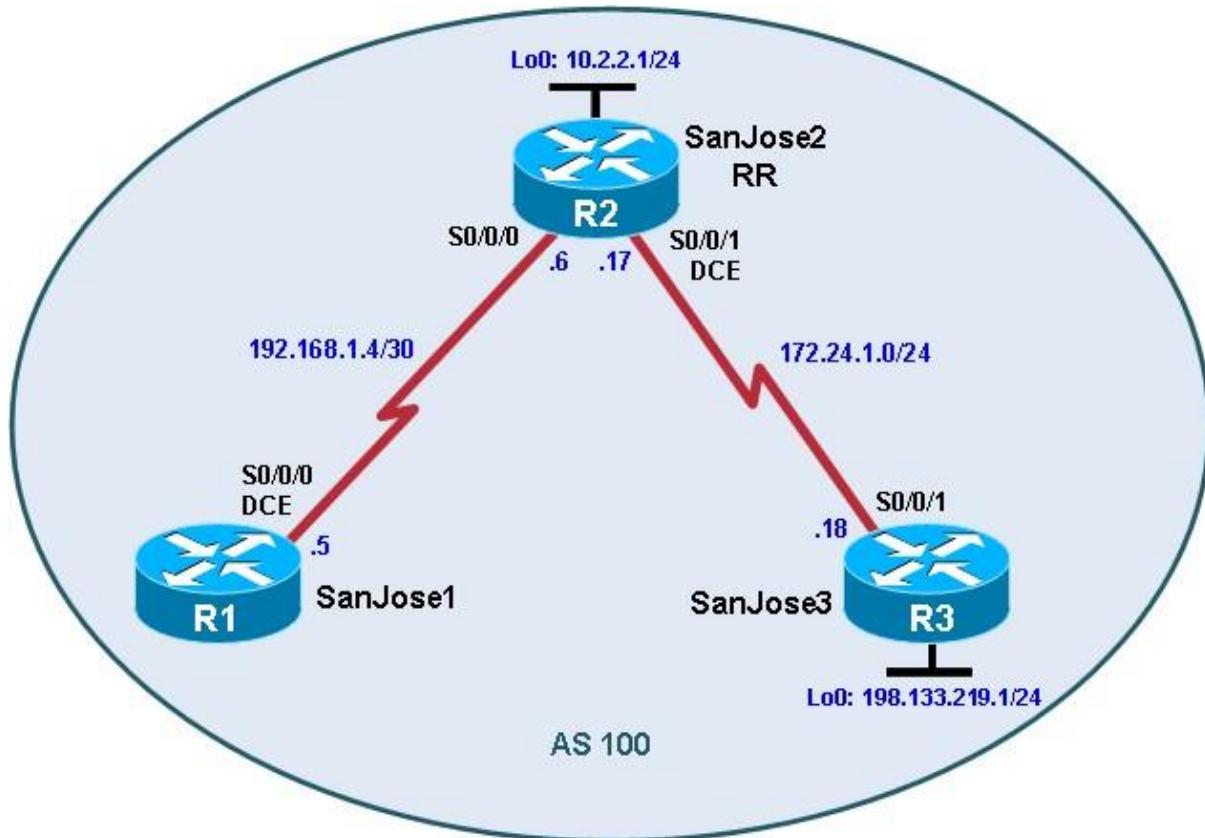
```
ISP# show ip bgp regexp ^100$
```

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than list all combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device. The table does not include any other type of interface, even though a specific router might contain one. For example, for an ISDN BRI interface, the string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Practical 4-C: BGP Route Reflectors and Route Filters

Topology



Objectives

- Configure IBGP routers to use a route reflector and a simple route filter.

Required Resources

- 3 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- Serial and console cables

Steps

Step 1: Prepare the Routers

- Cable the network as shown.
- Erase startup configuration and reload each router.
- Do not configure Loopback 0 on SanJose3 yet.

Step 2: Configure Hostname and Interface Addresses

SanJose1 (R1)

```
hostname SanJose1
```

```
interface Serial0/0/0
```

ip address 192.168.1.5 255.255.255.252

clock rate 128000

no shutdown

SanJose2 (R2)

hostname SanJose2

interface Loopback0

ip address 10.2.2.1 255.255.255.0

interface Serial0/0/0

ip address 192.168.1.6 255.255.255.252

no shutdown

interface Serial0/0/1

ip address 172.24.1.17 255.255.255.0

clock rate 128000

no shutdown

SanJose3 (R3)

hostname SanJose3

interface Serial0/0/1

ip address 172.24.1.18 255.255.255.0

no shutdown

Step 3: Configure RIPv2

SanJose1

configure terminal

router rip

version 2

no auto-summary

network 192.168.1.0

SanJose2

configure terminal

router rip

version 2

no auto-summary

```
network 172.24.0.0
```

```
network 192.168.1.0
```

```
network 10.0.0.0
```

SanJose3

```
configure terminal
```

```
router rip
```

```
version 2
```

```
no auto-summary
```

```
network 172.24.0.0
```

Verify:

```
SanJose1# show ip route
```

Step 4: Configure IBGP Peers and Route Reflectors

SanJose2

```
configure terminal
```

```
router bgp 100
```

```
neighbor 192.168.1.5 remote-as 100
```

```
neighbor 172.24.1.18 remote-as 100
```

SanJose1

```
configure terminal
```

```
router bgp 100
```

```
neighbor 192.168.1.6 remote-as 100
```

SanJose3

```
configure terminal
```

```
router bgp 100
```

```
neighbor 172.24.1.17 remote-as 100
```

Verify:

```
SanJose2# show ip bgp neighbors
```

Step 5: Inject a Network into BGP

SanJose3

```
configure terminal
```

```
interface loopback 0
```

```
ip address 198.133.219.1 255.255.255.0
```

```
router bgp 100
```

```
network 198.133.219.0
```

SanJose2

```
configure terminal
```

```
router bgp 100
```

```
neighbor 192.168.1.5 route-reflector-client
```

```
neighbor 172.24.1.18 route-reflector-client
```

```
Verify:
```

```
SanJose2# show ip route
```

```
SanJose2# ping 198.133.219.1
```

```
SanJose2# show ip protocols
```

```
SanJose1# show ip protocols
```

```
SanJose1# show ip route
```

```
SanJose1# ping 198.133.219.1
```

Step 6: Inject a Summary Address into BGP

SanJose3

```
configure terminal
```

```
router bgp 100
```

```
aggregate-address 198.0.0.0 255.0.0.0
```

SanJose2

```
configure terminal
```

```
ip prefix-list SUPERNETONLY permit 198.0.0.0/8
```

```
router bgp 100
```

```
neighbor 192.168.1.5 prefix-list SUPERNETONLY out
```

```
Verify:
```

```
SanJose2# show ip bgp 198.0.0.0
```

```
SanJose1# clear ip bgp * soft
```

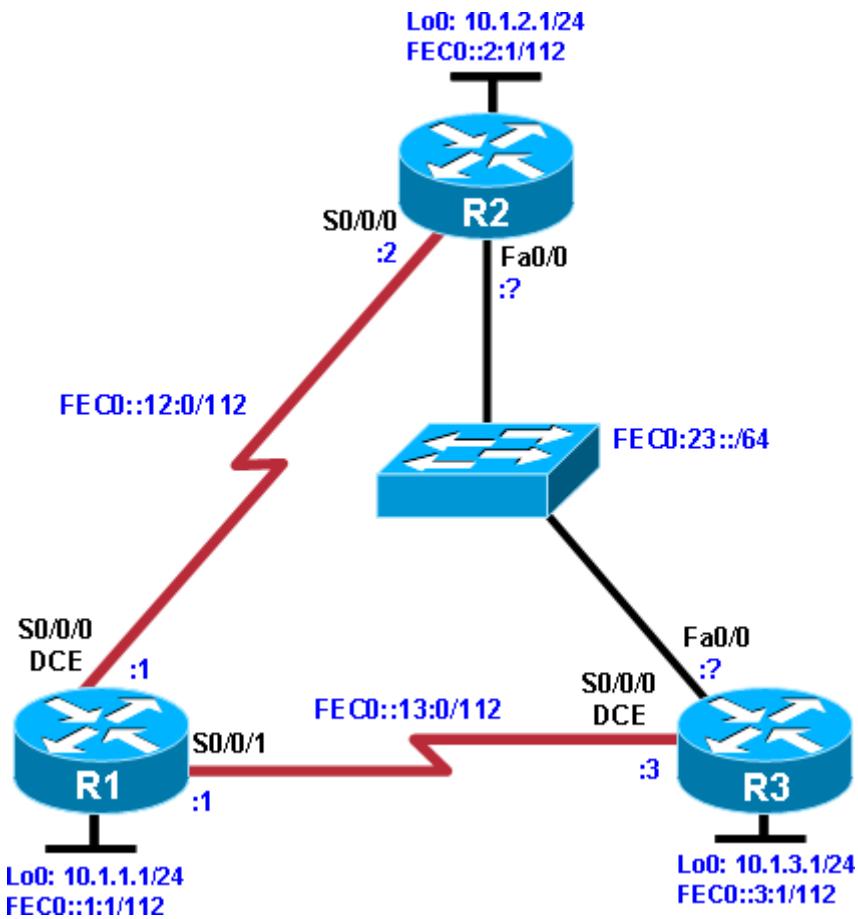
```
SanJose1# show ip route
```

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than try to list all the combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device. The table does not include any other type of interface, even though a specific router might contain one. An example of this is an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Practical 5-A: Configuring OSPF for IPv6

Topology



Objectives

- Configure a static IPv6 address on an interface.
- Change the default link-local address on an interface.
- Configure an EUI-64 IPv6 address on an interface.
- Enable IPv6 routing and CEF.
- Configure and verify single-area OSPFv3 operation.

Required Resources

- 3 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- 1 switch (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- Serial and Ethernet cables

Steps

Step 1: Prepare the Routers

- Cable the network as shown.
- Erase startup configuration and reload each router.

Step 2: Configure Hostname and Loopback Interfaces

R1

```
hostname R1

interface loopback0

ip address 10.1.1.1 255.255.255.0

ipv6 address FEC0::1:1/112
```

R2

```
hostname R2

interface loopback0

ip address 10.1.2.1 255.255.255.0

ipv6 address FEC0::2:1/112
```

R3

```
hostname R3

interface loopback0

ip address 10.1.3.1 255.255.255.0

ipv6 address FEC0::3:1/112
```

Step 3: Configure Static IPv6 Addresses

R1

```
configure terminal

interface serial0/0/0

ipv6 address FEC0::12:1/112

bandwidth 64

no shutdown

interface serial0/0/1

ipv6 address FEC0::13:1/112

bandwidth 64

no shutdown
```

R2

```
configure terminal
```

```
interface serial0/0/0
ipv6 address FEC0::12:2/112
bandwidth 64
no shutdown
```

R3

```
configure terminal
interface serial0/0/0
ipv6 address FEC0::13:3/112
bandwidth 64
no shutdown
```

Verify:

```
R1# ping FEC0::12:2
R1# ping FEC0::13:3
R2# ping FEC0::12:1
R3# ping FEC0::13:1
```

Step 4: Change the Link-Local Address

R1

```
configure terminal
interface serial0/0/0
ipv6 address FE80::1 link-local
```

R2

```
configure terminal
interface serial0/0/0
ipv6 address FE80::2 link-local
```

Verify:

```
R1# ping FE80::2
R2# ping FE80::1
R1# show ipv6 interface serial 0/0/0
R2# show ipv6 interface serial 0/0/0
```

Step 5: Configure EUI-64 Addresses

R2

```
configure terminal  
interface fastEthernet 0/0  
ipv6 address FEC0:23::/64 eui-64  
no shutdown
```

R3

```
configure terminal  
interface fastEthernet 0/0  
ipv6 address FEC0:23::/64 eui-64  
no shutdown
```

Verify:

```
R2# show ipv6 interface fastEthernet 0/0  
R2# ping FEC0:23::218:B9FF:FECD:BEFO  
R3# ping FEC0:23::218:B9FF:FE92:28D8
```

Step 6: Enable IPv6 Routing and CEF

R1

```
configure terminal  
ipv6 unicast-routing  
ipv6 cef
```

R2

```
configure terminal  
ipv6 unicast-routing  
ipv6 cef
```

R3

```
configure terminal  
ipv6 unicast-routing  
ipv6 cef
```

Step 7: Configure OSPFv3

R1

```
configure terminal  
interface loopback0  
ipv6 ospf 1 area 0
```

```
interface serial0/0/0
```

```
 ipv6 ospf 1 area 0
```

```
interface serial0/0/1
```

```
 ipv6 ospf 1 area 0
```

R2

```
configure terminal
```

```
interface loopback0
```

```
 ipv6 ospf 1 area 0
```

```
interface serial0/0/0
```

```
 ipv6 ospf 1 area 0
```

```
interface fastEthernet 0/0
```

```
 ipv6 ospf 1 area 0
```

R3

```
configure terminal
```

```
interface loopback0
```

```
 ipv6 ospf 1 area 0
```

```
interface serial0/0/0
```

```
 ipv6 ospf 1 area 0
```

```
interface fastEthernet 0/0
```

```
 ipv6 ospf 1 area 0
```

Verify:

```
R1# show ipv6 ospf neighbor
```

```
R2# show ipv6 ospf neighbor
```

```
R3# show ipv6 ospf neighbor
```

```
R1# show ipv6 ospf interface
```

```
R2# show ipv6 ospf interface
```

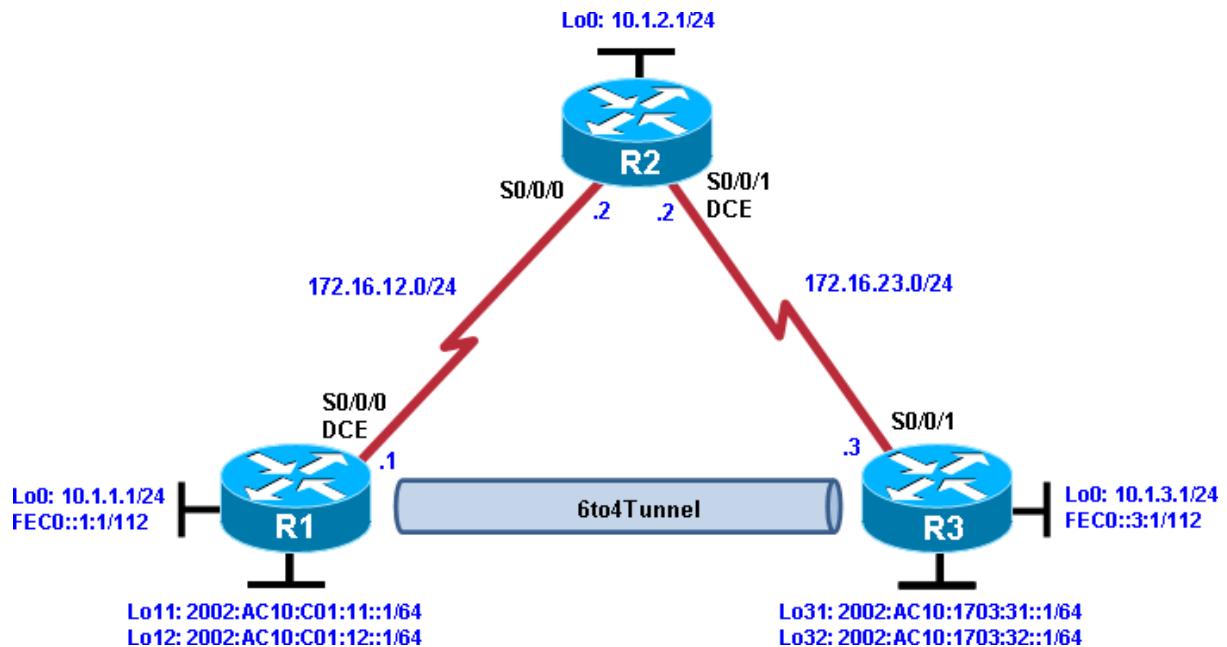
```
R3# show ipv6 ospf interface
```

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than list all combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device. The table does not include any other type of interface, even though a specific router might contain one. For example, for an ISDN BRI interface, the string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Practical 5-B: Configuring 6to4 Tunnels

Topology



Objectives

- Configure EIGRP for IPv4.
- Create a 6to4 tunnel.
- Configure static IPv6 routes.

Required Resources

- 3 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- Serial and console cables

Steps

Step 1: Prepare the Routers

- Erase startup configuration and reload each router.
- Set hostnames: R1, R2, R3.

Step 2: Configure Loopbacks and Physical Interfaces

R1

configure terminal

interface loopback0

ip address 10.1.1.1 255.255.255.0

ipv6 address FEC0::1:1/112

```
interface serial0/0/0
ip address 172.16.12.1 255.255.255.0
clockrate 64000
bandwidth 64
no shutdown
```

R2

```
configure terminal
interface loopback0
ip address 10.1.2.1 255.255.255.0
interface serial0/0/0
ip address 172.16.12.2 255.255.255.0
bandwidth 64
no shutdown
interface serial0/0/1
ip address 172.16.23.2 255.255.255.0
clockrate 64000
bandwidth 64
no shutdown
```

R3

```
configure terminal
interface loopback0
ip address 10.1.3.1 255.255.255.0
ipv6 address FEC0::3:1/112
interface serial0/0/1
ip address 172.16.23.3 255.255.255.0
bandwidth 64
no shutdown
```

Verify:

- Ping local subnets.

Step 3: Configure EIGRP

R1

```
configure terminal
```

```
router eigrp 1
```

```
no auto-summary
```

```
network 10.0.0.0
```

```
network 172.16.0.0
```

R2

```
configure terminal
```

```
router eigrp 1
```

```
no auto-summary
```

```
network 10.0.0.0
```

```
network 172.16.0.0
```

R3

```
configure terminal
```

```
router eigrp 1
```

```
no auto-summary
```

```
network 10.0.0.0
```

```
network 172.16.0.0
```

Step 4: Configure a Manual IPv6 6to4 Tunnel

R1

```
configure terminal
```

```
interface loopback11
```

```
ipv6 address 2002:AC10:0C01:11::1/64
```

```
interface loopback12
```

```
ipv6 address 2002:AC10:0C01:12::1/64
```

```
interface tunnel 0
```

```
tunnel mode ipv6ip 6to4
```

```
ipv6 address 2002:AC10:0C01:1::1/64
```

```
tunnel source serial0/0/0
```

```
exit
```

```
ipv6 unicast-routing
```

```
ipv6 route 2002::/16 tunnel0
```

R3

```
configure terminal

interface loopback31
 ipv6 address 2002:AC10:1703:31::1/64

interface loopback32
 ipv6 address 2002:AC10:1703:32::1/64

interface tunnel 0
 tunnel mode ipv6ip 6to4
 ipv6 address 2002:AC10:1703:1::3/64
 tunnel source serial0/0/1

exit

ipv6 unicast-routing
```

ipv6 route 2002::/16 tunnel0

Verify:

```
R1# ping 2002:AC10:1703:1::3
R1# ping 2002:AC10:1703:31::1
R1# ping 2002:AC10:1703:32::1
R3# ping 2002:AC10:C01:1::1
R3# ping 2002:AC10:0C01:11::1
R3# ping 2002:AC10:0C01:12::1
```

Step 5: Configure Static IPv6 Routes

R1

```
configure terminal
ipv6 route FEC0::3:0/112 2002:AC10:1703:1::3
```

R3

```
configure terminal
ipv6 route FEC0::1:0/112 2002:AC10:C01:1::1
```

Verify:

```
R1# show ipv6 route
R3# show ipv6 route
R1# ping FEC0::3:1
```

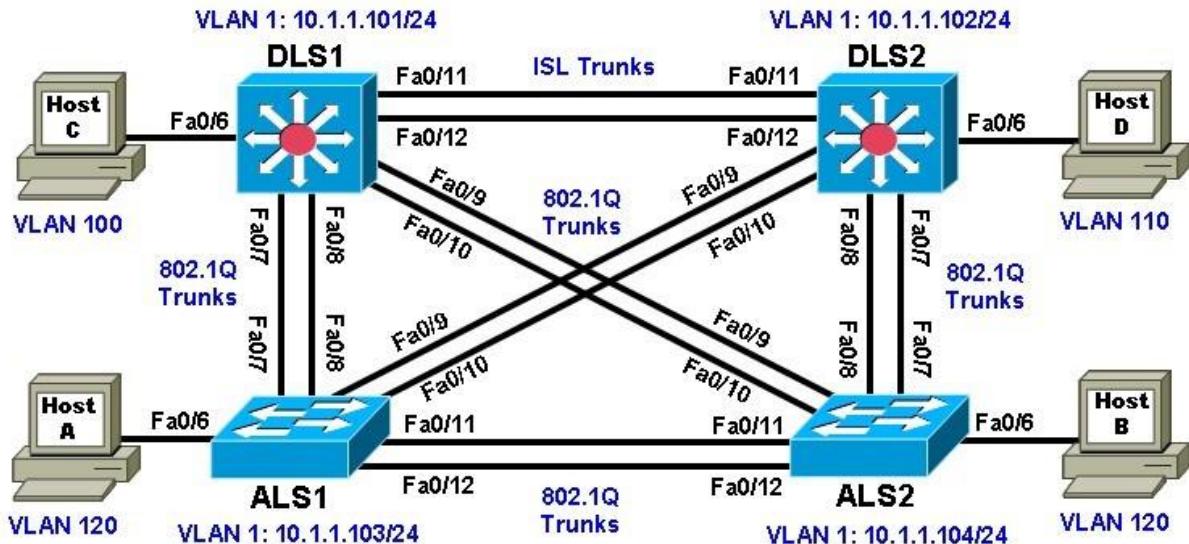
R3# ping FEC0::1:1

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. Rather than list all combinations of configurations for each router class, this table includes identifiers for the possible combinations of Ethernet and serial interfaces in the device. The table does not include any other type of interface, even though a specific router might contain one. For example, for an ISDN BRI interface, the string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Practical 6-A: Static VLANs, VLAN Trunking, and VTP Domains and Modes

Topology



Objectives

- Set up a VTP domain.
- Create and maintain VLANs.
- Configure ISL and 802.1Q trunking.

Required Resources

- 2 switches (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- 2 switches (Cisco 3560, IOS 12.2(46)SE C3560-ADVIPSERVICESK9-M or comparable)
- 4 PCs (optional)
- Ethernet and console cables

Steps

Step 1: Prepare the Switches

- Power up switches.
- Establish console connection.
- Erase startup configuration and reload.

Step 2: Configure Basic Switch Parameters

DLS1

configure terminal

hostname DLS1

```
interface vlan 1
ip address 10.1.1.101 255.255.255.0
no shutdown
enable secret cisco
line vty 0 15
password cisco
login
```

DLS2

```
configure terminal
hostname DLS2
interface vlan 1
ip address 10.1.1.102 255.255.255.0
no shutdown
enable secret cisco
line vty 0 15
```

```
password cisco
login
```

ALS1

```
configure terminal
hostname ALS1
interface vlan 1
ip address 10.1.1.201 255.255.255.0
no shutdown
enable secret cisco
line vty 0 15
password cisco
login
```

ALS2

```
configure terminal
hostname ALS2
interface vlan 1
```

```
ip address 10.1.1.202 255.255.255.0  
no shutdown  
enable secret cisco  
line vty 0 15  
password cisco  
login
```

Step 3: Display Default VLAN Information

```
ALS1# show vlan
```

```
DLS1# show vlan
```

Step 4: Examine VTP Information

```
DLS1# show vtp status
```

Step 5: Configure VTP

DLS1

```
configure terminal
```

```
vtp domain SWLAB
```

```
vtp version 2
```

Step 6: Configure Trunking

DLS1

```
configure terminal
```

```
interface range fastEthernet 0/7 - 10
```

```
switchport trunk encapsulation dot1q
```

```
switchport mode trunk
```

```
interface range fastEthernet 0/11 - 12
```

```
switchport trunk encapsulation isl
```

```
switchport mode trunk
```

ALS1

```
configure terminal
```

```
interface range fastEthernet 0/7 - 12
```

```
switchport mode trunk
```

DLS2

```
configure terminal
```

```
interface range fastEthernet 0/7 - 8  
switchport trunk encapsulation dot1q  
switchport mode trunk
```

Step 7: Verify Trunk Configuration

```
ALS2# show interfaces fastEthernet 0/7 switchport  
DLS1# show interfaces trunk  
DLS2# show interfaces trunk
```

Step 8: Configure Access Ports

ALS1

```
configure terminal  
interface fastEthernet 0/6  
switchport mode access  
Verify:
```

```
DLS1# show interfaces fastEthernet 0/6 switchport
```

Step 9: Verify VTP Configuration

```
ALS1# show vtp status  
ALS2# show vtp status
```

Step 10: Configure VLANs by Assigning Port Membership

DLS1

```
configure terminal  
interface fastEthernet 0/6  
switchport access vlan 100
```

DLS2

```
configure terminal  
interface fastEthernet 0/6  
switchport access vlan 110
```

Step 11: Configure VLANs in Configuration Mode

DLS1

```
configure terminal  
vlan 120
```

ALS1

```
configure terminal  
interface fastEthernet 0/6  
switchport access vlan 120
```

ALS2

```
configure terminal  
interface fastEthernet 0/6  
switchport access vlan 120
```

Verify:

```
ALS1# show vlan
```

Step 12: Change VLAN Names

DLS1

```
vlan 100  
name Server-Farm-1  
exit  
vlan 110  
name Server-Farm-2  
exit  
vlan 120  
name Net-Eng  
exit
```

Verify:

```
DLS1# show vlan
```

Step 13: Change VLAN Status

ALS1

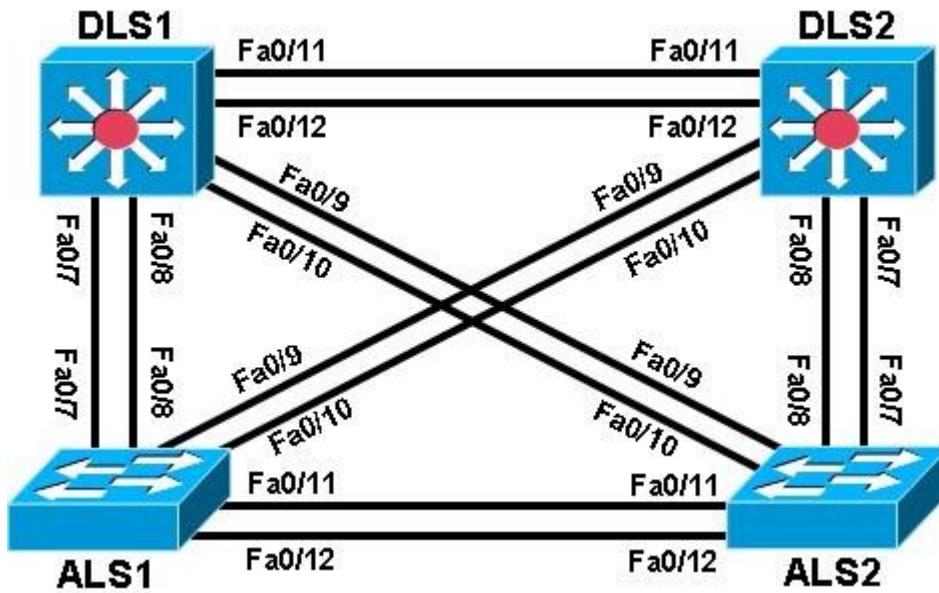
```
vlan 120  
shutdown  
no shutdown  
state suspend  
state active
```

Verify:

```
ALS1# show vlan brief
```

Practical 6-B: Configuring EtherChannel

Topology



Objective

- Configure EtherChannel.

Required Resources

- 2 switches (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- 2 switches (Cisco 3560, IOS 12.2(46)SE C3560-ADVIPSERVICESK9-M or comparable)
- Ethernet and console cables

Steps

Step 1: Prepare the Switches

- Delete vlan.dat, erase startup configuration, and reload all switches.

Step 2: Configure Basic Switch Parameters

DLS1

```
configure terminal
```

```
hostname DLS1
```

```
interface range fastEthernet 0/7 - 12
```

```
switchport trunk encapsulation dot1q
```

```
switchport mode trunk
```

DLS2

```
configure terminal
```

```
hostname DLS2
interface range fastEthernet 0/7 - 12
switchport trunk encapsulation dot1q
switchport mode trunk
```

ALS1

```
configure terminal
hostname ALS1
interface range fastEthernet 0/7 - 12
switchport mode trunk
```

ALS2

```
configure terminal
hostname ALS2
interface range fastEthernet 0/7 - 12
switchport mode trunk
```

Step 3: Configure an EtherChannel with PAgP

ALS1

```
configure terminal
interface range fastEthernet 0/11 - 12
channel-group 1 mode desirable
interface port-channel 1
switchport mode trunk
```

ALS2

```
configure terminal
interface range fastEthernet 0/11 - 12
channel-group 1 mode desirable
interface port-channel 1
switchport mode trunk
```

Verify:

```
ALS1# show etherchannel summary
ALS2# show etherchannel summary
ALS1# show interfaces trunk
```

```
ALS1# show spanning-tree
```

Step 4: Configure an 802.3ad LACP EtherChannel

ALS1

```
configure terminal
```

```
interface range fastEthernet 0/7 - 8
```

```
channel-group 2 mode active
```

```
interface port-channel 2
```

```
switchport mode trunk
```

DLS1

```
configure terminal
```

```
interface range fastEthernet 0/7 - 8
```

```
channel-group 2 mode active
```

```
interface port-channel 2
```

```
switchport mode trunk
```

Verify:

```
ALS1# show etherchannel summary
```

Step 5: Configure a Layer 3 EtherChannel

DLS1

```
configure terminal
```

```
interface range fastEthernet 0/11 - 12
```

```
no switchport
```

```
channel-group 3 mode desirable
```

```
interface port-channel 3
```

```
no switchport
```

```
ip address 10.0.0.1 255.255.255.0
```

DLS2

```
configure terminal
```

```
interface range fastEthernet 0/11 - 12
```

```
no switchport
```

```
channel-group 3 mode desirable
```

```
interface port-channel 3
```

```
no switchport  
ip address 10.0.0.2 255.255.255.0
```

Verify:

```
DLS1# ping 10.0.0.2  
DLS1# show etherchannel summary
```

Step 6: Configure Load Balancing

ALS1

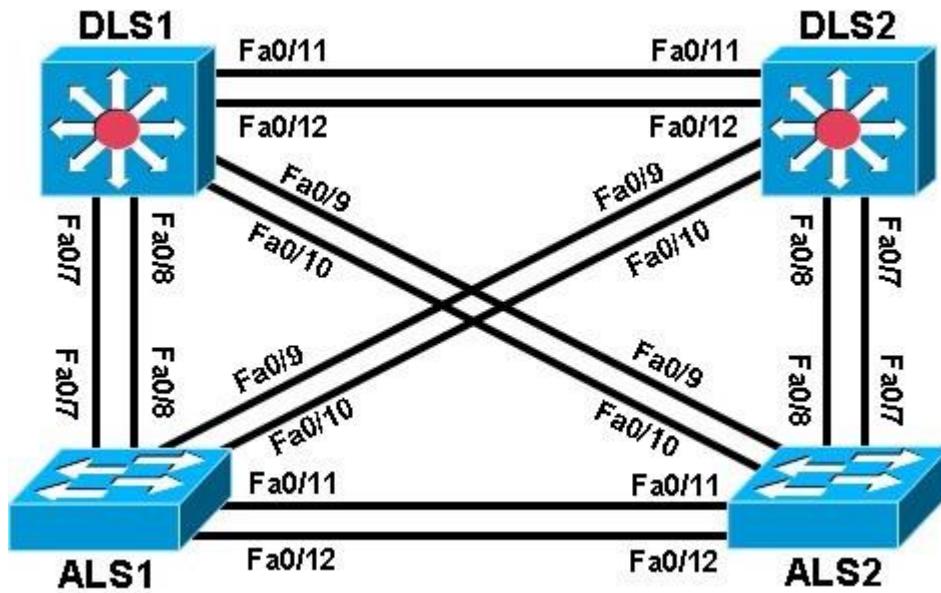
```
configure terminal  
port-channel load-balance src-dst-mac
```

Verify:

```
ALS1# show etherchannel load-balance
```

Practical 7-A: Spanning Tree Protocol (STP) Default Behavior

Topology



Objective

- Observe the default behavior of STP.

Required Resources

- 2 switches (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- 2 switches (Cisco 3560, IOS 12.2(46)SE C3560-ADVIPSERVICESK9-M or comparable)
- Ethernet and console cables

Steps

Step 1: Prepare the Switches

- Erase vlan.dat, startup configuration, and reload all switches.
- Cable as shown in topology.

Step 2: Configure Basic Switch Parameters

ALS1

enable

configure terminal

hostname ALS1

enable secret class

line console 0

logging synchronous

exec-timeout 0 0

password cisco

login

ALS2

enable

configure terminal

hostname ALS2

enable secret class

line console 0

logging synchronous

exec-timeout 0 0

password cisco

login

DLS1

enable

configure terminal

hostname DLS1

enable secret class

line console 0

logging synchronous

exec-timeout 0 0

password cisco

login

DLS2

enable

configure terminal

hostname DLS2

enable secret class

line console 0

logging synchronous

exec-timeout 0 0

password cisco

login

Step 3: Display Default Spanning Tree Information

DLS1# show spanning-tree

DLS2# show spanning-tree

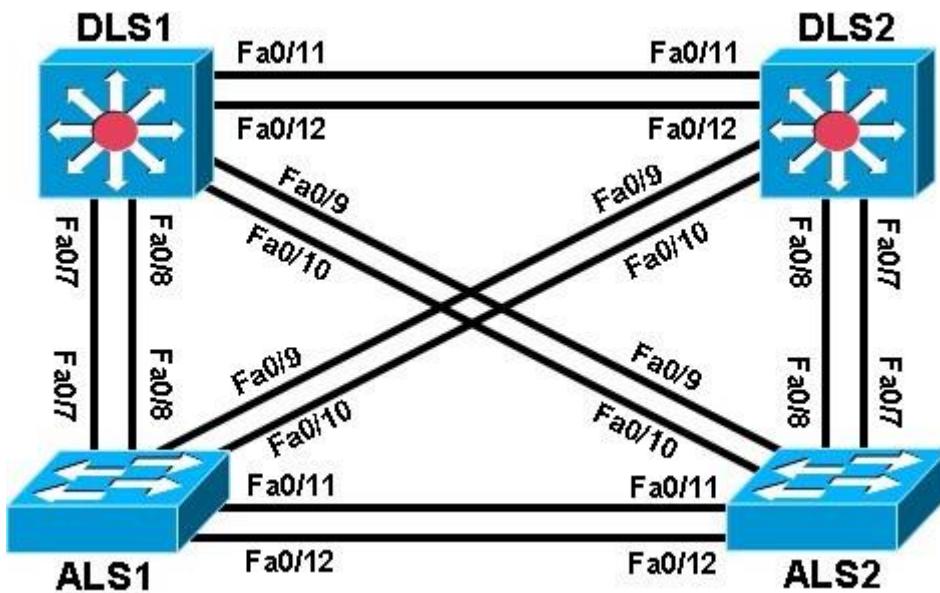
ALS1# show spanning-tree

ALS2# show spanning-tree

ALS1# show spanning-tree root

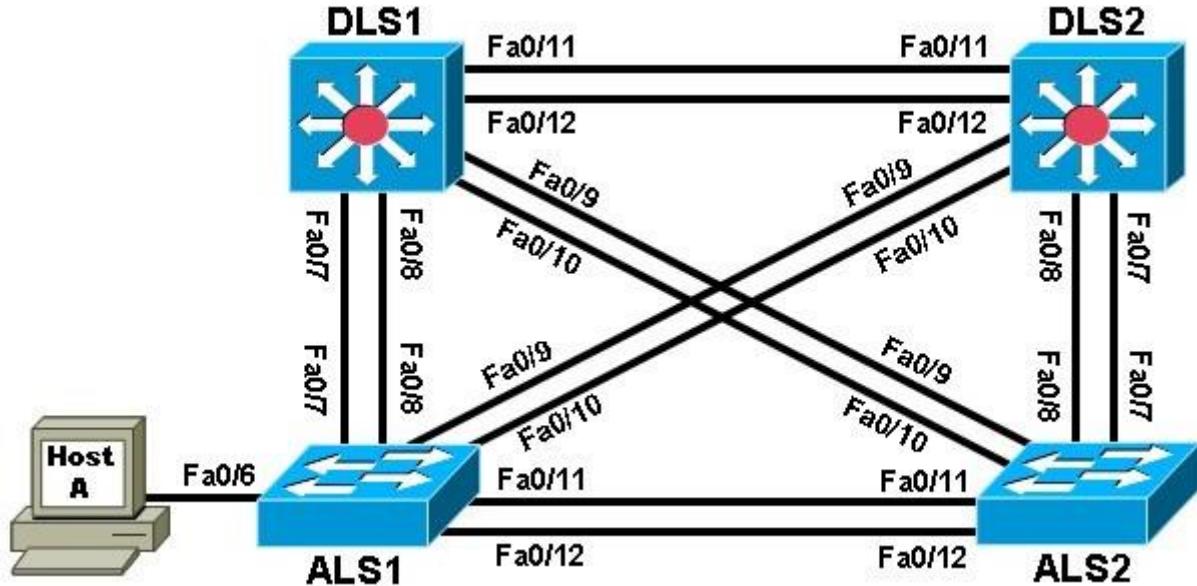
DLS2# show spanning-tree root

- Diagram STP topology for VLAN 1 identifying root bridge, root forwarding ports (R), designated forwarding ports (D), and alternate blocking ports (A).



Practical 7-B: Modifying Default Spanning Tree Behavior

Topology



Objective

- Observe what happens when the default spanning tree behavior is modified.

Required Resources

- 2 switches (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- 2 switches (Cisco 3560, IOS 12.2(46)SE C3560-ADVIPSERVICESK9-M or comparable)
- 1 PC (optional) attached to ALS1
- Ethernet and console cables

Steps

Step 1: Prepare the Switches

- Delete vlan.dat, erase startup configuration, and reload all switches.
- Assign hostnames: DLS1, DLS2, ALS1, ALS2.

DLS1

```
configure terminal
```

```
hostname DLS1
```

```
interface range fastEthernet 0/7 - 12
```

```
switchport trunk encapsulation dot1q
```

```
switchport mode trunk
```

DLS2

```
configure terminal  
hostname DLS2  
interface range fastEthernet 0/7 - 12  
switchport trunk encapsulation dot1q  
switchport mode trunk
```

ALS1

```
configure terminal  
hostname ALS1  
interface range fastEthernet 0/7 - 12  
switchport mode trunk
```

ALS2

```
configure terminal  
hostname ALS2  
interface range fastEthernet 0/7 - 12  
switchport mode trunk
```

Step 2: Display Default Spanning Tree Information

```
DLS1# show spanning-tree  
DLS2# show spanning-tree  
ALS1# show spanning-tree  
ALS2# show spanning-tree
```

```
DLS1# show interfaces trunk
```

Step 3: Configure Primary and Secondary Root**DLS2**

```
debug spanning-tree events
```

DLS1

```
configure terminal  
spanning-tree vlan 1 root primary
```

ALS1

```
configure terminal  
spanning-tree vlan 1 root secondary
```

Verify:

```
DLS1# show run | include span
```

```
ALS1# show run | include span
```

```
DLS1# show spanning-tree
```

Step 4: Change Root Port Using Port Priority

DLS1

```
configure terminal
```

```
interface fastEthernet 0/12
```

```
spanning-tree port-priority 112
```

Verify:

```
DLS2# show spanning-tree
```

```
DLS1# show spanning-tree
```

Step 5: Configure PortFast on an Access Port (Optional)

ALS1

```
configure terminal
```

```
interface fastEthernet 0/6
```

```
shutdown
```

```
exit
```

```
debug spanning-tree events
```

```
interface fastEthernet 0/6
```

```
switchport mode access
```

```
no shutdown
```

```
interface fastEthernet 0/6
```

```
shutdown
```

```
spanning-tree portfast
```

```
no shutdown
```

```
exit
```

```
undebbug all
```

Step 6: Change Root Port Using Cost

ALS2

```
configure terminal
```

interface fastEthernet 0/10

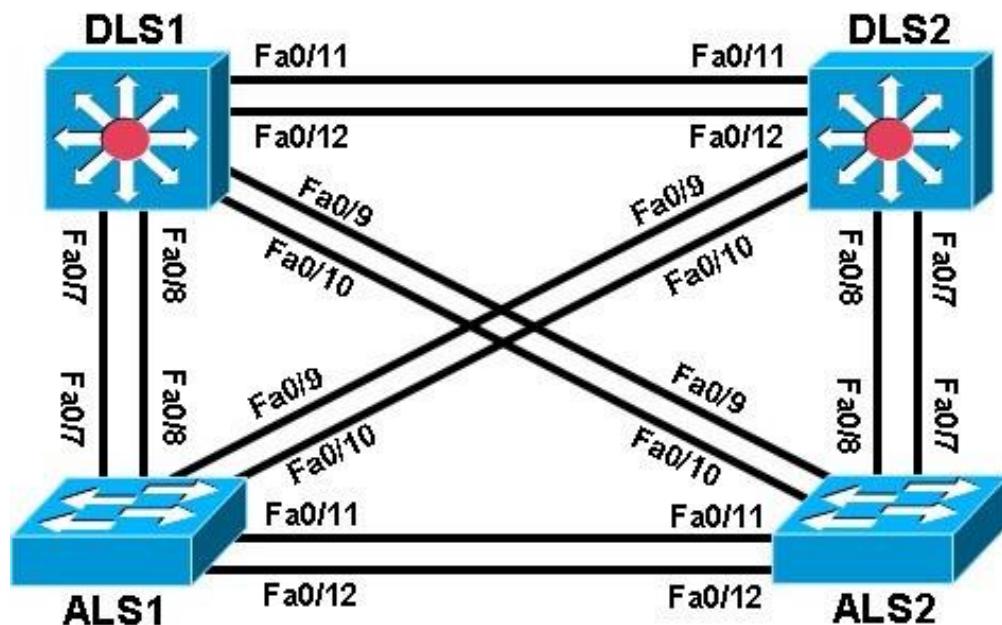
spanning-tree cost 10

Verify:

ALS2# show spanning-tree

Practical 8-A: Per-VLAN Spanning Tree Behavior

Topology



Objectives

- Observe the behavior of a separate spanning tree instance per VLAN.
- Change spanning tree mode to rapid spanning tree.

Required Resources

- 2 switches (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- 2 switches (Cisco 3560, IOS 12.2(46)SE C3560-ADVIPSERVICESK9-M or comparable)
- Ethernet and console cables

Steps

Step 1: Prepare the Switches

- Delete vlan.dat, erase startup configuration, and reload all switches.
- Assign hostnames: DLS1, DLS2, ALS1, ALS2.

DLS1

```
configure terminal
```

```
hostname DLS1
```

```
interface range fastEthernet 0/7 - 12
```

```
switchport trunk encapsulation dot1q
```

```
switchport mode trunk
```

DLS2

```
configure terminal  
hostname DLS2  
interface range fastEthernet 0/7 - 12  
switchport trunk encapsulation dot1q  
switchport mode trunk
```

ALS1

```
configure terminal  
hostname ALS1  
interface range fastEthernet 0/7 - 12  
switchport mode trunk
```

ALS2

```
configure terminal  
hostname ALS2  
interface range fastEthernet 0/7 - 12  
switchport mode trunk
```

Step 2: Configure VTP**DLS1**

```
configure terminal  
vtp mode transparent  
vtp domain CISCO  
vlan 10,20
```

DLS2

```
configure terminal  
vtp mode transparent  
vtp domain CISCO  
vlan 10,20
```

ALS1

```
configure terminal  
vtp mode transparent  
vtp domain CISCO
```

vlan 10,20

ALS2

configure terminal

vtp mode transparent

vtp domain CISCO

vlan 10,20

Verify:

DLS1# show vlan brief

DLS1# show spanning-tree

Step 3: Assign a Root Switch for Each VLAN

DLS1

spanning-tree vlan 10 priority 4096

DLS2

spanning-tree vlan 20 priority 4096

Verify:

DLS1# show spanning-tree

DLS2# show spanning-tree

ALS1# show spanning-tree

ALS2# show spanning-tree

Step 4: Configure RSTP

DLS1

spanning-tree mode rapid-pvst

DLS2

spanning-tree mode rapid-pvst

ALS1

spanning-tree mode rapid-pvst

ALS2

configure terminal

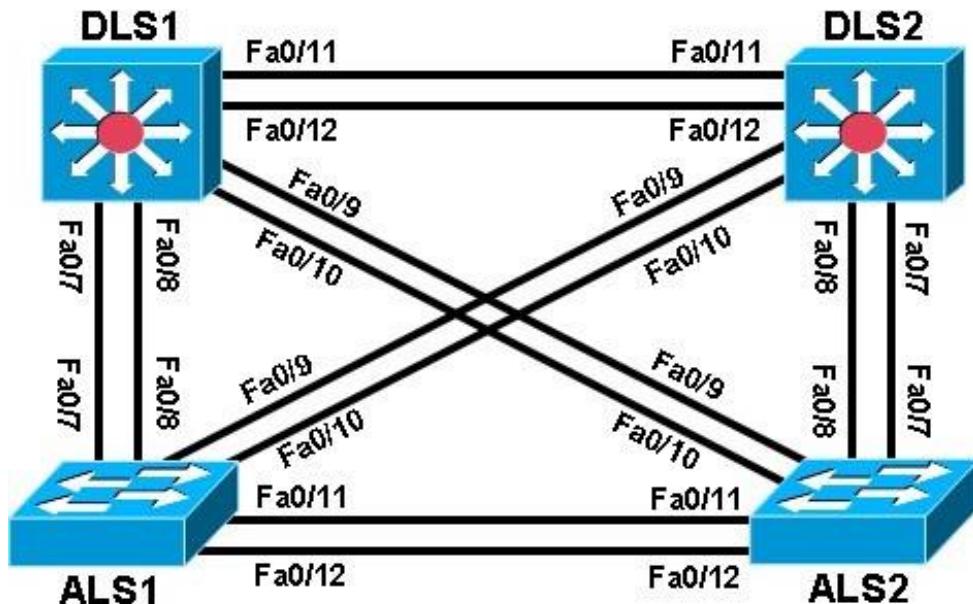
spanning-tree mode rapid-pvst

Verify:

DLS1# show spanning-tree

Practical 8-B: Multiple Spanning Tree

Topology



Objective

- Observe the behavior of multiple spanning tree (MST).

Required Resources

- 2 switches (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- 2 switches (Cisco 3560, IOS 12.2(46)SE C3560-ADVIPSERVICESK9-M or comparable)
- Ethernet and console cables

Steps

Step 1: Prepare the Switches

- Delete vlan.dat, erase startup configuration, and reload all switches.
- Assign hostnames: DLS1, DLS2, ALS1, ALS2.

DLS1

```
configure terminal
```

```
hostname DLS1
```

```
interface range fastEthernet 0/7 - 12
```

```
switchport trunk encapsulation dot1q
```

```
switchport mode trunk
```

DLS2

```
configure terminal  
hostname DLS2  
interface range fastEthernet 0/7 - 12  
switchport trunk encapsulation dot1q  
switchport mode trunk
```

ALS1

```
configure terminal  
hostname ALS1  
interface range fastEthernet 0/7 - 12  
switchport mode trunk
```

ALS2

```
configure terminal  
hostname ALS2  
interface range fastEthernet 0/7 - 12  
switchport mode trunk
```

Step 2: Configure VTP and VLANs**DLS1**

```
configure terminal  
vtp mode transparent  
vtp domain CISCO  
vlan 10,20,30,40,50,60,70,80,90,100
```

DLS2

```
configure terminal  
vtp mode transparent  
vtp domain CISCO  
vlan 10,20,30,40,50,60,70,80,90,100
```

ALS1

```
configure terminal  
vtp mode transparent  
vtp domain CISCO
```

```
vlan 10,20,30,40,50,60,70,80,90,100
```

ALS2

```
configure terminal
```

```
vtp mode transparent
```

```
vtp domain CISCO
```

```
vlan 10,20,30,40,50,60,70,80,90,100
```

Verify:

```
DLS1# show vlan brief
```

Step 3: Display Spanning Tree Information

```
DLS1# show spanning-tree
```

Step 4: Configure MST Globally

DLS1

```
configure terminal
```

```
spanning-tree mode mst
```

DLS2

```
configure terminal
```

```
spanning-tree mode mst
```

ALS1

```
configure terminal
```

```
spanning-tree mode mst
```

ALS2

```
configure terminal
```

```
spanning-tree mode mst
```

Verify:

```
DLS1# show spanning-tree
```

```
DLS1# show spanning-tree mst configuration
```

Step 5: Configure the MST Region and Instances

DLS1

```
configure terminal
```

```
spanning-tree mst configuration
```

```
name CISCO
```

revision 1

instance 1 vlan 20-50

instance 2 vlan 80,100

exit

DLS2

configure terminal

spanning-tree mst configuration

name CISCO

revision 1

instance 1 vlan 20-50

instance 2 vlan 80,100

exit

ALS1

configure terminal

spanning-tree mst configuration

name CISCO

revision 1

instance 1 vlan 20-50

instance 2 vlan 80,100

exit

ALS2

configure terminal

spanning-tree mst configuration

name CISCO

revision 1

instance 1 vlan 20-50

instance 2 vlan 80,100

exit

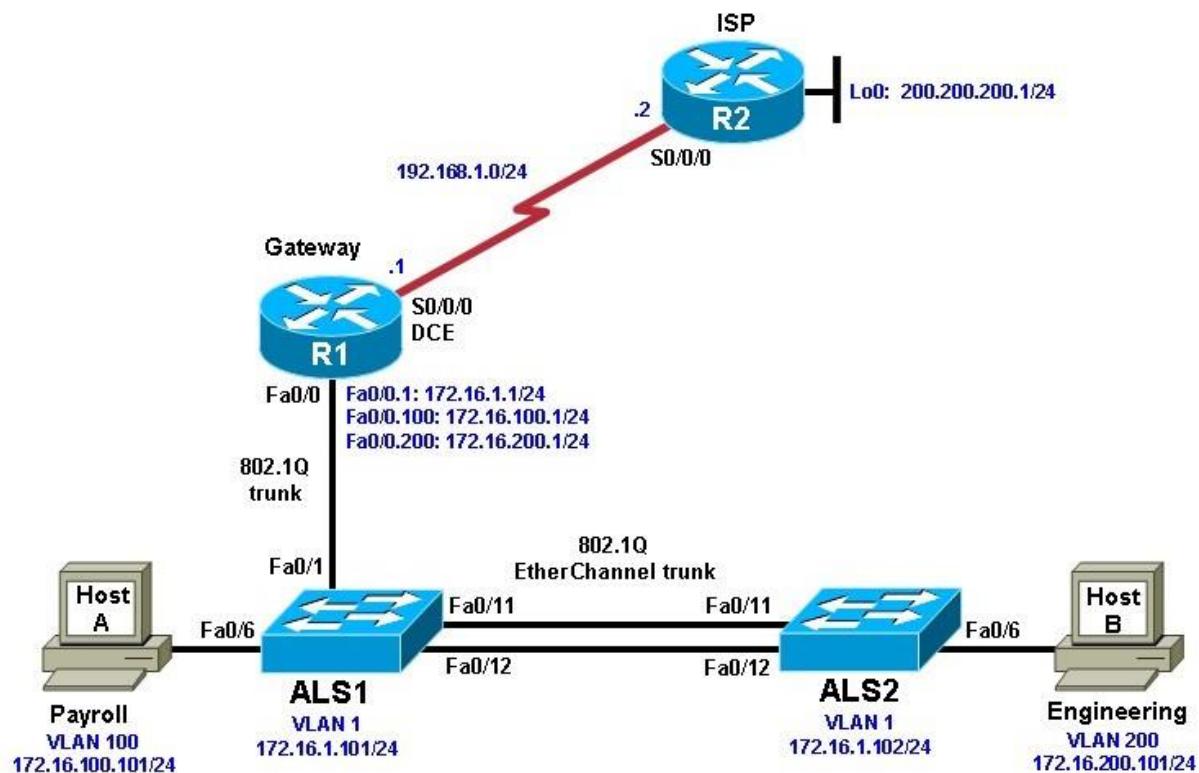
Verify:

DLS1# show spanning-tree mst configuration

DLS1# show spanning-tree

Practical 9-A: Inter-VLAN Routing with an External Router

Topology



Objective

- Configure inter-VLAN routing using an external router (router on a stick).

Required Resources

- 2 routers (Cisco 1841, IOS 12.4(24)T1 Advanced IP Services or comparable)
- 2 switches (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- Serial and Ethernet cables

Steps

Step 1: Prepare the Switches and Routers

- Cable the network as shown.
- Erase startup configuration, delete vlan.dat, and reload switches and routers.

Step 2: Configure the Hosts

- PC A: IP 172.16.100.10/24, Gateway 172.16.100.1
- PC B: IP 172.16.200.10/24, Gateway 172.16.200.1

Step 3: Configure the Routers

ISP

```
configure terminal  
hostname ISP  
interface Loopback0  
ip address 200.200.200.1 255.255.255.0  
interface Serial0/0/0  
ip address 192.168.1.2 255.255.255.0  
no shutdown  
ip route 172.16.0.0 255.255.0.0 192.168.1.1
```

Gateway

```
configure terminal  
hostname Gateway  
interface Serial0/0/0  
ip address 192.168.1.1 255.255.255.0  
clockrate 64000  
no shutdown  
ip route 0.0.0.0 0.0.0.0 192.168.1.2
```

Verify:

```
Gateway# ping 192.168.1.2
```

Step 4: Configure the Switches

ALS1

```
configure terminal  
hostname ALS1  
interface vlan 1  
ip address 172.16.1.101 255.255.255.0  
no shutdown  
ip default-gateway 172.16.1.1  
enable secret cisco  
line vty 0 15  
password cisco  
login
```

ALS2

```
configure terminal  
hostname ALS2  
interface vlan 1  
ip address 172.16.1.102 255.255.255.0  
no shutdown  
ip default-gateway 172.16.1.1  
enable secret cisco  
line vty 0 15  
password cisco  
login
```

Step 5: Confirm the VLANs

```
ALS1# show vlan
```

```
ALS2# show vlan
```

Step 6: Configure Trunk Links and EtherChannel**ALS1**

```
configure terminal  
interface range fastEthernet 0/11 - 12  
switchport mode trunk  
channel-group 1 mode desirable
```

ALS2

```
configure terminal  
interface range fastEthernet 0/11 - 12  
switchport mode trunk  
channel-group 1 mode desirable
```

Verify:

```
ALS1# show etherchannel 1 summary
```

Step 7: Configure VTP**ALS2**

```
configure terminal  
vtp mode client
```

ALS1

```
configure terminal
```

```
vtp domain SWLAB
```

```
vtp version 2
```

Verify:

```
ALS1# show vtp status
```

```
ALS2# show vtp status
```

Step 8: Configure VLANs and Switch Access Ports**ALS1**

```
configure terminal
```

```
vlan 100
```

```
name Payroll
```

```
vlan 200
```

```
name Engineering
```

```
interface fastEthernet 0/6
```

```
switchport mode access
```

```
switchport access vlan 100
```

```
spanning-tree portfast
```

ALS2

```
configure terminal
```

```
interface fastEthernet 0/6
```

```
switchport mode access
```

```
switchport access vlan 200
```

```
spanning-tree portfast
```

Verify:

```
ALS2# show vlan brief
```

Step 9: Configure ALS1 Trunking to Gateway Router**ALS1**

```
configure terminal
```

```
interface fastEthernet 0/1
```

```
switchport mode trunk
```

Step 10: Configure Gateway Router for VLAN Trunking

Gateway

```
configure terminal  
  
interface fastEthernet 0/0  
no shutdown  
  
interface fastEthernet 0/0.1  
description Management VLAN 1  
encapsulation dot1q 1 native  
ip address 172.16.1.1 255.255.255.0  
  
interface fastEthernet 0/0.100  
description Payroll VLAN 100  
encapsulation dot1q 100  
ip address 172.16.100.1 255.255.255.0  
  
interface fastEthernet 0/0.200  
description Engineering VLAN 200  
encapsulation dot1q 200  
ip address 172.16.200.1 255.255.255.0
```

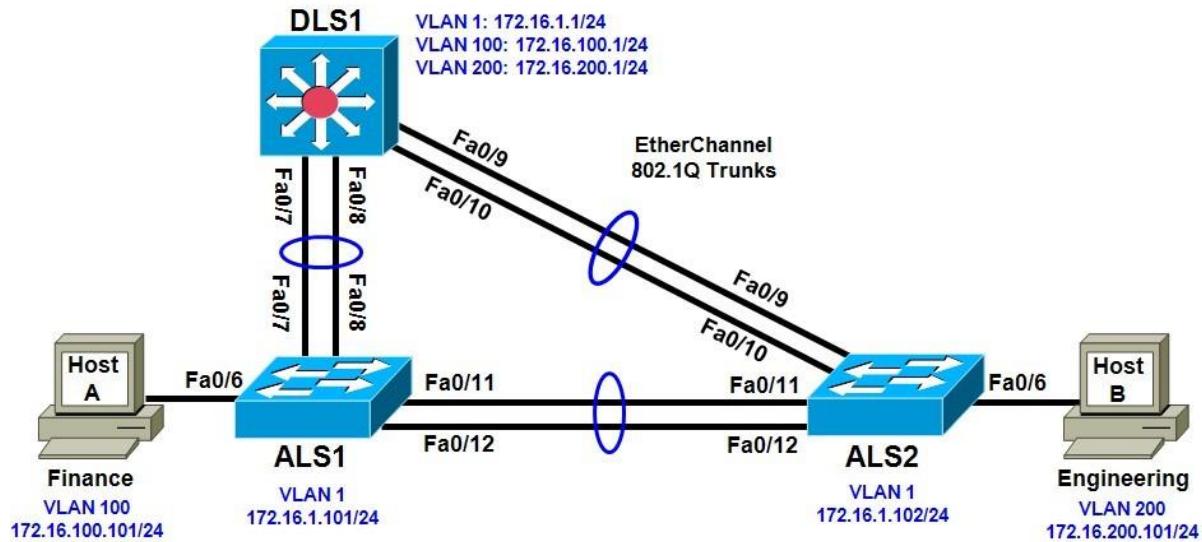
Verify:

```
Gateway# show ip interface brief  
  
Gateway# show interfaces description  
  
Gateway# show vlans  
  
Gateway# show cdp neighbor detail
```

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)
2800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Practical 9-B: Inter-VLAN Routing with an Internal Route Processor and Monitoring CEF Functions

Topology



Objective

- Route between VLANs using a 3560 switch with an internal route processor using Cisco Express Forwarding (CEF).

Required Resources

- 2 switches (Cisco 2960, IOS 12.2(46)SE C2960-LANBASEK9-M or comparable)
- 1 switch (Cisco 3560, IOS 12.2(46)SE C3560-ADVIPSERVICESK9-M or comparable)
- Ethernet and console cables

Steps

Step 1: Prepare the Switches

- Erase startup configuration, delete vlan.dat, and reload all switches.

Step 2: Configure Basic Switch Parameters

ALS1

```
configure terminal  
hostname ALS1  
enable secret cisco  
line vty 0 15  
password cisco  
login  
interface vlan 1
```

```
ip address 172.16.1.101 255.255.255.0
```

```
no shutdown
```

```
ip default-gateway 172.16.1.1
```

ALS2

```
configure terminal
```

```
hostname ALS2
```

```
enable secret cisco
```

```
line vty 0 15
```

```
password cisco
```

```
login
```

```
interface vlan 1
```

```
ip address 172.16.1.102 255.255.255.0
```

```
no shutdown
```

```
ip default-gateway 172.16.1.1
```

DLS1

```
configure terminal
```

```
hostname DLS1
```

```
enable secret cisco
```

```
line vty 0 15
```

```
password cisco
```

```
login
```

```
interface vlan 1
```

```
ip address 172.16.1.1 255.255.255.0
```

```
no shutdown
```

Step 3: Configure Trunks and EtherChannels

DLS1

```
configure terminal
```

```
interface range fastEthernet 0/7 - 8
```

```
switchport trunk encapsulation dot1q
```

```
switchport mode trunk
```

```
channel-group 1 mode desirable
```

```
interface range fastEthernet 0/9 - 10
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 2 mode desirable
```

ALS1

```
configure terminal
interface range fastEthernet 0/11 - 12
switchport mode trunk
channel-group 1 mode desirable
interface range fastEthernet 0/7 - 8
switchport mode trunk
channel-group 2 mode desirable
```

ALS2

```
configure terminal
interface range fastEthernet 0/11 - 12
switchport mode trunk
channel-group 1 mode desirable
interface range fastEthernet 0/9 - 10
switchport mode trunk
channel-group 2 mode desirable
```

Verify:

```
DLS1# show interface trunk
ALS1# show etherchannel summary
```

Step 4: Configure VTP on ALS1 and ALS2

ALS1

```
configure terminal
vtp mode client
```

ALS2

```
configure terminal
vtp mode client
```

Verify:

```
ALS2# show vtp status
```

Step 5: Configure VTP on DLS1

DLS1

```
configure terminal
```

```
vtp domain SWPOD
```

```
vtp version 2
```

```
vlan 100
```

```
name Finance
```

```
vlan 200
```

```
name Engineering
```

```
Verify:
```

```
DLS1# show vlan
```

```
DLS1# show vtp status
```

Step 6: Configure Ports

ALS1

```
configure terminal
```

```
interface fastEthernet 0/6
```

```
switchport mode access
```

```
switchport access vlan 100
```

ALS2

```
configure terminal
```

```
interface fastEthernet 0/6
```

```
switchport mode access
```

```
switchport access vlan 200
```

Step 7: Configure VLAN Interfaces and Enable Routing

DLS1

```
configure terminal
```

```
interface vlan 100
```

```
ip address 172.16.100.1 255.255.255.0
```

```
no shutdown
```

```
interface vlan 200
```

```
ip address 172.16.200.1 255.255.255.0
```

```
no shutdown
```

```
ip routing
```

Verify:

```
DLS1# show ip route
```

Step 8: Verify Inter-VLAN Routing

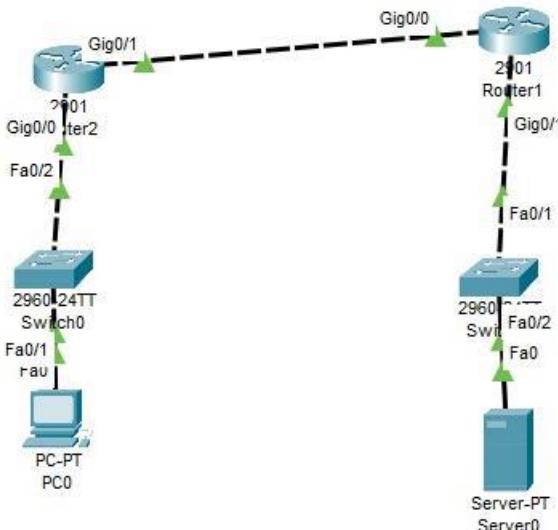
- Ping from Engineering host to Finance host.
- Telnet from a host to 172.16.1.1 (DLS1 VLAN 1 IP).

Step 9: Examine CEF Configuration

```
DLS1# show ip cef
```

Practical 10: NAT Configuration

Topology



Objective

- Configure NAT between a private network and a public network.

Required Resources

- 2 routers (e.g., Cisco 1841)
- 2 switches (e.g., Cisco 2960)
- 1 PC
- 1 Server
- Ethernet and console cables

Steps

Step 1: Set Up Devices and Connections

- Router1 (Gig0/0) → Switch1 → PC (192.168.1.10)
- Router1 (Gig0/1) → Router2 (Gig0/0)
- Router2 (Gig0/1) → Switch2 → Server (203.0.113.2)

Step 2: IP Address Configuration

Router1

```
configure terminal
```

```
interface gigabitEthernet 0/0
ip address 192.168.1.1 255.255.255.0
no shutdown
interface gigabitEthernet 0/1
ip address 10.0.0.1 255.255.255.252
no shutdown
```

Router2

```
configure terminal
interface gigabitEthernet 0/0
ip address 10.0.0.2 255.255.255.252
no shutdown
interface gigabitEthernet 0/1
ip address 203.0.113.1 255.255.255.0
no shutdown
```

PC

- IP: 192.168.1.10
- Subnet Mask: 255.255.255.0
- Default Gateway: 192.168.1.1

Server

- IP: 203.0.113.2
- Subnet Mask: 255.255.255.0
- Default Gateway: 203.0.113.1

Step 3: Set Up NAT (PAT) on Router2

Router2

```
configure terminal
access-list 1 permit 192.168.1.0 0.0.0.255
ip nat inside source list 1 interface gigabitEthernet 0/1 overload
interface gigabitEthernet 0/0
ip nat inside
interface gigabitEthernet 0/1
ip nat outside
```

Step 4: Test Connectivity

- Test 1: Ping from PC to Server

PC> ping 203.0.113.2

- Test 2: Configure and Test Static NAT (Optional)

Router2

configure terminal

ip nat inside source static 192.168.1.10 203.0.113.3

PC> ping 203.0.113.3

- Test 3: Check NAT Translations

Router2# show ip nat translations

Step 5: Save Configuration

Router1# write memory

Router2# write memory